INTRA-HOUSEHOLD HUMAN CAPITAL MEASURES AND CHILD AND MATERNAL HEALTH: EVIDENCE FROM ZAMBIA

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ABSTRACT

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Zambia has one of the highest rates of childhood stunting in the world. Traditional health production functions model that good health quality for young children is dependent on the necessary inputs of parental influences, including parental health, parental education, and household wealth. Using data from a Feed the Future survey from rural Zambia and the Women's Empowerment in Agriculture Index, I examine the relationship between several measurements of spousal human capital and the health outcomes of young children and women of child-bearing age. I find the ability to read and write of both spouses is highly correlated with positive changes in children's and women's health outcomes. Literacy and education campaigns which target both boys and girls should be heavily emphasized among rural and disadvantaged communities in southern Africa, as men's literacy and education as well as women's literacy are both important to improving future health outcomes for children and adults.

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TABLE OF CONTENTS

LIST OF TABLES vi

LIST OF FIGURES vii

KEY TO ABBREVIATIONS viii

CHAPTER 1. INTRODUCTION 1

CHAPTER 2. BACKGROUND AND COUNTRY CONTEXT 5
2.1 Background on Determinants of Children's Health 5
2.2 The Context of Zambia 7
2.2.a Children's Health in Zambia 9
2.2.b Maternal Health in Zambia 10
2.2.c Education and Literacy in Zambia 11
2.2.d Women's Role in Agriculture in Zambia 13

CHAPTER 3. ESTIMATION STRATEGY 14
3.1 Estimation Specifications 14
3.2 Description of Specifications 15

CHAPTER 4. DATA 17
4.1 Outcome Variables 21
4.1.a Child Anthropometry - children under 5 years old: 21
4.1.b Women's Dietary Diversity - women 15-49 years old: 23
4.2 Literacy and Education Variables 24
4.2.a Literacy 24
4.2.b Education 24
4.3 Women's Empowerment in Agriculture Index 26
4.3.a Empowerment Measures 26
4.4 Control Variables 30
4.4.a Children's Regression Controls 30
4.4.b General Regression Controls 30

CHAPTER 5. RESULTS 32
5.1 Children's Health Outcomes 32
5.1.a Parental Literacy 32
5.2 Women's Health Outcomes 35
5.2.a Spousal Literacy 35

CHAPTER 6. DISCUSSION 38

CHAPTER 7. CONCLUSION 41
7.1 Limitations and Future Research 41

APPENDICES 44
APPENDIX A. ROBUSTNESS CHECKS 45
APPENDIX B. CORRELATIONMATRIX OF KEY INDEPENDENT VARIABLES 50
APPENDIX C. WOMEN'S EMPOWERMENT IN AGRICULTURE INDEX 52

BIBLIOGRAPHY 54

LIST OF TABLES

Table 1: Summary Statistics. 20

Table 2: Parental Literacy as Predictors of Child Health Outcomes. 34

Table 3: Spousal Literacy as Predictors of Women's Dietary Diversity. 36

Table 4: Parental Education as Predictors of Child Health Outcomes. 46

Table 5: Spousal Education as Predictors of Women's Dietary Diversity. 47

Table 6: Spousal Literacy as Predictors of Women's Body-Mass-Index. 48

Table 7: Parental Empowerment as Predictors of Child Health Outcomes. 49

Table 8: Correlation Matrix of Key Independent Variables. 51

Table 9: The Domains of Empowerment in the Women's Empowerment in Agriculture Index. 53

LIST OF FIGURES

Figure 1: Map of Africa with Zambia emphasized. 8

Figure 2: Map of the Zone of Influence in Eastern Province, Zambia. 18

Figure 3: Distribution of Children's Height-for-Age Z-scores. 22

Figure 4: Distribution of Children's Weight-for-Age Z-scores. 22

Figure 5: Number of Food Groups Consumed by Women in Previous 24 Hours. 23

Figure 6: Distribution of Men's Years of Education. 25

Figure 7: Distribution of Women's Years of Education. 25

Figure 8: Distribution of Women’s Empowerment Scores. 28

Figure 9: Distribution of Men’s Empowerment Scores. 28

Figure 10: Contribution of each Domain to Women's Disempowerment. 29

Figure 11. Contribution of Each Indicator to Women’s Disempowerment. 29

Figure 12: Distribution of Height-for-Age Z-scores by Parental Literacy Status. The red reference line on each chart indicates the mean value of the HAZ of the children. 39

KEY TO ABBREVIATIONS

BMI: Body-Mass-Index

CSO: Central Statistical Office

DDS: Dietary Diversity Score

DHS: Demographics and Health Survey

FAO: Food and Agriculture Organization

FtF: Feed the Future

HAZ: Height-for-Age Z-Score

IFPRI: International Food Policy Research Institute

IYCF: Infant and Young Child Feeding

OPHI: Oxford Poverty and Human Development Initiative

RALS: Rural Agricultural Livelihoods Survey

UNICEF: United Nations Children's Fund

USAID: United States Agency for International Development

WAZ: Weight-for-Age Z-score

WEAI: Women's Empowerment in Agriculture Index

WHO: World Health Organization

ZOI: Zone of Influence

CHAPTER 1. INTRODUCTION

While Zambia is known to be a peaceful country, with relatively mild climates, good soil, and low population density, it is also highly food insecure. Of all Zambian households, 46% are undernourished, a rate similar to that of war-torn and climate-ravaged countries such as Yemen, Chad, and South Sudan (FAO et al., 2017; Grebmer et al., 2018). Zambia has one of the highest rates of childhood stunting in the world, with over 40% of children in Zambia under the age of five being moderately or severely stunted and 15% underweight (UNICEF, 2017; CSO et al., 2015). Children's long-term health outcomes are determined by a myriad of familial factors and environmental influences, and primary intervention pathways to improve young children's health and well-being often focus on improving resources and education for caretakers of young children, especially pregnant mothers, as some long-term health outcomes are partly influenced by conditions experienced in-utero (WHO, 2007; UNICEF, 2017).

This thesis provides some explanation for such surprisingly high rates of stunted and underweight Zambian children. I estimate a series of linear regressions with Ordinary Least Squares (OLS) models using survey data from a Feed the Future (FtF) Zone of Influence survey conducted in Eastern Province, Zambia, which includes a Women's Empowerment in Agriculture Index (WEAI) module tailored specifically to the Zambian context. I focus on the sub-sample of rural, male-headed households with children under 5 years of age. I find that in Zambia, the primary factors predicting child health outcomes include parental education and literacy. I also find that measures of mother's empowerment in household decision-making related to agriculture have a moderately positive relationship with children's health outcomes, but not as strong as expected given women's relative involvement in agricultural decisions in

Zambian households. This is the case even though I use several different measures that have been developed to formulate the widely used WEAI.

Because maternal health is often closely tied to the long-term health of young children (Rosenzweig and Schultz, 1982; Thomas et al., 1990; de Onis and Branca, 2016), I also analyze how women's own health may be associated with their own measures of human capital and empowerment, as well as the human capital characteristics of their husband. In regressions on measures of women's own health, I find that for women in Zambia, some measures of the degree to which they are empowered to make agricultural and financial household decisions may indicate improved health outcomes. I also find that the other key factors influencing their health include measures of their own education or literacy levels, and that of their husbands.

Prior studies have found that one's health in the long-term is due in part to the influence of one's parents. Valuable inputs that affect health include the health of one's parents, their education, and household wealth (Rosenzweig and Schultz, 1982; Thomas et al., 1990; Smith and Haddad, 2000; WHO, 2007; Güneş, 2015). The child health production function has been adapted from the generic health production function to include inputs related to parental human capital, which is often related to income, asset ownership (including land), and the probability of seeking health services (Barrera, 1990; Thomas et al., 1990; Cui et al., 2019). Maternal education is very often associated with children's health outcomes, as better educated mothers may be able to use medical and nutritional resources more efficiently (Barrera, 1990; Behrman, 1997; Smith and Haddad, 2000; Fafchamps and Shilpi, 2013).

In Zambia, a very limited number of studies have examined the dominating factors which influence children's health, particularly in exclusively rural areas. Even fewer have tried to quantitively measure women's empowerment and understand its relationship to child and

maternal health outcomes. Most work on women's empowerment focuses on improving the bargaining power of women to increase the household's overall food security and dietary diversity (Mofya-Mukuka and Sambo, 2018).

This thesis makes a valuable contribution to the literature. Rather than focusing on only one potential factor influencing children's health, I estimate several models with one dataset to measure differences in the relative importance of parental education, literacy, health, and women's household bargaining power. I also unpack spousal differences in education levels and literacy in order to examine the possibility for potential differences in the influence of individual parents. In doing so, I find that the strongest predictor of improved long-term health measures of young children is for the father and mother to both be able to read and write. That is, when both the husband and wife are literate, their household is more likely to have healthier children in comparison to households where only one spouse (either man or woman) can read and write, especially compared to households where neither spouse can read and write. These findings have important policy implications, and show that the combined influence of having each parent being literate is particularly predictive of positive health outcomes among young children. Thus, literacy campaigns should target both men and women, and boys and girls, particularly in disadvantaged communities in southern Africa.

This paper is presented as follows: Chapter 2 briefly describes the literature regarding children's health determinants and parental influence, then presents the context of Zambia and relevant demographic information. Chapter 3 presents the empirical strategy and explains the analysis and specifications applied in the estimations. Chapter 4 introduces the data used in the analysis and describes the key variables. Chapter 5 describes the regression results for children's and mother's health outcomes, and the interpretations of the coefficients. Chapter 6 discusses the

interpretations of the results as they relate to the existing literature. Chapter 7 concludes the paper with a broad interpretation of the results, and discusses some potential limitations as well as the potential of future research.

CHAPTER 2. BACKGROUND AND COUNTRY CONTEXT

2.1 Background on Determinants of Children's Health

To understand how children's health outcomes are determined, one must consider what factors contribute to the health of an individual, and particularly to a young child. Empirical literature explains that one's health is partly due to the influence of one's parents, especially in early life stages (Rosenzweig and Schultz, 1982; Barrera, 1990; Thomas et al., 1990; Güneş, 2015).

Smith and Haddad (2000) provide an overview of the relationships between determinants of child malnutrition in developing countries, and suggest that the primary determinants fit into three levels of influence: 1) immediate; 2) underlying; 3) basic. The first level, immediate causes of malnutrition, include dietary intake and health status. These are related to the underlying factors of food insecurity, care for mothers and children, and the quality of the health environment. Basic influences, such as the economic resource availability and the political environment, strongly affect the two previous levels. They offer a reduced form for household maximization of children's health:

$$N_{ch}^{i*} = (\beta, \Omega_{HEnv}, \Omega_{Food}, \Omega_{NEnv}, \Omega_c, E^M, P, I) \quad i = 1, \dots J \qquad (1)$$

where N_{ch}^{i*} is an individual child's nutritional status; β is the mother's relative status in the household; Ω_{HEnv} is the health environment, including the availability of sanitation and health services; Ω_{Food} is the community's food availability; Ω_{NEnv} represents the community's natural environment, including the agroclimatic potential, soil fertility and water stress level; Ω_c is the cultural norms affecting caring practices; E^M is the mother's education level; and P and I, which

are national and household incomes. This function is subject to the child's household's welfare, the nutritional provisioning process, and the mother's own nutritional status.[1]

In their analysis of 63 countries, Smith and Haddad (2000) find that women's education has the largest influence on child malnutrition. This finding is supported by many other studies of children's health which include characteristics of parental human capital (Barrera, 1990; Thomas et al., 1990; Thomas, 1994; Güneş, 2015). Maternal education is consistently identified as a determinant in several measures of improved child outcomes, and a possible reason could be that better-educated mothers are more efficient in their use of health inputs and can more easily understand health information to provide better care for their children (Barrera, 1990; Güneş, 2015).

