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"Green Famine": Mothers' Education and Children's Nutritional Outcomes in the Democratic Republic of the Congo

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“Green Famine”: Mothers’ Education and Children’s Nutritional Outcomes in the Democratic Republic of the Congo

by

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Dedication

This dissertation is dedicated to my loving father, the Late Dr. Moses Tabi Ebot. Your life's work was dedicated to making sure that no woman and child should ever feel the groans and pain of death. Through your sacrifice, I have become the daughter, sister, friend, and now scholar that you always wanted me to be. One day --I am sure of it-- we will meet again. But until then, may the better demographer win.

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It’s over already?!?! But I just got started! I guess it’s finally that time ladies and gents, for the graduate school at The University of Texas at Austin to finally give me my walking papers and kick me out into the real world. I keep on telling them I have more to learn but they just won’t listen. So here I am. But before that happens, it is only fitting that I take a few extra pages to thank all those that have made this rollercoaster ride a blast. First and foremost I give all honor and praise to my Lord Jesus Christ, through whom all things are possible. My strength and courage these last years has not been my own, so I give Him thanks.

I came to Austin, Texas 6 years ago with no clue as to what I wanted to study. I mean I knew what I wanted to research, but nobody seemed to care about it. I was told it was too cliché, nobody funds that anymore, Africa is so 2000 (seriously, a professor said that to me), etc. Then I met Bob Hummer. I don’t know whether it was that he took pity on me or because he could obviously tell that I had walked into the wrong office, but from that day forward, he never gave up on me. Even when I would turn a draft in late, change my comps subject out of the blue, or forget to print my dissertation in single-sided copies, he never failed to keep his door open to me. Dr. Hummer you took a young and lost graduate student that nobody wanted and turned me into a proud demographer. No words can describe what your mentorship has meant to me these last 6 years. Thank you. Dr. Hayward, you taught me that being a late bloomer is not a sign of failure but instead a sign of growth. And you taught me the finer qualities of tequila. Thank you. Drs. Umberson, Gordon, and Cavanagh: thank you for being supportive and challenging me during this entire process. Dr. Hopkins you taught me how to be a woman in this world

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“Green Famine”: Mothers’ Education and Children’s Nutritional Outcomes in the Democratic Republic of the Congo

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The University of Texas at Austin, 2014

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Undernourishment is considered the underlying cause for more than one-half of all child deaths in Sub-Saharan Africa. Undernourishment not only increases children’s risk of mortality, but also has negative long lasting health effects including developmental deficits, increased levels of hunger-related and chronic illnesses in adulthood, and adverse pregnancy outcomes for women. Studies analyzing determinants of child undernourishment have shown women’s individual-level educational attainment to be a key predictor of children’s nutritional outcomes, but have fallen short of fully considering community-level socioeconomic characteristics as determinants. Accounting for community-level characteristics points to the role that children’s external household factors and surroundings play in shaping their early-life health and nutrition outcomes. Additionally, substantial health and nutrition variation across urban and rural areas in Sub-Saharan Africa raises the need for researchers to not only study how the combination of individual-level and community-level factors affect children’s nutritional outcomes, but also how this relationship differs by urban-rural residential location. Therefore, this dissertation examines the relationship between individual-level and community-levels of women’s educational attainment and urban and rural children’s nutritional outcomes in the Democratic Republic of the Congo using a nationally-representative dataset: the 2007

Democratic Republic of the Congo Demographic and Health Survey. In sum, the findings reveal that: (a) rural Congolese children are more likely to be nutritionally deficient compared to urban Congolese children, yet the highest percentage of nutritionally deficient Congolese children reside in low educated urban communities; (b) whereas urban Congolese communities exhibit substantial variation in child nutritional outcomes by maternal education, rural Congolese communities show little variation in children's nutritional status; (c) individual-level and community-level women's education are associated with urban children's nutritional outcomes, though this association narrows after taking into account women's socioeconomic status; and (d) individual-level and community-level education are not associated with rural Congolese children's nutritional outcomes. Overall, the results underscore the importance of a community-context perspective in understanding educational and urban-rural disparities in children's nutritional outcomes.

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Chapter 1: Statement of the Problem

1.1 INTRODUCTION

This dissertation focuses on the nutritional outcomes of children in the Democratic Republic of the Congo (DRC). The overall objective is to understand to what extent and how mother's education at both the individual and community-levels impacts the nutritional outcomes of young children in this very large and very poor Sub-Sahara African (SSA) country. The remainder of this chapter details the state of children's nutrition in SSA and the DRC, discusses changes in maternal education, identifies gaps in related literature, presents the specific research questions that are the focus of my dissertation research, and concludes with a history of the DRC and the current status of women. Though this dissertation is not a historical analysis of trends in Congolese women's educational attainment, the addition of historical data allows readers to contextualize the current status of women's education and children's nutritional outcomes by understanding past experiences.

1.1.1 Childhood Nutrition in Sub-Saharan Africa

In the last three decades, many developing countries have experienced very high levels of food insecurity (Food and Agriculture Organization of the United Nations (FAO 2012b). Food insecurity exists when people do not have adequate physical, social or economic access to food (FAO 2010). Food insecurity usually leads to nutritional deficits among the most vulnerable members of society: the elderly, pregnant women, and most

especially, young children. The FAO estimates that 360 million children under the age of five suffered from chronic hunger at the end of 2010 (FAO 2012a).

Chronic hunger, or under-nourishment, is a serious medical condition marked by deficiency in essential proteins, fats, vitamins and minerals and occurs when calorie intake falls below the minimum dietary energy requirement: the amount of energy needed for light activity and a minimum acceptable weight for attained height (FAO 2010; Olack, Burke, Cosmas, Bamrah, Dooling, Feikin, Talley, and Breiman 2011). Under-nourished children are usually shorter and weigh less than children the same age who receive adequate nutrition. Under-nutrition is also considered the underlying cause of death (COD) for more than 50% of child deaths worldwide (Black, Morris, and Bryce 2003).Ten million children under the age of five die from preventable and treatable illnesses each year related to under-nourishment (Black, Morris, and Bryce 2003; Olack et al. 2011). Children who suffer from under-nourishment have negative long lasting health effects: developmental deficits, increased levels of hunger related and chronic illnesses in adulthood, and adverse pregnancy outcomes for women (Peña and Bacallao 2002; Silva 2005).

Though food insecurity and under-nourishment are global crises, they are especially heightened in SSA. At the end of 2011, 29 countries in SSA estimated that 15% or more of their total population suffered from under-nutrition (FAO 2012a). In addition, 120 million SSA children under the age of five suffer from under-nourishment (Olack et al. 2011).Further, 2/3 of all deaths to SSA children under five are associated

with under-nutrition (Black, Cousens, Johnson, Lawn, Rudan, Bassani, Jha, Campbell, Walker, Cibulskis, Eisele, Liu, Mathers, and Who 2010) (Black et al. 2010). Many non-government and public health organizations have identified the nutrition crisis plaguing SSA children as the focus of their health initiatives. In 2000, the Millennium Development Goals (MDGs) listed the eradication of extreme poverty and childhood hunger as their primary initiatives(FAO 2013).

1.1.2 Education of Women in Sub-Saharan Africa

A large body of literature has shown a strong relationship between socioeconomic resources and health outcomes in developing countries (Bicego and Ahmad 1996; Caldwell 1979; Cleland and van Ginneken 1988; Cochrane, Leslie, and O'Hara 1982; Frost, Forste, and Haas 2005).The United Nations Educational, Scientific, and Cultural Organization (UNESCO) and the FAO have stressed the multi-dimensional nature of national economic growth and development, community resources, and individual socioeconomic status for children's health outcomes. More recently, analysts have stressed the specific importance of mothers' educational attainment for children's nutritional outcomes. Between 1990 and 2009, it was estimated that 2.06 million fewer children under five years of age died due to increases in mothers' educational attainment, net of advancements in economic growth in developing countries (Gakidou, Cowling, Lozano, and Murray 2010). For central and east SSA, the growth of mean years of women's education between 1990 and 2009 accounted for a reduction of 308,000 child deaths (Gakidou et al. 2010). Both the Education For All (EFA) movement and the MDG

have concluded that advancements in education among young women in SSA would produce rapid drops in child mortality rates because women are the primary decision-makers when it comes to children's nutrition and health (Doan and Bisharat 1990; Gakidou, Cowling, Lozano, and Murray 2010)(Miles-Doan and Bisharat 1990; Gakidou et al. 2010).

Education related initiatives have led to significant progress in education attainment in developing countries; mean number of years of completed schooling have increased by approximately 1-2 years among women of reproductive age (15-49 years) in central and east SSA (Gakidou et al. 2010). Between 1990 and 2009, the mean years of education of women aged 25 years and plus in the DRC increased from 1.9 to 4.0 years (Gakidou et al. 2010).

Though there have been increases in the mean years of education among Congolese women, most women still receive less than 6 years of schooling. Additionally, Congolese people continue to be among the poorest in the world. Figure 1 provides 2007 data on the highest level of educational attainment among women in the DRC: an estimated 20.8% of Congolese women had not received any education at all (Figure 1). Approximately 60% of all women had received a primary and secondary school education. Yet, there were sharp differences by residential location. Approximately 7.4% of urban women had received zero years of education, compared to 32% of rural women. Though almost twice as many rural women received a primary school education than

urban women, 65% of urban women went on to complete a secondary school education or more, whereas only 20.4% of rural women attained a similar degree.

Furthermore, maternal educational attainment levels are significantly lower in areas that have experienced prolonged wars, as was found in Scanlan and Jenkins' (2001) study on the effects of military power on food insecurity in developing nations. During periods of war, governments typically increase their spending on military forces and decrease funding to their health and education sectors (Scanlan and Jenkins 2001).

1.1.3 Gaps in Related Literature

Previous work on the effects of socio-economic status on children's health has emphasized the importance of country-specific levels of women's literacy and education on infant survival rates in developed countries (Schell, Reilly, Rosling, Peterson, and Ekström 2007) and developing countries (Bicego and Ties Boerma 1993; Filmer and Pritchett 1999; Sandiford, Cassel, Sanchez, and Coldham 1997). Additional research has detailed the importance of individual-levels of maternal education and knowledge and better nutritional outcomes in Ethiopia (Christiaensen and Alderman 2004; Genebo, Girma, Haider, and Demissie 1999; Yimer 2000), and Egypt (Wachs and McCabe 2001). More specifically, the effects of household socio-economic status measures on children's health and nutritional outcomes have recently been estimated in the DRC (Emina, Kandala, Inungu, and Ye 2011; Tumwine and Barugahare 2002), Uganda (Kikafunda, Walker, Collett, and Tumwine 1998; Roberts, Ocaka, Browne, Oyok, and Sondorp 2009; Wamani, Tylleskar, Astrom, Tumwine, and Peterson 2004; Wamani, Åstrøm, Peterson,

Tylleskär, and Tumwine 2005), and Rwanda (Dowell, Toko, Sita, Piarroux, Duerr, and Woodruff 1995). However, no studies have analyzed the relationship between mother's education and children's nutrition at both the individual and community-levels in the DRC. A detailed analysis of human resources, especially education, has important implications for policy initiatives in SSA.

Recently, a study by Emina et al. (2011) examined the effects of maternal education on the nutritional outcomes of children in the DRC. Using secondary data from the Multiple Indicator Cluster Survey (MICS2), the authors examined the association between individual-level mother's education and children's stunting, wasting, underweight, and simultaneous multiple-malnutrition outcomes, controlling for women's empowerment and autonomy, health and reproductive behavior, socioeconomic status, and children's demographic characteristics. Their overall results demonstrated mixed effects of mother's education on children's nutritional outcomes. First, contrary to previous research, children of mothers with no education had 19% lower odds of being stunted than children whose mothers had a secondary school education or higher, net of all control variables. Second, there was no relationship between maternal education and child wasting, after controlling for province of residence. Finally, mother's education was significantly associated with the risk of children suffering from simultaneous multiple-malnutrition: compared to children whose mothers had a secondary education and higher, children with mothers that had no education or a primary school education had 89% and 51% higher odds of suffering from multiple forms of malnutrition, respectively.

My dissertation research builds off of Emina et al. (2011) by focusing on maternal education and children's nutritional outcomes in the DRC. Though the Emina et al. (2011) study advances our understanding of women's education and children's health, it also has key limitations that necessitate a more thorough analysis of the effects of women's education. First, while Emina et al. (2011) examined women's education in the DRC, their conceptualization of the different pathways by which maternal education is related to children's nutritional outcomes does not fully take into account additional measures. For example, to examine the effects of mother's education through reproductive behaviors, Emina et al. (2011) capture this by using measures of mother's age at birth of child, mother's number of children under five in the household, and whether or not each child had a health card. The authors do not include measures of mother's health knowledge, maternal access to health services in their province of residence, or birth spacing, which would be a more thorough representation of maternal health and reproductive behaviors. Therefore, the authors' results showing no effect of maternal reproductive health behavior on children's nutritional outcomes are solely based on demographic characteristics and not on specific fertility related health behaviors.

Second, in their study's conceptual framework, Emina et al. (2011) state that a clearer understanding of the relationship of women's empowerment and children's health status involves a multi-dimensional analysis of: 1) women's roles in household decision making, including use of preventive health services, children's nutrition, and treatment of sick children; and 2) women's access to the economic market and rights to reproductive

behavior. Yet, Emina et al.'s (2011) measures of women's empowerment and autonomy did not take into account women's perceptions of their roles within their household: it only captured their relationship to the head of household. The transformation of the relationship to head of household variable into a categorical variable (head of household, spouse or other) does not detail the roles of women within the household or women's perceptions of their ability to make health and nutrition decisions. Additionally, their descriptive statistics show that 12% (n=1,694) of children's mothers list "other" as their relationship to head of household, yet no explanation is given for which type of household head is an "other".

Third, Emina et al. (2011) do not control for children's health or mother's health and nutritional outcomes at the time of the survey. The inclusion of health measures is important because Emina et al. (2011) perform three analyses using stunting, wasting, and simultaneous multiple-malnutrition as outcomes. If the outcome variables are measuring a *nutritional* deficiency, then models testing determinants of nutritional outcomes should include controls for children's food intake. Furthermore, previous work has linked mother's own nutritional outcomes, a measure of childhood advantage or disadvantage, with mother's educational attainment and children's health (Behrman and Rosenzweig 2004; Fogel and Costa 1997).

Finally, Emina et al. (2011) do not include measures of community-level education. Though the aim of their paper was not to understand its impact on children's nutritional outcomes, a growing body of literature has shown that community-level

education is just as important as individual-level education in understanding childhood mortality and morbidity (Kravdal 2004; Pamuk, Fuchs, and Lutz 2011). Including community-level education measures allows a more complete understanding of how children's surroundings work to improve their overall health and nutrition.

1.2 Analysis Questions

My dissertation research uses data from a nationally representative sample of children aged 7-59 months from the DRC to examine the relationships between individual and community-levels of mother's educational attainment and children's nutritional outcomes.

My analysis first uses descriptive statistics and an analytic person-centered approach to detail and describe the backgrounds of a sample of Congolese mothers and their children. The person-centered approach facilitates a "thick description" of women and children at the individual-level and provides a clearer baseline understanding of the social environment within which specific women and their children live.

Next, I examine the relationship between mother's education, community-level education and children's nutritional outcomes, net of individual and community social and economic measures. This is an important analysis because different resources at the individual and community-level are related to children's nutritional outcomes. I perform this analysis separately by residential location because of growing evidence that various individual and community factors affect urban and rural children's health outcomes in significantly different manners.

Finally, I examine the relationship between mother's individual and community-level education and nutritional outcomes, as the education variables work through several indirect pathways including women's levels of autonomy and gender equity, socioeconomic status, reproductive behavior, media access, and knowledge. This analysis is important because it provides valuable information on not only the knowledge based advantages from education, but also how education works through other factors to affect children's nutrition. The results of this analysis are also stratified by residential location.

I focus on the DRC because it is one of the largest, most populated, and poorest countries in SSA. Figure 2 shows a map of the DRC. A focus on children's nutritional outcomes in the DRC is important because it is an extremely "food rich" country with extended rainy seasons and rich soil, yet exhibits a very high level of childhood malnutrition. Therefore, the problem of chronic childhood hunger in the DRC is not due to a complete lack of available food resources, but because of the inability of individuals to *access* health and food resources. In this research, education is not used as a marker of women's individual talents and intelligence but instead signifies the opportunities that come through educational attainment. An analysis of mother's education and children's nutrition is a key step toward understanding how and why one key socio-economic resource (maternal education) is related to children's nutritional outcomes. Thus, my dissertation aims to answer 3 main questions:

1. How do women's and children's lives in the DRC differ by individual and community-levels of women's education, for the country as a whole as well as in urban and rural areas?

2. Does children's nutritional outcomes in the DRC differ by individual and community-levels of mother's education? How do individual and community-level effects of education differ across urban and rural households?

3. To what extent do women's autonomy, reproductive behaviors, socioeconomic status, media access, and health knowledge mediate the relationships between individual and community-level education and children's nutritional outcomes?

1.3 THE DEMOCRATIC REPUBLIC OF THE CONGO

The DRC, a vast country located in Central Africa, is the 11th largest country in the world by area (slightly less than ¼ the size of the United States) (Central Intelligence Agency (CIA 2013). Figure 2 is a map of the DRC. Bordered by Zambia, Angola, Republic of the Congo, Central African Republic, Rwanda and Burundi, the DRC is also the 4th largest SSA nation by area. The DRC is made up of approximately 250 different ethnic groups, the largest being the Kongo, the Luba and the Anamongo ("Congo" 2012). Though the main language is French, over 700 local languages, including Kikongo, Thsiluba, Swahili, and Lingala are spoken (2012). The estimated 2011 mid-year population was 71,712,867(CIA 2013). The DRC is a largely rural country and is one of the poorest countries in SSA: only 32.6% of the total population resides in cities and the per capita gross national income (GNI) is $180USD (CIA 2013).

1.3.1 Colonial History

The DRC has had a long history of struggle from both foreign and domestic rulers who plunged the country into years of colonialism, poverty, and war. In 1885, the DRC became the private property of King Leopold II of Belgium (Hochschild 1999). Though King Leopold II defended expansion into the Congo as a "humanitarian effort" against inferiority of the black body, disease, and ignorance (Nzongola-Ntalaja 2002), in actuality, the underlying reason for the eventual exploitation of the Congo was the capital that was estimated to be reaped from the Congo's abundant natural resources, including timber, palm trees, coffee, tea, and wild rubber trees (Hochschild, 1999).

The Belgium monarch enacted a movement of "primitive accumulation", or compelling Congolese citizens to abandon their livelihoods and become workers of the Belgium state (Nzongola-Ntalaja 2002). From 1892-1910, most of the Congo's economy was linked to the rubber trade (Nelson 1994): a growing demand for rubber in American and European markets meant there was a large profit to be made from the Congo. Villagers that were unwilling or unable to fulfill their rubber or iron quotas were punished by public floggings, torture, rape, and mutilation (Nelson 1994).

Belgian colonial rule left a long-term legacy of death, disease and destruction amongst the Congolese. People's daily lives were disrupted and replaced with impoverishment, famine, illness, and death. The process of cultivating fields and gardens for food and trade was replaced by slave labor in the rubber, coffee and cotton farms and the railroads. Population estimates show that at the beginning of the colonial era, the

population was between 20 and 30 million. Yet by 1911, the population was reduced to 8.5 million (Nzongola-Ntalaja 2002).

1.3.2 Post-colonial History

After 75 years of colonial rule, the DRC became independent on June 30, 1960 and elected Patrice Lumumba as the nation's first prime minister. Yet Western fears of central Africa falling into Soviet hands drove United States and European allies to fear the "pro-Communism" rhetoric of Lumumba. The vast mineral and natural resources in the Congo were too lucrative to fall into the hands of the Soviet Union: uranium is used to manufacture nuclear weapons while niobium and tantalum are needed for space aeronautics. On August 18, 1960, U.S. President Dwight D. Eisenhower authorized the assassination of Patrice Lumumba (Nzongola-Ntalaja 2002). Lumumba was kidnapped by local militia men and Belgian troops, tortured, and then executed on January 17, 1961. Following a struggle for power between 1961 and 1964, Mobutu Sese Seko came to power in a coup in 1965 and changed the country's name to Zaire ("Congo" 2012). To ensure the stability of Zaire and central Africa, the United States provided Mobutu Sese Seko with more than $300 USD million for weapons and $100 USD million in military training (Dunn 2002). For over 30 years, the Mobutu regime ruled Congo, plunging the country into a state of poverty similar to that seen during colonialism. Failed projects, including the 'Zairianization' of private businesses, the use of public money to fund paramilitary forces, and the building of private mansions eroded the formal sector and silenced any form of democracy (Dunn 2002; Dunn 2005).

Following the Rwandan genocide in May 1996, millions of Hutu and Tutsi Rwandan refugees fled the violence and poured into Zaire, using refugee camps as military bases. As tensions between Zaire and its neighbors grew, anti-Mobutu factions, led by Laurent-Desire Kabila, joined forces with Rwandan and Ugandan forces to overthrow Mobutu on May 17, 1997 (CIA 2013). Yet distrust of his foreign allies led newly elected President Kabila to expel all foreign troops from the newly renamed Congo in July 1998. Aptly titled, the African World War began on August 2, 1998 and eventually ended with peace talks and a cease-fire in Pretoria, South Africa on December 17, 2002 ("Congo" 2012).

The series of civil and border wars displaced over 7 million individuals and led to the deaths of over 4.7 million Congolese people (CIA 2013). Long after the cease-fire, health organizations have identified long-term effects of the civil wars on Congolese children's survival rates and growth outcomes. The United Nations Children's Fund (UNICEF) estimates that the 2005 war related under-five mortality rate in the DRC was 205 deaths per 1000 (Kandala et al. 2009). Currently, the under-five mortality rate is estimated to be 168 deaths per 1,000 live births (UNICEF 2013a)Moreover, over 46% of DRC children are considered stunted (UNICEF 2013a).

1.4 CONGOLESE WOMEN

The current status of Congolese women's education is an outcome of colonial biases against social and economic advancements of women, and post-colonial civil and border wars that disrupted national educational systems. Prior to Belgian colonial rule,

Congolese women were free to own, cultivate and inherit land (Bouwer 2010). For the majority of Congolese women, farming and making household goods were important and successful means of profit (Bouwer 2010). Yet during colonialism, European gendered views of women erased the strong role of the Congolese woman: because European leaders only dealt or hired men, the land rights of women were swiftly removed and their ability to gain profit from the land was eroded (Bouwer 2010). Small subsistence farming became rural Congolese women's main occupation, growing out of a desperate need for women to feed their families by any means necessary. In addition, Congolese women became pawns and victims of abuse by colonial masters: women were typically victims of hostage situations, as in the case of husbands or villages not meeting their rubber quotas (Bouwer 2010).

After the succession of Mobutu Sese Seko in 1965, low government expenditures on the educational system and the lack of stable well-paying occupations meant that women, after freeing themselves from the yokes of colonial oppression, were once again economically marginalized. Between 1960 and the early 2000s, the Congolese national education budget fell from 7% of GDP and 25% of the national budget to 1% of GDP and 5% of the budget (Mokonzi and Kadongo 2010). In addition, the forced seizure of all businesses by the government known as 'Zairinization' (Hochschild 1999) and the dismantling of the formal sector meant that schooling for many young women was interrupted in order for them to seek early employment in the informal sector.

Finally, the civil and cross-national wars that erupted in 1997 abruptly shut down much of Congo's infrastructure and forced millions of Congolese families to flee into the forest or neighboring countries. The lack of a central government after the ousting of Mobutu Sese Seko's regime and the subsequent civil and border wars meant that any

advancements or efforts in improving the national educational system were completely abandoned (Bashir 2005). Urban and rural women and children fled by the thousands into the jungle, seeking help from churches, refugee sites, and aide organizations. Yet the forests of the Congo were teaming with advancing militia groups and soldiers from over 100 different Ugandan, Angolan, Sudanese, Zimbabwean, Namibian, Rwandan and Congolese political and military groups. Caught in the cross fires, Congolese women became the victims of rape, sexual slavery and violent attacks by many of the militia groups in the DRC. Some of the more graphic and brutal instances of violence include women with parts of their genitals cut off with razor blades or women shot in the vagina after being repeatedly raped. Most, if not all, of the sexual violence during the civil war went unreported. The cease fire in 2002 temporarily stopped the extreme violence that had crippled the DRC and caused the deaths of an estimated 6 million individuals. Even afterwards, many women did not receive medical or psycho-social aide for their physical and non-physical wounds (Brittain 2002).

Since the election of a new president in the DRC in 2006, few efforts have been made to improve the low levels of educational attainment among Congolese women. During the civil war between 1997 and 2002, many schools were destroyed or completely abandoned. Rebuilding efforts have been ineffective in reaching the large demand for schools to serve the DRC's large youth population: currently, 43.9 percent of the population is under 15 years of age (CIA 2013).The lack of trained teachers, corruption at the highest levels of the government, and a concentration of academic resources at the higher levels of education has made it difficult for Congolese women to receive an education. In addition, the lack of schools in the rural DRC means that millions of rural children are underserved, especially at the secondary level (Mokonzi and Kadongo 2010).

1.3 Outline of my Dissertation

1.3.1 Chapter 2

In Chapter 2 of my dissertation, I describe my dissertation's sample of Congolese women and children and contextualize their lives by type of community (i.e., urban and rural residential location and level of education). The aim of this chapter is to describe the social environment within which specific women and their children live and provide additional credibility to the interpretations of my results in subsequent chapters.

1.3.2 Chapter 3

Chapter 3 of my dissertation analyzes the overall relationship between individual and community-levels of women's education and children's nutritional outcomes in urban Congolese households. I hypothesize that women's individual-level of education and the education of other women within communities will have independent effects on children's nutritional outcomes across urban households the Democratic Republic of the Congo. In addition, I hypothesize that women's autonomy, socioeconomic status, reproductive behaviors, media access, and health knowledge will mediate the relationship between multi-levels of education and children's nutritional outcomes.

1.3.3 Chapter 4

Chapter 4 of my dissertation analyzes the overall relationship between individual and community-levels of women's education and children's nutritional outcomes in rural Congolese households. I hypothesize that individual and community-levels of education will have an effect on rural children's nutritional outcomes, though the effects will be

weaker in comparison to those found in Chapter 3. I hypothesize that women's autonomy, socioeconomic status, reproductive behaviors, media access, and health knowledge will mediate the relationship between multi-levels of education and children's nutritional outcomes.

1.3.4 Chapter 5

I conclude my dissertation with a review of the findings in each chapter, the limitations of the analyses, policy implications, and future research ideas.

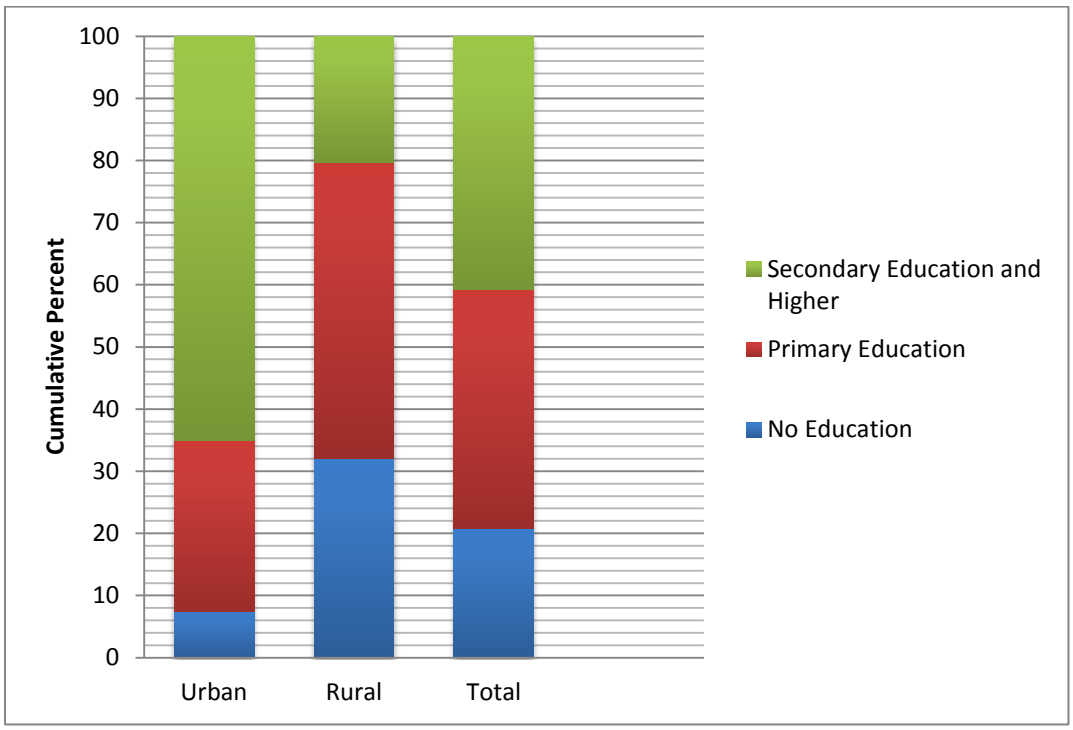

Figure 1.1: Distribution of Women 14-59 years in the Democratic Republic of the Congo (2007 EDS-RDC) by Highest Level of Educational Attainment

Source: 2007 EDS-RDC StatCompiler

Figure 1.2: Map of the Democratic Republic of the Congo

Source: Geo-Data: The World Geographical Encyclopedia

Chapter 2

> "When you civilize a man, you only civilize an individual; but when you civilize a woman, you civilize an entire nation" (Bouwer, 2010).