Some research suggests that positive effects of women's education on children's outcomes is due to the marriage market-matching between spouses of similar levels of education, where better educated women marry well-educated men who are more likely to earn higher incomes than men with less education (Chiappori et al., 2009; Fafchamps and Shilpi, 2013), and that related research should be more inclusive of controls which may be endogenous to mother's education (Behrman and Wolfe, 1987; Behrman, 1997). Nonetheless, spouses often make different decisions about the allocation of household resources depending on their own backgrounds and relative bargaining power (Chiappori, 1988; Browning et al., 1994; Haddad et al., 1994; Hoddinott and Haddad, 1995; Udry et al., 1995), and in households where disempowered women gain increased control and decision-making ability over some assets and income, there is sometimes an observed shift in the distribution of household resources in favor of improved

[1] See Chapter 2 of Smith and Haddad (2000) for a full description of contributing functions.

household nutrition and children's needs (Thomas, 1994; Lundberg, Pollak, and Wales, 1997; Rubalcava and Thomas, 2000; Mofya-Mukuka and Sambo, 2018).

2.2 The Context of Zambia

Zambia is a landlocked country in central southern Africa with a population of over 17.3 million people (see Figure 1) (World Bank, 2019a). Zambia was classified as a lower-middle income country in 2011 after a decade of robust economic growth, largely thanks to its exportation of copper (World Bank, 2019b). Despite these recent years of national economic growth and decades of foreign aid, Zambia is considered one of the poorest and most food-insecure countries in the world. In the second half of the 2010's, Zambia experienced several years of increasing political and financial instability and crippling droughts. Currently, about 56.5% of the population in Zambia is rural, and much of the wealth from the country's economic improvements has not improved overall poverty levels, but rather increased the country's wealth inequality (World Bank, 2019a). Over 76% of rural Zambians live below the poverty line of USD1.90 (2011 PPP)[2], and the rural poor account for 82% of all the poor in Zambia (World Bank, 2019c), which indicates that the burden of poverty disproportionately affects the rural communities in Zambia.

Nearly half (45.9%) of the population in Zambia is considered undernourished (FAO et al., 2017), and the Global Health Index finds the prevalence of hunger in Zambia is at "alarming" levels, grouping it with countries which are experiencing extreme climatic crises and sectarian violence, such as Yemen and Chad (Grebmer et al., 2018, pg. 5). Food insecurity disproportionally affects rural poor populations, especially young children. Zambia has one of

[2] International Poverty line: 6.4 Zambian Kwacha (2015) or USD1.90 (2011 PPP) (World Bank, 2019c).

the highest under-5 mortality rates in the world at 75 deaths per 1000 live births, and a large part of this is due to chronic malnutrition leaving children vulnerable to infections and disease (CSO et al., 2015; FAO et al., 2017). A common result of chronic malnutrition is stunting, the delayed or unachieved physical growth of a child defined as having height-for-age which is 2 standard deviations (or more) below the median height-for-age established by the World Health Organization's Child Growth Standards (WHO Multicentre Growth Reference Study Group, 2006). Childhood stunting is associated with severe long-term health concerns, including an increased risk of premature deaths from pneumonia and diarrhea, as well as being more susceptible to fatal infections, such as sepsis and meningitis (de Onis and Branca, 2016).

Figure 1: Map of Africa with Zambia emphasized.

Many countries in the world, including Zambia, experience a regular period of hunger each year after rural households use most of their monetary assets to purchase agricultural inputs and plant their crops, and before the first crops are available to harvest. In Zambia, this period begins in November and usually lasts until late February, when fresh maize is beginning to be harvested

(FEWS NET, 2013). Seasonal short-term hunger contributes to a periodically higher prevalence of underweight children and adults.

Unlike many of the other most "alarmingly hungry" countries (Grebmer et al., 2018), Zambia has not experienced violent conflicts or severe climatic crises (though, the regional rain patterns have become more erratic in recent years). Low agricultural production and a lack of infrastructure in rural areas continues to slow progress. Zambia is a very large country, and has a low population density, and when considering the relatively mild yet diverse climate (Zambia hosts three agro-ecological zones and many large freshwater resources), there is enormous potential for increased agricultural production to alleviate poverty and hunger.

2.2.a Children's Health in Zambia

Children's health and nutritional status can serve as an indication in the status of development of a country or region. The health status of children under 5 years old is often determined using anthropometric measures, including the height and weight of a child and how it compares to the standardized scale for a given age. These measures can indicate if a child is stunted, wasted or underweight. In Zambia, 40% of children under 5 years old are stunted (too short for their age), 6% are wasted (too thin for their height), and 15% are underweight (too thin for their age). Only about 11% of children ages 6 – 23 months consume an appropriate diet, as outlined by recommended infant and young child feeding (IYCF) practices (WHO, 2008). The above-mentioned under-5 mortality rate of 75 deaths per 1000 live births was estimated in 2014, and translates to one in every 13 children born in Zambia do not survive to their fifth birthday. In Eastern Province, where my survey data was collected, approximately 43.3% of children are stunted and the under-5 mortality rate is estimated at 115 deaths per 1000 live births. Overall, while stunting rates have only moderately decreased in the previous two decades, the mortality

rate has improved dramatically, as the national under-5 mortality rate was approximately 191 deaths per 1000 live births in 1992 (CSO et al., 2015).

Longer spacing between births is associated with a lower prevalence of several negative health indicators. When children are born more than 48 months after their mother's previous birth, the rate of stunting is approximately 34%, as compared to the rate of 48% of children born less than 24 months since the previous birth. Children born within two years of the previous birth are also more likely to die before age five than children who are born more than 3 years after the previous birth, and children who are born as the seventh or more birth of the mother also have a higher chance of dying before age five compared to the second to sixth child (CSO et al., 2015).

Some maternal characteristics are particularly important indicators of children's health in Zambia. Children are more likely to be stunted when their mother is underweight or if she has never attended school, and they are 4 times more likely to be underweight (5% versus 20%) and 2.5 times as likely to die before their fifth birthday if their mother has no education compared to children whose mother has more than a secondary education (109 deaths per 1000 live births versus 43 deaths per 1000 live births) (CSO et al., 2015).

2.2.b Maternal Health in Zambia

Beginning before they are even born, young children in Zambia face a multitude of obstacles to achieve good health and longevity. When children are conceived, the expectant mother's health can play an important role in determining the health outcomes of her child. To understand pathways for improving children's health, it is therefore important to consider the health of women of child-bearing age. In Zambia, approximately 10% of women ages 15-49 are underweight (Body-Mass-Index less than 18.5). Women in Eastern Province are less likely to be underweight than women in other provinces, as only 7.8% are underweight. Women who have

more years of education are less likely to be underweight, as about 12% of women who have no education or only primary educations are underweight, while about 8% of women who attended secondary school are underweight (CSO et al., 2015)

2.2.c Education and Literacy in Zambia

The Zambian education system consists of primary education from grade 1 through grade 7, then secondary education from grade 8 through grade 12, then tertiary education which consists of university and post-secondary professional training, such as nursing school and teacher's college. To increase the primary school enrollment rates, the Zambian government has maintained a regulation of free primary education in government-run schools since 2002. Secondary education is not free, but does have a maximum cap on the tuition a school can charge for grades 8-12 (CSO et al., 2015).

Despite the policy of free primary education, Zambia's education sector has not experienced increased primary school attendance: the rate of approximately 80% of primary-school-aged children attending school remained the same over the period from 2007 to 2014. Most unfortunately, the high enrollment rate for primary school drops precipitously for secondary school grade levels, with only about 40% of students continuing their education at the secondary-school level, though there have been improvements in girls' secondary education attendance, increasing from 35% in 2007 to 41% in 2014. Nationally, approximately 13% of women have completed secondary school or higher, and just over 21% of men have completed secondary school or higher. Eastern Province has some of the lowest rates of attendance and secondary school completion, with 70% primary school attendance and 22% secondary school attendance, and only 5.4% of adult women and 9.8% of adult men having completed secondary school or

higher. Women in Eastern province have attended school for an average of 4.8 years, and men attended for an average of 5.8 years (CSO et al., 2015).

There are several contributing factors to the relatively low and stagnant attendance rates, notably a lack of secondary schools in rural areas as well as steeply increased school fees beginning in Grade 8, which ultimately result in approximately fewer than 17% of all Zambian adults completing Grade 12. People living in rural areas are at a particular disadvantage to furthering their educations, because most rural communities can only access schools offering primary education. Women in rural areas have an average of 5.5 years of education, versus the 8.2 years of women in urban areas, and only 4.3% of rural women complete secondary school or higher, compared to the nearly 24% of urban-dwelling women who have completed secondary school or higher (CSO et al., 2015). Additionally, the policies of free primary education and price-capped secondary education are often not followed or enforced, or other indirect fees are applied, and therefore these policies to expand education have likely not been as beneficial as expected (RTE, 2012).

The Zambian Demographic and Health Survey (DHS) for 2013/2014 conducted a literacy exam among male and female respondents ages 15-49, and found that 83% of men and 68% of women are literate in at least one of seven major Zambian language groups. Younger people (ages 15-24) of both sexes are more likely to be literate than people in older age groups, and literacy also increases with higher wealth quintiles. There is also a large difference in literacy rates between urban and rural populations: 83% of women in urban areas can read and write, compared to the 54% of women in rural areas who can read and write. Similar to the underperforming education rates, Eastern Province has some of the lowest literacy rates in the country, as about 66.3% of men and 49.3% of women can read and write. It is not surprising that Eastern would have such

low literacy rates, given the low education rates and the strong relationship between education and literacy. (CSO et al., 2015).

2.2.d Women's Role in Agriculture in Zambia

In rural communities in Zambia, women and girls are actively involved in the agricultural activities of their household, and women constitute over half of the agricultural workers in Zambia (CSO, 2015). Typical of many regions of Africa, there is some division of agricultural labor, gendered crop production and home garden work, but agricultural households in Zambia are often more integrated than most areas in West Africa regarding the joint decision-making between spouses and their household's agricultural resources. Despite high levels of engagement in agricultural productivity, and even in decision-making regarding agricultural activities, many women in Zambia are rarely documented as landowners (SIDA, 2008). The lack of women's control over resources is particularly unfortunate, given recent research which has found that as women in rural Zambia have increased access to and control over agricultural resources in the household, there is an observed increase in the household dietary diversity (Mofya-Mukaka and Sambo, 2018).

CHAPTER 3. ESTIMATION STRATEGY

3.1 Estimation Specifications

I estimate various parental and household inputs of the child's health production function for quality health:

$$C_{ij} = \beta_0 + \boldsymbol{E_j^k \beta_1} + \boldsymbol{Literacy_j \beta_2} + \beta_3 BMI_j + \boldsymbol{X_j \beta_4} + \boldsymbol{I_{ij} \beta_5} + \boldsymbol{D_j \beta_6} + \varepsilon_{ij} \quad (2)$$

where C_{ij} is a given health outcome for child *i* in household *j*, namely their height-for-age (HAZ) and weight-for-age (WAZ) z-scores, which determine the status of being stunted or underweight; $\boldsymbol{E_j^k}$ represents the different parental empowerment measures which are estimated for their relationship to children's health, including the spouses' individual empowerment scores, and the woman's input on decisions regarding credit and agriculture, respectively; $\boldsymbol{Literacy_j}$ is a vector of binary variables indicating the literacy status of the spouses; BMI_j is the body-mass-index for the wife of household *j*; $\boldsymbol{X_j}$ is a vector of household characteristics, including the number of household members, the dependency ratio, a gender parity indicator[3] and the ages of the spouses; $\boldsymbol{I_{ij}}$ is a vector of child characteristics including age in months and gender; $\boldsymbol{D_j}$ is a vector of district indicators; the β's are parameters to be estimated; and ε_{ij} is an error term. The key parameters of interest are β_1 and β_2, as these represent the parameters for the parental inputs and other inputs used to predict the influences on children's health outcomes, defined below in section 3.2.