2.1 INTRODUCTION

In this chapter, I use data from the 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC) to describe the lives of Congolese women and children based on urban-rural context and women's average community-level of education: low, medium, and high. This chapter aims to address 3 questions: 1) What is the distribution of women's individual-level of education in the DRC? 2) How do women's and children's lives in the DRC differ by urban/rural residential location? 3) Is women's average community-level of education related to differences in household resources, autonomy, socioeconomic status, and nutritional outcomes?

In the next sections of this chapter, I define the "thick description" approach I loosely base this chapter on to contextualize the differences in urban and rural living. Next I describe urban and rural areas in the DRC. I then describe the data and "person centered" methods of my descriptive analyses, present my descriptive results, and conclude with a discussion of the results.

2.2 "THICK DESCRIPTIONS" AND COMMUNITY CONTEXT

As previously stated, the aim of this chapter is to not only describe Congolese women's and children's lives, but to also describe their social context using a loose form of "thick description". The concept of "thick description", originally introduced by Gilbert Ryle in his 1965 "*Thinking and Reflecting"* lecture, "involves understanding and

absorbing the context of a situation or behavior (…) in order to ascribe current and future intentionality to the behavior" (Ponterotto, 2006:539). Ryle's example of a "thick description" is the image of a golfer hitting golf balls towards a green and a passerby wondering what the golfer is doing. A "thin description" of the golfer's behavior would be that the golfer is solely hitting a tiny ball with a hooked device over and over again to a green patch. But a "thick description" would interpret the golfer's current behavior within a context of the golf course and the game of golf, and therefore ascribe a particular intention to the golfer's current behavior. In addition, the golfer's current behavior would also have future intentions ascribed to them: the golfer is practicing in order to improve his/her skill for a potential future game (either competitive or for leisure) (Ponterotto 2006).

Though the concept of "thick description" has been an integral part of qualitative research, quantitative researchers have only recently stressed the importance of richly and thickly understanding individuals' contexts in order to understand their behavior and outcomes. In "Putting People into Place", Barbara Entwisle (2007) called for researchers to create stronger descriptive connections between communities and health outcomes using more diverse approaches that account for both human agency and local context. Instead of solely analyzing a series of characteristics and then presenting a "thin description", researchers should describe these characteristics within a richly and thickly identified community context (Entwisle 2007). Norman K. Denzin's (1989) reinvention of "thick description" is the driving force behind my use of both descriptive statistics and

a “person centered approach” to bring even more detail to women’s and children’s lives in the DRC:

> A thick description…does more than record what a person is doing. It goes beyond mere fact and surface appearances. It presents detail, context, emotion, and the webs of social relationships that join persons to one another. Thick description evokes emotionality and self-feelings. It inserts history into experience. It establishes the significance of an experience, or the sequence of events, for the person or persons in question. In thick description, the voices, feelings, actions, and meanings of interacting individuals are heard (Denizen, 1989: 83).

Due to my lack of original qualitative data, I am unable to comprehensively use a “thick description” approach in this chapter. Indeed, walking through the streets of the DRC and interviewing individual women about their experiences would have provided a much richer and more detailed context and description. Yet my use of secondary qualitative and quantitative data still provides descriptions of Congolese women’s and children’s livelihoods, as well as their communities. The first section of this chapter describes the sights and sound of urban and rural DRC, with a detailed illustration of the lives and roles women embody. Second, combined with the descriptive results, I

introduce specific details of individual women's lives as a way to insert an actual experience within my research framework.

2.3 URBAN AND RURAL LIVING IN THE DEMOCRATIC REPUBLIC OF THE CONGO

Research on child morbidity and mortality outcomes in Sub Saharan Africa (SSA) has identified differences by urban and rural location. The most prominent studies have shown that an underlying explanation of the urban-rural health gap is the availability of *resources* at the urban and rural level. Urban residents typically have greater access than rural residents to resources such as health services, clean water, sanitation and education, which have all been positively associated with better nutritional outcomes, though recent work has challenged this urban advantage (Bocquier, Madise, and Zulu 2011; Garrett and Ruel 1999).

Building off of this previous literature, this chapter expands research on the urban-rural gap in child nutritional outcomes by describing how women's individual and community-levels of education differ across urban and rural areas in the DRC. I use both secondary research and survey data from the 2007 EDS-DHS to describe and contextualize Congolese women's and children's lives.

2.3.1 Urban Democratic Republic of the Congo

Urban growth in the DRC has occurred rapidly. Kinshasa or Kinois, the DRC's capital city, has grown to be one of the most populated cities in SSA: between 1960 and 2011, Kinshasa grew from 400,000 to 8.8 million residents (CIA Worldfactbook, 2012). Kinshasa is located on the south bank of the Congo River. On a clear day, residents can look across the bank to Brazzaville, the capital city of the Republic of the Congo. Though not as populated as Kinshasa, Kananga (878,000 residents), Kisangani (812,000

residents), Lubumbashi (1,543,000 residents) and Mbuji-Mayi (1,488,000 residents) are the other main urban centers in the DRC (CIA 2013).

The city sights and sounds of the DRC strongly mirror the country's sharp contrasts of the past and present. Along the Congo River waterways, hydroelectric power facilities and large river barges reside alongside small fishing boats (2013). Walking down Boulevard du 30 Juin, the main street in Kinshasa (Tran 2013), visitors can hear Soukous music from Papa Wemba and Pepe Kalle being played from passing taxis while the N'dombolo verses of Koffi Olomidé stream from the outdoor patios of local ngandas or small scale restaurants (Stewart 2000). Depending on the region of the ngandas, individuals can eat baked fish served with cooked plantains from the riverside ngandas or goat meat with rice and green vegetables from the kasai ngandas located in the wealthier regions while drinking Primus or Mutzig, the Congo's most popular beers (Tran 2013). The wide, unpaved, and congested city streets that snake throughout the city lead to a number of quartiers, or neighborhoods, where little children play pick-up games of football or adults have animated political or sports discussions in French (Tran 2013).

Though Congolese cities provide individuals with diverse resources, the landscape also presents the contrast between the few affluent residential areas and the sprawling slums that make up most of the city. The rich and famous of Kinshasa reside in majestic mansions in Cité de l'OUA, quartier Matonge, and Gombe. The average urban dweller resides in the many slums of Kinshasa. Across most urban communities, especially in Kinshasa, the average rent is US$55/month or approximately half of families' household monthly income (Bank 2011).In order to save funds, it is not uncommon for multiple families to be tightly packed into a shared house or compound,

resulting in overcrowding, limited privacy, and the easy spread of diseases (Iyenda 2005; Iyenda 2007; Matti 2010).

Urban homes lack many physical necessities. Approximately 21% of urban Congolese residents do not have access to an improved or clean source of water (UNICEF 2011). Therefore, young children and women of the household typically make 2-3 trips a day to collect water from a public tap, river or stream. Many homes also lack proper sanitation: 43% of urban households do not have access to improved toilet facilities (UNICEF 2011). The interior of most homes are small and cramped. The main part of the house typically includes a living room with 1 or 2 bedrooms. Bedrooms are often shared by 3-5 family members per room, with young children typically sleeping on the floor (Iyenda, 2005). The lack of beds means young children are exposed to bites from mosquitoes and other insects.

2.3.2 Urban Congolese Women

Most urban Congolese women are responsible for the majority of household chores and activities in their household. As the sun barely peaks up from the horizon, most urban women in the DRC are already awake and cooking breakfast for family members (Iyenda 2001). Limited indoor space and the expenses associated with owning a gas stove means that most urban Congolese women cook meals in the outside compound over a charcoal or wood stove. This increases accidents and contamination from dirty water, pollution, and livestock kept in the family compound for sale or consumption (Iyenda, 2005). Women may also wake up the youngest children to help with some of the morning chores, such as buying charcoal or ingredients for meals, fetching water from the local well or tap, sweeping the compound, or feeding the livestock.

Congolese women walk with food, coal, or other items tied in bundles on their head along the curbsides of the main intersections and busy streets of Kinshasa, ready to display their goods to passing customers and earn between US$2-5 (Belfiore 2002). Close to 40% of urban Congolese women are employed in the informal or manual sector as street vendors. Street vendors typically sell vegetables, fruit, bread, cakes, pastries, medicine (modern and traditional), and manufactured goods as well as their services as porters (Iyenda, 2005). Many vendors erect semi-permanent stalls. Fixed vendors, as they are called, typically engage in more technical activities: they fix car batteries and tires, cook and sell food (fresh and frozen), cut hair, and are money dealers and small shopkeepers. Though a majority of street vendors are adults, the sight of young children aiding their parents or relatives, working as carriers, shoe shiners, sellers of drinking water, peanuts, fruit or different cooked foods is very common in Kinshasa (Iyenda, 2005).

Though the informal or manual sector provides freedom from taxes and overt corruption, it is an unstable form of income for urban women (Iyenda, 2005). Approximately 27.5% and 65.0% of urban women have completed primary school and secondary school or higher, respectively (see Figure 1.1).. Yet most women are barred from working in the formal sector because of a lack of formal positions or a preference for male workers (Iyenda, 2005). Therefore, many urban Congolese women must work in the informal sector, sometimes in more than one occupation. In addition, the increase in urban women as the main income earners of their households means that many women must tackle the financial difficulties of their households on their own (Iyenda, 2005). Many of the choices women must make range from types of food cooked each day to which children will be able to go to school and which ones must remain at home and

work. Children who are able to attend school typically attend ill equipped and overcrowded public schools that are not up to date on governmental standards (Mokonzi and Kadongo 2010).

Women typically work at least 12 hours a day (Iyenda, 2005). As the day passes and customers stop by, women tend to sell most of their goods by noon and then begin to lower the prices of their remaining perishable goods by late afternoon (Iyenda, 2005). The lack of "standards and rules" in the informal sector means that many times, women are subject to "fees and penalties" by corrupt police officers and officials, which may deplete the $2-5USD profit they typically make in a day. Therefore, most urban female street vendors' livelihoods strongly depend on the trust, informal social networks, and relationships with neighbors and strong communication they have with the women in their communities and area of work (Iyenda 2005). Most women street vendors share not only customers with other women vendors, but also their income, skills, knowledge, and information about different aspects of business (Iyenda, 2005, 2007).

Though many women are employed in the informal sector, many do not have jobs outside of the home. Some women choose not to work outside the home for safety reasons and the lack of affordable or effective childcare. Other women may choose not to have a job outside the home because the additional income is not necessary, which is typically found in more educated households and communities.

2.3.3 Rural Democratic Republic of the Congo

As visitors leave the city, they are overcome by the lush scenery that cloaks their travels. Rural areas of the DRC consist of beautiful landscapes, marked by volcanic mountain ranges, lush, tropical forests, and hundreds of rivers and lakes. Over 36% of the DRC is covered by rainforests and forested areas make up 52% of the land (2008).Rural

communities make up a majority of the population: UN estimates show that in 2010, rural inhabitants numbered 43.7 million (UNPD 2010). By 2025, it is estimated that the rural population will increase to 55 million residents (UNPD 2011b).

The rural forests of the DRC are home to a number of species. Among the heights of the trees, chimpanzees and bonobo monkeys look down at forest walkers and search for ripe fruits. Forest elephants, okapi, and white rhinos reign the forest floor. The mountain ridges are home to mountain and silverback gorillas (McCoy 2003). Cars speeding down the dusty red dirt rural roads may pass by colorful farms of cassava, corn, banana, rice, coffee, tea, palm oil, rubber and cotton. Tucked into the forest curtains are small and remote rural communities (McCoy 2003).

Rural communities in the DRC have similar characteristics. Most homes are round or rectangular huts built with vines, sand, water, and sometimes cement. Most rural families reside in single 1-2 room residences with an outdoor structure built for cooking and washing of clothes. Because many rural parts of the DRC are environmentally protected areas, there are many regulations and restrictions on the construction of roads, bridges, radio towers, and other amenities. Therefore, very few households in the rural DRC have electricity, running water, or access to paved roads. During the civil war between 1997 and 2001, many rural communities were unable to hear current information on the war, receive necessary aide from UN peacekeeping troops, or have accessible retreats to safety. It was not until after the cease fire in 2002 that many rural inhabitants were able to safely travel to neighboring communities and send their children to the few available rural schools (Mokonzi and Kadongo 2010).

2.3.4 Rural Congolese Women

The daily lives of rural women in the DRC are marked by struggles and severe poverty. Similar to their urban counterparts, rural women in the DRC are overburdened with a range of household activities, including raising children, collecting daily water and firewood, preparing meals, taking care of the elderly and sick members of the household, and feeding the livestock (Gueye 2000). Therefore, women are less likely to find high paying jobs outside the home because of the number of responsibilities they have at home.

The crow of the distant rooster calls rural Congolese women to another work day. Most rural Congolese women work in the agriculture sector as self-employed subsistence farmers or laborers on a mass coffee, rubber, cotton, or plantain farm. After independence, rapid development initiatives poured foreign aid and national resources into urban areas. However, few dollars trickled down to rural communities (Rwomire 2001). Therefore, many rural women were unable to attend school or continue with their education. Data from 2007 showed that almost 70% of rural women only received a primary school education or less (see Figure 1.1). The lack of a proper education and occupational resources freezes most rural women and their families in a state of poverty.

As previously stated, rural women bear most of the responsibility for agriculture production. Their husbands typically assist in clearing and preparing the land, yet the majority of the labor falls on the shoulders of the women. Typically, rural Congolese women have 3 or 4 plots of land which enable them to cultivate cassava year round, and groundnuts, corn and vegetables seasonally (FAO 1997). Rural women use these plots to provide food for their families while also earning an income for basic necessities. Rural women take part in small-scale trading with members of their own or neighboring

communities. The lack of cash in the rural DRC means that the transactions are small or are paid in kind because most rural households lack cash. It also means that many rural women are unable to increase their share of the household income.

Rural Congolese women face a number of struggles in providing for their families. First, subsistence farming in the DRC can be unstable because of over-cultivation and grazing, poor soil, soil erosion, and occasional droughts, which lead to frequent periods of food insecurity and financial instability (Rwomire 2001). Second, during periods of financial instability, many households lose their most able bodied men to Kinshasa or other large urban areas, in search of jobs in the mining and informal sectors. Therefore, the loss of protection and harvesting abilities that women receive from male family members places a heavy burden on women and their young children. Finally, the frequent periods of food insecurity means that women are unable to provide adequate food or clothing for themselves and their children, increasing risks of malnutrition. It is not uncommon for most inhabitants of a rural household to have just one or two outfits of clothing in total. The lack of adequate and protective clothing has been shown to increase risk of infections, diseases, injuries, and animal bites (Rwomire 2001).

2.4 COMMUNITIES

2.4.1 DHS Geographic Data

The 2007 EDS-RDC recorded geographic coordinates of groupings of households or clusters in the DRC. First, census Enumeration Areas (EAs) were selected using a combination of population density information from a 1984 national survey and the 2006 national elections. From the census EAs, 300 clusters were selected. Figure 1 shows the approximate locations of the 300 clusters in the 2007 EDS-RDC. Clusters were typically

a census EA, a village, a settlement, a small town, or part of a larger town or a city. Each cluster consisted of approximately 14 to 53 female respondents, with an average of about 33 women.

To measure the location of each cluster, DHS fieldworker teams traveled to an open location at the center of each cluster which was not close to any tall buildings or tree canopies. Using a Global Positioning System (GPS) receiver, DHS fieldwork teams recorded geo-referenced locations (latitude, longitude and altitude) of each cluster. Each geographic recording was saved in the GPS receiver and on paper to prevent loss. To ensure respondent privacy, the coordinates of all 300 clusters were randomly displaced by 5 kilometers in rural areas and 2 kilometers in urban areas. A further 1 percent of rural clusters were displaced by up to 10 kilometers. Each cluster's geographical data was appended to each household's and individual respondent's record, allowing a potential link between individual files and GPS files. It should be noted that each GPS recording is an estimation of the *center* of a cluster, not the location of an individual household. Thus, using the GPS data to analyze the distance of a household to a specific location (school, clinic, body of water, etc.,) would not be an accurate method of analysis (International 2013).

2.4.2 Previous Geographic DHS Research

The utilization of DHS geographic data for health related analyses has several limitations and strengths that should be kept in mind. The first limitation is the overemphasis that DHS clusters are the actual neighborhoods and communities that DHS respondents reside in. The survey design of the DHS capitalized on previous census data that defined the primary sampling units. These measurements are efficient and clear but do not let researchers know if the primary sampling unit means anything to the

individuals residing within the country: the cluster or census EAs may not be meaningful within a country's cultural and social context. For example, do individuals within a cluster relate to their neighbors based on geographic census boundaries or on cultural, class, ethnic or gender boundaries that are not as easily drawn on a map?

A second related limitation comes from the use of clusters to measure potential interactions between neighbors and residents. Most clusters had on average the same number of households within them. Yet the distance between each household within the cluster differs by urban-rural residence: urban households are more likely to be geographically closer to one another compared to rural households because of higher congestion in urban areas and lower density in rural areas.

On the positive side, geographic data has allowed researchers to conduct important research on specific health outcomes (anemia and malaria status, nutritional outcomes, infant and child mortality, etc.) by geographic area. Kazembe and Namagale (2007) studied the spatial patterns of childhood co-morbidity (fever, diarrhea, and pneumonia) in Malawi and found a larger concentration of co-morbidity risk in the northern clusters and regions compared to the central and south-eastern clusters and regions. Links between malaria prevalence and infant and childhood mortality were more intense in rural Malawian clusters compared to urban Malawian clusters (Kazembe, Appleton, and Kleinschmidt 2007). Dake's (2012) study on the spatial distribution of overweight Ghanaian women found that urban clusters tended to have more overweight women compared to rural clusters (Dake 2012). In addition, DHS geographic data allows for cross-national health comparisons using different DHS datasets. Balk et al. (2004) estimated levels of childhood mortality in 11 West African countries and found that the effect of country-level differences in childhood mortality disappeared when household

and spatial characteristics were included in models (Balk, Pullum, Storeygard, Greenwell, and Neuman 2004). Further, Noor et al. (2009) used DHS and Multiple Indicator Cluster Survey (MICS) GIS data from 40 SSA countries to show the distributions of insecticide treated bed nets from 2000 to 2007 (Noor, Mutheu, Tatem, Hay, and Snow 2009).

2.5 DATA AND METHODS

The analytic purpose of this chapter is to first describe the backgrounds of Congolese women and children residing in urban and rural areas and second within varied communities defined by educational level. Though my central dissertation research specifically focuses on the relationship between Congolese women's individual and community-levels of educational attainment and their children's nutritional outcomes, the descriptive statistics and person centered approach provides a context to better understand the statistical results in the other chapters of this dissertation.

2.5.1. Data

The data used for this analysis were collected as part of the 2007 EDS-RDC. The 2007 EDS-RDC was the first nationally representative survey of its kind conducted in the country. The objective of the 2007 EDS-RDC was to provide data on fertility and family planning behavior, child mortality, children's nutritional outcomes, maternal and child health services, and knowledge of HIV/AIDS. The 2007 EDS-RDC was conducted between January and August 2007 and is representative at the national level, for urban and rural residences, and for eleven provinces (Kinshasa, Bas-Congo, Bandundu, Équateur, Orientale, Nord-Kivu, Sud-Kivu, Maniema, Katanga, Kasaï Orientale, and Kasaï Occidental). The EDS-RDC has complete interviews from 8,886 households, 9,995 women aged 15-49 and 4,757 men aged 15-59.

The 2007 EDS-RDC contains 3 separate survey questionnaires: the Household Questionnaire, the Women's Questionnaire, and the Men's Questionnaire. The Household Questionnaire collects information on each household member and visitor: background; parental survivorship; sanitation, water, and cooking sources; and assets. The Women's Questionnaire collects information on age; marital status; education; employment; residence; fertility history; fertility behavior; family planning and contraception; antenatal, delivery and postpartum care; breastfeeding and nutrition; children's health; status of women; knowledge of AIDS and other sexually transmitted infections; husband's background; and use of tobacco. The Men's Questionnaire is similar to but shorter than the Women's Questionnaire. It collects information on age; education; employment status; religion; residence; reproduction; knowledge and use of contraception; gender roles; and knowledge of AIDS and other sexually transmitted infections. In addition, the DHS collects anthropometric measures (height and weight) for children under age 5 and women aged 15-49. The three commonly used indicators to measure children's nutritional outcomes are height-for-age, weight-for-age and weight-for height. I limited my descriptive sample to 2007 EDS-RDC of children 7-59 months of age who: a) had complete data on maternal educational attainment, b) had complete anthropometric measurements, and c) whose mothers were married non-visiting residents of the interviewed household. This limited my sample size to 2,789 children.

2.5.2 Descriptive Variables

2.5.2.1 Children's Nutritional Outcomes

The overall focus of my dissertation is on women's education and Congolese children's nutritional outcomes. Height-for-age and weight-for-height indexes from the

2007 EDS-RDC are used as proxies of children's nutritional outcomes. Height-for-age is used to measure "stunting" and weight-for-height is used to measure "wasting". Stunting describes growth retardation among children (being very short for their age) and typically results from chronic nutritional deprivation coupled with repeated infections. Wasting is an anthropometric measure that taps into children's body mass in relation to length and is a measure of children's current nutritional outcomes. Both wasting and stunting are measured in the form of z-scores, which compare a child's height-for-age or weight-for-height to those of children in a reference healthy population (WHO 2013). The equations for determining a child's (1) height-for-age or (2) weight-for-height is:

$$Height - for - age\ z - score = \frac{H_i - H_r}{SD\ of\ the\ reference\ population} \quad (1)$$

$$Weight - for - age\ \ z - score = \frac{H_i - H_r}{SD\ of\ the\ reference\ population} \quad (2)$$

, where H_i is the height of the child; H_r is the median height of the reference population; and SD is the standard deviation of the height of the reference population (WHO, 2013). The National Center for Health Statistics/WHO definitions of childhood stunting and wasting describe children whose height-for-age or weight-for-height measures are two standard deviations below the median height-for-age or weight-for-height curve as stunted or wasted, respectively (WHO, 2013).

Children's stunting and wasting were coded as dummy variables. All children who were two standard deviations below the reference height-for-age category were defined as being stunted and were given a value of "1", whereas all other children were defined as not stunted and were given a value of "0". Similarly, all children who were

two standard deviations below the reference weight-for-height category were labeled as wasted and were given a value of “1”, whereas all other children were defined as not wasted and were given a value of “0”.

2.5.2.2 Mother’s Individual-level Educational Attainment

The primary independent variable is mother’s level of educational attainment, which is measured as a 5 category variable: no formal education (0 years), incomplete primary (>0-5 years), complete primary (6 years), incomplete secondary (>6-11 years), and complete secondary school or higher (12 plus years) (Kravdal 2002; Pamuk, Fuchs, and Lutz 2011).

2.5.2.3 Community-level of Education

The 2007 EDS-RDC is not representative at the community-level, yet utilizing the average level of women’s education in each cluster provides an effective estimate of the education “around” each child and their mother in the data set. The 2007 EDS-RDC has 300 total clusters -- 125 urban and 175 rural -- of approximately 33 women per cluster. Community-level education was calculated by averaging the years of schooling for all women aged 15-49 with a non-missing response of education in years in *each* of the 300 clusters. Next, after calculating the distributions of mean years of education for each cluster, I divided communities into 3 categories of average education: low average community education (less than 4 years), middle average community education (at least4 but less than 8 years), and high average community education (8 or more years) (Pamuk, Fuchs, and Lutz 2011). I also differentiated communities by urban and rural status.

2.5.2.4 Women's Autonomy

To gauge women's autonomy, I used the 2007 EDS-RDC questions about women's household decision-making abilities, ability to get care for child, and marital status. The questions on women's household decision making abilities were: "Who usually makes the final decision on your health care, the health care of children, the purchase of major household goods, visits to family or friends, and your earnings?" I recoded women's responses to these 5 different questions into three categories: the woman made the sole decision, the woman made the decision jointly with the husband/partner, or the husband/partner made the sole decision (Hindin 2000; Singh, Haney, and Olorunsaiye 2012). Next, each of the women's autonomy responses was used to also create an autonomy index measure. The autonomy index ranges from 0-5 and corresponds to the number of decisions in which a woman participated alone or jointly with her husband. A high score on the autonomy index indicates a higher level of household autonomy. Women who said they could decide to get care for their child are coded as "1", while those who said they could not decide to get care for their child are as coded as "0". Finally, women who said they were an only wife were coded as "0" whereas women who said they were not the only wife were coded as "1".

2.5.2.5 Socioeconomic Status

The 2007 EDS-RDC coded women's occupation into 7 categories: not employed, professional/technical/managerial, clerical, agriculture, services, skilled manual, and unskilled manual. Using previous work by Abbi et al. (1991), I coded maternal

occupation into 4 categories: no occupation, manual occupation, agriculture occupation, and professional occupation (Abbi 1991).

Additionally, the 2007 EDS-RDC has a wealth index, which is a composite measure of a household's cumulative living standard. It is calculated from data on a household's ownership of specific assets: televisions and bicycles; the building material of the home; and types of water access and sanitation facilities. Using principal component analyses, the wealth index places individual households on a continuous scale of relative wealth. Households were separated into 5 wealth quintiles: lowest, second, middle, fourth and highest. Wealth quintiles are expressed in terms of quintiles of individuals in a population and not quintiles of individuals at risk for a health or population indicator. The advantage to this approach is that information is directly relevant to the principal question of interest, for example, the health status or access to services for the poor in the population as a whole (Rutstein and Johnson 2004). The result is a substantive measure of relative and not absolute country-specific economic resources.

2.5.2.6 Reproductive Behaviors

I coded women's reproductive behaviors to be consistent with earlier studies (Palamuleni 2008; Rutstein 2005). The 2007 EDS-RDC asks women questions on their pregnancy behaviors. Variables measuring prevention of malaria and use of iron supplements during a woman's last pregnancy were coded as "1" if the woman answered yes to using a preventative malaria medication or taking an iron supplement. I coded

number of children under five years of age in the household as an interval variable ranging from 1-6.

2.5.2.7 Health Knowledge and Media Access

Variables measuring women's health knowledge and access to media were likewise coded to be consistent with earlier work (Arimond and Ruel 2004; Burchi 2010). First, women were asked how often they listened to the radio, watched television, or read newspapers/magazines. Women who used the sources of media at least once a week were given a value of "1", while women who used any source of media less than once a week were given a value of "0". Second, women were asked if they had any knowledge of oral rehydration therapy (ORT) and whether they gave their child a vitamin A supplement at birth. Women who answered no to these two questions were given a value of "0" and those who answered yes were given a value of "1".

2.5.3 Methods

All percentages were calculated using STATA SE 12.1(31). I used the svy command to take into account sampling weights and the cluster sampling design of the 2007 EDS-RDC.

In order to perform the "person centered analysis", I first divided all 300 communities by average level of women's education (low average, middle, high average) and urban-rural location. In Table 2.1, I included the original sample sizes in each of the communities. Next, in order to describe women within each of these communities, I used women's individual-level of educational attainment as the measure of differentiation. For example, in Table 2.1, the top left cell pertains to women who received no formal

education that reside in low average education urban communities. This process was done for all other communities, resulting in 18 different combinations. Third, I used the simple random sample function in STATASE 12, to randomly select 5 women within each individual and community-level of education combination. Finally, after analyzing each of these 5 women's household and individual characteristics, I then selected 1 woman from each cell who was an appropriate representation of the 5 randomly selected women. In Table 2.1, I also included labels of each representative woman for easier reference throughout the discussion.

2.6 DESCRIPTIVE RESULTS: URBAN AND RURAL DRC

2.6.1 Children's Nutritional Outcomes

Table 2.2 presents weighted descriptive percentages by urban and rural household residential location. Overall, 42% and 10% of Congolese children are stunted and wasted, respectively. Close to 35% and 11% of urban children are stunted and wasted, respectively, compared to 47% and 9% of rural children. Thus, urban children have a slightly higher level of wasting, while rural children have a significantly higher level of stunting. A higher level of wasting among urban children is surprising. These initial results suggest that more urban children are affected by short term fluctuations in food prices, daily household income, or natural disasters compared to rural children, who seem to suffer more from long term chronic nutritional deficiencies. Contrary to previous data detailing a severe rural burden in nutritional outcomes, Table 2.2 shows that large percentages of urban children also suffer from poor nutrition.

2.6.2 Women's Autonomy

Measures of women's autonomy and gender equity also show differences by household residential location. First, the autonomy index is higher in urban areas compared to rural areas. That is, urban Congolese women make more decisions solely or jointly compared to rural Congolese women. More specifically, most urban and rural mothers exhibit low levels of decision making concerning household purchases and movement outside the home but have high autonomy concerning domestic duties. However, urban mothers are more likely to make independent decisions compared to rural mothers. Approximately 48% of urban mothers and 54% of rural mothers say their husband/partner makes the final decision concerning household purchases, though about 30% of rural and urban mothers said they make purchasing decisions jointly with their husband/partner. Over 50% of urban and rural mothers say their husband/partner make the final decision concerning their visits to family/relatives. Not surprising, more than half of urban mothers said that they make the final decision on the types of food cooked daily. Rural and urban mothers have similar results in relation to final decision-making concerning women's health care. In addition, most women said they could decide to take their children for medical care.

Overall, urban mothers' ability to make sole decisions may be due to a less stringent practice of patriarchy. But what is interesting is the slight difference in joint decision-making: rural mothers make more joint decisions compared to urban women. So in the case of urban women, it's almost all or nothing concerning decision making, whereas rural women are evenly spread across the continuum. Finally, the results also show that women are taking a very active role in making health decisions about their children.

Second, both urban and rural mothers exhibit relatively high levels of financial-autonomy, though urban mothers have more sole financial decision making power: close to 24% of urban mothers said they make the final decision about their earnings compared to 11% of rural mothers. Once again, it must be noted that rural women have more financial joint decision-making abilities: joint decision making, and not just sole decision making, may be where rural women gain most of their autonomy. Finally, approximately 14% of urban mothers are in a polygynous marriage compared to 20% of rural mothers.

2.6.3 Socioeconomic Status

Urban mothers exhibited higher levels of individual-level educational attainment. Less than 8% of urban mothers have not received a formal education compared to over 30% of rural mothers. About 12% of urban mothers completed primary school compared to only 7% of rural mothers. Though a larger percentage of urban mothers have a secondary school education compared to rural mothers, close to 46% of urban mothers have not completed their secondary school education: only 10% of mothers completed secondary school and higher compared to less than 1% of rural mothers.

Differences in individual-level educational attainment by residential location speak to the different resources that women can use to improve their children's lives. Approximately 72% of rural women have less than a primary school level education. In other words, most rural women attend school for fewer than 5 years, severely limiting their economic mobility.

The higher level of individual-level educational attainment among urban mothers does not translate into more jobs: 33% of urban mothers do not work compared to 12% of rural mothers, yet it should be noted that more urban women work in manual or professional jobs. The majority of rural mothers (75%) work in the agriculture sector.

The index measure of household wealth shows that urban households are wealthier in comparison to rural households: approximately 70% of urban households are in the fourth or highest wealth quintiles compared to only 13% of rural households. Occupation differences are not surprising due to the differences in educational attainment, though what was surprising was the number of urban women who do not work. Though the 2007 EDS-RDC does not ask women why they do not work, it can be assumed than urban women do not work outside the home because of household chores and tasks. Unlike rural women who typically reside in villages surrounded by family members, urban women do not typically have similar social networks that could lead to shared workloads.

2.6.4 Reproductive Behaviors

Both urban and rural women exhibit positive reproductive behaviors. A larger percentage of urban mothers took malaria medication or an iron supplement during their last pregnancy compared to rural mothers. Most households have approximately 2 children under 5 years of age.

2.6.5 Health Knowledge and Access to Media

Urban mothers have higher levels of access to media and health knowledge compared to rural mothers. For example, 39% of urban mothers listen to the radio compared to 21% of rural mothers. About 11% of urban mothers read the newspaper compared to less than 4% of rural mothers. Additionally, less than 2% of rural mothers watch television compared to 27% of urban mothers. Overall, over 80% of urban and rural mothers know the benefits of oral rehydration therapy, yet only 16% of rural mothers know the benefits of vitamin A compared to 24% of urban mothers. Differences in access to media are most likely due to household wealth and the wider availability of

such items in urban areas. Additionally, gaps in health knowledge, especially concerning Vitamin A, are most likely also tied to limited access to media outlets. That is, many health campaigns are typically spread through newspapers, fliers, radio broadcasts, or on the television. Rural women tend to have lower levels of literacy and media access and are most likely not receiving these messages.

2.6.6 Discussion

The descriptive statistics in Table 2.2 show that urban and rural women and children exhibit statistically significant differences in nutritional outcomes, autonomy, reproductive behaviors, health knowledge, and media access. Urban children have a small advantage concerning nutritional outcomes and health access. Additionally, though urban women had more sole decision making abilities, rural women's shared decision making may work to improve children's nutritional outcomes. In the next section of this chapter, I use descriptive statistics to detail Congolese women and children's lives by community-level of education. In addition, I use "thick-descriptions" to describe individual lives of women in each community to give a more detailed understanding of women, net of their individual-level of education.

2.7. DESCRIPTIVE RESULTS: HOUSEHOLD RESIDENTIAL LOCATION AND COMMUNITY

2.7.1 Children's Nutritional outcomes

Table 2.3 presents descriptive statistics by urban-rural residential location and community-level of education. Across all the communities, children in low average education urban communities have the highest percentage of stunting (55.8%) and wasting (22.0%). Children in urban and rural high average education communities are the

least likely to be stunted. Children in urban middle education communities and rural low average education communities are the least likely to be wasted.

Breaking down children's nutritional outcomes by community provides a greater level of depth as to the spread of nutrient deficiencies, which would not have been recognized solely from the descriptive statistics in Table 2.2. First, more children in low education urban communities are stunted or wasted, compared to children in all other communities. Second, children in high education urban communities are least likely to be stunted. Thus, urban children's nutritional outcomes seem to be associated with community makeup. In contrast, similar percentages of stunting are seen across all rural communities. This suggests that the average community educational level in rural areas might not be associated with better nutritional outcomes of children.

2.7.2 Individual-Level Educational Attainment

Rural communities have higher percentages of uneducated mothers compared to urban communities. Additionally, all the urban communities have more mothers who have completed secondary school or higher compared to rural communities. Across urban communities, high average education communities have more highly educated mothers compared to low and middle average communities. Across rural communities, less than 2% of low and middle average education communities have mothers who have completed secondary school and higher compared to 17% of mothers in high average education rural communities.

As previously stated, urban women and children residing in low average education communities have the poorest nutritional outcomes. One possibility is that children's nutrition outcomes are associated not only with diet but also with household

resources. For example, Woman A is not formally educated and lives in a low education urban community. Woman A has very few household resources, including a toilet or running water: she and her children walk to a stream for daily water used for bathing, washing, and cooking. Her family shares a pit latrine with the other families in her compound or neighborhood. Most of the homes in her neighborhood, including her own, have no electricity: she cooks all foods outside over a charcoal stove or fire. Yet her lack of household resources is similar to that of a highly educated woman living in the same community. For both of these women, it could be hypothesized that the limiting force behind their lack of access to proper household resources that could improve their children's nutritional outcomes does not seem to be their individual-level of education, but rather their community of residence.

On the other hand, women residing in high education urban communities have many more household resources. For example, in this type of community, Woman C, who is also not formally educated, lives in a house with a protected (tin) roof. Unlike the women in the low average education communities, she collects her water from a public tap, which is cleaner than an open stream or body of water. In a high average education urban community, a highly educated woman has the most available resources. For example, Woman I lives in a cement and tin home with electricity and cooks food every day on an electric stove.

The household characteristics of rural women though, are starkly different than those of urban women: unlike urban women who vary by community, most rural

women's household characteristics are very similar, net of individual education. For example, Woman J is not formally educated and lived in a low education rural community in a thatched house with no electricity. Her children travel every day to get water from the local well. A different woman, Woman O, residing in a similar low education community, also has very few household resources: her home has no electricity, is made of grass and dirt, and she gets her water from a local river or stream. Even Woman Q, a highly educated woman residing in a high education rural community, seems to be no different than the women in other rural communities. For example, Woman Q has a home with a thatched roof and a dirt floor and has no electricity or running water. Woman Q's family gets their water from an open stream, though they do not share their pit latrine with any other families.

These initial patterns suggest that both individual-level education and community-level education may matter for the health of urban and rural children. Yet on closer inspection, urban children residing in less educated communities might be more affected by their communities than children in other communities.

2.7.3 Women's Autonomy

Overall, most women, especially rural communities, say their husbands tend to make the sole decision in most scenarios. When asked who makes the final decision on household purchases, most women said their husband makes the final decision, especially in high education rural communities. About 1/3 of women across all communities, except in high education rural communities, make joint decisions on household purchases. The

highest percentages of women who make the final decision on household purchases are in low education urban communities. Specifically, almost twice as many women in low education urban communities make the sole decision on household purchases compared to all the rural communities.

As expected, over 50% of mothers in each community say they make the final decision on foods cooked daily.

When asked about their movement outside the home, most women say their husband/partner makes the final decision on visits to family/relatives, especially in low education urban communities and high education rural communities. Women in rural communities are more likely to make joint decisions on visits to family/relatives compared to mothers in urban communities. Across urban communities, mothers in higher education communities are more likely to make joint and sole decisions compared to mothers in low or middle education urban communities. Across rural communities, women in high education communities are more likely to make the sole decision concerning visits to family/relatives compared to women in low or middle education rural communities.

The measures of financial decision making abilities shows that most women in all but one community make joint decisions concerning how their earnings are spent: 42% of women in high average education rural communities say their husband/partner makes the final decision on their earnings compared to less than 20% of mothers in the other urban and rural communities.

Few women said they could make the final decision on their own health care: most women say their husband makes the final decision concerning their health care. This is not the case in low education urban communities: most women say they make the final

decision on their health care (47%). Approximately 80% of women in urban and rural communities said they could decide when and where to take their child for health care.

Interpretations of women's autonomy by community are difficult based on limited additional questions that measure women's status in relation to other household members and her community. Yet it can be hypothesized that differences in autonomy probably stems from a combination of educational attainment and their community surroundings. For example, Woman A, a woman with no formal education from a low education urban community, has some autonomy. Woman A usually decides on the foods cooked daily, which is most likely due to the fact that preparing family meals falls solely on women. She is able to make the final decision on her own health care, though her access to health services is limited: financial and distance obstacles are her greatest road blocks in getting medical care. Woman C, who also has no formal education and resides in a high education community, has higher than average autonomy: though her husband makes the final decisions on household purchases, she typically makes joint decisions with her husband on household purchases, daily meals, and visits to family/relatives. She does not have any issues or obstacles when trying to get medical help for her children and is able to make joint decisions with her husband concerning her own health care.

Woman G, a highly educated woman residing in a low education urban community, also has high autonomy. Though her husband makes the final decision on visits to family members, she makes joint decisions on types of household purchases and what meals the family eats every day. Access and affordability hinders her attempts at receiving medical help. Across all the urban women, Woman I, the highly educated woman in the high education community, has the highest autonomy: she decides what to cook every day on her own and makes joint decisions with her husband about large

household purchases, visits to family members, and her own health care. When asked if she has any obstacles in receiving medical care for herself, she replied that she does not have any.

Interestingly, women in low education rural communities have higher autonomy than women in high education rural communities, though overall percentages show that rural women in general make few sole decisions. Woman J, the woman with no formal education in a low education rural community, has low autonomy: her husband typically makes the sole decision on household purchases, how her earnings are spent, and her visits to family/relatives, though she makes the final decision on meals for the family. Woman O, the highly educated woman from a low community, makes joint decisions with her husband about household purchases and her earnings. She also makes the final decision on daily meals though her husband makes the final decision on her visits to family and relatives. Woman Q, the highly educated woman in the high education rural community, has lower autonomy than Woman J and Woman O, who both reside in low education communities: her husband made all the final decisions concerning household purchases, visits to family and relatives, food cooked daily, her health care, and the earnings from her job as a farmer.

2.7.3 Socioeconomic Status

Across all urban communities, about 1/3 of women do not work. Most women in low education urban communities work in agriculture sectors. Women in middle education communities are divided almost equally in agriculture and manual sectors. The majority of women in high education urban communities work in manual sectors. The data do not tell us why women do or do not work, yet describing women's and their spouses' occupations within different communities provides a deeper description of the

economic gains or challenges that surround women and a clearer understanding of how educational attainment is related to different socioeconomic resources. For example, Woman A lives in a low education urban community. She is not formally educated and works in the agriculture sector with her husband. Woman G is highly educated woman and also resides in a low education urban community but does not work, most likely due to the large number of children under 5 years old in her household. At the extreme, Woman I is a highly educated woman and lives in a high education urban community. She does not work, most likely because of her household's financial stability: her husband is a scientific and academic professional, making it easier for her to stay home and look after the children and household affairs comfortably without the need for added household income. As expected, most women in rural communities are concentrated in the agriculture sector.

2.7.5 Reproductive Behaviors

Overall, mothers across all the communities exhibit average reproductive behaviors. About 50% of women in each community took a medication to prevent malaria during their last pregnancy and approximately 25% of women in each community took an iron supplement during their last pregnancy.

2.7.6 Health Knowledge and Media Access

Measures of women's health knowledge show an urban advantage. Across urban communities, mothers in high average education communities are more likely to listen to the radio and watch television compared to mothers in low or middle average education urban communities. Across rural communities, mothers in high education rural

communities are more likely to use all media sources compared to mothers in the low or middle education rural communities.

Mothers in high average education urban communities are more likely to know the benefits of vitamin A and oral rehydration therapy compared to mothers in low or middle average education urban communities. Similar percentages of mothers in all rural communities know the benefits of vitamin A, yet more mothers in low and middle average education rural communities know the benefits of oral rehydration therapy.

2.8 DISCUSSION AND CONCLUSIONS

This chapter's descriptive statistics show several key differences in women's and children's characteristics that I predict will significantly influence Congolese children's nutritional outcomes. Overall, rural children are more likely to be stunted compared to urban children, which has been seen in studies on geographic differences in nutrition (Fotso 2006; Garrett and Ruel 1999; Gracey 2002). Yet within communities, the largest percentage of nutritionally deprived Congolese children live in low education urban communities, which is contrary to research detailing a clear urban advantage in children's nutritional outcomes. Growth in urban poverty and food insecurity across many SSA countries, coupled with the lack of proper resources at the community-level, are possible driving forces behind the nutritional disadvantage for urban children in low average communities (Brockerhoff and Brennan 1998; Chen, Gu, and Wu 2006; El Araby 2002; Harpham 2009). Approximately 55.8% and 47.3% of urban and rural Congolese children in low average education communities are stunted, respectively. A possible explanation for these differences might be that experiences of food insecurity among urban children are not similar to those of rural children (McGranahan and Satterthwaite 2003).

2.8.1 Individual-level Educational Attainment and Socioeconomic Status

As expected, the descriptive results show a baseline rural disadvantage in not only educational start up but also in completion of academic levels. First, over 31% of rural women have not received a formal education. Further, more than 40% of rural women have not completed their primary school education. On the other hand, more urban mothers have completed primary school compared to rural mothers, though close to 50% of urban women's education was interrupted during secondary school. More educated Congolese women may have more educational related opportunities to improve their children's nutritional outcomes including better paying jobs, higher autonomy, and health access and knowledge. In addition, more educated Congolese women may also be able to use their educational opportunities as a "buffer" against periods of instability and food insecurity that occur in the DRC.

Yet it should be pointed out that though they live in communities with similar average levels of education, fewer children in low education rural communities were stunted compared to children in low education urban communities. This suggests that education or the use of educational opportunities may be experienced and used differently in various locations and communities. For example, education and its subsequent opportunities might be the only means through which urban mothers can improve their children's nutritional outcomes, while rural mothers might more so rely on other community resources to improve children's nutrition.

2.8.2 Women's Autonomy

Individual measures of women's autonomy show insightful and interesting differences. First, across urban-rural location, urban Congolese women are more likely to make the sole final decision compared to rural women in every decision-making scenario.

Additionally, rural Congolese women are more likely to say their husbands make sole final decisions compared to urban Congolese women, though rural women make more joint decisions compared to urban women. Women are usually the main child-rearers in the household and therefore more likely to notice initial symptoms of nutritional deficiencies and illnesses. Each measure of women's autonomy can therefore speak to a different pathway through which women could potentially influence their children's nutrition. Women who are able to make the final decision on visits to family/relatives may also be more likely to leave their homes and seek proper health services or food for their children compared to women who have more physical constraints (Hoddinott and Haddad 1995; Woldemicael and Tenkorang 2010). Also, women with the ability to decide how their earnings are spent might be more likely to spend their money to improve children's health and nutrition, compared to women who do not have any say in how their money is spent (Hoddinott and Haddad 1995). In addition, joint decision making may be the pathway through which rural women increase their autonomy. By contrast, urban Congolese women may have a number of additional pathways that may influence their children's nutritional outcomes.

Second, the community differences are also insightful. In urban communities, lower levels of women's autonomy (husband makes the sole final decision) are found predominantly in the low and middle average education communities. Specifically, urban women in middle average education communities have the lowest levels of autonomy: they are more likely to have no final decision making abilities concerning household purchases, food cooked daily, women's earnings, and women's health care. The lack of autonomy in middle education urban communities might be due to the lack of defined gender roles. Because women in low education urban communities were are less

educated, their levels of autonomy might have come from their households or occupations. On the other extreme, women in high education urban communities might either use their education as means to increase their autonomy or mimic the behaviors of the women around them.

Women's autonomy in urban communities is reversed in rural communities: lower levels of women's autonomy (husband makes the sole final decision) are concentrated in high average education communities. Rural women in high average education communities are more likely to have no final decision making abilities on household purchases, visits to family/relatives, women's earnings, and women's health care. The relative high levels of education in communities does not translate to higher autonomy for rural women, as it seemed to for urban women.

2.8.3 Reproductive Behavior, Health Knowledge, and Media Access

Overall, women's reproductive behaviors are positive across both rural and urban areas and all the communities. Most urban and rural women took medication to prevent malaria during their last pregnancy and took an iron supplement. Congolese women seemed to know how to not only provide safe and proper in utero care for their children but are also utilizing and implementing these services.

Women's health knowledge differed by urban and rural regions. Urban women are more likely to use a media source (television, paper, radio) compared to rural women, which is most likely an outcome of household poverty or lack of these items in communities. Yet even in low education communities, which tend to have extremely high levels of poverty, women in these communities use media sources more than their rural counterparts. Urban women across all communities, seem to have increased access to the

outside world, health and nutrition public service announcements, family planning initiatives, knowledge, and autonomy.

2.8.4 "Thick Descriptions"

The individual "thick descriptions" enhanced the descriptions of women's and children's lives in the DRC. Though my dissertation does not specifically focus on individuals, the details of women's and children's lives go past "thin descriptions" and provide an element of depth to how my study sample lives. The descriptions stressed not only the importance of individual-levels of educational attainment for women, but also how it manifested itself within specific communities. The most critical insight obtained was that, net of urban-rural residential location, communities also seem to matter. By looking past women's individual educational attainment, and even further, community education, I have described Congolese women's and children's lives. These person-centered descriptions provide a basic context to the behaviors of women, and provide an initial understanding of how child health within the DRC is produced by both individual and community-level factors.

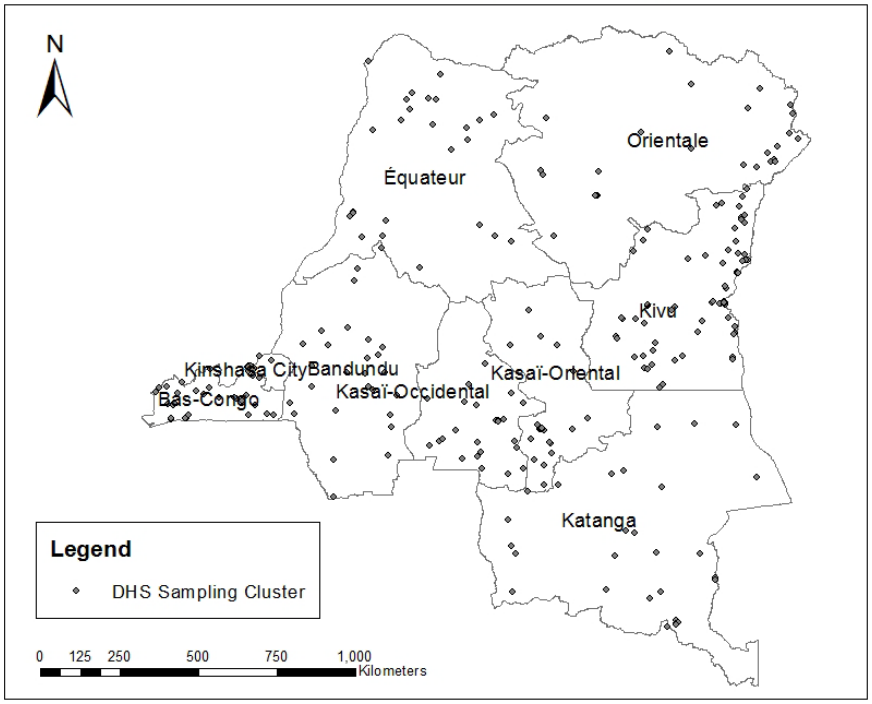

Figure 2.1: Geographic clusters in the 2007 Demographic and Health Surveys Democratic Republic of the Congo (EDS-RDC)

Table 2.1 Grid of Maternal Education by Community-Level Female Education and Urban-Rural Residence in the Democratic Republic of the Congo

	Urban N=1118			**Rural N=1671**		
	Low Education Community (0-<4 years) N=9[4]	Middle Education Community (4-<8 years) N=46[4]	High Education Community (8+years) N=70[4]	Low Education Community (0-<4 years) N=119[4]	Middle Education Community (4-<8 years) N=53[4]	High Education Community (8+years) N=3[4]
No Education[1]	*Original N=24*[5] *Woman A*	*Original N=38*[5] *Woman B*	*Original N=21*[5] *Woman C*	*Original N=495*[5] *Woman J*	*Original N=67*[5] *Woman K*	***No observations***
Middle Education[2]	*Original N=35*[5] *Woman D*	*Original N=221*[5] *Woman E*	*Original N=117*[5] *Woman F*	*Original N=567*[5] *Woman L*	*Original N=302*[5] *Woman M*	*Original N=6*[5] *Woman N*
High Education[3]	*Original N=11*[5] *Woman G*	*Original N=200*[5] *Woman H*	*Original N=451*[5] *Woman I*	*Original N=82*[5] *Woman O*	*Original N=129*[5] *Woman P*	*Original N=23*[5] *Woman Q*

[1] Individual level education: women who have received no formal education
[2] Individual level education: women with incomplete or completed primary school educational attainment
[3] Individual level education: women with incomplete or completed secondary school education or higher
[4] Number of communities
[5] Number of women from sample

Table 2.2: Demographic, Social, and Health Characteristics of Mothers and Children Aged 7-59 Months in the Democratic Republic of the Congo, Total and by Urban-Rural Residence

	ALL N=2,789 %	**URBAN N=1,118** %	**RURAL N=1,671** %
Stunted	42.4	34.9	47
Wasted	9.8	10.6	9.3
Individual-level of education			
No formal education[1]	22.0	7.6	31.5
Incomplete primary	34.4	23.1	41.9
Completed primary	9.6	12.8	7.5
Incomplete secondary	28.8	46.0	17.5
Completed secondary and more	5.2	10.5	1.6
Women's Autonomy			
Person who makes final decision on household purchases			
Respondent	15.4	18.8	13.1
Joint	32.3	32.7	32.1
Husband/Partner	52.3	48.5	54.8
Person who makes final decision on food cooked daily			
Respondent	57.7	59.6	56.4
Joint	15.9	14.9	16.5
Husband/Partner	26.5	25.5	27.1
Person who makes final decision on visits to family/friends			
Respondent	19.5	22.9	17.3
Joint	26.2	24.3	27.5
Husband/Partner	54.3	52.8	55.3
Person who makes final decisions regarding respondent's earnings			
Respondent	16.8	24.6	11.7
Joint	65.8	61.5	68.6
Husband/Partner	17.4	13.9	19.7
Person who makes final decisions on respondent's health care			
Respondent	25.3	29.0	22.8
Joint	18.2	17.6	18.6
Husband/Partner	56.6	53.5	58.6

[1] Reference category

Table 2.2, continued			
Autonomy Index mean (0-5)	2.93	3.06	2.84
Can decide to take child for medical care	86.6	93.0	82.3
Polygynous marriage	18.1	13.9	20.9
Socioeconomic Status			
Occupation			
No occupation[1]	21.2	33.8	12.9
Manual	21.5	38.2	10.5
Agriculture	55.6	25.3	75.7
Professional	1.6	2.7	1.0
Household Wealth Index			
Poorest[1]	22.5	7.1	32.7
Poorer	18.6	4.5	27.9
Middle	22.6	16.9	26.4
Richer	21.1	34.8	12.0
Richest	15.2	36.6	1.0
Reproductive behavior			
Number of children under age 5 in household (mean)	2.2	2.2	2.2
Took medication to prevent malaria during pregnancy	63.3	73.4	56.6
Took iron supplement during pregnancy	27.9	32.2	25.0
Health Knowledge and Media Access			
Listens to the radio	28.4	39.1	21.3
Reads the newspaper	7.1	11.9	3.9
Watches television	12.1	27.5	2.0
Knows benefits of Vitamin A	19.6	24.6	16.2
Knows benefits of oral rehydration therapy	82.4	84.7	80.8
Controls			
Mother's age (years)[2] (mean)	29.8	30.1	29.6
Mother's age squared [2] (mean)	937.36	948.5	930.0
Mother's BMI			
Underweight	13.9	10.7	16.0
Normal	72.1	67.7	75.0
Overweight	10.2	15.4	6.8
Obese	2.3	4.6	0.8
Child sex (Female)	51.6	50.9	52.3
Child's age (months)[2] (months)	32.1	32.1	32.1
Child's birth size			
Small[1]	7.8	6.7	8.5
Average	36.2	37.4	35.4
Big	56.0	55.9	56.1

1 Reference Category

Table 2.3: Demographic, Social, and Health Characteristics of Mothers and Children Aged 7-59 Months in the Democratic Republic of the Congo by Community Education within Urban and Rural Settings

	Urban N=1118			**Rural N=1671**		
	Low education community N=9	**Middle education community N=46**	**High education community N=70**	**Low education community N=119**	**Middle education community N=53**	**High education community N=3**
Stunted	55.8	39.6	27.0	47.3	47.8	43.8
Wasted	22.0	8.7	10.5	7.9	11.7	10.6
Individual-level education						
No education	30.1	7.8	3.5	41.9	14.5	0
Incomplete primary	53.3	28.2	13.2	42.4	44.3	5.1
Completed primary	9.0	17.2	9.3	6.0	9.3	17.3
Incomplete secondary	5.2	43.2	55.6	8.9	30.0	60.0
Completed secondary and higher	2.4	3.5	18.4	0.8	1.8	17.5
Autonomy						
Person who makes final decision on household purchases						
Mother	27.2	20.9	15.5	14.7	10	12.6
Joint	35.3	26.3	38.1	32.2	33.9	9.8
Husband/Partner	37.5	52.8	46.4	53.1	56.1	77.5
Person who makes final decision on foods cooked daily						
Mother	56.4	52.7	66.4	59.2	50.8	59.5
Joint	16.6	16.1	13.6	12.2	17.0	9.8
Husband/Partner	27.1	31.2	20.0	19.3	32.1	30.7
Person who makes final decision on visits to family/friends						

Table 2.3, continued						
Mother	20.6	19.0	26.8	19.1	13.2	22.7
Joint	20.5	23.7	25.5	26.9	29.6	14.8
Husband/Partner	58.9	57.3	47.7	53.9	57.2	62.6
Person who makes final decisions regarding respondent's earnings						
Mother	11.8	18.7	32.1	12.4	9.3	22.5
Joint	82.0	59.6	59.7	67.9	72.8	35.4
Husband/Partner	6.1	21.7	8.1	19.7	17.8	42.1
Person who makes final decisions on respondent's health care						
Mother	47.1	23.4	31.0	26.9	15.8	15.0
Joint	14.7	16.3	19.2	18.0	20.5	9.8
Husband/Partner	38.2	60.3	49.8	55.1	63.7	75.2
Autonomy Index	3.32	2.77	3.28	2.94	2.73	2.12
Polygynous Marriage	21.4	18.1	8.8	24.2	15.4	10.0
Can take child for care	95.2	88.4	96.9	82.0	82.3	87.6
Socioeconomic Status						
Occupation						
No occupation	31.4	32.5	35.5	12.9	13.3	8.7
Manual	8.2	33.9	47.3	12.3	6.7	6.2
Agriculture	60.3	31.0	14.1	73.7	79.3	77.6
Professional	0.1	2.7	3.1	0.8	0.8	7.5
Household Wealth						
Lowest	11.4	11.8	2.1	33.8	29.1	49.8
Lower	11.6	5.8	2.2	28.3	28.0	16.4
Middle	35.6	23.8	7.5	26.3	25.9	33.7
Fourth	37.7	44.6	25.3	10.0	16.9	0
Highest	3.7	14.0	7.9	1.6	0.1	0
Reproductive Behavior						
Number of children under age 5 in household	1.9	2.3	2.2	2.2	2.2	2.1
Took malaria medication during last pregnancy	51.1	71.3	79.1	54.8	59.5	63.5

Table 2.3, continued						
Took iron supplement during last pregnancy	24.8	28.2	37.2	26.8	21.6	26.0
Media Access						
Listens to radio	19.8	32.8	48.1	17.2	25.4	62.4
Reads the paper	5.1	14.0	11.1	3.5	4.6	4.9
Watches television	0	12.3	46.0	2.5	0.4	9.8
Health Knowledge						
Knows benefits of Vitamin A	21.3	19.7	29.6	15.4	17.7	17.7
Knows benefits of oral rehydration therapy	67.3	80.7	91.4	78.7	85.7	69.4
CONTROLS						
Mother's age	29.3	29.3	30.9	29.6	29.8	28.2
Mother's BMI						
Underweight	11.9	10.9	10.4	13.9	17.8	40.0
Normal	77.4	72.4	61.7	75.4	76.6	50.2
Overweight	6.6	12.7	19.5	8.4	3.4	9.8
Obese	1.2	2.6	7.1	1.1	0.4	0.0
Child sex-Female	51.6	49.0	52.6	53.6	48.5	67
Child's age	31.4	31.9	33.8	31.4	32	31.5
Child's birth size						
Small	8.6	4.9	8.0	8.3	8.8	10.8
Average	44.2	34.2	39.3	34.8	38.4	15.0
Large	47.2	60.9	52.7	56.9	52.8	74.3
Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)						

Chapter 3

3.1 INTRODUCTION

Globally, approximately 195 million children overall and 26 million children under the age of five are stunted or wasted, respectively. Recent data from Sub Sahara Africa (SSA) estimates that 43% and 10% of all children under the age of five are stunted or wasted, respectively (UNICEF ; UNICEF 2013b) In addition, 2/3 of all deaths to SSA children under five have been associated with under-nutrition (Black et al. 2010). In the Democratic Republic of the Congo (DRC) -- the largest, most populated, and poorest African country -- over 60% of children are nutritionally deficient (UNICEF 2010). Apart from being related to increased risk of mortality (Black et al. 2010; Black, Morris, and Bryce 2003), children who suffer from undernourishment have negative long lasting health effects including developmental deficits, increased levels of hunger-related and chronic illnesses in adulthood, and adverse pregnancy outcomes for women (Peña and Bacallao 2002; Silva 2005). Thus, identifying the factors that limit children's nutrition is important in increasing their survival chances and later life health.