[3] Gender Parity is defined in section 4.4.

To estimate the inputs of women's health outcomes, I apply similar equations as used for children's health outcomes, but I exclude the BMI variable as well as child characteristics:

$$\boldsymbol{W_j} = \beta_0 + \boldsymbol{E_j^k \beta_1} + \boldsymbol{Literacy_j \beta_2} + \boldsymbol{X_j \beta_3} + \boldsymbol{D_j \beta_4} + \varepsilon_{ij} \quad (3)$$

where $\boldsymbol{W_j}$ represents a given health outcome of the wife in household *j*, namely her own dietary diversity and body mass index. These estimates are included in the analysis of understanding children's health, because the health of a child's mother is an important input in the children's health production function (Barrera, 1990; Thomas et al., 1990), therefore it is valuable to establish how various human capital inputs are related to improved health outcomes for women of child-bearing ages (15 - 49 years old). All primary female respondents ages 15-49 are included in this analysis, and most, though not all, of the women included in the analysis had children under 5 years old, but they are included because they are in the child-bearing age range.

3.2 Description of Specifications

Equations (2) and (3) are each estimated using five specifications to determine the relationship between the parental/spousal human capital inputs and the health outcomes of children under five years of age and women of child-bearing age. The specifications are denoted by E_i^k above in equations (2) and (3):

Literacy-focused specifications:

1) Indicator variables representing if both spouses can read and write, the woman cannot read and write but the man can, or the woman can read and write but the man cannot (only one of these indicators can equal 1 for each household);
2) The same variables as above, with the inclusions of maternal BMI (BMI is excluded in equation (3), therefore this specification is not included in the women's health analysis);

3) All variables from the second specification, as well as the individual empowerment scores of both the husband and wife;
4) All variables from the second specification, as well as a dummy indicating if the household got a loan, and empowerment measures of the women's input on decisions to borrow credit and how to use the credit, respectively:
5) All variables from the second specification, as well as the woman's input on agricultural decisions.

Following the established methods of studies using the WEAI measurements (Sraboni et al., 2014; Malapit and Quisumbing, 2015; Malapit et al, 2015; Malapit et al., 2019), the woman's decision input variables for specifications 4 and 5 are included to examine the relationships of female empowerment measures with children's health outcomes. These specific variables are included because they are derived from the empowerment indicators which most contribute to women's disempowerment in this sample (see Data section on WEAI).

Robust standard errors are obtained by clustering at the household level for the children's regressions, because there are several households with more than one child under the age of five. In Appendix A, there are several robustness checks estimating how health outcomes are related to the independent variables of parental and spousal education, women's BMI, and parental empowerment scores. Due to the likely endogeneity of the empowerment measures and scores, all results should be interpreted as associative rather than causal.

CHAPTER 4. DATA

I use cross-sectional survey data from Zambia. The survey was conducted as the baseline instrument for the United States' Agency for International Development's Feed the Future Initiative- Zone of Influence (ZOI): Zambia population-based survey,[4] and was implemented between November 19 and December 6, 2012. The geographic area targeted by the Feed the Future interventions (i.e., the "Zone of Influence") consists of five districts within Eastern Province: Lundazi, Chipata, Katete, Petauke, and Nyimba (see Figure 2). Across the ZOI, a total of 1,640 households were interviewed during this round of data collection. All the sampled households had been interviewed as part of the Rural Agricultural Livelihoods Survey, which was implemented by the Lusaka-based Indaba Agricultural Policy Research Institute during June and July 2012 (FEEDBACK, 2013).

The ZOI survey collected information on 1) household characteristics: household member demographics, dwelling characteristics, and a household hunger scale; 2) physical characteristics of women and young children: anthropometric measures of women ages 15-49 and children under 5 years old; 3) Dietary Consumption: a 24-hour dietary recall for women ages 15-49 and children under 2 years old; and 4) women's empowerment: the WEAI module, which was administered to both the male and female household heads, whenever possible. About three-fourths (~76%) of the nearly 1,400 female respondents were between 15 and 49 years old, but the survey includes women above that age range, as well.

[4]Researchers at the International Food Policy Research Institute (IFPRI) designed the survey, and Rockville, Maryland-based Westat implemented it in partnership with TANGO international and IFPRI. The Zambia Central Statistical Office (CSO) conducted the survey with help from the National Food and Nutrition Commission.

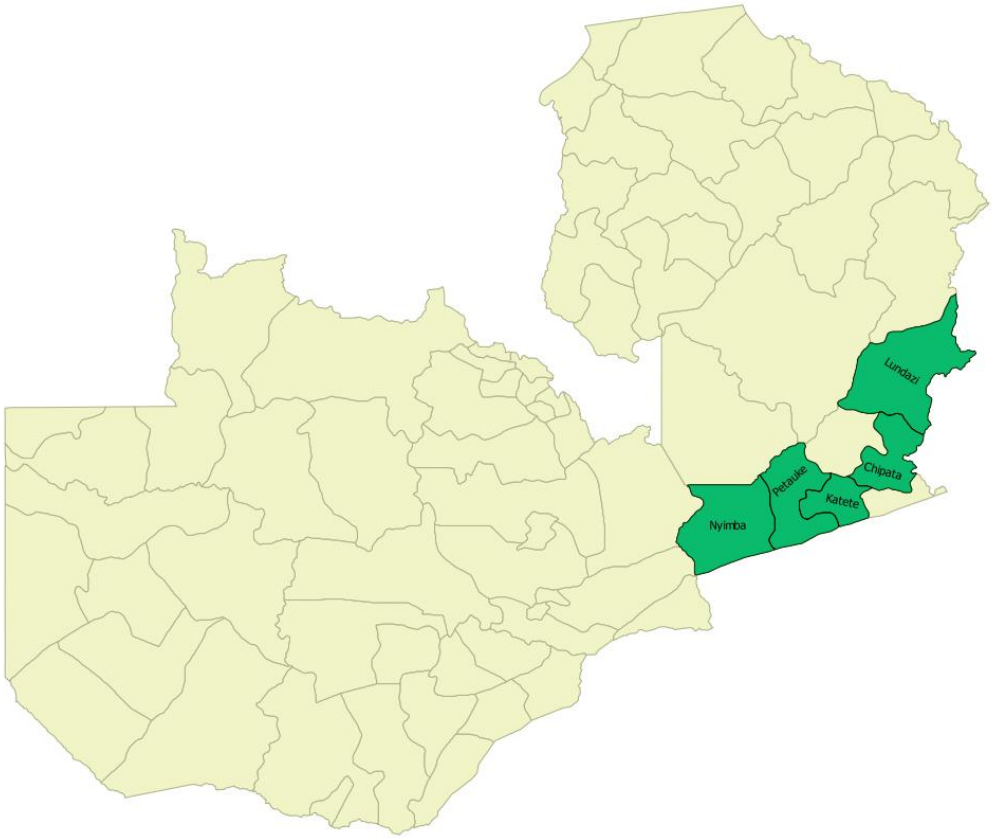

Figure 2: Map of the Zone of Influence in Eastern Province, Zambia.[5]

My analysis is restricted to rural households. I further restrict the sample to households which have at least one child under 5 years old and from which a male and female adult respondent have both completed the survey. While the survey is administered to both male and female adults of households, there are fewer men who responded to the survey: more than 300 female respondents did not have a male co-respondent despite most of them living in male-headed household. This absence of male respondents resulted in a smaller useable sample size, since only houses with both male and female respondents could be analyzed due to the estimation of

[5] This map reflects the district borders as they were defined in 2012, when the data was collected. In recent years, Zambia has redefined the borders of many districts.

variables based on the male partner.[6] For nearly every household included in the sample, the adult male and female survey respondents are reported as being husband and wife, so I often refer to them as spouses. Similarly, the vast majority of primary respondents were recorded as the parent of any child under 5 years old, so the spouses are both presumed to be the parents of children in the household. I analyze individual-level data of 1,094 children under 5 years old. These children come from a total of 943 households. Table 1 presents the descriptive statistics of the variables used in the analysis.

The children's z-score variables and the women's health variables are the dependent variables, while the independent variables are indicators and measurements of the spouses' literacy statuses and their empowerment measurements. The correlation matrix of key variables can be found in Appendix B. I perform linear regressions using OLS to analyze the relationships between the children's health indicators and parental human capitol measures, and I analyze predictors of women's DDS using Ordered Logit.

[6] Female-headed households (FHHs) were excluded from this analysis due to the pervasive differences in household characteristics exhibited in FHHs, such as less land and asset ownership, well as women often being the sole-decision-maker (Asian Development Bank, 2013), which does not reflect the differences in spousal empowerment I examine in this analysis.

Table 1: Summary Statistics.

VARIABLE	Obs	Mean	Std. Dev.	Min	Max
A. Child Outcomes and characteristics, 0-59 months					
Height for Age Z-score (HAZ)	1072	-1.851	1.423	-5.89	5.24
Weight for Age Z-score (WAZ)	1092	-0.904	1.06	-4.79	3.49
Girl	1094	0.518	0.500	0	1
Age in months	1094	31.8	14.6	6	59
B. Women's Outcomes and Characteristics					
Dietary Diversity - Number of Food Groups Consumed (out of 9 food groups)	943	3.97	1.17	0	8
Body Mass Index (BMI)	874	22.6	3.40	10.7	45.9
C. Education and Literacy Indicators					
Man can read and write	941	0.61	0.500	0	1
Woman can read and write	940	0.34	0.492	0	1
Both spouses can read and write	943	0.26	0.494	0	1
Man can, Woman cannot read and write	943	0.35	0.388	0	1
Man cannot, Woman can read and write	943	0.06	0.171	0	1
Neither spouse can read or write	943	0.32	0.477	0	1
Man’s number of years of schooling	910	6.42	2.82	0	12
Woman's number of years of schooling	700	5.42	2.59	0	12
D. Empowerment Indicators					
Female Empowerment Score, = 1 if empowered in all indicators	943	0.735	0.141	0.067	1
Male Empowerment Score	886	0.815	0.110	0.333	1
Percent difference of Parity Gap	886	0.088	0.233	-1.70	0.926
Parity, =1 if woman is equal to or greater than man’s empowerment score	886	0.361	0.445	0	1
Household Access Credit	943	0.402	0.49	0	1
Woman’s Input into Decision to Borrow	943	0.199	0.4	0	1
Woman’s Input into Decision of Use of Credit	943	0.230	0.421	0	1
Number of Agricultural Production Decisions Woman is involved in	943	5.40	2.50	0	11
E. Household Characteristics					
Household head age in years	943	43.53	15.1	17	93
Wife’s age in years	943	37.6	15	15	93
Household size	943	7.06	2.79	2	25
Dependency Ratio	943	1.42	0.802	0	3.5
Annual Per Capita Gross Income (USD)	943	473.3	775.9	7.2	13105.9

4.1 Outcome Variables

4.1.a Child Anthropometry - children under 5 years old:[7]

Height-for-Age Z-score / Stunting: A child is considered stunted if his or her height-for-age measurement (HAZ) is two or more standard deviations below the median of the reference group. The HAZ can be used as an indication of chronic malnutrition. The children in this sample have an average HAZ of -1.8 (Figure 3).[8] Almost half (44.7%) of the children under 5 years old in this sample are severely or moderately stunted, as they have an HAZ which is less than -2.0.