Children's health outcomes have been shown to vary by urban-rural residential location. Specifically, children residing in urban areas typically have lower risks of mortality and better nutritional outcomes relative to their rural counterparts (Anyamele 2009; le R Booysen 2003; Zere and McIntyre 2003). Though much of the "urban advantage" has been explained through greater access to health services, proper sanitation, and overall higher wealth levels in cities, higher levels of educational

attainment in cities have also been a key driving force of the "urban advantage" in health (Bicego and Ties Boerma 1993).

Yet, the deterioration of urban cities in SSA has led to researchers and health organizations alike, to reanalyze the current existence of the "urban advantage" in health (Fotso 2006; Haddad, Ruel, and Garrett 1999; Magadi, Zulu, and Brockerhoff 2003). First, after independence, many SSA cities experienced large waves of young poor residents migrating from villages, who sought education and occupation opportunities that had been previously denied to them by white colonialists. Rapid urbanization beginning in the mid-1980s led to the urban SSA population growing from 26% to 43% in two decades. Population projections suggest that by 2035, over 50% of the SSA population will live in cities (see Figure 3.1). Yet risky economic decisions fueled by international pressure to enter the global market prematurely, led to the deterioration of many African economies beginning in the late 1980s. The collapse of the economic sector led to a sharp increase in the number of civil wars and an increase in the number of poor urban residents living in shantytowns and slums without access to basic sanitation, clean drinking water, and social and health services (Collier and Hoeffler 2002). Between 1985 and 2013, the urban population in the DRC nearly doubled from about 28% to 48% (see Figure 3.1). Close to 77% of Congolese residents live below the poverty line (CIA 2013). Overall, the health and nutrition of urban residents, especially children, have large implications for economic growth, population stabilization, and poverty alleviation (UNFPA 2007). Therefore, it is important to understand the extent to which women's

education is a key determinant of children's health and nutrition in the rapidly urbanizing DRC.

Researchers have not only focused on women's education as a determinant of children's health and nutrition, but also on how external household factors, especially community-context, shape child health outcomes (Luke and Xu 2011; Montgomery and Hewett 2005). Specifically, a growing body of literature has documented how community-level measurements of education are related to health outcomes (Desai and Alva 1998; Kravdal 2004; Parashar 2005). Yet there remains little evidence of how and why community-level education might matter for children's nutritional outcomes in SSA above and beyond a woman's own education. The descriptive statistics from Chapter 2 revealed a larger amount of heterogeneity in children's nutrition and wealth percentages in urban communities compared to rural communities. Specifically, the nutrition-gap between low and high education urban communities was larger in urban communities than rural communities. In addition, the highest percentage of nutritionally deficient Congolese children resided in low average education urban communities. Overall, substantial health variation in African cities raises the need for health researchers and policymakers to take into account how the combination of individual and community socioeconomic factors affects the health of urban children.

The driving motivation of my research is to analyze the relationship between individual and community-levels of women's education and children's height-for-age (stunting) and weight-for-height (wasting) in urban communities in the DRC. Using data

from the 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC), this chapter answers two main questions:

1. Do urban children's nutritional outcomes (stunting and wasting) in the DRC differ by individual and community-levels of women's education?
2. To what extent do measures of women's autonomy, socioeconomic status, reproductive behavior, media access, and health knowledge mediate the relationships between individual and community-levels of education and urban children's nutritional outcomes (stunting and wasting)?

In the next sections of this chapter, I review the literature on individual and community-level education as determinants of children's health and nutrition. Next, I describe my conceptual framework, and present my hypotheses. Subsequently, I describe the data and methods, present my results, and conclude with a discussion of these results.

3.2 BACKGROUND

3.2.1 Benefits of Women's Education

A considerable body of research suggests that women's formal education is an important factor for children's health outcomes in developing countries (Basu and Stephenson 2005; Boyle, Racine, Georgiades, Snelling, Hong, Omariba, Hurley, and Rao-Melacini 2006; Caldwell 1979; Caldwell and Caldwell 1985; Caldwell 1994; Pena, Wall, and Persson 2000). Women, as children's primary care givers, shape children's health outcomes through the physical and non-physical education-related resources they bring into the household. In general, higher maternal education lowers children's risk of

poor health and nutritional outcomes (Christiaensen and Alderman 2004; Wachs, Creed-Kanashiro, Cueto, and Jacoby 2005).

A number of studies have examined the influences of women's individual-level education on children's health and odds of survival in developing countries. Cleland et al.'s (1988) review of 20 years' worth of data from developing countries showed that, on average, single year increases in mother's education were associated with 7-9% decreases in infant mortality. Women's education also influences children's health in-utero. Using birth weight as a measure of child health in utero, Kabubo-Mariara et al. (2009) showed that mother's schooling had a positive effect on birth-weight of Kenyan children (Kabubo-Mariara, Ndenge, and Mwabu 2009). Indian children whose mothers have any level of education had lower odds of late post-neonatal and toddler mortality (8-24 months) and early post-neonatal mortality (1-7 months) compared to children whose mothers are illiterate (Basu and Stephenson 2005).

Recently, a study by Emina et al. (2011) examined the effects of women's education on the nutritional outcomes of children in the DRC. Their overall results demonstrated mixed effects of women's education on children's nutritional outcomes. Specifically, contrary to previous research, children of mothers with no education have 19% lower odds of being stunted than children whose mothers had a secondary school education or higher, net of all control variables. Second, there was no relationship between maternal education and child wasting, after controlling for province of residence. Finally, mother's education was significantly associated with the risk of children suffering from simultaneous multiple-malnutrition: compared to children whose mothers had a secondary education and higher, children with mothers that had no

education or a primary school education had 89% and 51% higher odds of suffering from multiple forms of malnutrition, respectively (Emina, Kandala, Inungu, and Ye 2011).

3.2.2 Benefits of Other Women's Education

Children's nutritional outcomes are not only related to women's individual-level of education, but also to the education of other community members. I specifically focus on community-levels of women's education because demographic studies have found evidence of it having an effect on community members' health behaviors and health outcomes in both developed (Pickett and Pearl 2001; Robert 1999) and developing countries (Kravdal 2002; Sastry 1996).

Several key studies have identified the significant influence of other women's education on children's mortality, health, and nutrition net of individual-level factors, including women's own education. For example, Desai and Alva (1998) found that women's individual-level educational attainment had a marginal effect on children's mortality and nutritional outcomes when within cluster-level education was controlled in 22 developing countries[2]. Alderman et al. (2003) estimated the relationship between community context and children's nutrition in Peru and found that provision of sanitation and women's education at the community-level lowered children's odds of being stunted, though the community-level women's education effect was only significant in rural neighborhoods (Alderman, Hentschel, and Sabates 2003). Luke and Xu (2011) used survey data collected from residents of South India's tea estates to explore the relationship between neighborhood context and children's nutritional outcomes. Using aggregate measurements of women's and men's education, women's income, and

[2] Africa (Botswana, Burundi, Ghana, Kenya, Liberia, Mali, Ondo Sate, Senegal, Zimbabwe); Asia/North Africa (Egypt, Indonesia, Morocco, Sri Lanka, Thailand, Tunisia); Latin America/Caribbean (Bolivia, Brazil, Colombia, Dominican Republic, Ecuador, Guatemala, Peru).

household income, the authors showed that net, of all covariates, the education of other women in a community had a positive "spillover" effect on malnutrition. Recently, Pamuk et al. (2011) performed a multi-country analysis of the effects of individual, community, and country specific education and income measures on infant mortality rates in 43 developing countries[3]. Their results showed a strong association between infant death and both individual and community-level education, net of household wealth, community average wealth, gross national income, and country level education. More specifically, across all 43 countries, mothers with incomplete primary, complete primary, incomplete secondary, and complete secondary education levels exhibited odds of infant death that were 2%, 9%, 20% and 40% lower, respectively, than women with no education. Finally, women residing in a community with high average education had 16% lower odds of infant death, net of individual-level factors.

Overall, these studies provide strong evidence of a direct relationship between community-level education and children's health and nutrition, though several questions in this area of study remain. Specifically, most studies analyzing the effect of community education on health outcomes compare this relationship across multiple countries. This method provides broad evidence of the existence (or not) of a community-level education effect; yet due to the constraints of using variables and data that are comparable across multiple countries, the results fail to capture country-specific mechanisms. In addition, among the country-specific studies which have analyzed this relationship, few have accounted for the variation that exists not only between urban-rural locales, but also

[3] Bangladesh, Benin, Bolivia, Burkina Faso, Cambodia, Cameroon, Chad, Colombia, Congo, Democratic Republic of the Congo, Dominican Republic, Egypt, Ethiopia, Ghana, Guinea, Haiti, Honduras, India, Indonesia, Jordan, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Morocco, Mozambique, Namibia, Nepal, Niger, Nigeria, Pakistan, Peru, Philippines, Rwanda, Senegal, Sierra Leone, Swaziland, Tanzania, Uganda, Zambia, Zimbabwe.

within these areas. Failing to take into account within residential location patterns in child health and nutrition outcomes inadequately describes potential determinants. Therefore, this dissertation analysis builds upon previous literature to analyze the intra-urban relationship between community-level education and children's nutrition in SSA, where evidence has shown higher socioeconomic heterogeneity across urban areas due to higher concentrations of poverty and poor health (Dye 2008; Fotso 2007; Haddad, Ruel, and Garrett 1999; Menon, Ruel, and Morris 2000; Montgomery and Hewett 2005; Timaeus 1998).

3.3 CONCEPTUAL FRAMEWORK

This analysis is based on a modified version of the conceptual framework developed by Mosley and Chen (1984) to understand the social and biological proximate determinants of childhood survival in developing countries (1984). In addition, I draw upon Link and Phelan's (1995, 2002) conceptualization of socioeconomic-status as a fundamental cause of health(2010; 1995; 2002) . According to Mosley and Chen (1984), socioeconomic-status determinants work through maternal factors, environmental contamination, nutrient deficiency, and injury to impact children's health in developing countries. Socioeconomic determinants are grouped into three broad categories: individual-level variables (individual productivity, traditions/norms/attitudes), household-level variables (income/wealth) and community-level variables (ecological setting, political economy, health system). When these pathways negatively affect children, children's health suffers. Their poor health then has a direct effect on their growth and chances of survival.

Link and Phelan's (2002) fundamental cause theory also addresses the importance of social conditions on health. Link and Phelan's (2002) thesis states that as populations

develop, individuals' abilities to avoid or minimize the consequences of diseases and illnesses is strongly shaped by their social resources. More specifically, individuals with higher socioeconomic-status possess a wider range of resources (money, knowledge, prestige, power and beneficial social connections) than those at lower socioeconomic levels (Phelan, Link, Diez-Roux, Kawachi, and Levin 2004). The creation of new medical interventions and technology allows individuals with higher socioeconomic status to take advantage of these medical advancements and the ability to extend their lives, compared to those with fewer resources (Phelan et al. 2004). The fundamental cause theory, though utilized to explain health disparities in developed nations, can also be used to explain health disparities in developing countries. For example, during the early years of the HIV/AIDS epidemic, there were few differences in infection rates by socioeconomic status, yet current statistics show that the vast numbers of infected people in developing countries are poor and not well educated (Fife and Mode 1992).

Figure 3.1 presents an adapted conceptual framework for understanding how individual and community-level education affect urban children's nutritional outcomes. The next section outlines each primary pathway and mediating mechanism and develops hypotheses for the forthcoming analysis. As previously stated, prior research has shown these mechanisms to be important for health outcomes, yet they remain to be studied within an urban African context. The next section outlines the relationships between education and each mediating factor and then concludes with the hypotheses.

3.3.1 Individual-Level Educational Attainment

The first primary pathway shows that women's individual-level educational attainment directly affects children's nutritional outcomes. First, formal education provides women with specific knowledge and skills. In school, women learn reading,

writing, numerical, and problem solving skills. Some of the knowledge women accumulate is related to specific classroom subjects, global events, history, and health (Kravdal 2002). The longer women are in school, the more knowledge on certain topics they accumulate, and the more likely they will be to adopt specific behaviors that eventually maximize the economic and social returns to education (Baker, Leon, Smith Greenaway, Collins, and Movit 2011). Therefore women's accumulated knowledge becomes a base from which they can "pull" information to improve their children's nutrition.

Second, formal education provides women with specific credentials that improve their economic outcomes. That is, every completed level of educational attainment 'signals' to potential employers that they have a set of skills, social status, or personality traits that are aligned with that of a specific occupation (Spence 1973). Therefore, more educated women work in skilled and higher paying positions compared to less educated women. Economic gains from their education allow women to access resources that can be used to invest in children's nutrition.

Finally, formal education allows women to gain greater control of their lives. More educated women are more likely to come in contact with modern ideas of women's autonomy and status, including having a voice in who they marry (Kravdal 2002), how many children they have (Bbaale and Buyinza 2012), and how much money they spend (Cleland and van Ginneken 1988). More educated women also have more control over their children's health and nutrition (Glick and Sahn 1998; Hoddinott and Haddad 1995; Thomas, Strauss, and Henriques 1991).

3.3.2 Community-Level Education

Independent of individual-level education, community-level education also has a direct association with children's nutritional outcomes. Indeed, women interact with other women on a daily basis. Though it is unrealistic to think that women *directly* interact with every single woman in their community, it can be assumed that women come into contact with other women within smaller sub-groups, whose members are part of other sub-groups, which in turn spans the entire female community population. Therefore, through social learning and social influence, women receive information that can benefit their children's health and nutrition (Bongaarts and Watkins 1996; Kravdal 2002; Montgomery and Hewett 2005).

First, social learning, defined as the transmission of knowledge and behaviors through observation or communication, is a way for women to lower children's risk of poor health (Kravdal 2002). More educated women are more likely to exhibit positive health behaviors, have current health information, provide their children with better quality food, go to prenatal and antenatal visits, and vaccinate their children compared to less educated women (Basu and Stephenson 2005; Block 2007; Burchi 2010; Cleland and van Ginneken 1988; Frost, Forste, and Haas 2005; Gakidou, Cowling, Lozano, and Murray 2010). Therefore, in communities where the average level of women's education is high, less educated women residing in these communities would most likely receive most of their health knowledge and information directly or through observation from the more educated women around them. More educated women who live in highly educated communities might not benefit as much from the diffusion of health information, yet might be more likely to better interpret the information and behaviors of the women around them compared to less educated women. In communities where the average level

of women's education is low, less educated women would be less likely to imitate positive health behaviors or receive correct health information. More educated women would continue to exhibit more positive health behaviors, but would be less likely to gain additional information from the less educated women around them.

Second, fear of social discrimination or sanctions are also ways through which community-level education influences children's nutritional outcomes. Female norms are defined by the actions and social influence of higher status women and their status in relation to men. In communities where education is related to higher social status, the influence of more educated men and women are valued more highly in comparison to the influence of less educated men and women. This may be particularly the case if educated individuals have significantly different behaviors and knowledge than all other women (Moursund and Kravdal 2003). Therefore, in highly educated communities, less educated women may adopt the health behaviors of highly educated women in order to not feel like outcasts or be sanctioned socially or legally. In low educated communities where educational attainment might not be the standard to which women's status is determined, social discrimination could negatively impact less educated women's children's health.

Finally, highly educated communities are characterized by improved economic well-being, higher women's status, and increases in the number of women working outside the home (Kravdal 2004). Educational expansion leads to economic growth and greater investments in sanitation, health services and facilities, and social-welfare programs (Kravdal 2002). Women of all education levels residing in high average education communities would have greater access to services that could be used directly or indirectly to improve their children's health compared to women of all education levels residing in low average education communities.

3.3.4 Education and Women's Autonomy

Women's education influences children's health and nutrition by increasing women's decision-making capabilities (Ross and Wu 1995). Decision-making, or autonomy, is defined as the capacity to manipulate and have control over one's personal environment to make decisions about one's own livelihood or about close family members (Bloom, Wypij, and Das Gupta 2001). Increased autonomy means women have an increased sense of control over their livelihoods, net of what other men and women around them think.

In many cultures, women have primary responsibility for household and child-rearing activities and are the first to recognize symptoms in sick children. Yet in many traditional societies, decision-making regarding health care and household financial allotments are typically made by the male head of household (Ngom, Debpuur, Akweongo, Adongo, and Binka 2003). If women are the primary care givers of children, limited decision making abilities concerning children's health may have negative effects on children's nutritional outcomes: mothers' autonomy becomes the means through which they improve children's health and nutritional outcomes (Doan and Bisharat 1990).

Most studies on the effects of women's autonomy have related it to women's fertility decision-making (Dharmalingam and Morgan 1996), though several have found it to also have an effect on children's nutritional outcomes (Shroff, Griffiths, Adair, Suchindran, and Bentley 2009; Shroff, Griffiths, Suchindran, Nagalla, Vazir, and Bentley 2011). In Miles-Doan and Bisharat's (1990) study on women's autonomy and children's nutritional outcomes in Amman, Jordan, children whose mothers had low levels of women's autonomy[4] had lower height-for-age z scores compared to children whose

[4] Low autonomy was measured as whether or not a woman lived with her in-laws. High autonomy was measured whether a woman was the single or co- household head.

mothers had high levels of women's autonomy (1990). Brunson, Shell-Duncan, and Steele (2009) also found positive effects of women's autonomy on children's nutritional outcomes in northern Kenya, yet only for older children[5] and not younger children[6] (2009). Specifically, a 1 level increase in women's autonomy score resulted in a 0.23 increase in older children's weight-for-height z-scores, net of socioeconomic status and community environmental measures. The authors' results suggest that older children, who are susceptible to changes in food availability, benefit the most from greater maternal control over household resources.

Though the association between community education, women's autonomy, and children's nutritional outcomes has not been thoroughly investigated, there is evidence showing that increases in community-levels of education are related to increases in women's autonomy and status (Koenig, Ahmed, Hossain, and Mozumder 2003; Moursund and Kravdal 2003). Therefore, it can be hypothesized that less educated women are more likely to make joint or sole decisions in communities where women are more educated. On the other hand, in lower educated communities, women of all educational backgrounds are less likely to have decision making authority. Improvements in women's status could therefore change gender norms and increase female solidarity, which could then increase individual women's decision making related to children's health and nutrition (Berhane, Gossaye, Emmelin, and Hogberg 2001; Boehmer and Williamson 1996; Luke and Xu 2011).

[5] 3-10 years
[6] 0-35 months

3.3.5 Education and Socioeconomic Status

A large amount of research has identified socioeconomic status (household wealth, income, land, occupation, access to sanitation, etc.) as a pathway through which education works to influence children's health (Crystal, Shea, and Krishnaswami 1992; Dapi, Janlert, Nouedoui, Stenlund, and Håglin 2009; Fotso and Kuate 2005; Fotso 2007; Kuate 1996). Women's education influences children's nutritional outcomes by increasing female labor force participation and household income (Bbaale and Buyinza 2012). The skills and experience women receive in school qualify them for more technical, higher paid positions. Their job experience, income, and academic skills work jointly to increase their standard of living, problem solving skills, and social and economic mobility, which can be used to improve children's nutritional outcomes both long-term and during short term periods of food insecurity (Burchi 2010). The addition of women's wages to overall household income provides women with more money to purchase better quality foods, medicine, and medical services for children as well alleviate short-term periods of food insecurity (Aromolaran 2010; Glewwe 1999). Therefore, socioeconomic-status may be a key mediator of the relationship between maternal education and child nutritional outcomes.

A number of studies have shown that socioeconomic status has positive effects on children's health and nutritional outcomes. In Pongou, Ezzati, and Salomon's (2006) work on socioeconomic and environmental determinants of children's nutritional outcomes in Cameroon between 1991 and 1998, the authors found that household economic status[7] and not mother's education had a positive effect on height-for-age and weight-for-age z-scores for older children. Fotso and Kuate (2005) found similar results

[7] This variable was operationalized as an index of household assets.

in their study on children's morbidity and nutritional outcomes in Cameroon, Kenya, Zimbabwe, Egypt, and Burkina Faso: household socioeconomic status was the strongest predictor of children's diarrhea infection and malnutrition, net of mother's education and community-level socioeconomic status.

Socioeconomic status could also work as a mediator between community-level education and children's nutrition. More educated communities may have more economic growth, improved sanitation, health services and facilities, and social-welfare programs (Kravdal 2002). Women residing in these communities, especially less educated women who would have fewer household economic resources, could improve children's nutrition by taking advantage of available health resources.

3.3.6 Education and Reproductive Health Behaviors

Reproductive behaviors, especially family planning and pre- and post-natal behaviors, are mechanisms through which women's education improves children's nutritional outcomes (Bhutta, Lassi, Pariyo, and Huicho 2010; Ceesay, Prentice, Cole, Foord, Poskitt, Weaver, and Whitehead 1997). Compared to less educated women, higher educated women are more likely to delay fertility because they receive more information on modern contraception and family planning while in school. In addition, higher educated women tend to face higher opportunity costs of childbearing, be less dependent on children as a means of support in old age, and have other sources of satisfaction (Kravdal 2002). When they decide to have children, higher educated women are observed to shift fertility preferences from quantity to quality: fewer children yet better and longer investments in children's health (Kravdal and Kodzi 2011). Larger numbers of young children in the household and family size have been associated with higher risk of child malnourishment (Eloundou-Enyegue and Williams 2006) and infant mortality (Rutstein

2005). Shorter birth intervals, especially in poor SSA households, may create uneven distributions of household food and health provisions.

Though women's individual education is linked to reproductive choices, community-level education also plays a part in the fertility decisions women make. Kravdal (2002) tested the effects of individual and community-levels of education on birth rates in SSA between 1992 and 1999. Increases in individual women's education lowered women's first-birth rate: compared to women with 0-2 years of education, women with 9-10 years of education lowered the odds of a first birth during the study interval.

3.3.7 Education and Media Access and Knowledge

Several studies have found that women's media access and health knowledge mediate the effect of women's education on children's health and nutrition (Burchi 2010; Glewwe 1999), while others have questioned this mediating relationship and instead found evidence of a direct relationship between women's knowledge and children's nutritional outcomes (Block 2007; Wachs, Creed-Kanashiro, Cueto, and Jacoby 2005). During their time spent in school, women learn different modes of communication and knowledge transmission. They are taught to read and write and perform numeric problems, which increases their overall knowledge base and cognitive abilities (Baker et al. 2011). They also receive information through different modes of mass media on ways to improve their health and the health of children, including: proper hygiene; nutrient rich diets; benefits of exercise; modern remedies; health services locations; modern contraception; and safe child rearing practices (Kravdal 2002). Women's education and academic skills enhance their ability to process and understand their surroundings and learn different ways of problem solving (Lee and Mason 2005). Therefore, women's

knowledge-base acts as a pathway between mother's education and children's nutritional outcomes because increased knowledge implies a greater understanding of positive health behaviors and disease and illness prevention. In many areas of the DRC that have experienced repeated crisis periods, women's knowledge-base provides them with a greater ability to adapt and increase their coping mechanisms (Wachs, Creed-Kanashiro, Cueto, and Jacoby 2005). In areas with limited or no health care providers, women with increased levels of knowledge would be more likely to have or find information on domestic and local medicines and remedies, compared to women with lower levels of knowledge (Burchi 2010).

Few studies have analyzed the association between community-levels of education, health knowledge, and child health. Andrzejewski, Reed, and White (2009) examined the effects of community-level education on indexes of women's knowledge of child diseases in Ghana. Results show that community-level education increased individual general knowledge of the causes, prevention and treatment of childhood malaria, diarrhea and respiratory infection, net of individual-levels of education. The community-level education results showed that illiterate women residing in communities with high levels of literacy could still improve their children's health through improved knowledge. This association implies that though less educated women do not have access to the same learning mechanisms as higher educated women, they are adopting better health behaviors and hygiene by mimicking the actions of more educated women (Lee and Mason 2005).

3.3.8 Hypotheses

The literature on educational attainment and health suggests a direct relationship with childhood nutrition. Therefore, I expect to find an association between higher levels

of individual and community-levels of education and more favorable urban children's nutritional outcomes. Additionally, I expect several key individual characteristics – including women's autonomy, socioeconomic status, reproductive health and behaviors, media access, and health knowledge – to also influence urban children's nutritional outcomes. Specifically, I hypothesize that:

Hypothesis 1: Higher women's individual-level education will be associated with lower odds of children's stunting and wasting.

Hypothesis 2: Urban children residing in more educated communities will be less likely to be stunted or wasted compared to urban children in less educated communities.

Hypothesis 3: Women's autonomy will mediate the relationship between both individual and community-levels of education and children's odds of being stunted or wasted.

Hypothesis 4: Socioeconomic status will mediate the relationship between both individual and community-levels of education and children's odds of being stunted or wasted.

Hypothesis 5: Women's reproductive health and behaviors will mediate the relationship between both individual and community-levels of education and children's odds of being stunted or wasted.

Hypothesis 6: Women's media access and knowledge will mediate the relationship between both individual and community-level educational attainment and children's odds of being stunted or wasted.

3.4 DATA

This chapter uses data from the 2007 EDS-RDC. The 2007 EDS-RDC was the first nationally representative survey of its kind conducted in the DRC. The objective of the EDS-RDC was to provide data on fertility and family planning behavior, child mortality, children's nutritional outcomes, maternal and child health services, and knowledge of HIV/AIDS. The 2007 EDS-RDC was conducted between January and August 2007 and is representative at the national level, for urban and rural residences, and for eleven provinces (Kinshasa, Bas-Congo, Bandundu, Équateur, Orientale, Nord-Kivu, Sud-Kivu, Maniema, Katanga, Kasaï Orientale, and Kasaï Occidental). The 2007 EDS-RDC has complete interviews from 8,886 households, 9,995 women aged 15-49 years, and 4,757 men aged 14-59 years.

The 2007 EDS-RDC contains 3 separate survey questionnaires: the Household Questionnaire, the Women's Questionnaire, and the Men's Questionnaire. The Household Questionnaire collects information on each household member and visitor: background; parental survivorship; sanitation, water, and cooking sources; and assets. The Women's Questionnaire collects information on age; marital status; education; employment; residence; fertility history; fertility behavior; family planning and contraception; antenatal, delivery and postpartum care; breastfeeding and nutrition; children's health; status of women; knowledge of AIDS and other sexually transmitted infections; husband's background; and use of tobacco. The Men's Questionnaire is similar to but shorter than the Women's Questionnaire. It collects information on age;

education; employment status; religion; residence; reproduction; knowledge and use of contraception; gender roles; and knowledge of AIDS and other sexually transmitted infections. In addition, the EDS-RDC collects anthropometric measures (height and weight) for children under age 5 and women aged 15-49. The three commonly used indicators to measure children's nutritional outcomes are height-for-age, weight-for-age and weight-for height.

This study limits the sample to 2007 EDS-RDC urban children 7-59 months of age who: a) had complete data on maternal educational attainment, b) had complete anthropometric measurements, and c) whose mothers were married non-visiting residents of the interviewed household. This limited my sample size to 1,118 children.

3.4.1 Dependent Variable

The overall focus of my dissertation is on women's education and Congolese children's nutritional outcomes. Height-for-age and weight-for-height indexes from the 2007 EDS-RDC are used as proxies of children's nutritional outcomes. Height-for-age is used to measure "stunting" and weight-for-height is used to measure "wasting". Stunting describes growth retardation among children (being very short for their age) and typically results from chronic nutritional deprivation coupled with repeated infections. Wasting is an anthropometric measure that taps into children's body mass in relation to length and is a measure of children's current nutritional outcomes. Both wasting and stunting are measured in the form of z-scores, which compares a child's height-for-age or weight-for-height to those of children in a reference healthy population (WHO 2013). The equations for determining a child's (1) height-for-age and (2) weight-for-height are:

$$Height - for - age\ z - score = \frac{H_i - H_r}{SD\ of\ the\ reference\ population} \quad (1)$$

$$Weight - for - age\ z - score = \frac{H_i - H_r}{SD\ of\ the\ reference\ population} \quad (2)$$

, where H_i is the height of the child; H_r is the median height of the reference population; and SD is the standard deviation of the height of the reference population (WHO 2013). The National Center for Health Statistics/WHO definitions of childhood stunting and wasting describe children whose height-for-age or weight-for-height measures are two standard deviations below the median height-for-age or weight-for-height curve as stunted or wasted, respectively (WHO 2013).

Children's stunting and wasting were coded as dummy variables. All children who were two standard deviations below the reference height-for-age category were defined as being stunted and were given a value of "1", whereas all other children were defined as not stunted and were given a value of "0". Similarly, all children who were two standard deviations below the reference weight-for-height category were labeled as wasted and were given a value of "1", whereas all other children were defined as not wasted and were given a value of "0".

3.4.2 Independent Variables

3.4.2.1 Individual-level Education

The primary independent variable is mother's level of educational attainment, which is measured as a 5 category variable: no formal education (0 years), incomplete primary (>0-5 years), complete primary (6 years), incomplete secondary (>6-11 years), and complete secondary school or higher (12 plus years) (Kravdal 2002; Pamuk, Fuchs, and Lutz 2011).

3.4.3.2 Community-level Education

The 2007 EDS-RDC is not representative at the community-level; yet utilizing the average level of women's education in each survey cluster provides an effective estimate of the education "around" each child and their mother. The 2007 EDS-RDC has 300 total clusters, 125 of which are urban of approximately 33 women per cluster. First, community-level education was calculated by averaging the years of schooling for *all women* aged 15-49 with a non-missing response of education in years in *each* of the clusters. After calculating the distributions of mean years of education for each cluster, I divided communities into 3 categories of average education: low average community education (less than 4 years), middle average community education (at least 4 but less than 8 years), and high average community education (8 or more years) (Pamuk, Fuchs, and Lutz 2011).

3.4.4.3 Mediating Factors

To understand how maternal education is related to urban Congolese children's nutritional outcomes, I analyze mediating factors; these include individual-level measurements of women's autonomy, socioeconomic status, reproductive behaviors, media access, and health knowledge.

To gauge women's autonomy, I used the 2007 EDS-RDC questions about women's household decision-making abilities, ability to get care for child, and marital status. The questions on women's household decision making abilities were: "Who usually makes the final decision on your health care, the health care of children, the purchase of major household goods, visits to family or friends, and your earnings?" I recoded women's responses to these 5 different questions into three categories: the

woman made the sole decision, the woman made the decision jointly with the husband/partner, or the husband/partner made the sole decision (Hindin 2000; Singh, Haney, and Olorunsaiye 2012). Next, each of the women's autonomy responses was used to create an autonomy index measure. The autonomy index ranged from 0-5 and corresponded to the number of decisions in which a woman participated alone or jointly with her husband. A high score on the autonomy index indicated a higher level of household autonomy. Women who said they could decide to get care for their child were coded as "1", while those who said they could not decide to get care for their child were as coded as "0". Finally, women who said they were an only wife were coded as "0" whereas women who said they were not the only wife were coded as "1".

The 2007 EDS-RDC coded women's occupation into 7 categories: not employed, professional/technical/managerial, clerical, agriculture, services, skilled manual, and unskilled manual. Using previous work by Abbi et al. (1991), I coded maternal occupation into 4 categories: no occupation, manual occupation, agriculture occupation, and professional occupation.

Additionally, the 2007 EDS-RDC has a wealth index, which is a composite measure of a household's cumulative living standard. It is calculated from data on a household's ownership of specific assets: televisions and bicycles; the building material of the home; and types of water access and sanitation facilities. Using principal component analyses, the wealth index places individual households on a continuous scale of relative wealth. Households were separated into 5 wealth quintiles: lowest, second,

middle, fourth and highest. Wealth quintiles are expressed in terms of quintiles of individuals in a population and not quintiles of individuals at risk for a health or population indicator. The advantage to this approach is that information is directly relevant to the principal question of interest, for example, the health status or access to services for the poor in the population as a whole (Rutstein and Johnson 2004). The result is a substantive measure of relative and not absolute country-specific economic resources.

I coded women's reproductive behaviors to be consistent with earlier studies (Palamuleni 2008; Rutstein 2005). The 2007 EDS-RDC asks women questions on their pregnancy behaviors. Variables measuring prevention of malaria and use of iron supplements during a woman's last pregnancy were coded as "1" if the woman answered yes to using a preventative malaria medication or taking an iron supplement. I coded number of children under five years of age in the household as an interval variable ranging from 1-6.

Variables measuring women's health knowledge and access to media were likewise coded to be consistent with earlier work (Burchi 2010; Arimond and Ruel 2002, 2004; Rose et al. 2002). First, women were asked how often they listened to the radio, watched television, or read newspapers/magazines. Women who used the sources of media at least once a week were given a value of "1", while women who used any source of media less than once a week were given a value of "0". Second, women were asked if they had any knowledge of oral rehydration therapy (ORT) and whether they gave their

child a vitamin A supplement at birth. Women who answered no to these two questions were given a value of "0" and those who answered yes were given a value of "1".

All models in the analyses control for mother's age, mother's body mass index (BMI), child's sex, child's age, and child's birth size.

3.4.4.4. Statistical Methods

Multilevel modeling methods are used because individuals are clustered within communities. I used multilevel binomial logistic models to predict the odds of children's stunting and wasting status using individual-level and community-level covariates. I first estimated a two-level unconditional means model. The unconditional means model, also called the empty model, has no covariates and is used to calculate the intra-class correlation (ICC), which assesses whether there is significant variation between communities in stunting or wasting. Most importantly, the ICC also informs researchers whether or not multilevel modeling is an appropriate method of estimation (Raudenbush and Bryk 2002). Previous research has shown that ICC values between 0.05 and 0.20 are common in cross-sectional multilevel modeling applications in social research studies (Peugh 2010). Equation 3 is the baseline unconditional means model for child *I* in community *j*:

$$\log\left[\frac{Prob(Nutritional\ Status_{ij}=1|\beta_j)}{(1-Prob(Nutritional\ Status_{ij}=1|\beta_j))}\right] = \beta_{0j} \quad (3)$$

, where β_{0j}, the intercept, is modeled at level-2 as,

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad (4)$$

, where γ_{00} represents the grand mean of nutritional outcomes, and u_{0j} represents the random error among communities. This random error is also assumed to be normal with variance τ. The intercept β_{0j} has a subscript *j* which indicates that every community in my sample has a unique intercept. Results from the unconditional models for both stunting and wasting are presented in Tables 3.2 and 3.3. Equation 5 is the individual-level model analyzing the effect of women's individual-level education:

$$\log\left[\frac{Prob(Nutritional\ Status_{ij}=1|\beta_j)}{(1-Prob(Nutritional\ Status_{ij}=1|\beta_j)}\right] = \beta_{0j} + \beta_{1j}(Incomplete\ primary_{ij}) + \beta_{2j}(Complete\ primary_{ij}) + \beta_{3j}(Incomplete\ secondary_{ij}) + \beta_{4j}(Complete\ secondary\ and\ higher_{ij}) + \beta_{5-14j}(Control\ variables_{ij}) + u_{0j} \quad (5)$$

, where β_{1j} to β_{14j} are the coefficients associated with the individual characteristics within each community. Equation 6 is the community-level model analyzing the effect of community-level education:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(Middle\ education\ community) + \gamma_{02}(High\ education\ community_{j}) + \beta_{1-9j}(Control\ variables_{ij}) + u_{0j}$$

$$\beta_{1j} = \gamma_{10}$$

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(6)

, where γ_{01} to γ_{02} are the regression coefficients associated with community-level education and β_1 to β_{10j} are the coefficients associated with the control variables. Finally, the full mixed model (Equation 7) of both individual and community-level characteristics is:

$$\log\left[\frac{Prob(Nutritional\ Status_{ij}=1|\beta_j)}{(1-Prob(Nutritional\ Status_{ij}=1|\beta_j)}\right] =$$

$$\gamma_{00} + \gamma_{01}(Middle\ education\ community) + \gamma_{02}(High\ education\ community\ _j) +$$
$$\gamma_{10}(Incomplete\ primary_j) + \gamma_{20}(Complete\ primary_{ij}) +$$
$$\gamma_{30}(Incomplete\ secondary\ and\ higher\ _{ij}) + \gamma_{50-140j}(Control\ variables\ _{ij}) +$$
$$u_{0j} \qquad (7)$$

, where γ_{00} is the grand mean of the intercept, γ_{0q} are the regression coefficients associated with community-level education and γ_{p0} are the regression coefficients associated with individual-level characteristics.

All the models were estimated using HLM7 software, which is a common software used to analyze data from clustered samples, which in this case is children nested within communities (Raudenbush, Bryk, Cheong, Congdon, and Toit 2004). HLM has two key characteristics which made it ideal for my analyses: 1) it allows for a simultaneous analysis of variables at different levels, and 2) it can estimate multilevel logistic regressions using weighted sample data, which is the case with the 2007 EDS-RDC. In all the analyses, individual-level variables were centered around the grand mean, which means that individual characteristics were converted into deviations from the overall sample mean. The intercepts in all the models can therefore be interpreted as the

odds of children being stunted or wasted based on the average characteristics of all the variables in the model. All coefficients are expressed as odds ratios.

3.5 RESULTS

3.5.1 Descriptive Statistics

Table 3.1 presents weighted descriptive statistics for all the measures used in the multivariate analyses for the analytic sample of urban Congolese children. Close to 35% of urban children and 11% were stunted or wasted, respectively. These percentages are lower than earlier estimates for both SSA and the DRC (UNICEF 2010). The majority of urban children's mothers were formally educated. Specifically, less than 8% of urban children's mothers were not formally educated. About 23% of urban children's mothers did not finish primary school while close to 13% did complete primary school. Over 56% of urban children's mothers attended secondary school. Urban children's mothers had average scores on the autonomy index measurement. Approximately 14% of urban mothers were in polygynous marriages at the time of the survey and most mothers said they could decide whether to take their child for medical care.

Measures of socioeconomic status provide evidence of an urban wealth advantage in relation to rural families. That is, about 1/3 of urban children's mothers had no occupation. Most mothers were employed in the manual sector. About ¼ of urban children's mothers worked in the agriculture sector and less than 3% worked in the professional sector. The household wealth index showed that over 70% of urban children resided in households in the fourth and highest wealth quintiles. Most urban households had about 2 children under the age of five residing in the residence. Over 70% of urban

children's mothers took malaria medication during their last pregnancy whereas only 32% of mothers took an iron supplement.

Finally, access to most media outlets was limited for urban children's mothers. Close to 40% of urban children's mothers listened to the radio, yet less than 12% watched television and less than 28% read the newspaper. Measurements of women's health knowledge showed that over 84% of urban children's mothers knew the benefits of oral rehydration therapy, yet only 24.6% of urban mothers knew the benefits of vitamin A.

3.5.2 Urban Stunting

3.5.2.1 Education and Stunting

Table 3.2 presents the results from the multivariate logistic regression models with fixed effects and robust standard errors. The outcome variable is urban children's odds of being stunted. Table 3.2 first shows the unconditional means model (Model 1), which does not include any covariates. Model 1 shows three important results. First, the non-zero grand-mean of stunting is significant (γ_{00} =0.53, $p<0.001$). This means that children's stunting outcomes vary at the individual-level. Second, there is significant variance in stunting across the community context (τ=0.28, $p<0.001$). And third, an ICC of 0.08 indicates that approximately 8% of the total variation in stunting exists between urban communities. The ICC of 8% also indicates the need for multilevel modeling of urban children's stunting.

Model 2 introduces individual-level women's education. In line with my first hypothesis, the results show that net of all background variables, individual-level women's educational attainment is associated with childhood nutritional outcomes. Specifically, children of mothers with an incomplete secondary school education or those

who completed secondary school and more had 48% and 79% lower odds of being stunted, respectively, compared to children whose mothers received no formal education. Female children had 27% lower odds of being stunted compared to male children and children who were large at birth had 39% lower odds of being stunted.

Model 3 introduces community-level education. The results suggest that, as predicted in hypothesis 2, community-level women's education is strongly related to urban children's nutritional outcomes. For example, the likelihood of children being stunted were lower for those who lived in middle (OR=0.58, $p<0.001$) or high (OR=0.28, $p<0.001$) average education urban communities compared to children who lived in low educated urban communities.

Finally, Model 4 includes both women's individual-level and community-level education. The results show that net of all background characteristics, education, a key predictor of children's health and nutrition in developing countries, is significantly related to urban children's nutritional outcomes. Specifically, the results show that higher levels of education at both the individual and community-levels are associated with lower odds of children being stunted. For example, children whose mothers completed secondary school and more are 70% less likely to be stunted compared to children whose mothers received no formal education. Children who live in middle average education urban communities have 28% lower odds of being stunted (OR=0.72, $p=0.062$) compared to children living in low educated urban communities. Even more telling, children who live in high average education communities had 59% lower odds of being stunted (OR=0.41, $p<0.001$) than children who live in low educated urban communities. Some of the control variables -- including child female sex and large birth size -- were associated with lower odds of stunting. Older child age was associated with higher odds of stunting.

3.5.2.2 Education, Mediating Pathways and Stunting

Table 3.3 analyzes the relationship between the two measures of education, mediating pathways, and urban Congolese children's nutritional outcomes. Overall, the results from this table show that though education continues to affect stunting even after accounting for all mediators, several factors mediate the relationship.

Model 1 repeats the relationship between individual and community-levels of education and children's stunting.

Model 2 tests my third hypothesis, which predicts that women's autonomy will mediate the relationship between individual and community-levels of education and children's odds of being stunted. Instead, the results show that women's autonomy does not explain the relationship between both levels of education and stunting. Similar to the effects in Model 1, both individual and community-level education remain significant.

Model 3 assesses the mediating effect of socioeconomic status. As predicted in hypothesis 4, socioeconomic status, especially women's occupation and household wealth, partially explains the relationship between individual-level education and stunting. Controlling for socioeconomic status largely explained away the effect of community-level education. That is, in comparison to Model 1, most of the individual-level education effects disappear or diminish in strength. Only children of mothers with completed secondary school educations (OR=0.30, p=0.011) had lower odds of stunting. For example, urban children whose mothers work in manual labor have 25% lower odds of being stunted (OR=0.75, p=0.064) compared to children whose mothers do not work. Children from the lower, middle, and high wealth quintiles have higher odds of being stunted relative to children from households in the highest wealth quintile.

Model 4 examines the mediating effect of women's reproductive behaviors. The results show that contrary to hypothesis 5, women's reproductive behaviors do not explain the relationship between individual-level education and children's stunting. Additionally, reproductive behaviors are not associated with community-level education and stunting. Compared to Model 1, the effects of individual and community-level education remained nearly identical in Model 4.

Model 5 included measurements of media access and health knowledge. In line with hypothesis 6, the results show that media access partially explains the relationship between individual-level education and stunting. Additionally, media access partially explains the relationship between community-level education and stunting. Specifically, children whose mothers watched television at least once a week were 51% (OR=0.49, $p<0.001$) less likely to be stunted compared to children whose mothers said they did not watch television. Health knowledge did not explain the relationships between both levels of education and stunting. In comparison to Model 1, both individual and community-level education diminished in statistical strength and the magnitude of their effect in Model 5. Children whose mothers have completed secondary school have 59% lower odds of being stunted (OR=0.41, $p=0.027$) compared to children whose mothers are not formally educated. Children who reside in high average education urban communities have 56% lower odds of being stunted (OR=0.49 $p=0.014$) relative to children residing in low educated urban communities.

Finally Model 6 includes both measurements of education and all mediating factors. Overall, the results show that net of all mediators, women's own education has a direct relationship with children's stunting. That is, children whose mothers completed secondary school or more have 61% lower odds of being stunted compared to children

whose mothers are not formally educated. Community-level education is not significant. Additionally, net of all mediators, women's occupation and household wealth are significant. Some of the control variables – including child's female sex and older child's age – had an effect on stunting.

3.5.3 Urban Wasting

3.5.3.1 Education and Wasting

Table 3.4 presents the results from the multivariate logistic regression models with fixed effects and robust standard errors for the second outcome variable, wasting. The results from the unconditional means model (Model 1) shows that the non-zero grand-mean of wasting is significant (γ_{00}=0.12, p<0.001). Wasting variation across communities is not significant (τ=0.24, p=0.274). The lack of significant variation at the community-level indicates that multilevel modeling is not an appropriate means of modeling the relationship between individual and community-level education and wasting. Therefore, the odds ratio results in Table 3.4 (Models 2-4) and Table 3.5 (Models 1-6) are analyzed using logistic regressions at the individual-level.

In Table 3.5, Model 2 introduces women's individual-level education. In line with hypothesis 1, the results show that women's individual-level education is associated with wasting. For example, children whose mothers have incomplete primary, complete primary, or incomplete secondary educations are 55%, 72%, and 77%, respectively, less likely to be wasted compared to children whose mothers are not formally educated.

Model 3 analyzed the relationship between community-level education and children's odds of being wasted. The results suggest that as predicted in hypothesis 2, community-level education affects whether or not children are wasted, though it should

be cautioned that this result was analyzed at the individual-level. Specifically, children living in middle average education communities (OR=0.31, p=0.01) are less likely to be wasted compared to children living in low educated communities. Residing in a high average community lowers children's odds of being wasted by 58% (OR=0.42, p=0.09).

Finally, Model 4 included women's individual and community-level education. The results show that net of all background characteristics, individual-level education is related to children's wasting. Community-level education is not associated with children's wasting. More specifically, children whose mothers have incomplete or complete secondary school educations are 75% and 62%, respectively, less likely to be wasted compared to children whose mothers are not formally educated. Higher mothers' BMI and older child's age are associated with lower odds of children being wasted.

3.5.3.2. Education, Mediating Pathways, and Wasting

Table 3.5 documents the relationship between individual and community-levels of education, mediating pathways, and wasting. Overall the results from this table show that though community composition of education does not influence children's odds of being wasted, the relationship between women's own education and wasting is partially explained by women's autonomy, household wealth, and reproductive behaviors.

Model 1 repeats the relationship between individual and community-levels of education and urban children's wasting.

Model 2 includes individual and community-levels of education and women's autonomy. The results confirm hypothesis 2 and show that women's autonomy, specifically women's marital status, partially explains the relationship between individual-level education and wasting. That is, children whose mothers are in

polygynous marriages are almost twice as likely to be wasted (OR=2.00, p=0.071) compared to children whose mothers are not in polygynous marriages. Compared to Model 1, the effect of individual-level education on wasting remains nearly identical. The autonomy index and women's ability to provide care for their children are not associated with individual-level education and wasting.

Model 3 assesses the mediating effect of socioeconomic status on children's wasting. The results show that of all the socioeconomic measures, only household wealth partially explains the relationship between individual-level education and children's odds of being wasted. That is, children who reside in households from the middle wealth quintile have 73% lower odds of being wasted compared to children who reside in households from the lowest wealth quintile. Compared to Model 1, only children whose mothers have incomplete secondary school education have lower odds of being wasted (OR=0.29, p=0.006) in Model 3.

Model 4 examined the mediating effect of women's reproductive behaviors. The results are in line with hypothesis 5: women's reproductive behaviors partially explain the relationship between individual-level education and wasting. For example, children whose mothers took a malaria supplement during their last pregnancy had 36% lower odds of being wasted compared to children whose mothers did not take a supplement during their last pregnancy. Children whose mothers took an iron supplement during their last pregnancy had 59% lower odds of being wasted relative to children whose mothers did not take an iron supplement. Relative to Model 1, individual-level education diminishes in strength in Model 4. Interestingly, community-level education became significant in Model 4. Surprisingly, children who reside in middle average education

urban communities are 57% less likely to be wasted (OR=0.43, p=0.068) compared to children in low educated urban communities.

Model 5 includes measures of media access and health knowledge. In line with hypothesis 6, the results show that media access, specifically watching television, partially explains the relationship between individual-level education and wasting. Children whose mothers watch television more than once a week had 63% higher odds of being wasted compared to children whose mothers do not watch television. Compared to the results in Model 1, the effect of individual-level education remains nearly identical.

Finally Model 6 includes both measurements of education and all mediating factors. Overall, the results show that net of all mediators, individual-level education has a direct relationship with children's wasting. That is children whose mothers have incomplete secondary school educations have 60% lower odds of being wasted (OR=0.40, p=0.049) compared to children whose mothers are not formally educated. Additionally, net of all mediators, women's marital status, household wealth, and iron supplementation are significant. Some of the control variables – including higher mothers' BMI and older children's age – are associated with lower odds of children being wasted.

3.6 DISCUSSION

Studies have shown that women's education is positively related to reproductive behaviors and health outcomes, yet few studies have analyzed the effects of individual and community-level education on children's nutritional outcomes in SSA cities (Andrzejewski, Reed, and White 2009). In addition, no studies to date have investigated these relationships in the DRC despite its growing urban population and large number of

nutritionally deficient children. I used a nationally representative sample of urban Congolese children to investigate the relationships between individual and community-levels of women's education and children's odds of being nutritionally deficient. This analysis has worked to contribute to health research in developing countries by showing that both individual and community-level women's education are strongly associated with nutrition outcomes.

The first key finding in this analysis echoes much research on education and health and my first hypothesis: individual-level women's education is related to children's nutritional outcomes, as measured by stunting and wasting. Specifically, secondary school education was associated with children's risk of being stunted or wasted. This outcome reconfirms results from other studies that women's education is related to child health outcomes only at the higher levels of educational attainment (Ainsworth-Darnell and Downey 1998; Harttgen, Klasen, and Vollmer 2013; Willey, Cameron, Norris, Pettifor, and Griffiths 2009). The completion of secondary school -- whether through the long or short cycles (see Appendix) -- provides women more access to specific resources and skills that allow them to improve their children's well-being compared to less educated women. It should be noted that in preliminary analyses, I included fathers' education. Yet the results showed that fathers' education did not have a significant on children's nutritional outcomes, and was therefore not included in the final analyses.

The second key finding, which is in line with my second hypothesis, reveals that urban children's nutritional outcomes is influenced not only by women's own education, but also by the education of other female community members, net of covariates. Though the data cannot inform us as to the content and quality of women's social interactions

with community members, the results reaffirm evidence showing that experiences of social learning, social influence, and socioeconomic status explain how community-level education influences urban children's nutritional outcomes (Kravdal 2004) . These results show that less educated women may be able to influence their children's nutritional outcomes if they reside in highly educated urban communities. It must be noted that community-level education was only related to stunting (height-for-age) and not wasting (weight-for-height). Stunting is a measure of children's long-term and chronic experiences of nutritional deficiencies. Therefore, these results further indicate that accumulated socioeconomic advantages at the community-level might have long and lasting imprints on children's growth during their early years. On the other hand, wasting, which measures children's current nutritional outcomes, might be more related to within-household economic and health resources instead of the characteristics of other community members.

To understand how individual and community-levels of women's education were associated with children's nutritional outcomes, I analyzed the mediating effects of women's autonomy, socioeconomic status, reproductive behaviors, media access, and health knowledge. The autonomy index was not associated with children's stunting, though being in a polygynous marriage was associated with children's odds of being wasted. The DHS does not provide information as to what recent incident led to children being wasted, yet it can be conjectured that women in polygynous marriages might have to share household and economic resources with other wives, which lessens available resources per child.

Socioeconomic status partially explained the relationship between individual and community-level education on stunting. Specifically, children from high wealth

households or whose mothers worked in the manual sector had lower odds of being stunted compared to children from low wealth households or whose mothers were not employed. This finding is consistent with those found in other studies on household socioeconomic status and children's nutrition in SSA (Uthman 2008; Van de Poel, O'Donnell, and Van Doorslaer 2007). Yet these findings suggest that a large part of the relationship between education and stunting is due to household socioeconomic status. Household wealth mediated the relationship between individual-level education and wasting, yet it marginally increased children's odds of being wasted.

Women's reproductive behaviors were not associated with stunting. Yet they did explain the association between individual-level education and wasting. Specifically, malaria and iron supplementation were associated with lower nutritional deficiency among urban children. Formally educated women are more likely to not only know where to access prenatal services, but also how to use medications to prevent poor in-utero health. Through this pathway, women can positively influence their children's good health and nutrition after birth. Media access and health knowledge did not explain the relationship between both levels of education and stunting and wasting.

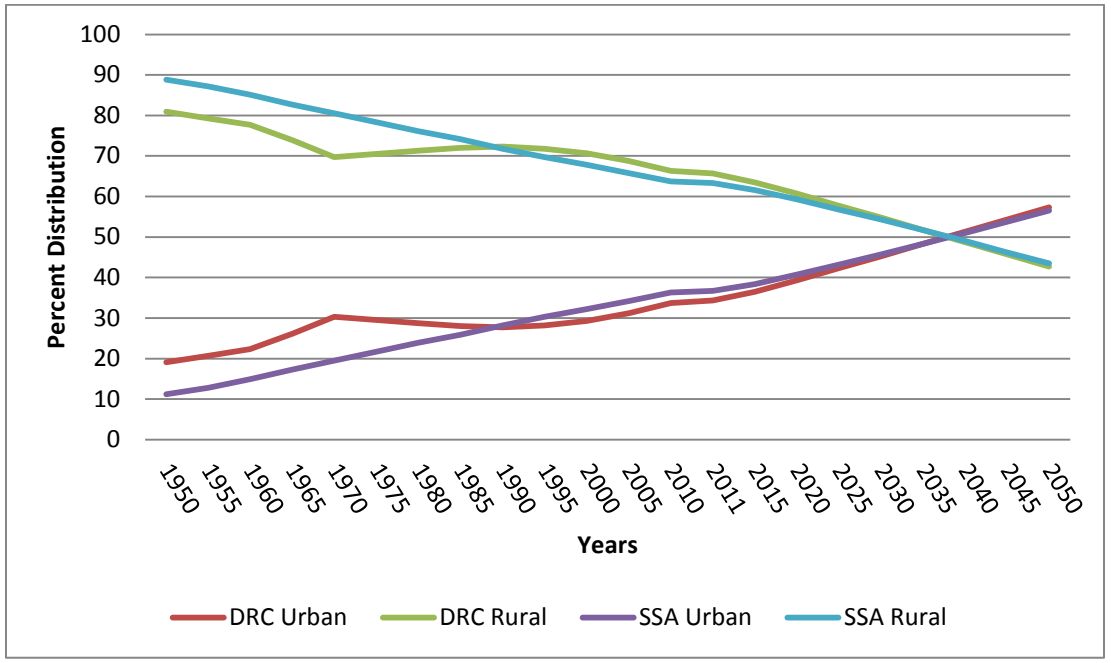
3.7 LIMITATIONS

This study has several limitations. Community-level education was conceptualized as an aggregate measurement of women's education. Yet my models did not include information on other community contexts, like crime or victimization, political instability, health access, or mean income. Though this study effectively assesses the role of community-level education, it fails to understand the contribution that communities as a whole have on children's health and nutrition.