Weight-for-Age Z-score / Underweight: A child is considered underweight if his or her weight-for-age measurement (WAZ) is two or more standard deviations below the median of the reference group. A low WAZ can indicate a combination of both chronic and acute malnutrition. The average WAZ for children in this study is -0.9 (Figure 4). Nearly one-in-seven (14%) of children from this sample are underweight, as their WAZ is less than -2.0.

The sample averages are similar to the national prevalence of stunted and underweight children under 5 years of age, which are 40% and 15%, respectively, according to the 2013-2014 Zambia Demographic Household Survey (CSO et al., 2015).

[7] Calculated using the 2006 WHO Child Growth Standards

[8] Z-scores beyond ± 6.0 were not included in the analysis, as values beyond those limits are considered measurement errors (WHO Multicentre Growth Reference Study Group, 2006).

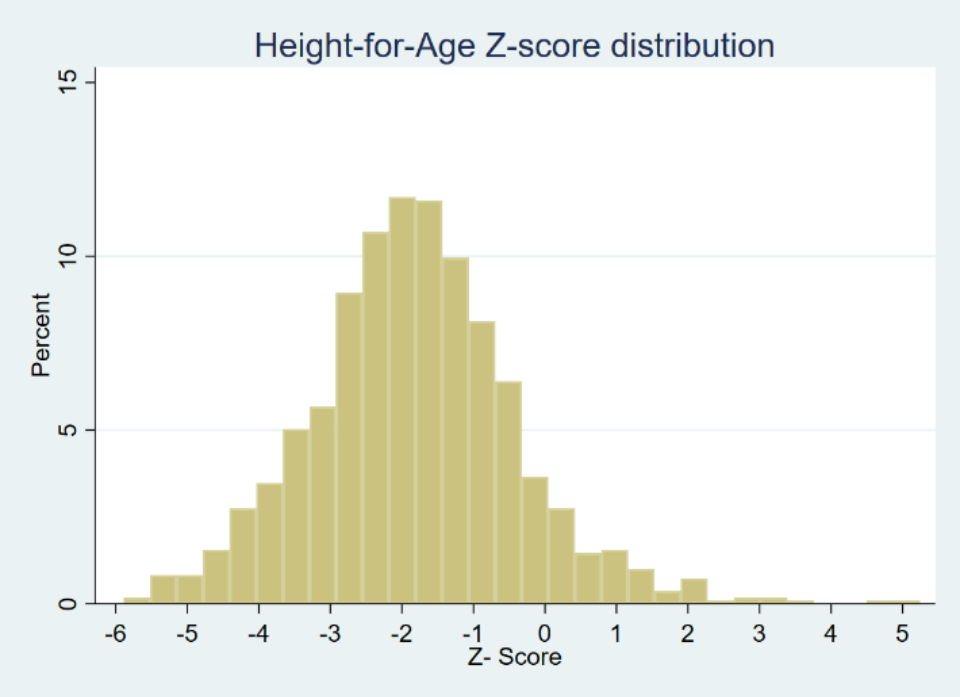

Figure 3: Distribution of Children's Height-for-Age Z-scores.

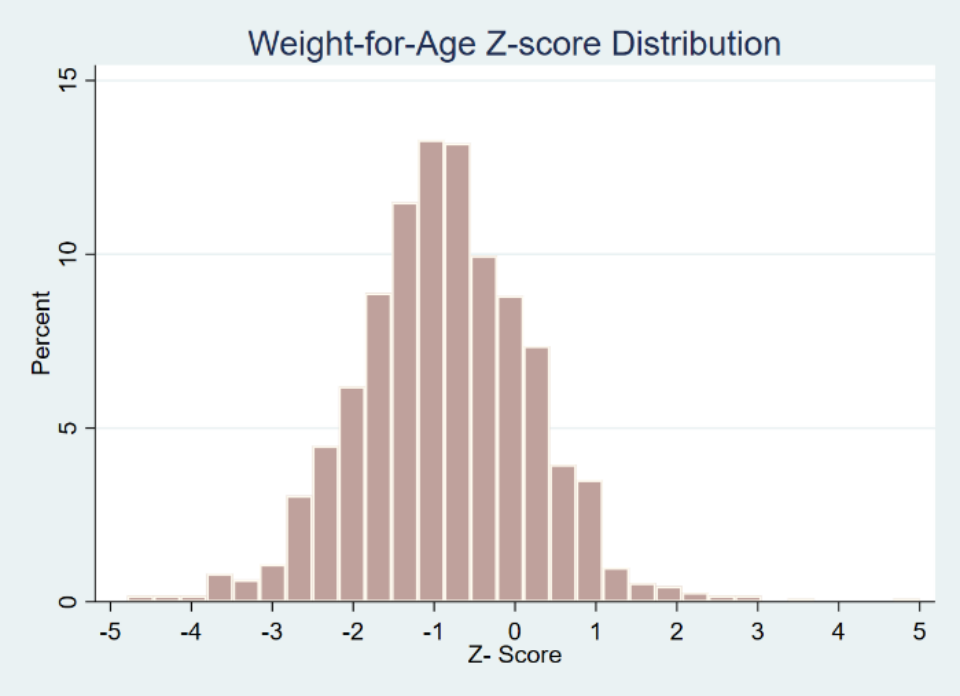

Figure 4: Distribution of Children's Weight-for-Age Z-scores.

4.1.b Women's Dietary Diversity - women 15-49 years old:

Dietary Diversity Score (DDS): DDS is defined as the number of food groups consumed in the past 24 hours, out of nine food groups: 1) grains, roots, and tubers; 2) legumes and nuts; 3) dairy products; 4) organ meat; 5) eggs; 6) flesh foods (i.e. meat, fish, insects); 7) vitamin-A-rich dark, leafy greens; 8) Other vitamin-rich fruits and vegetables (ex., pumpkin or orange-flesh sweet potatoes); and 9) other fruits and vegetables (FAO, 2011). The women in this sample consumed an average of about four food groups during the day before the survey (Figure 5).

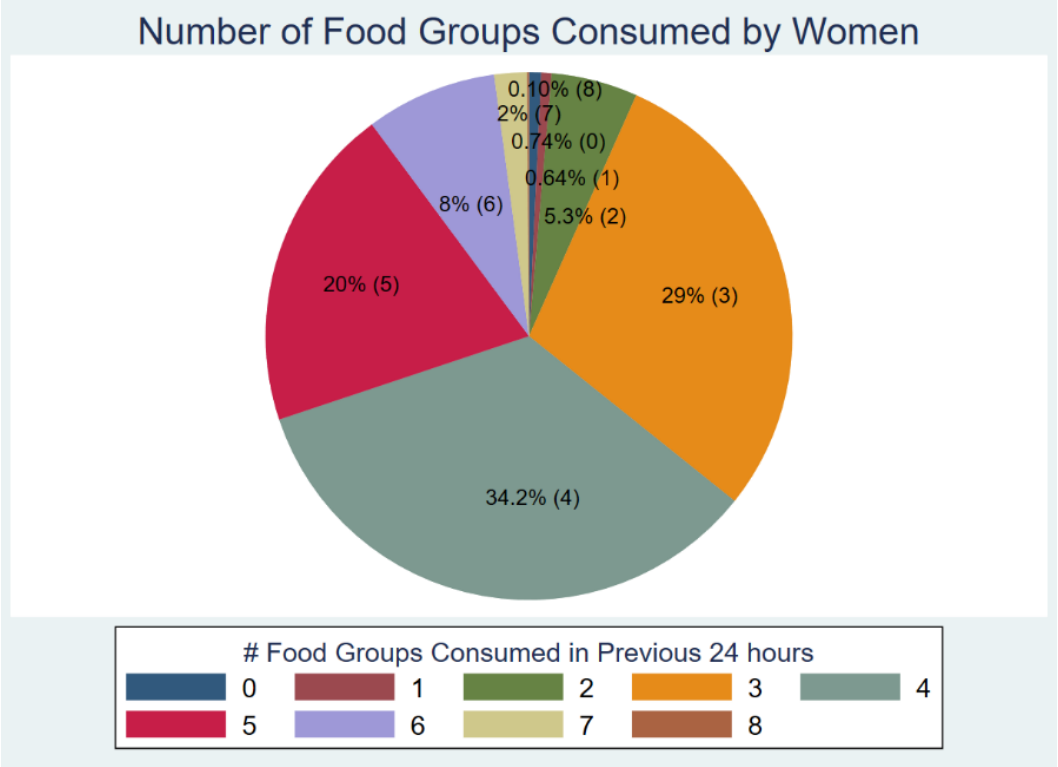

Figure 5: Number of Food Groups Consumed by Women in Previous 24 Hours.

4.2 Literacy and Education Variables

4.2.a Literacy

The literacy status of spouses, whether the primary male and female respondents are able to read and write, is used to estimate the relationship between spousal human capital and the health outcomes of young children or women, respectively. Of the adult survey respondents, 61.4% of men are able to read and write, and 34.9% of women can read and write.

4.2.b Education

The number of years of education completed by the individual spouses are used as independent variables to estimate the relationship between the human capital of spouses and the health outcomes of young children or women of child-bearing age. The average amount of education completed by male respondents is about 6.4 years (Figure 6). The average amount of education completed by female respondents is about 5.4 years (Figure 7).

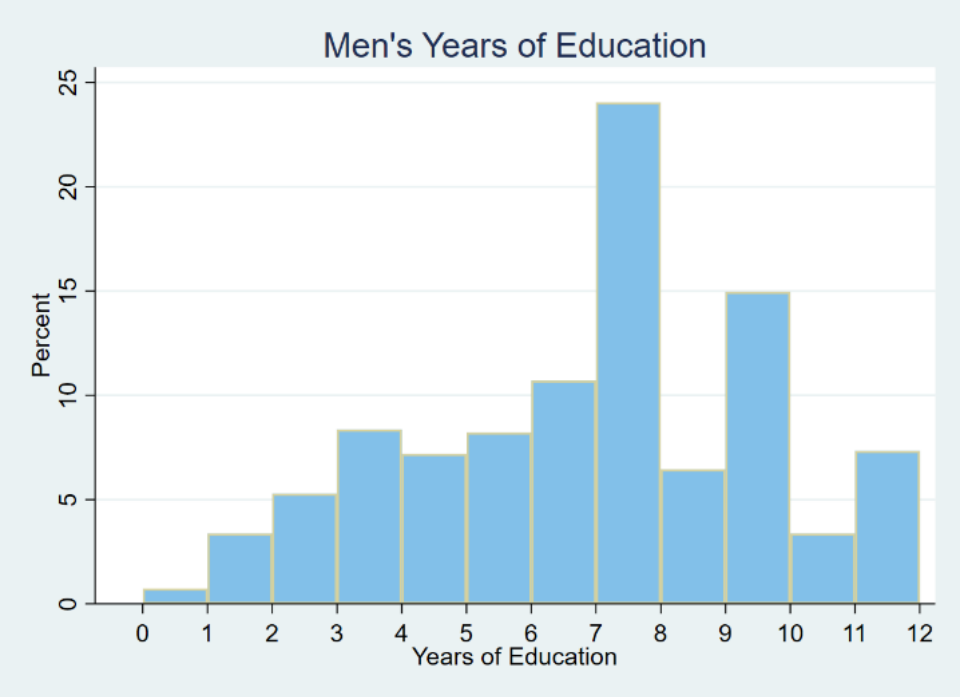

Figure 6: Distribution of Men's Years of Education.