Second, the association between community-level education and urban children's nutritional status could be due to factors that are not measured or controlled for. Specifically, my conceptual framework states that the community context effect is an indication of social processes or social learning for all women in each community, or it could reflect characteristics of women that are correlated with beneficial health outcomes that are not measured in the data (unobserved heterogeneity) (Luke and Xu, 2011). The DHS does not provide adequate social network measurements, so the results showing an effect of community-level education should be interpreted cautiously. In addition, this analysis fails to take into account the effect of migration. That is, women with high levels of education might be more likely to migrate to communities with better resources. Therefore, community-context might actually be mediating the effect of access to individual-level resources and not the other way around.

3.8 CONCLUSION

Overall, these results suggest that formal education at both the individual and community-level is positively associated with children's nutrition outcomes. Moreover, the results have shown that maternal educational differences in children's nutritional outcomes are large in urban areas. Specific health and education policies should be implemented that not only improve poor urban children's health and nutrition, but also increase the number of women who are being formally educated. The next chapter analyzes whether the mechanisms that explain intra-urban differentials in children's nutritional outcomes also explain differences in rural children's nutritional outcomes.



Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat, World Population Prospects: The 2010 Revision and World Urbanization Prospects: The 2011 Revision

Figure 3.1: Urban and rural percent distribution in Sub-Saharan Africa and the Democratic Republic of the Congo between 1950 and 2050

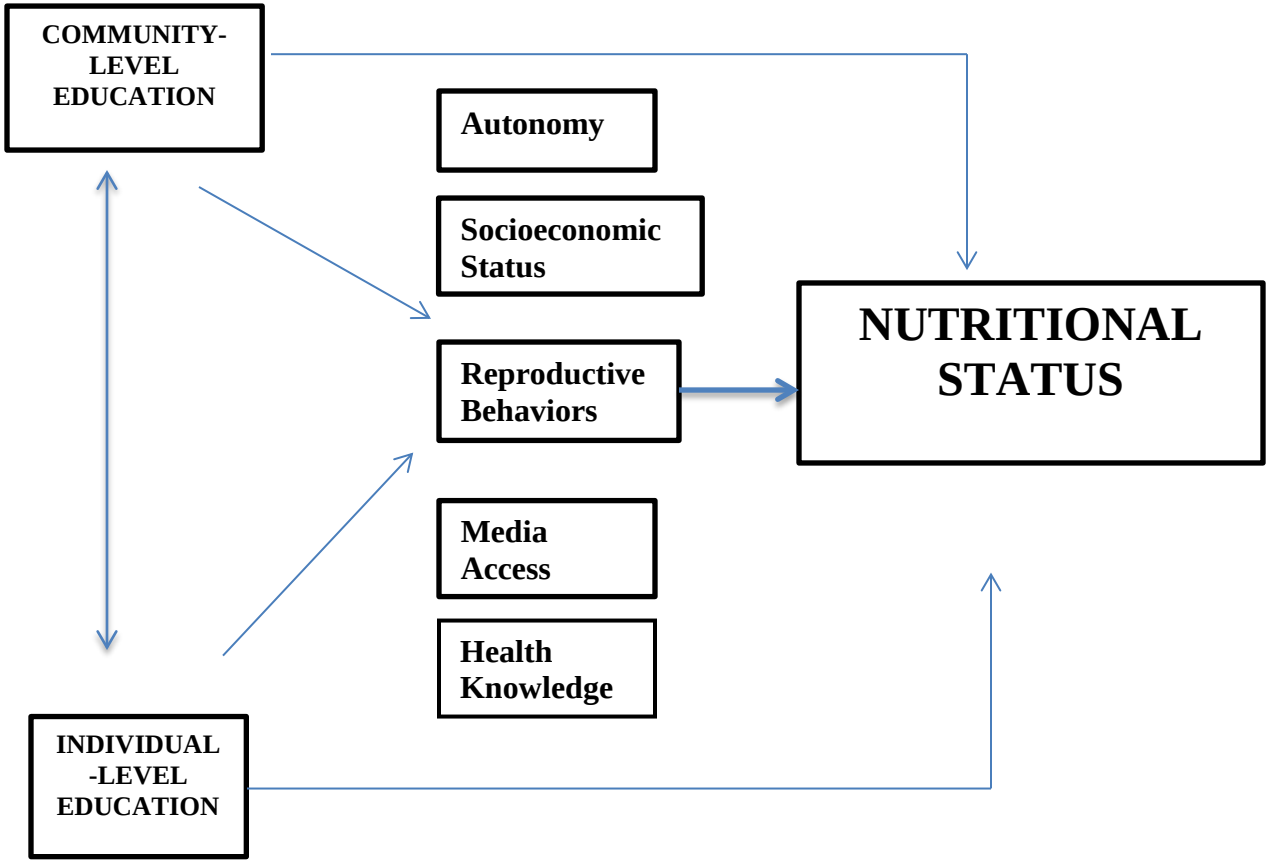


Figure 3.2: Conceptual Framework Illustrating the Relationship between Individual and Community-Level Education, Mediating Factors, and Urban Children's Nutritional outcomes

Table 3.1: Demographic, Social, and Health Characteristics of Urban Mothers and Children Aged 7-59 Months in the Democratic Republic of the Congo, 2007

Child Stunted	34.9%
Child Wasted	10.6%
INDIVIDUAL-LEVEL VARIABLES	
Women's education level	
No formal education [1]	7.6%
Incomplete primary	23.1%
Completed primary	12.8%
Incomplete secondary	46.0%
Completed secondary and more	10.5%
Autonomy	
Autonomy index mean (0-5)	3.1
Polygynous marriage	13.9%
Can decide to take child for medical care	93.0%
Socioeconomic Status	
Occupation	
No occupation [1]	33.8%
Manual	38.2%
Agriculture	25.3%
Professional	2.7%
Household Wealth Index	
Lowest [1]	7.1%
Second	4.5%
Middle	16.9%
Fourth	34.8%
Highest	36.6%
Reproductive behavior	
Number of children under age 5 in household (mean)	2.2
Took malaria medication during last pregnancy	73.4%
Took iron supplement during last pregnancy	32.2%
Media Access	
Listens to radio	39.1%
Watches TV	11.9%
Reads newspaper	27.5%
Health Knowledge	
Knows benefits of Vitamin A	24.6%
Knows benefits of oral rehydration therapy	84.7%
Controls	

Table 3.1, continued

Mother's age (years) [2]	30.1
Mother's age squared [2]	948.5
Mother's BMI	
Underweight [1]	12%
Normal	65%
Overweight	16%
Obese	7%
Female child	50.9%
Child's age (months) [2]	32.1
Child's age squared (months) [2]	1298.6
Child's birth size	
Small [1]	6.7%
Average	37.4%
Big	55.9%
N (Individual Children)	1118
COMMUNITY-LEVEL VARIABLES	
Community-level of education	
Low average education community [1]	9
Middle average education community	46
High average education community	70
N (Communities)	125

[1] Reference category
[2] Mean
Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)

Table 3.2: Multilevel Logistic Regressions Predicting Urban Congolese Children's Stunting, Focusing on Individual and Community-Level Education

	1 (OR)	2 (OR)	3 (OR)	4 (OR)
INTERCEPT	**0.53*** **	**0.46*** **	**0.45*** **	**0.44*** **
LEVEL 2				
Community average level of education (Reference category is Low 0-<4)				
Middle (4-<8 years)			**0.58*** **	**0.72+**
High (8+)			**0.28*** **	**0.41*** **
LEVEL 1 FIXED EFFECTS				
Individual-level of education (Reference Category is No Education)				
Incomplete primary		1.02		1.08
Completed primary		0.63		0.72
Incomplete secondary		**0.52***		0.65
Completed secondary and more		**0.21*** **		**0.30*** **
Controls				
Mother's Age		0.93	0.89	0.93
Mother's age (squared)		1.00	1.00	1.00
Mother's BMI (Reference Category is Underweight)				
Normal		0.78	0.83	0.78
Overweight		0.57	0.64	0.62
Obese		0.57	0.57	0.63
Child sex-Female		**0.73+**	0.77	**0.74+**
Child's Age		**1.12*** **	**1.12*** **	**1.12*** **
Child's age (squared)		**1.00** **	**1.00** **	**1.00** **
Child's birth size (Reference Category is Small)				
Average		0.78	0.72	0.74
Large		**0.61+**	**0.51***	**0.56***
Variance Component (random effects)				
INTERCEPT	**0.28*** **	**0.18***	**0.13***	**0.12+**
ICC	0.08	0.05	0.04	0.03
log likelihood	-1.58	-1.58	-1.58	-1.58

N=1,118, *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)

Table 3.3: Multilevel Logistic Regressions of Urban Congolese Children's Stunting, Focusing on Individual and Community-levels of Education and Mediating Factors

	1 (OR)	2 (OR)	3 (OR)	4 (OR)	5 (OR)	6 (OR)
INTERCEPT	**0.44*** **	**0.44*** **	**0.43*** **	**0.44*** **	**0.43*** **	**0.42*** **
LEVEL 2						
Community-level Education						
(Reference category is Low 0-<4)						
Middle (4-<8 years)	**0.72+**	**0.72+**	0.76	0.74	0.73	0.81
High (8+)	**0.41*** **	**0.41*** **	0.64	**0.44** **	**0.49***	0.68
LEVEL 1 FIXED EFFECTS						
Individual-level of education						
(Reference Category is No Education)						
Incomplete primary	1.08	1.09	1.18	1.11	1.13	1.23
Completed primary	0.72	0.72	0.64	0.77	0.76	0.71
Incomplete secondary	0.65	**0.65+**	0.69	0.68	0.74	0.77
Completed secondary and more	**0.30*** **	**0.30** **	**0.33***	**0.32** **	**0.41***	**0.39***
Autonomy						
Autonomy Index		0.99				1.00
Polygynous Marriage		1.07				1.00
Can take child for care		1.09				1.24
Socioeconomic Status						
Occupation						
(Reference Category is No Occupation)						
Manual			**0.75+**			**0.70***
Agriculture			0.73			**0.68+**
Professional			0.70			0.65
Household Wealth						
(Reference Category is Highest)						

Table 3.3, continued

Lowest			1.55			1.30
Second			**2.34****			**1.90+**
Middle			**3.54*****			**3.12*****
Fourth			**3.01*****			**2.63*****
Reproductive Behavior						
Number of children under age 5 in household				0.98		0.94
Took malaria medication during last pregnancy				0.77		**0.73+**
Took iron supplement during last pregnancy				0.86		1.06
Media Access						
Listens to radio					1.07	1.11
Watches television					**0.49*****	0.70
Reads newspaper					0.66	0.62
Health Knowledge						
Knows benefits of Vitamin A					0.81	0.76
Knows benefits of oral rehydration therapy					1.11	1.16
CONTROLS						
Mother's Age	0.93	0.93	0.96	0.94	0.91	0.95
Mother's age (squared)	1.00	1.00	1.00	1.00	1.00	1.00
Mother's BMI						
(Reference Category is Underweight)						
Normal	0.78	0.79	0.77	0.78	0.82	0.77
Overweight	0.62	0.63	0.71	0.62	0.69	0.73
Obese	0.63	0.64	0.86	0.63	0.72	0.87
Child sex-Female	0.74+	**0.74+**	0.75	**0.75+**	0.76	0.77
Child's age	**1.12*****	**1.12*****	**1.12**	**1.12*****	**1.12*****	**1.12*****
Child's age (squared)	**1.00*****	**1.00****	**1.00**	**1.00****	**1.00****	**1.00****
Child's birth size						
Average Birth Size	0.74	0.74	0.76	0.75	0.77	0.80
Large	**0.56***	**0.56***	**0.60+**	**0.57***	**0.61+**	0.62
Variance Component (random effects)						
INTERCEPT	0.12+	**0.12+**	0.09	0.10	0.05	0.05
ICC	**0.03**	0.03	0.03	0.03	0.01	0.02
log likelihood	-1.58	-1.60	-1.59	-1.59	-1.59	-1.62

Table 3.3, continued

N=1,118; *** p<0.001, ** p<0.01, * p<0.05, + p<0.10; Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)

Table 3.4: Logistic Regressions of Urban Congolese Children's Wasting Status, Focusing on Individual and Community-Levels of Women's Education

	1[8] (OR)	2 (OR)	3 (OR)	4 (OR)
INTERCEPT	**0.12*** **			
LEVEL 2				
Community average level of education				
(Reference category is Low 0-<4)				
Middle (4-<8 years)			**0.31***	0.46
High (8+)			**0.42***	0.71
Level 1 Fixed Effects				
Individual-level of education				
(Reference Category is No Education)				
Incomplete primary		**0.45+**		0.49
Completed primary		**0.28+**		0.31
Incomplete secondary		**0.23****		**0.25****
Completed secondary and more		0.40		**0.38***
Controls				
Mother's Age		1.22	1.18	1.24
Mother's age (squared)		1.00	1.00	1.00
Mother's BMI				
(Reference Category is Underweight)				
Normal		**0.37****	**0.39***	**0.38****
Overweight		**0.23****	**0.22****	**0.23****
Obese		0.36+	0.36+	0.35+
Child sex-Female		1.02	1.03	1.03
Child's Age		**0.93***	**0.92***	**0.91***
Child's age (squared)		1.00	1.00	**1.00+**
Child's birth size (Reference Category is Small)				
Average		1.47	1.42	1.49
Large		0.83	0.81	0.89
Constant		0.17	0.27	0.23
Variance Component (random effects)				
INTERCEPT	0.24			
ICC	0.07			

Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)
N=1,118; *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

[8] Model was analyzed in HLM using multilevel logistic regression methods in order to measure the ICC and variance between communities. Wasting variation across communities was not significant (τ=0.24, p=0.274). Therefore Models 2-4 were analyzed in STATA 13.1 using logistic regression methods.

Table 3.5: Logistic Regressions Predicting Education, Indirect Pathways, and Urban Congolese Children's (7-59 months) Wasting Status

	1 (OR)	**2 (OR)**	**3 (OR)**	**4 (OR)**	**5 (OR)**	**6 (OR)**
LEVEL 2						
Community-level Education						
Middle (4-<8 years)	0.46	0.49	0.43	**0.43+**	0.48	0.44
High (8+)	0.71	0.78	0.59	0.75	0.71	0.68
LEVEL 1 FIXED EFFECTS						
Individual-level of education						
(Reference category is no education)						
Incomplete primary	0.49	0.48	0.54	0.51	0.52	0.66
Completed primary	0.31	0.31	0.39	0.35	**0.33**	0.52
Incomplete secondary	**0.25****	**0.26****	**0.29****	**0.29***	**0.27****	**0.40***
Completed secondary and more	**0.38***	**0.36***	0.49	0.49	**0.38+**	0.65
Autonomy						
Autonomy Index		1.07				1.07
Polygynous Marriage		**2.00+**				**2.07+**
Can take child for care		1.27				0.98
Socioeconomic Status						
Occupation						
(Reference category is no occupation)						
Manual			1.28			1.19
Agriculture			1.71			1.75
Professional			0.53			0.72
Household Wealth						
(Reference Category is Highest)						
Lowest			1.36			1.65
Second			0.67			0.65
Middle			**0.27***			**0.25***
Fourth			0.68			0.64
Reproductive Behavior						
Number of children under age 5 in household				1.13		1.14

Table 3.5, continued

Took malaria medication during last pregnancy				**0.64+**		0.68
Took iron supplement during last pregnancy				**0.41****		**0.33*****
Media Access						
Listens to radio					0.70	0.72
Watches television					**1.63+**	1.55
Reads newspaper					0.80	0.88
Health Knowledge						
Knows benefits of Vitamin A					1.17	1.65
Knows benefits of oral rehydration therapy					0.62	0.62
CONTROLS						
Mother's Age	1.24	1.17	1.19	1.26	1.27	1.20
Mother's age (squared)	1.00	1.00	1.00	1.00	1.00	1.00
Mother's BMI						
(Reference Category is Underweight)						
Normal	**0.38****	**0.41***	**0.38****	**0.36****	**0.39***	**0.42***
Overweight	**0.23****	**0.27****	**0.21****	**0.22****	**0.21****	**0.22****
Obese	0.35+	0.38	**0.33+**	0.37	0.33+	0.39
Child sex-Female	1.03	1.03	1.00	1.08	1.02	1.06
Child's age	**0.91***	**0.92***	**0.93***	**0.89****	**0.91***	**0.90****
Child's age (squared)	**1.00+**	**1.00**	**1.00**	**1.00**	**1.00+**	**1.00***
Child's birth size						
Average	1.49	1.47	1.35	1.52	1.54	1.42
Large	0.89	0.97	0.81	1.01	0.90	1.00
Constant	0.23	0.27	0.46	0.31	0.20	0.55

Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Chapter 4

4.1 INTRODUCTION

In Sub-Saharan Africa (SSA), under-nutrition is a primary leading cause of death to children under 5 years of age (Black et al. 2010; Black, Morris, and Bryce 2003). The Democratic Republic of the Congo (DRC) is one of five countries that accounts for over 50% of under-five child deaths globally[9] [10] [11](UNICEF 2013a). Additionally about 43% and 9% of Congolese children are stunted (height-for-age) or wasted (weight-for-height), respectively (UNICEF 2010). Therefore the focus of my dissertation has been to identify the factors that are related to improving Congolese children's nutritional outcomes. Specifically, the aim of my dissertation has been to understand the relationship between individual and community-levels of women's education and children's nutritional outcomes in the DRC and how this relationship differs by urban-rural residential location.

As thoroughly discussed in Chapter 3, educational attainment matters for children's nutritional outcomes for several reasons. First at the individual-level, formal education provides women with specific knowledge (Baker et al. 2011), problem solving skills (Kravdal 2002), employment related credentials(Card 1999), and an increased sense of control over their lives (Bbaale and Buyinza 2012; Glick and Sahn 1998; Hoddinott and Haddad 1995). Therefore education allows women to increase their knowledge-base and socioeconomic benefits, which can then be used to influence children's overall

[9] India, DRC, China, Nigeria, and Pakistan.
[10] The DRC accounts for approximately 391,000 under-five child deaths or 6% share of global total in 2012.
[11] The DRC under-five mortality rate in 2012 was 145 deaths per 1,000 live births.

nutritional outcomes and well-being. Additionally, more educated women are more likely to have better health behaviors than less educated women, which is key to influencing children's nutritional outcomes (Basu and Stephenson 2005; Block 2007). Second, at the community-level, women who reside in highly educated communities might exchange information, mimic or be coerced into emulating the health behaviors of other female community members and in turn, indirectly or directly influence their children's nutritional outcomes (Moursund and Kravdal 2003). Additionally, women who reside in highly educated communities might also benefit from the economic expansion that is characteristic of more educated communities. That is, more improved economic well-being leads to faster and higher economic growth, which would in turn lead to greater investments in public infrastructures like improved sanitation, health services, and facilities. Therefore, women of all education levels would have greater access to resources and services that could be used to directly or indirectly improve children's nutrition.

Several studies have found a relationship between individual and community-levels of education and women's fertility outcomes and lower risks of infant mortality and morbidity (Andrzejewski, Reed, and White 2009; Burchi 2010; Desai and Alva 1998; Frost, Forste, and Haas 2005; Kravdal 2004; Pamuk, Fuchs, and Lutz 2011). Yet it is important to distinguish the effects of this relationship by urban-rural residential location for several reasons. First, a large body of research has shown that in many developing

countries, rural residents typically have lower levels of educational attainment[12], less access to health services, poor sanitation, and overall lower wealth levels relative to urban residents (Bicego and Ties Boerma 1993). Additionally, rural children tend to have higher risks of mortality and worse nutritional outcomes relative to their urban counterparts (Anyamele 2009; le R Booysen 2003; Zere and McIntyre 2003). Second, recent evidence has shown that though urban-rural gaps in children's health outcomes are shrinking (Fotso 2007), rural communities in SSA continue to have a higher burden of disease, malnutrition, and illness than urban communities (Fotso 2007; UNPD 2011a). Therefore, overall socioeconomic and nutritional differences by location necessitates a deeper analysis to understand if education --a key determinant of child mortality and morbidity outcomes in developing countries-- is also a determinant of Congolese children's nutritional outcomes and whether this effect manifests itself differently for rural children relative to urban children.

In Chapter 2, I employed a person-centered approach to describe how the lives of Congolese women and children vary by urban-rural residential location. Using secondary qualitative data and descriptive statistics, the person-centered approach echoed previous research on the DRC showing a rural disadvantage in children's nutritional outcomes, women's educational attainment, and household wealth. Additionally, in contrast to the heterogeneity in children's nutritional outcomes and household wealth across urban Congolese communities, rural Congolese communities exhibited little variation in

[12] Both paternal and maternal.

nutritional outcomes, women's individual-level educational attainment, and household wealth. That is, most rural Congolese communities had high percentages of nutritionally deficient children and poor households they were low educated communities. Overall, the person-centered analysis showed that women and children's livelihoods and children's nutritional outcomes in the DRC seem to vary by urban-rural residence and that many of these differences might be due to education and wealth differences. Additionally, the person-centered analysis provided some early evidence that community context might matter more for urban areas than rural areas.

In Chapter 3, I analyzed the relationship between individual and community-level education and children's nutritional outcomes within the urban DRC. I also analyzed the effects of women's autonomy, socioeconomic status, reproductive behaviors, health knowledge, and media access as potential mediating factors. The results showed that individual and community-levels of education are key determinants of children's nutritional outcomes. Specifically, children of more educated women were less likely to be nutritionally deficient than children of mothers who were not formally educated. Additionally, children who reside in high educated urban communities were less likely to be nutritionally deficient compared to children who reside in low educated urban communities. Several mediating factors --including women's occupation, household wealth, media access, and reproductive behaviors-- were also associated with urban children's nutritional outcomes. Overall, education-related resources at the community-level seem to be important for urban children's nutritional outcomes; yet it remains

unclear whether multiple levels of women's educational attainment are associated with rural children's nutritional outcomes.

Against this backdrop, this chapter's purpose is to consider whether individual and community-levels of education are associated with children's nutritional outcomes in rural DRC. Using data from the 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC), this chapter answers two main questions:

1. Do rural children's nutritional outcomes (stunting and wasting) in the DRC differ by individual- and community-levels of women's education?
2. To what extent do measures of women's autonomy, socioeconomic status, reproductive behavior, media access, and health knowledge mediate the relationships between individual and community-levels of education and rural children's nutritional outcomes (stunting and wasting)?

In the next section of this chapter, I describe my conceptual framework, and present my hypotheses. Subsequently, I describe the data and methods, present my results, and conclude with a discussion of these results.

4.2 CONCEPTUAL FRAMEWORK

As previously described, this analysis is based on a modified version of the conceptual framework developed by Mosley and Chen (1984) to understand the social and biological proximate determinants of childhood survival in developing countries. In addition, I use Link and Phelan's (1995, 2002) conceptualization of socioeconomic-status as a fundamental cause of health. According to Mosley and Chen (1984), socioeconomic-status determinants work through maternal factors, environmental contamination, nutrient

deficiency, and injury to impact children's health in developing countries. Socioeconomic determinants are grouped into three broad categories: individual-level variables (individual productivity, traditions/norms/attitudes), household-level variables (income/wealth) and community-level variables (ecological setting, political economy, health system). When these pathways negatively affect children, children's health suffers. Their poor health then has a direct effect on their growth and chances of survival.

Link and Phelan's (2002) fundamental cause theory also addresses the importance of social conditions on health. Link and Phelan's (2002) thesis states that as populations develop, individuals' abilities to avoid or minimize the consequences of diseases and illnesses is strongly shaped by their social resources. More specifically, individuals with higher socioeconomic-status possess a wider range of resources (money, knowledge, prestige, power and beneficial social connections) than those at lower socioeconomic levels (Phelan et al. 2004). The creation of new medical interventions and technology allows individuals with higher socioeconomic status to take advantage of these medical advances and the ability to extend their lives, compared to those with fewer resources (Phelan et al. 2004).

Figure 4.1 presents an adapted conceptual framework for understanding how individual and community-level education affects rural children's nutritional outcomes. This conceptual framework is similar to the framework in Chapter 3, though I have included fathers' educational attainment as an additional primary pathway and fathers' socioeconomic status as a mediating factor. In the next section, I will provide evidence for the use of these two measures in this rural context and conclude with the hypotheses.

4.2.1 Individual Level Fathers' Educational Attainment and Socioeconomic Status

Several studies have shown that fathers' education is equal to or more important than mothers' education as a predictor of children's health and nutritional outcomes. Semba et al. (2008) found that fathers' educational attainment, and not mothers' education, was an important predictor of children's stunting in Bangladesh. Additional work in Indonesia found that mothers' and fathers' education had equal effects on child mortality (Breierova and Duflo 2004). In this analysis, I included a measure of fathers' individual-level education as a second primary pathway for several reasons. First, in Chapter 3, fathers' education did not have a significant effect –and was subsequently not included in the final analysis-- on urban children's nutritional outcomes. This was most likely because fathers and mothers in urban DRC had similar educational attainment levels. Therefore, women --who play more of an active and obvious role in care-giving to children-- might be more likely to use and invest their educational resources for their children. In rural DRC though, fathers have over 4 more years of education than mothers (see Table 4.1). Therefore, if higher levels of educational attainment are hypothesized to be an important determinant of children's nutritional outcomes, including a measure of fathers' education in rural DRC is important. Second, I also include fathers' education because of the lower levels of autonomy found among women in rural DRC. Rural mothers have lower levels of sole decision-making capabilities (see Table 2.3) compared to urban mothers. Therefore, it might be hypothesized that lower levels of women's autonomy in rural DRC limits women's influence on decisions related to their children's health and increases the necessary addition of fathers' education (Semba, de Pee, Sun, Sari, Akhter, and Bloem 2008).

In addition, a large body of research has shown a strong association between women's socioeconomic status and children's health and nutrition (Crystal, Shea, and Krishnaswami 1992; Dapi et al. 2009; Fotso and Kuate 2005; Fotso 2007; Kuate 1996; Pongou, Ezzati, and Salomon 2006), yet few studies have found a relationship between fathers' socioeconomic status and children's nutritional outcomes (Vella, Tomkins, Borghesi, Migliori, Adriko, and Crevatin 1992). In rural DRC, most households are poor and lack many resources -- including piped water and clean sanitation. In addition, compared to urban women, most rural women work in low paying agriculture jobs. Therefore, scarce socioeconomic and health resources in rural areas might suggest that rural children benefit more from the availability of both parents' resources compared to their urban counterparts.

4.2.2 Hypotheses

In Chapter 3, I reviewed part of the literature on educational attainment, which suggests a direct relationship with childhood nutrition. Additionally, the results from Chapter 3 showed that both individual and community-levels of education were associated with urban children's nutritional status. Therefore, building upon this and the brief review of fathers' education and socioeconomic status as a potential predictor of children's nutritional status, I expect to find an association between higher levels of mothers' and fathers' individual-level education and rural children's nutritional outcomes. Additionally, I expect that higher levels of community-level education will also have an effect on rural children's nutritional outcomes. Finally, I expect several key individual characteristics --including women's autonomy, socioeconomic status, reproductive health and behaviors, media access, and health knowledge-- to also influence rural children's nutritional outcomes. Specifically, I hypothesize that:

Hypothesis 1: Higher women's individual-level education will be associated with lower odds of children's stunting and wasting.

Hypothesis 2: Higher fathers' individual-level education will be associated with lower odds of children's stunting and wasting.

Hypothesis 3: Rural children residing in more educated communities will be less likely to be stunted or wasted compared to rural children in less educated communities.

Hypothesis 4: Women's autonomy will mediate the relationship between both individual and community-levels of education and children's odds of being stunted or wasted.

Hypothesis 5: Socioeconomic status will mediate the relationship between both individual and community-levels of education and children's odds of being stunted or wasted.

Hypothesis 6: Women's reproductive health and behaviors will mediate the relationship between both individual and community-levels of education and children's odds of being stunted or wasted.

Hypothesis 7: Women's media access and knowledge will mediate their relationship between individual and community-levels of education and children's odds of being stunted or wasted.

4.3 DATA AND METHODS

This chapter uses data from the 2007 EDS-RDC. The 2007 EDS-RDC was the first nationally representative survey of its kind conducted in the DRC. The objective of the 2007 EDS-RDC was to provide data on fertility and family planning behavior, child mortality, children's nutritional outcomes, maternal and child health services, and knowledge of HIV/AIDS. The 2007 EDS-RDC was conducted between January and August 2007 and is representative at the national level, for urban and rural residences, and for eleven provinces (Kinshasa, Bas-Congo, Bandundu, Équateur, Orientale, Nord-Kivu, Sud-Kivu, Maniema, Katanga, Kasaï Orientale, and Kasaï Occidental). The 2007 EDS-RDC has complete interviews from 8,886 households, 9,995 women aged 15-49 years, and 4,757 men aged 14-59 years.

The 2007 EDS-RDC contains 3 separate survey questionnaires: the Household Questionnaire, the Women's Questionnaire, and the Men's Questionnaire. The Household Questionnaire collects information on each household member and visitor: background; parental survivorship; sanitation, water, and cooking sources; and assets. The Women's Questionnaire collects information on age; marital status; education; employment; residence; fertility history; fertility behavior; family planning and contraception; antenatal, delivery and postpartum care; breastfeeding and nutrition; children's health; status of women; knowledge of AIDS and other sexually transmitted infections; husband's background; and use of tobacco. The Men's Questionnaire is similar to but shorter than the Women's Questionnaire. It collects information on age; education; employment status; religion; residence; reproduction; knowledge and use of

contraception; gender roles; and knowledge of AIDS and other sexually transmitted infections. In addition, the EDS-RDC collects anthropometric measures (height and weight) for children under age 5 and women aged 15-49. The three commonly used indicators to measure children's nutritional outcomes are height-for-age, weight-for-age and weight-for height.

This study limits the sample to 2007 EDS-RDC rural children 7-59 months of age who: a) had complete data on maternal educational attainment, b) had complete anthropometric measurements, and c) whose mothers were married non-visiting residents of the interviewed household. This limited my sample size to 1,671 children.

4.3.1 Dependent Variable

The overall focus of my dissertation is on women's education and Congolese children's nutritional outcomes. Height-for-age and weight-for-height indexes from the 2007 EDS-RDC are used as proxies of children's nutritional outcomes. Height-for-age is used to measure "stunting" and weight-for-height is used to measure "wasting". Stunting describes growth retardation among children (being very short for their age) and typically results from chronic nutritional deprivation coupled with repeated infections. Wasting is an anthropometric measure that taps into children's body mass in relation to length and is a measure of children's current nutritional outcomes. Both wasting and stunting are measured in the form of z-scores, which compares a child's height-for-age or weight-for-height to those of children in a reference healthy population (WHO 2010). The equation for determining a child's (1) height-for-age and (2) weight-for-height is:

$$Height - for - age\ z - score = \frac{H_i - H_r}{SD\ of\ the\ reference\ population} \quad (1)$$

$$Weight - for - age\ z - score = \frac{H_i - H_r}{SD\ of\ the\ reference\ population} \quad (2)$$

, where H_i is the height of the child; $H_r$is the median height of the reference population; and SD is the standard deviation of the height of the reference population (WHO 2010). The National Center for Health Statistics/WHO definitions of childhood stunting and wasting describes children whose height-for-age or weight-for-height measures are two standard deviations below the median height-for-age or weight-for-height curve as stunted or wasted, respectively (WHO 2010).

Children's stunting and wasting were coded as dummy variables. All children who were two standard deviations below the reference height-for-age category were defined as being stunted and were given a value of "1", whereas all other children were defined as not stunted and were given a value of "0". Similarly, all children who were two standard deviations below the reference weight-for-height category were labeled as wasted and were given a value of "1", whereas all other children were defined as not wasted were given a value of "0".

4.3.2 Independent Variables

4.3.2.1 Mothers' Individual-Level Educational Attainment

The primary independent variable is mother's level of educational attainment, which is measured as a 4 category variable: no formal education (0 years), incomplete primary (>0-5 years), complete primary (6 years), and incomplete secondary or higher (>6 years) (Kravdal 2002; Pamuk, Fuchs, and Lutz 2011).

4.3.2.2 Fathers' Individual-Level Educational Attainment

Fathers' level of educational attainment is measured as a 5 category variable: no formal education (0 years), incomplete primary (>0-5 years), complete primary (6 years), incomplete secondary (>6-11 years), and complete secondary or higher (12+ years) (Fotso 2007).

4.3.2.3 Community-Level Educational Attainment

The 2007 EDS-RDC is not representative at the community-level; yet utilizing the average level of women's education in each survey cluster provides an effective estimate of the education "around" each child and their mother. The 2007 EDS-RDC has 300 total clusters, 175 of which are rural of approximately 33 women per cluster. First, community-level education was calculated by averaging the years of schooling for *all women* aged 15-49 with a non-missing response of education in years in *each* of the clusters. After calculating the distributions of mean years of education for each cluster, I divided communities into 2 categories of average education due to small cell counts at the higher levels of community-level education: low community education (less than 4 years) and high community education (4 or more years) (Pamuk, Fuchs, and Lutz 2011).

4.3.2.4 Mediating Factors

To understand how maternal education is related to rural Congolese children's nutritional outcomes, I analyze mediating factors; these include individual-level measurements of women's autonomy, socioeconomic status, reproductive behaviors, media access, and health knowledge. To gauge women's autonomy, I used the 2007 EDS-RDC questions about women's household decision-making abilities, ability to get care for child, and marital status.

The questions on women's household decision making abilities were: "Who usually makes the final decision on your health care, food cooked daily, the purchase of major household goods, visits to family or friends, and your earnings?" I recoded women's responses to these 5 different questions into three categories: the woman made the sole decision, the woman made the decision jointly with the husband/partner, or the husband/partner made the sole decision (Hindin 2000; Singh, Haney, and Olorunsaiye 2012). Next, each of the women's autonomy responses was used to create the final autonomy index measure. The autonomy index ranged from 0-5 and corresponded to the number of decisions in which a woman participated alone or jointly with her husband. A high score on the autonomy index indicated a higher level of household autonomy. Women who said they could decide to get care for their child were coded as "1", while those who said they could not decide to get care for their child were as coded as "0". Finally, women who said they were an only wife were coded as "0" whereas women who said they were not the only wife were coded as "1".

The 2007 EDS-RDC coded women's occupation into 7 categories: not employed, professional/technical/managerial, clerical, agriculture, services, skilled manual and unskilled manual. Using previous work by Abbi et al. (1991), I coded maternal occupation into 3 categories: no occupation, manual or professional occupation, and agriculture occupation.

The 2007 EDS-RDC coded fathers' occupation into 7 categories: not employed, professional/technical/managerial, clerical, agriculture, services, skilled manual, and

unskilled manual. I coded fathers' occupation into 4 categories: no occupation, agriculture, manual, and professional.

Additionally, the 2007 EDS-RDC has a wealth index, which is a composite measure of a household's cumulative living standard. It is calculated from data on a household's ownership of specific assets: televisions and bicycles; the building material of the home; and types of water access and sanitation facilities. Using principal component analyses, the wealth index places individual households on a continuous scale of relative wealth. Households were separated into 4 wealth quintiles: lowest, second, middle, and fourth/highest. Wealth quintiles are expressed in terms of quintiles of individuals in a population and not quintiles of individuals at risk for a health or population indicator. The advantage to this approach is that information is directly relevant to the principal question of interest, for example, the health status or access to services for the poor in the population as a whole (Rutstein and Johnson 2004). The result is a substantive measure of relative and not absolute country-specific economic resources.

I coded women's reproductive behaviors to be consistent with earlier studies (Ceesay et al. 1997; Rutstein 2005). The 2007 EDS-RDC asks women questions on their pregnancy behaviors. Variables measuring prevention of malaria and use of iron supplements during a woman's last pregnancy were coded as "1" if the woman answered yes to using a preventative malaria medication or taking an iron supplement. I coded number of children under five years of age in the household as an interval variable ranging from 1-6.

Variables measuring women's health knowledge and access to media were likewise coded to be consistent with earlier work (Arimond and Ruel 2004; Burchi 2010; Rose, Chotard, Oliveira, Mock, and Libombo 2008). First, women were asked how often they listened to the radio. Women who listened to the radio at least once a week were given a value of "1", while women who listened to the radio less than once a week were given a value of "0". Second, women were asked if they had any knowledge of oral rehydration therapy (ORT) and whether they gave their child a vitamin A supplement at birth. Women who answered no to these two questions were given a value of "0" and those who answered yes were given a value of "1".

All models in the analysis control for mother's age, mother's body mass index (BMI), child's sex, child's age, and child's birth size.

4.3.3 Statistical Methods

Multilevel modeling methods are used because individuals are clustered within communities. I used multilevel binomial logistic models to predict the odds of children's stunting and wasting status using individual-level and community-level covariates. I first estimated a two-level unconditional means model. The unconditional means model, also called the empty model, has no covariates and is used to calculate the intra-class correlation (ICC), which assesses whether there is significant variation between communities in stunting or wasting. Most importantly, the ICC also informs researchers whether or not multilevel modeling is an appropriate method of estimation (Raudenbush and Bryk 2002). Previous research has shown that ICC values between 0.05 and 0.20 are common in cross-sectional multilevel modeling applications in social research studies

(Peugh 2010). Equation 3 is the baseline unconditional means model for child *i* in community *j*:

$$\log\left[\frac{Prob(Nutritional\ Status_{ij}=1|\beta_j)}{(1-Prob(Nutritional\ Status_{ij}=1|\beta_j))}\right] = \beta_{0j} \quad (3)$$

, where β_{0j}, the intercept, is modeled at level-2 in Equation 4 as,

$$\beta_{0j} = \gamma_{00} + u_{0j} \quad (4)$$

, where γ_{00} represents the grand mean of nutritional outcomes, and u_{0j} represents the random error among communities. This random error is also assumed to be normal with variance τ. The intercept β_{0j} has a subscript *j* which indicates that every community in my sample has a unique intercept. Results from the unconditional models for both stunting and wasting are presented in Tables 4.2 and 4.3. Equation 5 is the individual-level model analyzing the effect of women's individual-level education:

$$\log\left[\frac{Prob(Nutritional\ Status_{ij}=1|\beta_j)}{(1-Prob(Nutritional\ Status_{ij}=1|\beta_j))}\right] = \beta_{0j} + \beta_{1j}(Incomplete\ primary_{ij}) + \beta_{2j}(Complete\ primary_{ij}) + \beta_{3j}(Incomplete\ secondary\ and\ higher_{ij}) + \beta_{4-12j}(Control\ variables_{ij}) + u_{0j} \quad (5)$$

, where β_{0j} to β_{12j} are the coefficients associated with the individual characteristics within each community. Equation 6 is the individual-level model analyzing the effect of fathers; individual-level education:

$$\log\left[\frac{Prob(Nutritional\ Status_{ij}=1|\beta_j)}{(1-Prob(Nutritional\ Status_{ij}=1|\beta_j)}\right] = \beta_{0j} + \beta_{1j}(Fathers'\ incomplete\ primary_{ij}) + \beta_{2j}(Father's\ Complete\ primary_{ij}) + \beta_{3j}(Father's\ Incomplete\ secondary\ and\ higher\ _{ij}) + \beta_{4j}(Father's\ complete\ secondary\ and\ higher\ _{ij})\beta_{5-13j}(Control\ variables\ _{ij}) + u_{0j} \quad (6)$$

, where β_{0j} to β_{13j} are the coefficients associated with the individual characteristics within each community. Equation 7 is the community-level model analyzing the effect of community-level education:

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(High\ education\ community) + \beta_{1-9j}(Control\ variables\ _{ij}) + u_{0j}$$

$$\beta_{0j} = \gamma_{10}$$

.

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$$\beta_{9j} = \gamma_{90} \quad (7)$$

, where γ_{01} to γ_{02} are the regression coefficients associated with community-level education and β_1 to β_{9j} are the coefficients associated with the control variables. Finally, the full mixed model (Equation 8) of both individual and community-level characteristics is:

$$\log\left[\frac{Prob(Nutritional\ Status_{ij}=1|\beta_j)}{(1-Prob(Nutritional\ Status_{ij}=1|\beta_j)}\right] =$$

$$\gamma_{00} + \gamma_{01}(High\ education\ community\ \ ) + \gamma_{10}(Women's\ incomplete\ primary) +$$

$$\gamma_{20}(Women's\ completed\ primary_j) +$$
$$\gamma_{30}(Women's\ incomplete\ secondary\ and\ higher)\ ) +$$
$$\gamma_{40}(Father's\ incomplete\ primary\ _{ij}) +$$
$$\gamma_{50}(Father's\ complete\ primary\ _{ij}) + \gamma_{60}(Father's\ incomplete\ secondary\ _{ij}) +$$
$$\gamma_{70}(Father's\ complete\ secondary\ and\ higher\ _{ij}) +$$
$$\gamma_{80-330j}(Control\ variables\ _{ij}) + u_{0j} \quad (8)$$

, where γ_{00} is the grand mean of the intercept, γ_{0q} are the regression coefficients associated with community-level education and γ_{p0} are the regression coefficients associated with individual-level characteristics.

All the models were estimated using HLM7 software, which is a common software used to analyze data from clustered samples, which in this case is children nested within communities (Raudenbush et al. 2004). HLM has two key characteristics which made it ideal for my analyses: 1) it allows for a simultaneous analysis of variables at different levels, and 2) it can estimate multilevel logistic regressions using weighted sample data, which is the case with the 2007 EDS-RDC. In all the analyses, individual-level variables were centered around the grand mean, which means that individual characteristics were converted into deviations from the overall sample mean. The intercepts in all the models can therefore be interpreted as the odds of children being stunted or wasted based on the average characteristics of all the variables in the model. All coefficients are expressed as odds ratios.

4.4 RESULTS

4.4.1 Descriptive Statistics

Table 4.1 presents weighted descriptive statistics for all the measures used in the multivariate analyses for the analytic sample of rural Congolese children. About 47% of rural children were stunted and 9.3% were wasted. The wasting percentages are similar to the wasting average for SSA, yet stunting percentages are higher than stunting averages for all of SSA as well as urban areas in the DRC. UNICEF nutritional outcomes trends between 2001 and 2007 show that though stunting and wasting prevalence across rural areas has decreased, the burden of chronic hunger in the DRC remains in rural areas (UNICEF 2010). Close to 31% of rural children's mothers are not formally educated. About 41% of rural children's mothers have not complete primary school while less than 8% have not completed primary school. Over 19% of rural children's mothers attended some secondary school and more. Less than 12% of rural children's fathers were not formally educated and about 22% did not complete primary school. Close to 10% of rural children's fathers completed primary school and over 43% did not finish secondary school. Only 13% of rural children's fathers completed secondary school and higher. Rural children's mothers had slightly lower than average scores on the autonomy index measurement. Approximately 20% of rural mothers were in polygynous marriages at the time of the survey and most mothers said they could decide whether to take their child for medical care.

Measures of socioeconomic status measures show that rural children are economically disadvantaged in relation to urban children. About 13% of rural children's mothers have no occupation. The majority of rural children's mothers are employed the agriculture sector. Less than 5% of rural children's fathers have no occupation and over

67% of fathers work in manual sectors. The household wealth index shows that over 60% of rural children reside in households in the first 2 wealth quintiles. Most rural households have about 2 children under the age of five residing in the residence. Over 15.2% of rural children's mothers took malaria medication during their last pregnancy whereas only 25% of mothers took an iron supplement.

Finally, media access was very limited for rural children's mothers: about 21% of rural children's mothers listen to the radio at least once a week. Measurements of women's health knowledge showed that over 80% of rural children's mothers know the benefits of oral rehydration therapy, yet only 16% of rural mothers know the benefits of vitamin A.

4.4.2 Rural Stunting

4.4.2.1 Education and Stunting

Table 4.2 presents the results from the multivariate logistic regression models with fixed effects and robust standard errors for the outcome variable, rural children's odds of being stunted. Table 4.2 first shows the unconditional means model (Model 1), which does not include any covariates. Model 1 shows three important results. First, the non-zero grand-mean of stunting is not significant (γ_{00} =0.89, p=0.26). Second, there is significant variance in stunting across community context (τ=0.28, p<0.001). And third, an ICC of 0.08 indicates that approximately 8% of the total variation in stunting exists between rural communities. The ICC of 8% also indicates the need for multilevel modeling of rural children's stunting.

Model 2 introduces individual-level women's education. In contrast to my first hypothesis, the results show that individual level women's education is not associated with rural children's stunting.

Model 3 introduces individual-level fathers' education. In contrast to my second hypothesis, fathers' educational attainment is also not associated with children's odds of being stunted.

Model 4 assesses the effect of community-level education. The results suggest that unlike what was predicted in hypothesis 3, community-level education is not related to rural children's stunting.

Model 5 includes both mothers' and fathers' individual-level education and community-level education. The results show that unlike the results in Chapter 3 for urban children's nutritional outcomes, individual levels of education –both mothers' and fathers'-- are not significantly related to rural children's likelihood of being stunted. Moreover, community-level education is not associated with stunting.

4.4.2.2 Education, Mediating Pathways, and Stunting

Table 4.3 analyzes the relationship between the three measures of education, mediating pathways, and rural Congolese children's nutritional outcomes. Overall, the results show that education does not affect children's stunting. Instead, several mediating factors --including socioeconomic status, reproductive behavior, and health knowledge-- have an effect on rural children's stunting.

Model 1 repeats the relationship between individual and community-levels of education and children's stunting.

Model 2 assesses the effect of women's autonomy. The results show that none of the measurements of women's autonomy are associated with rural children's stunting.

Similar to the effects in Model 1, mothers' and fathers' individual-level education are not significant. Community-level education is also not significant.

Model 3 tests my fifth hypothesis, which predicts that maternal and paternal socioeconomic status will mediate the relationship between individual and community-levels of education and rural children's odds of being stunted. The results show that unlike mothers' and fathers' education, women's occupation and household wealth are predictors of rural children's stunting. For example, rural children whose mothers work in the agriculture sector have 39% lower odds of being stunted (OR=0.61, p=0.02) compared to rural children whose mothers do not work. Interestingly, rural children from the lowest, second, and middle wealth quintiles have lower odds of being stunted relative to children from households in the fourth wealth quintile. In comparison to Model 1, all the education measures remain insignificant.

Model 4 examines the mediating effect of women's reproductive behaviors. As predicted in hypothesis 6, women's reproductive behaviors are associated with rural children's stunting. That is, residing in a home with more than 1 child under 5 years of age increases rural children's odds of being stunted by 22%. Similar to the effects in Model 1, individual and community-levels of education are not associated with stunting.

Model 5 included measurements of media access and health knowledge. In line with hypothesis 7, the results show that health knowledge is associated with stunting. Rural children whose mothers are familiar with ORT are 39% more likely to be stunted than rural children whose mothers do not know of ORT. Similar to the effects in Model 1, individual and community-levels of education do not predict stunting.

Finally, Model 6 includes all measurements of education and all mediating factors. Overall, the results show that mothers' and fathers' education are not associated

with rural children's stunting. Additionally, community-level education is not associated with stunting. Instead, net of all mediators, women's agriculture occupation, household wealth, and number of children under age 5 in the household are significant predictors of rural stunting. Child female sex is also associated with a lower level of rural children's stunting.

4.4.3 Rural Wasting

4.4.3.1 Education and Wasting

Table 4.4 presents the results from the multivariate logistic regression models for the second outcome variable, wasting. The results from the unconditional means model (Model 1) show that the non-zero grand-mean of wasting is significant (γ_{00}=0.10, p<0.001). There is significant variation in wasting across communities (τ=0.48, p=0.12). Finally, an ICC of 0.13 indicates that approximately 13% of the total variation in wasting exists between rural communities. The ICC of 13% also indicates the need for multilevel modeling of rural children's wasting.

Model 2 introduces individual-level women's education. Contrary to hypothesis 1, women's individual-level education is not associated with wasting.

Model 3 introduces individual-level fathers' educational attainment. The results are in line with hypothesis 2: rural children whose fathers completed secondary school have 68% lower odds of being wasted (OR=0.32, p=0.07) compared to rural children whose fathers have no formal education.

Model 4 analyzes the direct relationship between community-level education and children's odds of being wasted. The results suggest that, unlike hypothesis 3, community level education does not affect whether or not children are wasted.

Finally, Model 5 includes mothers' and fathers' individual-level education and community-level education. The results show that individual-level women's education continues to have no effect on rural children's wasting. Rural children whose fathers have completed primary school have 69% lower odds of being wasted (OR=0.31, p=0.07) compared to rural children whose fathers have no formal education. Community-level education does not have an effect on rural children's stunting. Higher mothers' BMI, female child sex, and large birth size are associated with lower odds of rural children being wasted.

4.4.3.2 Education, Mediating Pathways, and Wasting

Table 4.5 documents the relationship between individual and community-levels of education, mediating pathways, and wasting. The results from this table show that individual levels of mothers' education are not directly related to children's odds of being wasted. Fathers' education is associated with wasting. Additionally, community-level education does not influence wasting. Instead, several mediating pathways --including women's autonomy, socioeconomic status, reproductive behavior, and health knowledge-- are predictors of wasting.

Model 1 repeats the relationship between individual and community-levels of education and rural children's wasting.

Model 2 includes individual and community-levels of education and women's autonomy. The results confirm hypothesis 4 and show that women's autonomy --specifically, polygynous marriage and ability to get care for child --has an effect on wasting. Specifically, rural children whose mothers are in a polygynous marriage have 64% lower odds of being wasted (OR=.36, p=0.01) than rural children whose mothers are not in a polygynous marriage. Rural children whose mothers say they can decide to take

their child for care have 42% lower odds of being wasted (OR=0.58, p=0.08) compared to rural children whose mothers say they cannot. Compared to Model 1, the effect of father's individual level education remains nearly identical. Neither women's individual-level education nor community level education has an effect on wasting.

Model 3 assesses the mediating effect of socioeconomic status. The results confirm my fifth hypothesis: socioeconomic status, specifically household wealth, partially explains the relationship between individual-level education and children's odds of being wasted. That is, children who reside in households from the lower, second, and middle have higher odds of being wasted compared to children who reside in households from the fourth wealth quintile. Fathers' and mothers' occupation measures are not significant. Compared to Model 1, the effect of father's education is marginally weaker. Rural children whose fathers have completed primary school have 66% lower odds of being wasted (OR=0.34, p=0.09) compared to children whose fathers have no formal education. Rural children whose fathers have completed secondary school and higher are twice as likely to be wasted compared to children whose fathers have no formal education (OR=2.19, p=0.09).

Model 4 examines the mediating effect of women's reproductive behaviors measures. The results are line with hypothesis 6: women's reproductive behaviors partially explain the relationship between individual-level education and wasting. For example, rural children who live in a household with more than 1 child under the age of five are 32% less likely to be wasted (OR=0.68, p=0.02) compared to rural children who live in a household with only 1 child under the age of five. Relative to Model 1, all the education measures remain nearly identical.

Model 5 includes measures of media access and health knowledge. The results show that health knowledge partially explains the relationship between individual-level education and wasting. For example, rural children whose mothers know the benefit of Vitamin A are 1.6 times more likely to be wasted (OR=1.65, p=0.07) compared to mothers who do not know the benefit of Vitamin A. Additionally, rural children whose mothers know the benefit of ORT are 50% less likely to be wasted (OR=0.50, p=0.01) compared to rural children whose mothers do not know the benefit of ORT. Compared to Model 1, the education effects remain nearly identical.

Finally, Model 6 includes all the measures of education and all mediating factors. Overall, the results show that net of all mediating factors, fathers' individual-level education has an effect on children's wasting, though not in the expected direction. Rural children whose fathers have completed secondary school or higher are more than 2 times as likely to be wasted (OR= 2.63, p=0.06) compared to rural children whose fathers are not formally educated. Additionally, net of all mediators, women's marital status, ability to get care for children, household wealth, number of children under age 5 in household, knowledge of Vitamin A, and knowledge of ORT are significant. Some of the control variables – including higher mothers' BMI, female child sex, and large birth size – are associated with lower odds of being wasted.

4.5 DISCUSSION

Studies have analyzed the effects of individual and community-level education on children's nutritional outcomes in cities (Andrzejewski, Reed, and White 2009), yet no current studies have aimed to explore intra-rural differentials in children's nutritional outcomes and explore the pathways through which these effects could be operating. As previously stated, the aim of this dissertation was to analyze the relationship between

individual and community-level education and children's nutritional outcomes in the DRC and test to see whether this relationship varied by urban-rural residential location. Chapter 3 showed that urban children's nutritional outcomes are strongly associated with not only women's own education but also community-level education. Additionally, these results suggest that the educational differentials in urban children's nutritional outcomes narrow after controlling for measures of women's socioeconomic status, reproductive behaviors, and marital status. Overall Chapter 3 provided evidence for Mosley and Chen's conceptualization that women's education is a highly significant determinant of children's nutritional outcomes.

In Chapter 4, I used a nationally representative sample of rural Congolese children to investigate the relationships between individual-levels of women's and fathers' education and community-level education and children's odds of being nutritionally deficient. The three key findings from this analysis are:

1. Mothers' individual-level educational attainment is not associated with rural Congolese children's stunting or wasting outcomes.
2. Fathers' individual-level educational attainment is not associated with rural Congolese children's stunting but has a marginal effect on rural children's wasting outcomes.
3. Community-level education is not associated with rural Congolese children's stunting or wasting outcomes.

Overall, the results from Chapter 3 and 4 provide strong evidence not only showing that Congolese children's nutritional outcomes significantly vary by residential location, but also that different mechanisms are predicting children's nutritional outcomes, which has important implications for implementing health initiatives.

At first glance, the lack of an effect of mothers' education or a strong effect of fathers' education on rural children's nutritional outcomes suggests that education is not a significant predictor of rural children's nutrition. Yet it might not be that education has no effect on rural children's nutritional outcomes; instead, it might have a *delayed* effect. Recent studies theorize that the relationship between education and health outcomes might not be a direct one, but might be instead mediated by economic development (Baker et al. 2011). That is, the "educational-revolution" which saw the wide-scale spread of primary and secondary education in many developing countries *led* to modern development and not vice-versa. Modern development and economic growth therefore paved the way for increased life expectancy, rapid drops in fertility, and led to health and nutrition transitions. Yet across rural DRC, educational attainment levels are low: over 70% and 35% of women and men have less than six years of schooling, respectively. Less than 2% of rural households have piped water and less than 7% have a safe/clean toilet facility[13]. Therefore, the combination of low levels of educational attainment, low access to safe household resources, and poor sanitation provides a rational for the lack of an education-health link in the rural DRC. The lack of community-level education effect is also most likely due to the lack of educational expansion at the individual level.

To understand how individual and community-levels of women's education were associated with rural children's nutritional outcomes, I analyzed the mediating effects of women's autonomy, socioeconomic status, reproductive behaviors, media access, and health knowledge. Net of all mediating pathways, women's occupation, and household wealth had the strongest effect on children's nutritional outcomes. Specifically, mothers' employment in agriculture jobs lowered children's odds of being stunted. Interestingly,

[13] Data comes from the 2007 EDHS.

children residing in low wealth households had lower odds of being stunted compared to children from wealthier households. On the other hand, increases in household wealth lowered children's risk of being wasted. Being in a polygnyous marriage, household wealth, number of children under 5 years in the household, iron supplementation, and knowledge of vitamin A or ORT were associated with children's odds of being wasted.

4.6 LIMITATIONS

This study has several limitations. First, rural community-level education was not significant in any of the models, yet the variance components results showed that children's stunting and wasting vary across communities. It can be assumed that other unmeasured community factors –such as income, health knowledge, health access, political instability, or health status-- are responsible for the community-level variance. Therefore, though this study does not effectively assess the effect of community-level education, it opens up future potential research on the contribution that communities as a whole have on rural children's health and nutrition.

Second, though the link between formal education and children's nutritional outcomes is weak, this analysis does not control for women's overall knowledge or cognitive behaviors. That is, for many rural women who have limited formal education, their day-to-day knowledge about child rearing, market work, farming, cooking, etc., that they received outside of the educational system might influence children's nutritional outcomes above and beyond their education. Yet the 2007 EDS-RDC does not ask questions related to women's learned knowledge. Second, evidence has shown that exposure to school transforms how individuals think, reason, and solve problems which in turn increases their cognitive behavior (Baker et al. 2011). Therefore, an analysis that

includes measures women's overall knowledge outside of schooling would help to explain the relationship between education and health in a rural context.