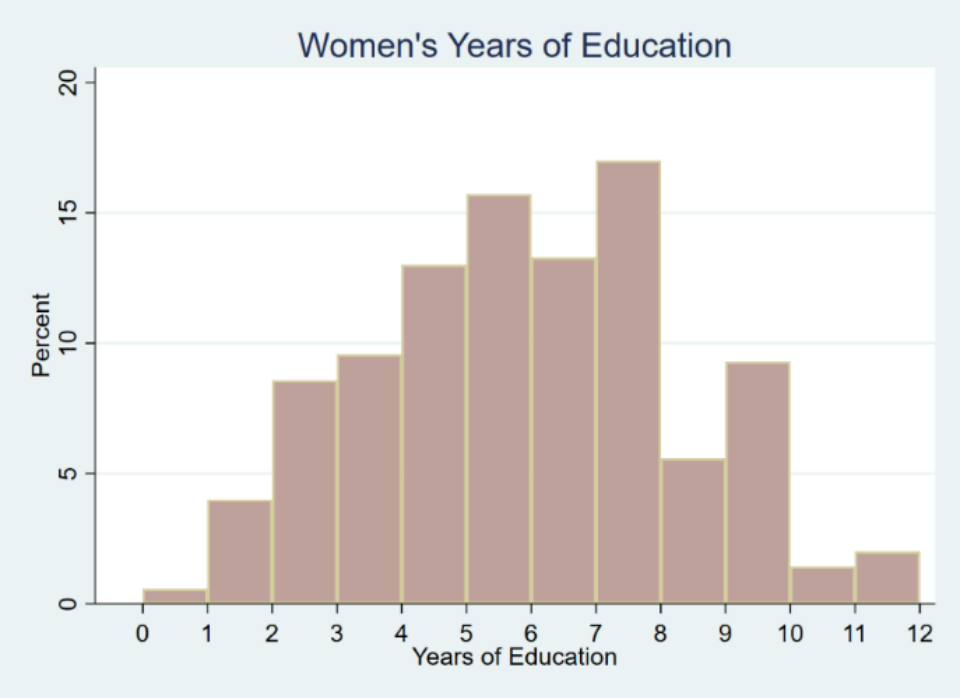

Figure 7: Distribution of Women's Years of Education.

4.3 Women's Empowerment in Agriculture Index

To incorporate the possibility for the potential influence of women's empowerment on children's nutritional outcomes, I also include empowerment indicators in regressions for children's and women's health outcomes, using data from the WEAI.

The WEAI is an instrument developed by the Oxford Poverty and Human Development Initiative (OPHI) and IFPRI as a cross-country tool to measure women's empowerment in several dimensions related to household, social and agricultural decisions in low - and middle-income countries (Alkire et al., 2013a). The index was initially developed to measure changes in women's empowerment which may occur due to USAID's Feed the Future Initiative programs, but other institutions and governments have embraced WEAI to better understand relationships related to women's empowerment in agriculture.[9]

The WEAI module is administered to men and women to measure their own individual levels of empowerment. The WEAI aggregates data from dozens of variables to calculate an individual WEAI score, which ranges from 0.066 to 1.0, based on the five domains of empowerment. These five domains are created from a total of ten indicators, and each domain is weighted equally. (See Appendix C for a table of the domains and indicators).

4.3.a Empowerment Measures

My analysis uses 9 of the 10 indicators, and the domains were re-weighted accordingly. [10, 11] Within my analysis, of the 943 female respondents whose WEAI score is used, the average

[9] See Alkire et al., (2013a) for more details about methodology, piloting and validation of the WEAI.
[10] To analyze the WEAI module, I follow the instructions provided in the Instructional Guide on the WEAI (Alkire et al., 2013b).
[11] The time-use indicator, 5.1, was not available for my dataset.

empowerment score is 0.735 (Figure 8). The male respondents had an average WEAI score of 0.81 (Figure 9).

Following the methods introduced by Sraboni et al. (2013), I use the indicators which are most important in the disempowerment of women in this sample to create models to test for relationships between women's empowerment and children's nutritional status. The primary contributors to *dis*empowerment are used because these are considered the areas in which women are most vulnerable. Figure 10 presents the values of how much each of the five domains contributes to the disempowerment of the women surveyed. The domains of Production and Resources, respectively, contribute 37.1% and 28.9% to the disempowerment of women in rural Zambia. Further, looking at a breakdown of the indicators of disempowerment, Autonomy in Agriculture and Access to and Decisions on Credit contribute the most in their respective domains and to women's overall disempowerment (see Figure 11).

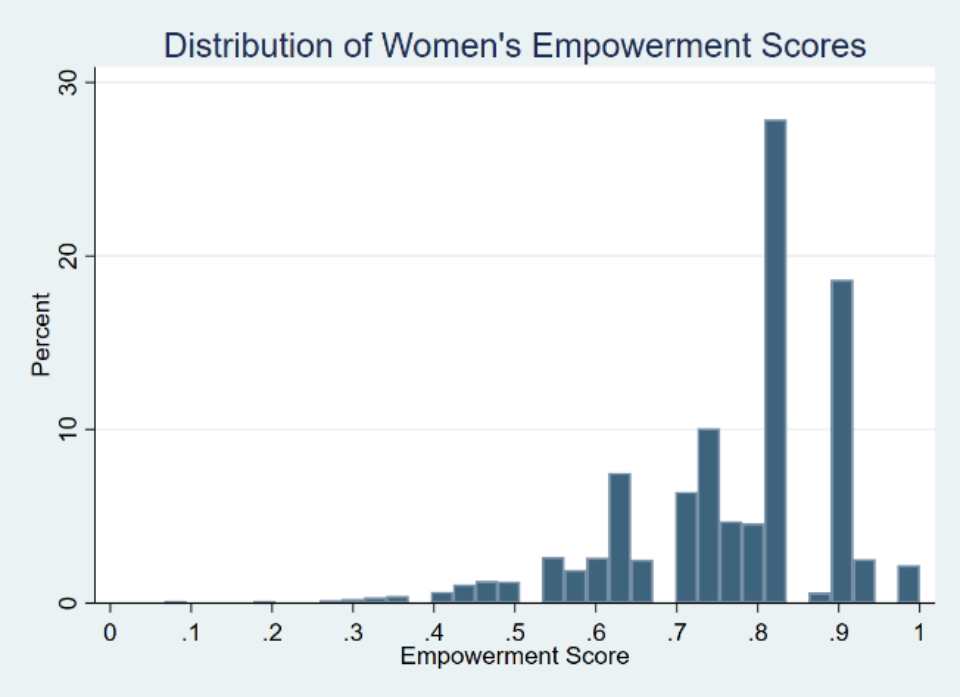

Figure 8: Distribution of Women's Empowerment Scores.

Figure 9: Distribution of Men's Empowerment Scores.

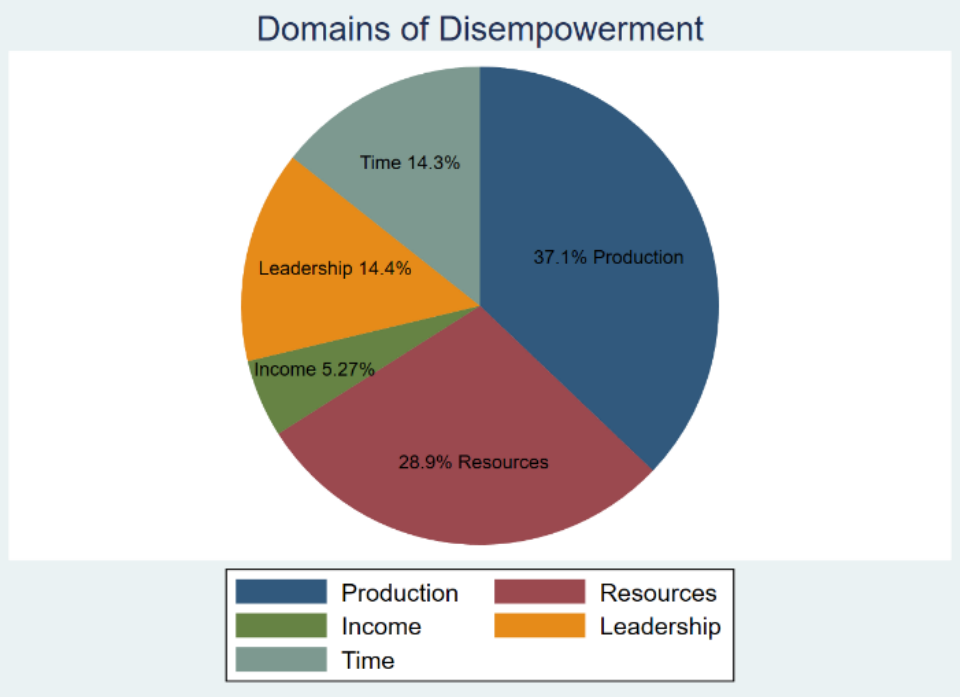

Figure 10: Contribution of each Domain to Women's Disempowerment.

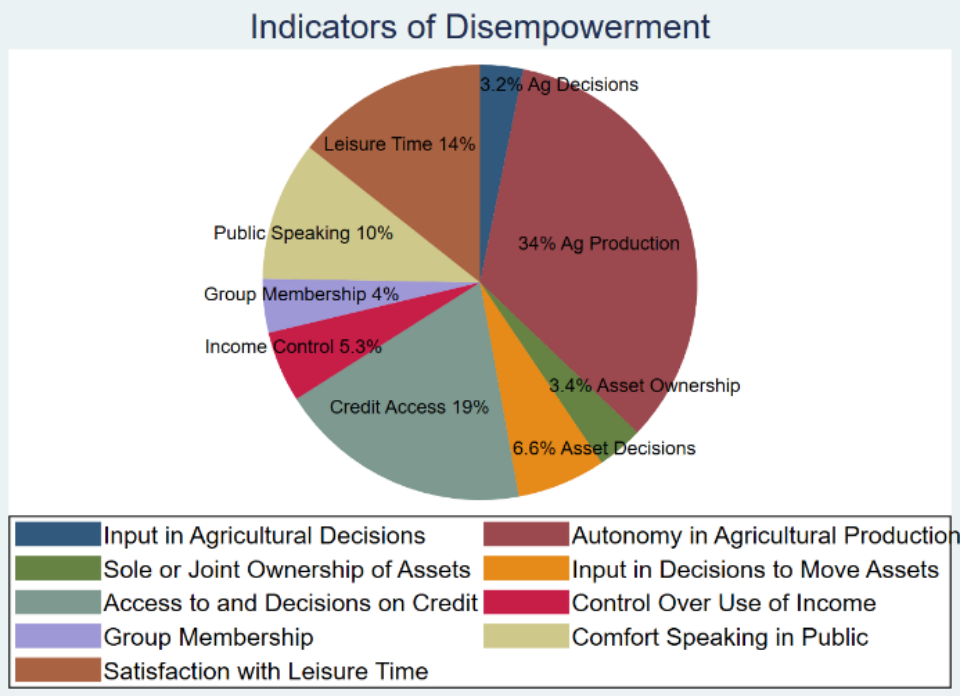

Figure 11. Contribution of Each Indicator to Women's Disempowerment.