4.7 CONCLUSION

Overall, these finding suggest that educational attainment, at both the individual and community-levels, is not positively associated with children's nutritional outcomes in rural DRC. The results also suggest that specific policies should be targeted at increasing the number of female children in rural DRC in schools.

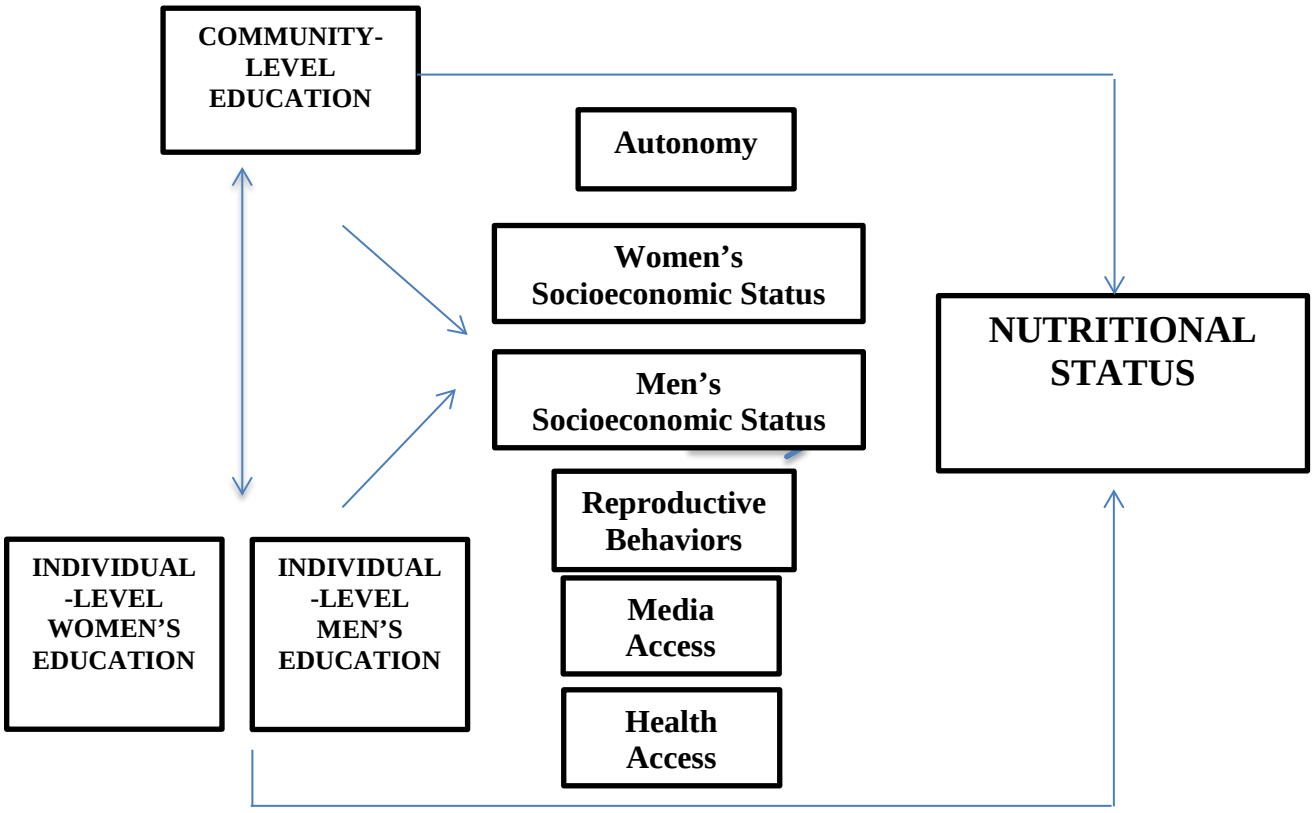

Figure 4.1: Conceptual Framework Illustrating the Relationship between Individual and Community-Level Education, Mediating Factors, and Rural Congolese Children's Nutritional Outcomes

Table 4.1: Demographic, Social, and Health Characteristics of Rural Mothers and Children Aged 7-59 Months in the Democratic Republic of the Congo, 2007

Child Stunted	47.40%
Child Wasted	9.30%
INDIVIDUAL-LEVEL VARIABLES	
Women's education level	
No formal education [1]	31.50%
Incomplete primary	41.90%
Completed primary	7.50%
Incomplete secondary and higher	19.10%
Father's education level	
No formal education [1]	11.70%
Incomplete primary	22.60%
Completed primary	9.20%
Incomplete secondary	42.90%
Completed secondary and higher	13.60%
Autonomy	
Autonomy index mean (0-5)	2.84
Polygynous	20.90%
Can decide to take child for medical care	82.30%
Socioeconomic Status	
Women's occupation	
No occupation [1]	12.90%
Manual+Professional	11.4%
Agriculture	75.70%
Father's occupation	
No occupation [1]	4.7%
Agriculture	15.4%
Manual	67.3%
Professional	12.6%
Household wealth index	
Lowest [1]	32.70%
Second	27.90%
Middle	26.40%
Fourth+Highest	13.00%
Reproductive behavior	
Number of children under age 5 in household (mean)	2.2

Table 4.1: continued

Took malaria medication during last pregnancy	15.2%
Took iron supplement during last pregnancy	25%
Media Access	
Listens to Radio	21.30%
Health Knowledge	
Knows benefits of Vitamin A	16.2%
Knows benefits of oral rehydration therapy	80.8%
Controls	
Mother's age (years) [2]	29.6
Mother's age squared [2]	930
Mother's BMI	
Underweight	16.0%
Normal	75%
Overweight+Obese	7.6%
Female child	52.3%
Child's age (months) [2]	31.6
Child's age squared (months) [2]	1225.3
Child's birth size	
Small [1]	8.5%
Average	35.4%
Large	56.1%
N (Individual Children)	1671
COMMUNITY-LEVEL VARIABLES	
Community-level of education	
Low average education community [1]	42.7
High average education community	57.3
N(Communities)	175

[1] Reference category
[2] Mean
Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)

Table 4.2: Multilevel Logistic Regressions Predicting Rural Congolese Children's Stunting Status, Focusing on Individual and Community-Level Education

	1 (OR)	2 (OR)	3 (OR)	4 (OR)	5 (OR)
INTERCEPT	0.89	0.90	0.88	0.89	0.89
LEVEL 2					
Community average level of education					
(Reference category is Low 0-<4)					
High (4+ years)				0.96	1.01
LEVEL 1 FIXED EFFECTS					
Women's education level					
(Reference category is no education)					
Incomplete primary		0.80			0.82
Completed primary		1.25			1.21
Incomplete secondary and higher		0.72			0.73
Father's education level					
(Reference category is no education)					
Incomplete primary			0.74		0.78
Completed primary			0.97		1.02
Incomplete secondary			0.93		0.99
Completed secondary and higher			0.76		0.84
Controls					
Mother's age		0.98	0.97	0.97	0.97
Mother's age (squared)		1.00	1.00	1.00	1.00
Mother's BMI					
(Reference category is underweight)					
Normal		1.8	1.05	1.08	1.06
Overweight and Obese		0.65	0.63	0.65	0.64
Female child		**0.66**	**0.66****	**0.66****	**0.65****
Child's age		**1.05**	**1.05+**	**1.05+**	**1.05+**
Child's age (squared)		1.00	1.00	1.00	1.00
Child's birth size					
(Reference category is small)					
Average		1.17	1.17	1.15	1.18
Large		0.94	0.91	0.90	0.95
Variance Component					
(random effects)					
INTERCEPT	**0.28*****	**0.33*****	**0.31*****	**0.32*****	**0.32*****
ICC	0.08				
log likelihood	-2.38	-1.16	-2.37	-2.37	-2.37
N=1,671					

Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)
*** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table 4.3: Multilevel Logistic Regressions Predicting Rural Congolese Children's Stunting, Focusing on Individual and Community-Level Education and Mediating Factors

	1 (OR)	2 (OR)	3 (OR)	4 (OR)	5 (OR)	6 (OR)
INTERCEPT	0.89	0.89	0.89	0.89	0.88	0.89
LEVEL 2						
Community-level education						
(Reference category is Low 0-<4)						
High (4+)	1.01	1.02	0.94	0.99	0.99	0.94
LEVEL 1 FIXED EFFECTS						
Women's education level						
(Reference category is no education)						
Incomplete primary	0.82	0.84	0.82	0.82	0.80	0.83
Completed primary	1.21	1.25	1.30	1.27	1.25	1.29
Incomplete secondary and higher	0.73	0.77	0.77	0.75	0.70	0.83
Fathers' education level						
(Reference category is no education)						
Incomplete primary	0.78	0.80	0.71	0.74	0.73	0.69
Completed primary	1.02	1.05	0.94	0.98	0.96	0.91
Incomplete secondary	0.99	1.03	0.96	0.95	0.92	**0.94+**
Completed secondary and higher	0.84	0.85	0.89	0.81	0.76	0.85
Autonomy						
Autonomy Index		1.09				1.09
Polygynous marriage		1.19				1.15
Can take child for care		1.22				1.15
Socioeconomic Status						
Women's Occupation						
(Reference category is no occupation)						
Manual +Professional			0.71			0.75
Agriculture			**0.61***			**0.64***
Father's Occupation						
(Reference category is no occupation)						
Manual			0.79			0.57
Agriculture			0.50			0.81

Table 4.3, continued

Professional			0.53			0.48
Household Wealth						
(Reference category is fourth)						
Lowest			**0.49***			**0.52***
Second			**0.51***			**0.55***
Middle			**0.64+**			0.68
Reproductive Behavior						
Number of children under age 5 in household				**1.22***		**1.21+**
Took malaria medication during last pregnancy				1.01		0.91
Took iron supplement during last pregnancy				0.99		0.95
Media Access						
Listens to radio					1.04	0.91
Health Knowledge						
Knows benefits of Vitamin A					1.05	1.09
Knows benefits of oral rehydration therapy					**1.61***	1.37
CONTROLS						
Mother's age	0.97	0.98	0.98	0.95	0.98	0.95
Mother's age (squared)	1.00	1.00	1.00	1.00	1.00	1.00
Mother's BMI						
(Reference category is underweight)						
Normal	1.10	1.02	1.04	1.06	1.07	1.02
Overweight and obese	0.67	0.62	0.61	0.61	0.62	0.57
Female child	**0.66****	**0.64*****	**0.65****	**0.64*****	**0.66****	**0.63****
Child's age	**1.05+**	**1.05+**	**1.05+**	**1.05+**	**1.05+**	**1.05***
Child's age (squared)	1.00	1.00	1.00	1.00	1.00	1.00
Child's birth size						
(Reference category is small)						
Average	1.17	1.17	1.14	1.20	1.15	1.12
Large	0.94	0.95	0.98	0.97	0.92	0.99
Variance Component (random effects)						
INTERCEPT	**0.33*****	**0.34*****	**0.28*****	**0.35*****	**0.31*****	**0.33*****
ICC	0.09					
log likelihood	-1.60	-2.37	-2.36	-2.37	-1.15	-2.36

Table 4.3, continued

N=1671; *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)

Table 4.4: Multilevel Logistic Regressions Predicting Rural Congolese Children's Wasting, Focusing on Individual and Community-Levels of Education

	1 (OR)	2 (OR)	3 (OR)	4 (OR)	5 (OR)	6 (OR)
INTERCEPT	**0.10*** **	**0.08*** **	**0.08*** **	**0.08*** **	**0.08*** **	**0.08*** **
LEVEL 2						
Community average level of education						
(Reference category is Low 0-<4)						
High (4+)					1.30	1.45
LEVEL 1 FIXED EFFECTS						
Women's education level						
(Reference category is no education)						
Incomplete primary		1.28		1.24		1.15
Completed primary		1.10		0.97		0.89
Incomplete secondary and higher		0.63		0.56		0.48
Father's education level						
(Reference category is no education)						
Incomplete primary			1.214	1.27		1.15
Completed primary			**0.32+**	**0.31+**		**0.31+**
Incomplete secondary			1.20	1.37		1.19
Completed secondary and higher			1.11	1.09		1.26
Controls						
Mother's age		1.09	1.07	1.09	1.07	1.00
Mother's age (squared)		1.00	1.00	1.00	1.00	1.00
Mother's BMI						
(Reference category is underweight)						
Normal		**0.61+**	**0.61+**	**0.62+**	0.64	0.64
Overweight and Obese		**0.24****	**0.24****	**0.23****	**0.25****	**0.25****
Female child		**0.60***	**0.62***	**0.61***	**0.61***	**0.60***
Child's age		1.00	1.00	0.99	0.99	1.00
Child's age (squared)		1.00	0.99	1.00	1.00	1.00
Child's birth size						
(Reference category is small)						
Average		0.62	0.62	0.62	0.63	0.61
Large		**0.42***	**0.40****	**0.41****	**0.41***	**0.41***
Variance Component						
(random effects)						
INTERCEPT	**0.48***	**0.36+**	0.32	0.29	**0.34+**	0.24
ICC	0.13					
log likelihood	-2.21	-2.63	-2.26	-2.26	-2.65	-2.26

Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)
N=1,671; *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Table 4.5: Multilevel Logistic Regressions Predicting Rural Congolese Children's Wasting, Focusing on Individual and Community-Levels of Education and Mediating Factors

	1 (OR)	2 (OR)	3 (OR)	4 (OR)	5 (OR)	6 (OR)
INTERCEPT	**0.08*** **	**0.07*** **	**0.07*** **	**0.07*** **	**0.08*** **	**0.06*** **
LEVEL 2						
Community average level of education						
(Reference category is Low 0-<4)						
High (4+)	1.45	1.34	1.34	1.46	1.44	1.24
LEVEL 1 FIXED EFFECTS						
Women's education level						
(Reference category is no education)						
Incomplete primary	1.15	1.15	1.24	1.13	1.15	1.14
Completed primary	0.89	0.89	0.91	0.87	0.87	0.86
Incomplete secondary and higher	0.48	0.45	0.51	0.45	0.47	0.41
Father's education level						
(Reference category is no education)						
Incomplete primary	1.15	1.04	1.19	1.28	1.22	1.20
Completed primary	**0.31+**	**0.29+**	**0.34+**	**0.32+**	**0.31+**	0.32
Incomplete secondary	1.19	1.10	1.38	1.33	1.30	1.49
Completed secondary and higher	1.26	1.42	**2.19+**	1.42	1.40	**2.63+**
Autonomy						
Autonomy Index		0.99				1.00
Polygynous Marriage		**0.36***				**0.38***
Can take child for care		**0.58+**				**0.60+**
Socioeconomic Status						
Women's Occupation						
(Reference category is no occupation)						
Manual +Professional			0.71			0.66
Agriculture			1.03			1.06

Table 4.5, continued

Father's Occupation						
(Reference category is no occupation)						
Manual			1.29			1.43
Agriculture			1.22			1.35
Professional			0.50			0.62
Household Wealth						
(Reference category is fourth+highest)						
Lowest			**2.32***			**2.15+**
Second			**2.21***			**2.05+**
Middle			**1.89+**			1.67
Reproductive Behavior						
Number of children under age 5 in household				**0.68***		**0.72***
Took malaria medication during last pregnancy				1.20		1.33
Took iron supplement during last pregnancy				0.70		0.59+
Media Access						
Listens to radio					1.17	1.27
Health Knowledge						
Knows benefits of Vitamin A					**1.65+**	**2.11***
Knows benefits of oral rehydration therapy					**0.50****	**0.62+**
CONTROLS						
Mother's age	1.00	1.12	1.06	1.14	1.09	1.16
Mother's age (squared)	1.00	1.00	1.00	1.00	1.00	1.00
Mother's BMI						
(Reference category is underweight)						
Normal	0.64	0.63	0.64	**0.63+**	**0.61+**	**0.60+**
Overweight and Obese	**0.25****	**0.22****	**0.22****	**0.26****	**0.24****	**0.22****
Female child	**0.60***	**0.60***	**0.59***	**0.62***	**0.60***	**0.62***
Child's age	1.00	0.99	1.00	0.99	1.00	1.00
Child's age (squared)	1.00	1.00	1.00	1.00	1.00	1.00

Table 4.5, continued

Child's birth size						
(Reference category is small)						
Average	0.61	0.64	0.68	0.61	0.62	0.72
Large	**0.41***	**0.43***	**0.43***	**0.39****	**0.41***	**0.42****
Variance Component (random effects)						
INTERCEPT	0.24	0.23	**0.25+**	0.25	0.18	0.17
ICC	0.08					
log likelihood	-2.26	-2.28	-2.53	-2.27	-2.30	-2.32

Source: 2007 Democratic Republic of the Congo Demographic and Health Survey (EDS-RDC)
N=1,671; *** p<0.001, ** p<0.01, * p<0.05, + p<0.10

Chapter 5

5.1 REVIEW

Since the initiation of the Millennium Development Goals (MDG) in 2000, many developing countries have made significant strides in reaching their country-specific poverty, education, gender equality, child mortality, maternal health, disease, environment, and development goals. Of great accomplishment has been the MDG #1 of reducing the proportion of people living on less than $1.25 a day, which fell from 47% in 1990 to 22% in 2010 (FAO 2013). Yet global reductions in the proportion of people who suffer from hunger have slowed down and remain especially high in Sub-Saharan Africa (SSA), where over 57% of children under 5 years of age are undernourished (FAO 2013). Additionally, global aims at meeting the target of universal primary education by 2015 are unlikely to be accomplished due to the high numbers of out-of-school boys and especially girls of primary school age. At the individual-level, increased poverty and health burdens not only hinders household members quality of life, but increases their risk of death, infectious diseases, and lowers the quality of care for children. At the population level, failed poverty and health programs have consequences for the availability of a healthy workforce, a young age structure, and a challenge for few but available resources. Therefore focusing on educational attainment as a way of reducing children's risk of early nutritional deprivation should be an urgent aim of health researchers.

As shown in this dissertation, previous work analyzing educational differences in children's nutritional outcomes have several limitations. First, most studies on the effects of education solely focus on how women's own education solely shapes and affects their own children directly: very few studies aggregate women's education to the community-

level. As a result, the education-health link is solely attributed to individual-level factors and not to larger community-level characteristics that can shape outcomes. Second, though most SSA residents dwell in rural areas, many African countries are experiencing rapid growth in cities, which is expected to not only affect the economic sector, but may also extend to population health outcomes. Yet research often fails to move beyond solely comparing urban to rural areas and compare communities within urban and rural areas. Many studies have shown that urban and rural livelihoods are complex and different and therefore need to be analyzed as two distinctly different regions.

This dissertation aimed to address these limitations and was shaped by my interest in how women's educational attainment at the individual and community levels affects Congolese children's risks of being nutritionally deficient. This research combined key parts of Mosley and Chen's (1984) proximate determinants framework and Link and Phelan's (1995) fundamental cause theory to explain the ways that women, as children's primary care-takers, use their educational attainment to prevent their children from becoming nutritionally deficient. As my analyses progressed, it become clear that any analysis of the effects of education on children's nutrition also needed to include community-context measurements. That is, communities shape our relationships, occupational opportunities, which schools we attend, healthcare access, etc. (Desai 1992; Panelli and Welch 2005). Communities may also affect the diffusion of education-related knowledge and resources, such that this knowledge and resources directly affect women's abilities to care for their children and lower their risk of poor nutrition.

5.2 KEY FINDINGS

The key findings from my analyses are:

Chapter 2

The descriptive analysis revealed that rural Congolese children are more likely to be stunted compared to urban children and that urban women are more higher educated than rural women, a finding that has been reported in previous studies (Fotso 2007; Smith, Ruel, and Ndiaye 2005). Yet within urban communities, children's nutrition percentages varied more than in rural communities. Specifically, the nutrition-gap between low and high educated communities was larger in urban communities than rural communities. Additionally, the highest percentage of nutritionally deficient Congolese children reside in low educated urban communities, most likely due to evidence found in previous studies showing that urban areas harbor pockets of extreme poverty and deprivation (Haddad, Ruel, and Garrett 1999; Menon, Ruel, and Morris 2000; Zere and McIntyre 2003). The individual "thick descriptions", enhanced the descriptions of women's and children's lives in the DRC. Specifically, analyzing individual women's lives and experiences showed not only how important educational attainment is for women, but also how critical community context is for women and children's livelihoods.

Chapter 3

Recent evidence has suggested a reversal in the "urban advantage" in health in many developing countries due to rapid urbanization, stagnant economic growth, and poor health infrastructures. Building off this, I analyzed the relationship between individual and community-levels of women's education and children's height-for-age (stunting) and weight-for-height (wasting) in urban communities in the DRC. In addition, I analyzed the mediating effects of women's autonomy, socioeconomic status,

reproductive behaviors, media access, and health knowledge. My results show that: (1) women's own education is associated with urban children's lower risks of nutritional deficiencies; (2) higher education of other female community members is associated with more favorable urban children's nutritional outcomes; and (3) the association between education and health narrows after taking into account women's socioeconomic status. These results are similar to previous literature showing an effect of women's education on child health and nutrition outcomes only at the higher levels of educational attainment (Ainsworth-Darnell and Downey 1998; Harttgen, Klasen, and Vollmer 2013; Willey et al. 2009). Yet few studies have analyzed the individual and community-level effects of education on children's nutritional outcomes in SSA and no studies to date have analyzed these relationships in the DRC, despite its growing urban population and large number of nutritionally deficient children. Therefore this analysis advances the literature by moving beyond an individual-level understanding of the determinants of children's nutritional outcomes by incorporating community-level context to show that communities matter for improving children's nutritional outcomes in SSA.

Chapter 4

In Chapter 3, education at the individual and community-levels were important for urban children's nutritional outcomes; yet it has remained unclear whether multiple levels of women's educational attainment are associated with rural children's nutritional outcomes. Therefore I analyzed the relationship between individual and community-levels of mothers' and fathers' education and children's height-for-age (stunting) and weight-for-height (wasting) in rural communities in the DRC. In addition, I analyzed the mediating effects of women's autonomy, socioeconomic status, reproductive behaviors,

media access, and health knowledge. My results show that: (1) rural estimates of children's nutritional outcomes in the DRC are not only higher than urban estimates but also rank as some the highest across SSA; (2) individual-levels mothers' education has no effect on rural Congolese children's nutritional outcomes; (2) fathers' education has a marginal and weak association with rural Congolese children's nutritional outcomes; and (3) community-level education has no effect on rural Congolese children's nutritional outcomes. Though these results do not provide evidence for the claim that education is the key to improving children's health and survival in developing countries (Caldwell 1994), the results do suggest a need for further research on how educational investments are related to nutritional outcomes.

5.3 LIMITATIONS

The analyses in this dissertation are not without several limitations which might alter or even challenge the results. First, I only use two outcomes (stunting and wasting) from one dataset (2007 EDHS) to analyze children's nutritional status. Each of these indicators measures anthropometric growth but does not take into account the quality of children's diets. A better analysis of children's nutritional status would also include measures of children's dietary diversity to capture the quality of children's nutrition. Second, based off of previous work, I operationalize communities using data on clusters from the 2007 EDHS GIS data file. Yet, women in the survey are not asked their level of interaction or communication with other women in their geographic location. Therefore, framing clusters as actual culturally and socially defined communities is not completely accurate. Third, this analysis does not include information on additional community

context variables including health, agriculture and vegetation, health care, political instability, or mean income. Some of these factors might be important predictors of children's nutritional outcomes, but could not be included in this analysis due to data limitations. Therefore, the DHS does not provide adequate social network or social processes measurements, so the results showing an effect of community-level education should be interpreted cautiously. Finally, this analysis fails to take into account the effect of migration. That is, women with high levels of education might have more resources that allow them to move to communities with better resources. Therefore, the effect of community-context might actually be mediating the effect of access to individual-level resources and not the other way around.

5.4 POLICY

Overall the results of these analyses suggest that certain policies and programs usually targeted at alleviating food insecurity and undernourishment in rural areas, should also be geared at improving children's nutritional outcomes in urban communities, in light of growing evidence of rapidly declining living standards in SSA cities. Yet to successfully accomplish this, surveys including the MICS, DHS, and nationally representative censuses, should move beyond urban and rural dichotomies and aim to better capture the livelihoods and outcomes of women and children living in numerous informal and illegal settlements and slum areas that cannot be clearly labeled as urban or rural. Additionally, the results shows that advancements in maternal education are likely to have a positive influence on children's growth during their early years. Therefore SSA governments --many that are not going to meet the MDG 2015 deadline for increasing primary school enrollment—need to reinvigorate their investments in ensuring that female children are receiving appropriate formal education.

5.5 FUTURE RESEARCH

My future research will primarily build off my dissertation as I will continue to pursue a research agenda that aims to answer this fundamental question: to what extent and how does community-context matter for children's health and nutrition outcomes in SSA? Expanding this research is very important for showing how to eliminate large disparities in children's health across SSA. Specifically, while increasing women's educational attainment past secondary school as a means of improving children's health and nutrition has been the focus of researchers and policy makers, I believe that current approaches fail to consider multi-level socioeconomic effects. Therefore, I plan to continue to advance a community-context framework for researching determinants of children's health and nutrition, making sure early childhood health analyses are rooted in a rich understanding of the community characteristics that children are exposed to during their early critical years. Furthermore, my dissertation has shown that educational attainment at the community-level is important for shaping urban Congolese children's nutritional outcomes. As described in previous chapters, the community-context literature on health outcomes has mainly focused on establishing links between community-level education and health behaviors. Yet, that country-specific MDG in SSA, targeted at lowering childhood undernourishment are not being met reflects the need for community-context to be taken as an important factor in reducing African children's risk of mortality and morbidity. Therefore, taking a more accurate account of women and children's "exposure" to community-level factors is essential for understanding current and future health and nutrition transitions in SSA.

In terms of specific questions about community-context and child health outcomes n SSA, I plan on focusing on two main research projects. The first focuses on the relationship between community-context and children's nutritional outcomes across Central SSA. As one of the continent's poorest regions, Central SSA has been plagued by political instability, slow economic growth, overcrowding in cities, high infant mortality rates, and high percentages of severely malnourished children. Additionally, few Central SSA countries are expected to reach their country-specific MDG #4 of reducing child mortality rates by 2/3. I am interested in doing cross-country child nutrition comparisons and assessing the extent to which community-context has shaped nutrition outcomes. Second, I am interested in how low educated women use their health and general knowledge-base to affect children's growth in their first five years. Evidence has shown that women's health knowledge is related to improvements in children's nutrition net of educational attainment. Additionally, my dissertation results show that women's educational attainment is not related to rural children's nutritional outcomes. Therefore I am interested in expanding on these results to research how low-educated women protect their children against undernourishment beyond their few years of schooling and occupation.

Appendix

The education system in the DRC is closely modeled to the three stage schooling system used across European countries: primary, secondary, and tertiary schooling. In the DRC, compulsory education or primary school is for six years between the ages of 6-11 years. The primary education stage is divided into 3 stages of two years each. Students are awarded a certificate once primary school is completed(Depreeuw 2007) .

Upon advancing into secondary school, students must decide to either progress through a long or short cycle. The long cycle first introduces students to general subjects in the first two years and advanced classes in the last four years. The short route trains student for vocational or technical occupations. Receiving a vocational based education lasts about 4 years. The secondary school stage corresponds to children between the ages of 12-17 years.

After completing secondary school, only students from the long route are allowed to gain entrance into tertiary schools. This higher education consists of three years of undergraduate and two years of postgraduate.

The access and quality of education in the DRC varies. First, access to education is difficult. As previously discussed in Chapter 2, most schools are located in urban areas, which are not accessible to rural children. In addition, the high costs and low benefits of attending secondary school for poor children means that many of them drop out during the primary education stage. In many cases, parents are forced to pay for their children's school fees at the school gates before children can enter the school compound: those unable to pay are turned away and many cases, sit out a full academic year until all fees are paid (Mokonzi and Kadongo 2010). Second, the quality of education in the DRC is low due to language barriers, poor teacher-training, and lack of supplies. During primary

school, courses can be taught in any language. Starting in secondary school, all courses are taught in French, which makes it difficult for children who have not mastered French (Depreeuw 2007). In addition, the majority of teachers have only received a secondary school education and have not taken completed their courses at teacher-training institutions (Mokonzi and Kadongo 2010). Many teachers also lack basic resources for their students to use: there are few textbooks and the only materials used are blackboards and chalk. Finally, the technical and vocational cycles do not provide students with knowledge and skills that can be used especially in the rural and informal labor market. Overall, the education system in the DRC suffers from low primary school completion, few useful alternative education cycles, limited school resources, and unqualified teachers (Depreeuw 2007).

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