4.4 Control Variables

4.4.a Children's Regression Controls

These control variables are included in the children's health analysis, but not used as controls for the maternal health analysis.

Child's sex: Nearly 52% of children under 5 years old in this sample are female, and about 48% are male children.

Child's age: The children included in this study are a maximum of 59 months old, and the youngest child who is included in the analysis is 6 months old (there were very few observations for children 0-6 months included in the data collection). The average age in months is nearly 32 months of age, which is 2 years and 8 months old.

Mother's Body-Mass-Index (BMI): BMI is defined as the ratio of weight (in kgs) to the square of height (in meters) (kg/m^2). A woman is considered underweight if her BMI is below 18.5. The average BMI of the women in this sample is 22.6, and 6.4% of the women are underweight. The proportion of underweight women in this sample is less than the 10% national average found during the 2013-2014 Zambia-DHS. The average in Eastern Province was lower, at 7.8% (CSO et al., 2015).

4.4.b General Regression Controls

These variables are included as controls in the analysis of both children's and women's health outcomes.

Men's age: The average age of the male household head in this sample is about 43.5 years old. The youngest male primary respondent is 17 while the oldest included in the analysis is 93.

Women's age: The average age of the female respondent in this sample is about 37.5 years old. The youngest female primary respondent is 15 while the oldest woman included in the analysis is 93; however, anthropometric measures are only available for women 15-49.

Household size: The average household in this sample has about 7 people living in their house or immediate vicinity with whom the primary respondents share their resources. The largest household has 25 people, while the smallest household only has 2 people.

Gender Parity: The Gender Parity Index captures the relative empowerment of women, as their empowerment score is compared to the empowerment score of the male WEAI respondent in their household. The Gender Parity Gap refers to the difference in empowerment between the male and female WEAI respondents in a household. Dual-adult households are considered to have achieved gender parity if the woman's WEAI score is the same as or greater than her husband's empowerment score. Approximately 36% of couples have achieved gender parity, as measured by their WEAI scores.

Dependency ratio: The average household in this sample has a dependency ratio of 1.4, indicating that for every adult, there are 1.4 minors in the household, or about 3 minors for every 2 adults, on average. The smallest dependency ratio is 0, indicating no minors in the home, and the largest ratio is 6, indicating there are 6 minors for each adult in the household.

Per capita gross income (USD): The average gross per capita income from households in this sample is 473.25 USD. The lowest per capita income in a household is 7.20 USD, while the largest per capita income is 13, 105.90 USD.

CHAPTER 5. RESULTS

I estimate the children's health regressions via OLS. I estimate the women's DDS using Ordered Logit, as it is a count variable, rather than a continuous variable.

5.1 Children's Health Outcomes

To facilitate interpretation, the estimated parameters are divided by the mean value of the outcome variable to find the average percentage change, rather than describing the changes as point-value changes. This interpretation is intended to clarify the estimates as relative changes to the outcome variable since the outcome variables are standardized as z-score values.

5.1.a Parental Literacy

Across all specifications estimating the correlation between parental literacy and children's health outcomes (Table 2), when both parents can read and write, there is a very strong and positive relationship with large increases in children's HAZ and WAZ. Children from households where both parents can read and write are expected to have a HAZ that is an average of 34% higher than children from homes where both parents are illiterate, and a WAZ that is, on average, about 32% greater. These values suggest a very large difference among children, especially when considering that the average HAZ is -1.8 and the average WAZ is -0.9, and 34% and 32% increases, respectively, could potentially bring many moderately stunted and underweight children above the threshold of being stunted and underweight. In cases when the father is literate but the mother is not, children in the household could have a WAZ that is, on average, 20% higher than that of children whose male household head is illiterate, but these values were only statistically significant at the 10% level for specifications 2 and 5.

The coefficient of the woman's empowerment score may appear small, but the coefficient indicates that an increase of 0.10 in a women's WEAI empowerment score is associated with an average increase of 11% in a child's WAZ and an average of a 6% increase in HAZ. This 0.10 increase is the approximate equivalent of a woman being considered adequately empowered in one more indicator of the WEAI index.[12]

Looking at the regressions for HAZ, there is a large negative correlation related to households that have gotten a loan in the past year and children's HAZ. The coefficient of 0.30 indicates an average decrease of 16% in the HAZ of children from households which borrow credit from households which do not borrow credit.

[12] See Alkire et al. (2013a) and Appendix C for further explanation and breakdown of WEAI indicators.

Table 2: Parental Literacy as Predictors of Child Health Outcomes.

	Height-for-Age Z-score (mean = -1.8)					Weight-for-Age Z-score (mean = -0.9)				
VARIABLES	1	2	3	4	5	1	2	3	4	5
Both Spouses can Read and Write	0.523***	0.631***	0.608***	0.607***	0.631***	0.290***	0.295**	0.280**	0.301**	0.292**
	(0.142)	(0.156)	(0.153)	(0.156)	(0.156)	(0.109)	(0.122)	(0.121)	(0.124)	(0.121)
Woman can, Man cannot Read and Write	0.075	0.119	0.110	0.098	0.116	0.035	0.108	0.102	0.095	0.122
	(0.185)	(0.206)	(0.200)	(0.203)	(0.208)	(0.150)	(0.169)	(0.167)	(0.170)	(0.169)
Woman cannot, Man can Read and Write	0.118	0.207	0.201	0.179	0.206	0.146	0.180*	0.173	0.181	0.183*
	(0.122)	(0.132)	(0.132)	(0.132)	(0.132)	(0.098)	(0.109)	(0.107)	(0.110)	(0.108)
Maternal Body Mass Index		0.001	-0.001	0.001	0.001		0.017	0.014	0.017	0.017
		(0.017)	(0.017)	(0.017)	(0.017)		(0.013)	(0.013)	(0.013)	(0.013)
Woman's Empowerment Score			0.012**					0.010**		
			(0.006)					(0.004)		
Man's Empowerment Score			-0.006					-0.002		
			(0.007)					(0.004)		
Household Borrows Credit				-0.300**					-0.034	
				(0.136)					(0.108)	
Woman's Input on Decision to Borrow Credit				0.172					-0.138	
				(0.208)					(0.163)	
Woman's Input on Decision to Use Credit				0.009					0.097	
				(0.194)					(0.154)	
Woman's Input in Agricultural Decisions					-0.007					0.028
					(0.026)					(0.020)
Observations	855	706	706	706	706	869	713	713	713	713
R-squared	0.054	0.074	0.079	0.081	0.074	0.047	0.051	0.059	0.053	0.054
Robust standard errors in parentheses.										
*** p<0.01, ** p<0.05, * p<0.1										

Additional controls include: Number of household members, dependency ration, gender parity indicator, woman's age, man's age, child's age (in months), child's sex, and district indicators.

5.2 Women's Health Outcomes

The results values presented are the Odds Ratios from the Ordered Logit regressions: the difference from 1 indicates the percentage likelihood of a change from one discrete value to the next.

5.2.a Spousal Literacy

The estimations of predictors for women's health indicate that households where both spouses can read and write are more likely to have women with higher dietary diversity scores. Table 3 presents the estimated odds ratios, and the only statistically significant predictor of women's health is simultaneous literacy of spouses.

When both spouses can read and write, women are 40% more likely to have consumed an additional food group in the previous 24 hours than women who come from households where both spouses are illiterate. The average woman in this sample had consumed four food groups the day before, and this indicates that the average woman who is literate and has a literate husband is more likely to have consumed five food groups. This result is robust across all specifications at the 5% significance level.

Table 3: Spousal Literacy as Predictors of Women's Dietary Diversity.

VARIABLES	Dietary Diversity Score 1	2	3	4
Both Spouses can Read and Write	1.472**	1.466**	1.435**	1.459**
	(0.249)	(0.249)	(0.245)	(0.247)
Woman can, Man cannot Read and Write	1.200	1.194	1.220	1.203
	(0.329)	(0.327)	(0.335)	(0.329)
Woman cannot, Man can Read and Write	1.123	1.129	1.118	1.116
	(0.178)	(0.179)	(0.177)	(0.177)
Woman's Empowerment Score		1.008		
		(0.007)		
Man's Empowerment Score		1.000		
		(0.007)		
Household Borrows Credit			1.062	
			(0.177)	
Woman's Input on Decision to Borrow Credit			1.346	
			(0.323)	
Woman's Input on Decision to Use Credit			0.890	
			(0.208)	
Woman's Input in Agricultural Decisions				1.047
				(0.031)
Observations	812	812	812	812

Values expressed as odds ratios. Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Additional controls include: Number of household members, dependency ratio, gender parity indicator, woman's age, man's age, and district indicators.

The lack of statistically significant findings of important magnitude related to women's health indicates a lack of predictive power of women's health in determining children's health. The robustness checks of women's BMI (Appendix A, Table 6) potentially demonstrate that women's health is not as important of a factor in children's health as parental human capital inputs. By estimating the woman's health against the same series of specifications, I can eliminate the threat of multicollinearity of women's health and the specifications used to determine the parental inputs for children's health. This finding contradicts literature which finds that the mother's height and weight can predict her child's likelihood of being too short or too thin (Thomas et al., 1990; Thomas, 1994; Malapit and Quisumbing, 2015).

CHAPTER 6. DISCUSSION

The results provide an overarching indication that the joint literacy of parents is very important to positive health outcomes of young children. These results are supported by a large body of existing literature which find that increased parental education is associated with healthier children (Rosenzweig and Schultz, 1982; Barrera, 1990; Thomas et al., 1990; Smith and Haddad, 2000; Fafchamps and Shilpi, 2013). Additionally, the results support research which finds that the mother's education is not always more important to children's well-being than their father's education (Behrman, 1997), perhaps because marriage market matching of better educated women marrying better educated men, and the educational attainment of both parents is important (Chiappori, Iyigun, and Weiss, 2009; Fafchamps and Shilpi, 2013).

The parental literacy-focused results (Table 2) find a very large correlation between households where both parents are literate and positive outcomes for children's health. Considering that about 26% of households in this sample have parents who are both literate, and in about 32% of households neither parent is literate, these results suggest that there could be very real differences in these groups of households. Indeed, the average HAZ for children from households with parents who are both able to read and write is approximately -1.47, while the average HAZ for children from households with illiterate parents is -2.11. See Figure 12 for the distribution of children's HAZ by each category of parental literacy.

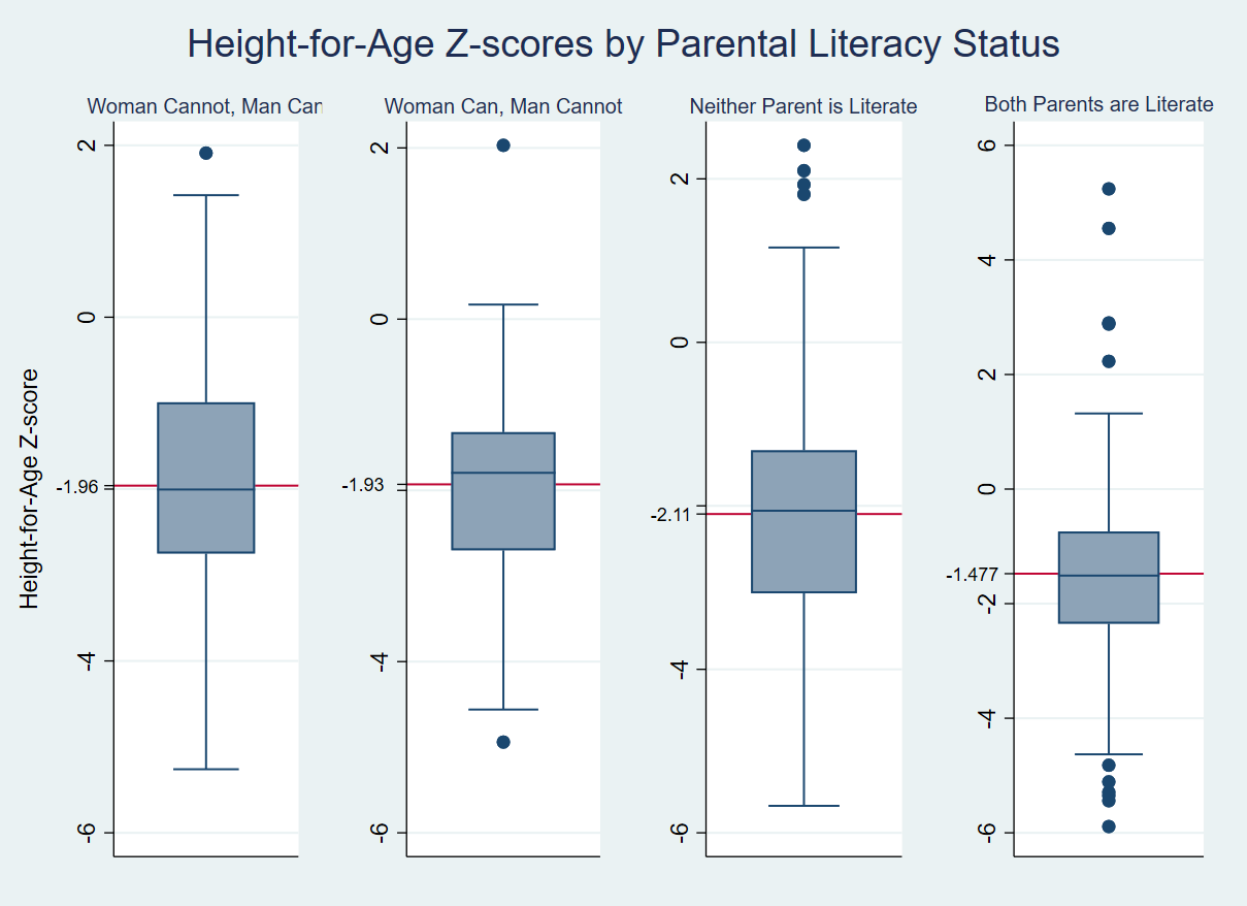

Figure 12: Distribution of Height-for-Age Z-scores by Parental Literacy Status. The red reference line on each chart indicates the mean value of the HAZ of the children.

The estimates of the women's empowerment score as a partial predictor of children's health suggests that there is a positive relationship between this empowerment measure and children's health, so as a woman's overall empowerment regarding agricultural decisions and activities improves, there may be observed improvements in her children's health. However, the other empowerment measures derived from the WEAI, the indicators which contribute to women's disempowerment, do not indicate strong relationships with the children's health outcomes. These results are aligned with previous studies which fail to identify strong relationships between the WEAI indicators and children's health outcomes, despite the identified positive correlation with

the general empowerment of the mother (Malapit et al., 2015; Malapit and Quisumbing, 2015; Malapit et al., 2019). These findings may be partially due to the construction of the survey and its focus on productive activities, rather than asking more specifically about behaviors that might influence children's health outcomes more directly.

The analyses for determining predictors of women's health outcomes revealed some consistent correlations between a couple's human capital attributes and the wife's positive health outcomes, implying that when a literate woman is married to a literate man, she is likely to have a slightly more diverse diet than a woman who is not literate or whose husband is not literate.

The other variables in the women's health analysis do not indicate any statistically significant relationship between the intra-household human capital or empowerment measures and women's health outcomes. This may imply that there are many unobserved influences that contribute to an adult woman's health status, an implication which is supported by research which suggests that unobserved influences, such as childhood health endowments, are important for a woman's adult health (Behrman and Wolfe, 1987).

CHAPTER 7. CONCLUSION

The results indicate a robust positive relationship between parental literacy and children's health. This finding is compatible with associations that better educated household heads are often better able to provide for their households. The results of the literacy specifications imply that while the individual literacy of a parent might positively contribute somewhat to child health outcomes, the combination of both household heads being able to read and write has a consistently large, positive relationship.

In rural Zambia, where so few women complete secondary school (about 4%), policies and interventions which support increasing women's education are important for closing the gender gap in education and literacy. While advocacy for improvements in women's education for the sake of improving women's and children's well-being is important, it is essential for *both* parents to achieve literacy and work towards higher levels of education. One parent cannot be left behind in this context of educational parity, as their combined contributions create an environment which provides their children with better odds of a healthy present and future.

7.1 Limitations and Future Research

Few works of research are ideal, and this analysis was limited in several ways. Because this study is based on cross-sectional data from a mostly self-reported survey, rather than experimental data from an intervention evaluation or panel data, it is not possible to make any causal inferences. The results present statistically significant positive associations between parental literacy and children's HAZ and WAZ, but I cannot conclusively state that parental literacy affects children's health directly.

The Feed the Future survey collected data on many household and individual characteristics, but did not include a few indicators of children's health which are helpful in predicting children's future well-being. These indicators include recent illnesses, such as diarrhea and malaria, as well as birth order and distance to health services. Using this same data set, further analysis could be performed to understand potential environmental factors influencing children's health, including the types of water and sanitation access the households use. While these hygiene indicators may not provide direct information about the recent poor health incidents of individuals in the household, they can provide some context of household conditions that may inform researchers about the strength of these characteristics and one's chronic health status.

An additional limitation is that the WEAI module solicits responses relating to a household's agricultural activities and decision making, but it does not ask specific for information related to the types of crops planted, nutritional knowledge, food accessibility, or dietary preferences. While the surveyed households had recently participated in the RALS, which collects extensive information about the household's productive activities, including crops, livestock raising, and income sources, that data set is not easily linked to this consumption component. The RALS survey was collected as panel data in 2012, 2015 and 2019, and there are additional rounds of FtF surveys, but the 2015 survey interviewed different households from RALS than the 2012 survey used in this study, so a panel analysis is not possible. If the RALS data were properly linked to the FtF data, an analysis on agricultural diversity would be interesting to see how it may relate to the foods consumed by members of the household. This information could help to clarify if the observed dietary consumption of women and children is a choice or based on limited options.

Beyond the scope of this data set, analysis of countries in Africa which have documented marked improvement in children's health outcomes can help determine which policies or demographic changes are aligned with the shift in health outcomes. Many organizations have collected rich data sets from this region which could possibly be used to better understand the related pathways and relationships connecting policy changes or household behavior and child health outcomes. Zambia has some of the highest rates of stunting in the world, especially in its rural areas, and research which emphasizes improved agricultural production could be analyzed in the context of effects on children's health. Because stunting results from chronic malnutrition, potential interventions would require longer time frames to ensure that women's antenatal health status and health care follows children over their life course.

APPENDICES

APPENDIX A.

ROBUSTNESS CHECKS

Table 4: Parental Education as Predictors of Child Health Outcomes.

	Height-for-Age Z-score (mean = -1.8)					Weight-for-Age Z-score (mean = -0.9)				
VARIABLES	1	2	3	4	5	1	2	3	4	5
Man's Years of Education	0.058***	0.068***	0.070***	0.073***	0.068***	0.039***	0.035**	0.035**	0.037**	0.035**
	(0.015)	(0.017)	(0.017)	(0.017)	(0.017)	(0.011)	(0.015)	(0.015)	(0.015)	(0.015)
Woman's Years of Education	0.026	0.03	0.027	0.025	0.029	0.015	0.007	0.006	0.006	0.005
	(0.020)	(0.027)	(0.027)	(0.027)	(0.027)	(0.016)	(0.021)	(0.021)	(0.021)	(0.021)
Maternal Body Mass Index		0.001	0.000	-0.001	0.000		0.026*	0.024*	0.024	0.026*
		(0.019)	(0.020)	(0.019)	(0.019)		(0.015)	(0.014)	(0.015)	(0.014)
Woman's Empowerment Score			0.011					0.011**		
			(0.007)					(0.005)		
Man's Empowerment Score			-0.009					-0.005		
			(0.007)					(0.004)		
Household Borrows Credit				-0.277*					-0.095	
				(0.152)					(0.122)	
Woman's Input on Decision to Borrow Credit				0.116					-0.131	
				(0.222)					(0.179)	
Woman's Input on Decision to Use Credit				-0.085					0.135	
				(0.219)					(0.178)	
Woman's Input in Agricultural Decisions					0.010					0.027
					(0.031)					(0.024)
Observations	792	536	536	536	536	807	542	542	542	542
R-squared	0.060	0.084	0.090	0.092	0.084	0.044	0.059	0.068	0.062	0.062
Robust standard errors in parentheses.										
*** p<0.01, ** p<0.05, * p<0.1										

Additional controls include: Number of household members, dependency ration, gender parity indicator, woman's age, man's age, child's age (in months), child's sex, and district indicators.

Table 5: Spousal Education as Predictors of Women's Dietary Diversity.

VARIABLES	Dietary Diversity Score 1	2	3	4
Man's Years of Education	1.013	1.014	1.011	1.013
	(0.030)	(0.030)	(0.030)	(0.030)
Women's Years of Education	1.082**	1.082**	1.083**	1.082**
	(0.039)	(0.039)	(0.039)	(0.039)
Woman's Empowerment Score		1.007		
		(0.009)		
Man's Empowerment Score		1.000		
		(0.008)		
Household Borrows Credit			1.085	
			(0.219)	
Woman's Input on Decision to Borrow Credit			1.181	
			(0.338)	
Woman's Input on Decision to Use Credit			0.928	
			(0.260)	
Woman's Input in Agricultural Decisions				0.995
				(0.036)
Observations	537	537	537	537
Values expressed as odds ratios. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1				

The values presented are odds ratios of the ordered logit coefficients. Additional controls include: Number of household members, dependency ratio, gender parity indicator, woman's age, man's age, and district indicators.

Table 6: Spousal Literacy as Predictors of Women's Body-Mass-Index.

	Body-Mass-Index			
VARIABLES	1	2	3	4
Both Spouses can Read and Write	0.509	0.534	0.551	0.481
	(0.359)	(0.361)	(0.356)	(0.359)
Woman can, Man cannot Read and Write	-0.155	-0.187	-0.150	-0.150
	(0.484)	(0.476)	(0.488)	(0.478)
Woman cannot, Man can Read and Write	-0.291	-0.283	-0.274	-0.302
	(0.326)	(0.326)	(0.325)	(0.326)
Woman's Empowerment Score		0.023		
		(0.014)		
Man's Empowerment Score		0.018		
		(0.013)		
Household Borrows Credit			0.131	
			(0.336)	
Woman's Input on Decision to Borrow Credit			-0.518	
			(0.446)	
Woman's Input on Decision to Use Credit			0.331	
			(0.452)	
Woman's Input in Agricultural Decisions				0.067
				(0.055)
Observations	729	729	729	729
R-squared	0.052	0.062	0.053	0.053
Robust standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Additional controls include: Number of household members, dependency ratio, gender parity indicator, woman's age, man's age, and district indicators

Table 7: Parental Empowerment as Predictors of Child Health Outcomes.

	Height-for-Age Z-score					Weight-for-Age Z-score				
VARIABLES	1	2	3	4	5	1	2	3	4	5
Woman's Empowerment Score	0.004	0.013**	0.012**	0.014**	0.014**	0.004	0.010**	0.010**	0.012***	0.009**
	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)
Man's Empowerment Score	-0.005	-0.008	-0.006	-0.006	-0.008	0.001	-0.003	-0.002	-0.003	-0.003
	(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Maternal Body Mass Index		0.003	-0.001	0.003	0.004		0.016	0.014	0.015	0.016
		(0.018)	(0.017)	(0.018)	(0.018)		(0.013)	(0.013)	(0.013)	(0.013)
Both Spouses can Read and Write			0.608***					0.280**		
			(0.153)					(0.121)		
Woman can, Man cannot Read and Write			0.110					0.102		
			(0.200)					(0.167)		
Woman cannot, Man can Read and Write			0.201					0.173		
			(0.132)					(0.107)		
Household Borrows Credit				0.214					-0.047	
				(0.208)					(0.109)	
Woman's Input on Decision to Borrow Credit				-0.089					-0.131	
				(0.201)					(0.158)	
Woman's Input on Decision to Use Credit				-0.305**					0.028	
				(0.139)					(0.155)	
Woman's Input in Agricultural Decisions					-0.015					0.020
					(0.028)					(0.021)
Observations	873	706	706	706	706	885	713	713	713	713
R-squared	0.040	0.055	0.079	0.064	0.055	0.035	0.049	0.059	0.051	0.050

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Additional controls include: Number of household members, dependency ration, gender parity indicator, woman's age, man's age, child's age (in months), child's sex, and district indicators.

APPENDIX B.

CORRELATIONMATRIX OF KEY INDEPENDENT VARIABLES

Table 8: Correlation Matrix of Key Independent Variables.

VARIABLES	Both Spouses can Read and Write	Woman can, Man cannot Read and Write	Woman cannot, Man can Read and Write	Man's Years of Education	Woman's Years of Education	Maternal Body Mass Index	Woman's Input on Decision to Borrow Credit	Woman's Input on Decision to Use Credit	Household Borrows Credit	Woman's Input in Agricultural Decisions
Both Spouses can Read and Write	1									
Woman can, Man cannot Read and Write	-0.222***	1								
Woman cannot, Man can Read and Write	-0.532***	-0.232***	1							
Man's Years of Education	0.402***	-0.169***	0.0812	1						
Woman's Years of Education	0.592***	0.104*	-0.374***	0.421***	1					
Maternal Body Mass Index	0.132**	-0.0204	-0.0257	0.0695	0.0445	1				
Woman's Input on Decision to Borrow Credit	0.0819	-0.0751	-0.0196	0.133**	0.0442	-0.00611	1			
Woman's Input on Decision to Use Credit	0.0200	-0.0227	-0.0220	0.108*	0.0216	0.0673	0.684***	1		
Household Borrows Credit	0.00828	-0.0590	-0.0239	0.120**	-0.0238	-0.0346	0.489***	0.596***	1	
Woman's Input in Agricultural Decisions	0.105*	-0.0749	-0.0477	0.0654	0.129**	0.0734	0.141***	0.167***	0.0693	1

APPENDIX C.

WOMEN'S EMPOWERMENT IN AGRICULTURE INDEX

Table 9: The Domains of Empowerment in the Women's Empowerment in Agriculture Index.

Domain	Indicator	Definition of Indicator	Weight
1. Production	1.1 Input in Productive Decisions	Sole or joint decision-making over food and cash-crop farming, livestock, and fisheries	1/10
	1.2 Autonomy in Production	Autonomy in agricultural production (what inputs to buy, what livestock to raise, etc.)	1/ 10
2. Resources	2.1 Ownership of Assets	Sole or joint ownership of major household assets	1/15
	2.2 Purchase, Sale, or Transfer of Assets	Whether respondent participates in decision to buy, sell, or transfer own assets	1/15
	2.3 Access to and Decisions on Credit	Access to and participation in decision-making concerning credit	1/15
3. Income	3.1 Control Over use of Income	Sole or joint control over use of income and expenditures	1/5
4. Leadership	4.1 Group Membership	Whether respondent is an active member in at least one economic or social group (e.g., agricultural marketing, credit, water users' groups)	1/10
	4.2 Speaking in Public	Whether the respondent is comfortable speaking in public about various issues such as intervening in family disputes, ensuring proper payments of wages for public work programs, etc.	1/10
5. Time	5.1 Workload	Allocation of time to productive and domestic tasks	1/10
	5.2 Leisure	Satisfaction with the available time for leisure activities	1/10

Source: Alkire et al. (2013a).

BIBLIOGRAPHY

BIBLIOGRAPHY

Alkire, S., R. Meinzen-Dick, A. Peterman, A. Quisumbing, G. Seymour, and A. Vaz. *The Women's Empowerment in Agriculture Index* (No. 58). OPHI, Oxford, UK. 2013a.

Alkire, S., H. Malapit, R. Meinzen-Dick, A. Peterman, A. Quisumbing, G. Seymour, and A. Vaz. *Instructional Guide on the Abbreviated Women's Empowerment in Agriculture Index (WEAI)*. OPHI, Oxford, UK. 2013b.

Barrera, A. "The Role of Maternal Schooling and its Interaction with Public Health Programs in Child Health Production." *Journal of Development Economics* (1990).

Behrman, J. "Women's Education and Children's Schooling: A Review." PIER Working Paper 97 – 025 (1997)

Behrman, J. and B. Wolfe. "How Does Mother's Schooling Affect Family Health, Nutrition, Medical Care Usage, and Household Sanitation?" *Journal of Econometrics* 36 (1987): 185-204.

Browning, M., F. Bourguignon, P. Chiappori, and V. Lechene. "Income and Outcomes: A Structural Model of Intrahousehold Allocation." *Journal of Political Economy* 102, 6 (1994): 1067–1096.

CSO (Central Statistical Office). *Zambia Labor Force Survey Report 2014*. Lusaka, Zambia. 2015.

CSO (Central Statistical Office), MOH (Ministry of Health), and ICF International. *Zambia Demographic and Health Survey 2013-2014*. Rockville, Maryland, USA. 2015

Chiappori, P. "Rational Household Labor Supply." *Econometrica* 56, 1 (1988): 63–90.

Chiappori, P., M. Iyigun and Y. Weiss. "Investment in Schooling and the Marriage Market." *American Economic Review* 99, 5 (2009): 1689-1713.

de Onis, M., and F. Branca. "Childhood stunting: A global perspective." *Maternal and Child Nutrition* 12(2016):12–26.

Fafchamps, M., and F. Shilpi. "Education and Household Welfare." *Economic Development and Cultural Change,* University of Chicago Press, 63 (2014): 73-115.

FAO. *Guidelines for Measuring Household and Individual Dietary Diversity*. Rome, Italy. 2011.

FAO, IFAD, UNICEF, WFP, and WHO. *The State of Food Security and Nutrition in the World 2017. Building Resilience for Peace and Food Security.* (FAO, Ed.). Rome, Italy. 2017.

FEEDBACK, F. T. F. *Feed the Future Zambia Zone of Influence Baseline Report*. Rockville, MD. 2013.

Grebmer, K. von, J. Bernstein, F. Patterson, A. Sonntag, L. M. Klaus, J. Fahlbusch, … H. Fritschel. *2018 Global Hunger Index: Forced Migration and Hunger*. Dublin, Ireland; Bonn, Germany. 2018.

Güneş, P. M. "The Role of Maternal Education in Child Health: Evidence from a Compulsory Schooling Law." *Economics of Education Review* (2015)

Haddad, L., J. Hoddinott, and H. Alderman. *Intrahousehold Resource Allocation: An Overview* (No. 1255). *Policy Research Working Paper*. Washington, DC. 1994.

Hoddinott, J., and L. Haddad. "Does Female Income Share Influence Household Expenditures? Evidence From Côte D'Ivoire." *Oxford Bulletin of Economics and Statistics* 57, 1 (1995): 77–96.

Lundberg, S. J., R. A. Pollak, and T. J. Wales. "Do Husbands and Wives Pool Their Resources ? Evidence from the United Kingdom Child Benefit." *The Journal of Human Resources* 32, 3 (1997): 463–480.

Malapit, H. J. L., S. Kadiyala, A. R. Quisumbing, K. Cunningham, and P. Tyagi. "Women's Empowerment Mitigates the Negative Effects of Low Production Diversity on Maternal and Child Nutrition in Nepal." *Journal of Development Studies* 51, 8 (2015): 1097–1123.

Malapit, H. J. L., and A. R. Quisumbing. "What Dimensions of Women's Empowerment in Agriculture Matter for Nutrition in Ghana?" *Food Policy* 52 (2015): 54–63.

Malapit, H. J. L., E. Sraboni, A. R. Quisumbing, and A. U. Ahmed. "Intrahousehold Empowerment Gaps in Agriculture and Children's Well-Being in Bangladesh." *Development Policy Review* 37, 2 (2019): 176–203.

Mofya-Mukuka, R., and J. Sambo. *Household Dietary Diversity Impact of Women Control over Income from Agriculture in Zambia* (No. 136). Lusaka, Zambia. 2018.

Right to Education (RTE) Project. *Country Factsheet: Zambia.* August 2012.

Rosenzweig, M., and T. P. Schultz. "The Behavior of Mothers as Inputs to Child Health: The Determinants of Birth Weight, Gestation, and Rate of Fetal Growth." Chapter 2, *Economic Aspects of Health*. University of Chicago Press. 1982.

Rubalcava, L., and D. Thomas. "Family Bargaining and Welfare." *Working Papers*.

Sraboni, E., H. J. Malapit, A. R. Quisumbing, and A. U. Ahmed. "Women's Empowerment in Agriculture: What Role for Food Security in Bangladesh?" *World Development* 61 (2014): 11–52.

Smith, L., and J. Haddad. *Explaining Child Malnutrition in Developing Countries: A Cross-Country Analysis.* International Food Policy Research Institute, Washington, D.C. 2000.

Thomas, D. “Like Father, Like Son; Like Mother, Like Daughter: Parental Resources and Child Height.” *Journal of Human Resources* 29, 4 (1994): 950-988.

Thomas, D., J. Strauss, and M. Henriques. “Child Survival, Height for Age and Household Characteristics in Brazil.” *Journal of Development Economics* 33 (1990): 197–234.

Udry, C., J. Hoddinott, H. Alderman, and L. Haddad. “Gender Differentials in Farm Productivity: Implications for Household Efficiency and Agricultural Policy.” *Food Policy* 20, 5 (1995): 407–423.

UNICEF. *State of the World’s Children 2017*. United Nations Children’s Fund. 2017.

World Bank Group. *World Data: Zambia* (https://data.worldbank.org/country/zambia). 2019a.

World Bank Group. *Zambia Overview*. (www.worldbank.org/en/country/zambia/overview). 2019b.

World Bank Group. *Poverty & Equity Brief: Zambia*. 2019c.

World Health Organization (WHO) Multicentre Growth Reference Study Group. *WHO Child Growth Standards: Length/Height-for-Age, Weight-for-Age, Weight-for-Length, Weight-for-Height and Body Mass Index-for-Age: Methods and Development*. World Health Organization Press. Geneva, Switzerland. 2006.

World Health Organization (WHO). *“Indicators for Assessing Infant and Young Child Feeding Practices: Part 1”* World Health Organization Press. Geneva, Switzerland. 2008.