EXPLORING MODELS OF ECONOMIC INEQUALITY AND THE
IMPACT ON MENTAL AND PHYSICAL HEALTH OUTCOMES
IN RURAL EASTERN PROVINCE, ZAMBIA

by

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DEDICATION

I dedicate this dissertation to my family members living in the United States and Zambia, who all sacrificed something to make the completion of this dissertation possible. I especially dedicate the dissertation to my mother and father, my two sisters, my daughters Dorothy and Emily, my son Mulenga, and to my wife, Nsamwa, who supported me without fail throughout the entire dissertation process.

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ABSTRACT

Structural adjustment measures adopted during the early 1990s considerably altered the rural landscape throughout Zambia. Households responded and continue to respond in a variety of ways, although many do so under highly inequitable terms. Poverty rates, food insecurity, and income inequality all remain unacceptably high in Zambia, particularly in rural areas. Using a biocultural and livelihoods approach, this alternate "publication in scholarly journals" format dissertation examines some of the complexities that condition livelihoods and differentially shape biologies in rural Zambia today. Three main problems are explored: 1) the relationship between food insecurity and adult mental health; 2) piecework (casual labor) as a coping strategy and indicator of household vulnerability to food insecurity; and 3) the association between relative deprivation and adult physical health. Research for the dissertation took place in a rural area in Eastern Province, Zambia in 2009. The research employed a mixed methodology, collecting qualitative and household-level survey data during the rainy and dry season. Various statistical analyses were utilized in the three papers appended to the dissertation. The results were further explored using the findings from the qualitative data.

In paper one, a positive relationship between food insecurity and poor mental health was found. Food insecurity during the dry season had a greater effect on mental health than in the rainy season. In paper two, the results demonstrate the importance of piecework labor as a coping strategy and the need to adopt a multi-period lens to robustly assess

whether participation in piecework reflects a household's vulnerability to food insecurity. In the third paper, a negative association was established between relative deprivation and adult nutritional status. Together, the results from the dissertation provide clear evidence that both the material and relative circumstances of people play important roles in patterning variation in mental and physical health outcomes in rural Zambia.

CHAPTER ONE: INTRODUCTION

"Life is very hard and unkind. There are few days of happiness"
Mr. Sakala (village elder age 73), March 14, 2009

1.1 Introduction to the Dissertation

The quote above comes from a village elder named Mr. Sakala. I first met Mr. Sakala in 2001 when serving as a volunteer in Zambia. Our friendship strengthened when I returned to conduct my dissertation research in a rural area he calls home, Chiyembekezo. Chiyembekezo is situated roughly 22 kilometers from the small town of Katete in Eastern Province, Zambia. Mr. Sakala uttered these words during the rainy/cultivation season in 2009, shortly after hearing that his 2-year-old grand daughter, Hope, passed away. She had malaria starting some five days prior to her death. Hope's mother and uncle made trips to the local rural health center to acquire anti-malarials, but were informed that supplies had not yet arrived and to come back the following day. Hope's condition worsened on day four, and along with her five-year-old cousin, was referred and taken to Saint Francis Hospital in Katete for further attention. It was feared that Hope's cousin had malaria, and so her parents also took advantage of the free transport provided by a non-government organization working in Chiyembekezo that day.

The story touches on more than just poor access to adequate health care. The families of both children continued to attend to their agricultural fields each day during the course of their children's sicknesses. The two families are without a doubt the poorest households in their village. Farming is their primary source of food and cash, and neglecting their fields would have resulted in poorer yields come harvest season.

They both own no cattle to help with cultivating and are incapable of purchasing fertilizer to improve their yields. They supply their casual labor (piecework) in other people's fields as a means of addressing food and cash shortages during the rainy season.

After Hope died at the hospital in Katete, her body was escorted back to the village using a taxi. The driver of the taxi inflated the usual price by twenty-five percent because there was a deceased body in his vehicle. Hope's mother, a 41-year-old divorcee, had no cash to pay the driver and was assisted by one of her brothers who offered one of his goats as payment. Women in the village began weeping loudly upon their arrival, a sound that remains rooted in my memory still today. The men in the village had already prepared the coffin and spread word of Hope's death to other villages throughout Chiyembekezo by the time Hope's body arrived. After various meetings that involved conversations mostly about food and other expenses, the funeral was soon to start. Its proceedings, however, were disturbed by a cell phone call notifying everyone that Hope's cousin who remained in Katete had just passed away.

The people of Chiyembekezo, a rather small community of sixteen villages, are not so different from those living in other rural areas of Zambia. Their lives are unmistakably hard, unkind, and at times, filled with little joy. National-level agricultural and health policies largely dictate the (lack of) opportunities available within their locale. Households respond in their own unique ways of course, yet many do so under highly inequitable conditions. Consequently, the biologies of people living, working, and interacting in Chiyembekezo are differentially shaped (Krieger 2001; Dufour 2006). Some escape the grips of malaria, diarrhea, and malnutrition given their households'

sufficient access to bed nets, cash, safe drinking water, and nutritious foods. This requires, in part, adequate land to farm on using inputs such as draught power (oxen), fertilizers, hybrid seed, and a healthy labor force. Devoid of these resources, tired old land receives the same attention year after year from bodies equipped with a meager hand hoe and might, fueled above all by pangs of hunger.

In this dissertation I explore some of the conditions and complexities influencing livelihoods and biologies in rural Zambia today. The dissertation employs a mixed methodology by combining qualitative and household-level survey data collected in Chiyembekezo during the rainy and dry season in 2009. Two main theoretical perspectives were used to help structure the dissertation's study design and organize the analytical analyses and writing of each paper included in this alternate "publication in scholarly journals" format dissertation.

This introductory chapter describes the unique contribution the dissertation makes to the field of anthropology. In the first main section I present the theoretical perspectives responsible for guiding the dissertation, which is followed by relevant background information on Zambia including a historically informed sub-section that aims to illustrate how various "upstream" factors changed the context in which rural households carry out their livelihoods today. I then provide a broad literature review of the problem explored in each of the papers included in this dissertation. I end with a short explanation of the dissertation format.

1.2 Explanation of the Problem and Its Context

In this section the two main theoretical perspectives used to help guide the dissertation are provided, specifically the biocultural and livelihoods approaches. The biocultural model I employ draws heavily on theories from biological anthropology, political economy/ecology, and social epidemiology. Scholars within the international development literature typically adopt the livelihoods approach used. Their fusion was not by accident. My training in health/nutrition, agricultural economics, and biological/applied anthropology heavily influenced my decision to utilize the perspectives. By blending these two approaches we are better able to understand the many complexities that condition rural livelihoods and differentially shape biologies in Zambia today (Crooks et al. 2007).

1.2.1 A Biocultural Approach

A biocultural approach to understanding variation in biological outcomes is rather unique in that it recognizes the interplay between "humans as biological beings and the social, cultural, and physical environments" in which they live (Dufour 2006: 1). The approach utilizes a combination of theoretical threads from both within and outside the discipline of anthropology. Certain scholars influenced the biocultural model that is predominately used in biological, and to some extent, medical anthropology today (e.g., see Leatherman 1996; Leatherman and Goodman 1997; authors within Goodman and Leatherman 1998). Their framing of a biocultural approach undoubtedly structures the ways I conceptualize human adaptability, broadly defined here as the ability of humans to

adapt within their changing environments (Little 1995). The use of a biocultural approach to understanding variation in biological outcomes provides one tool to conduct informed research in Zambia, where causes of poor health appear blurred given the perverse levels of poverty and inequality that exists in rural areas.

A biocultural approach often utilizes perspectives from both political economy/ecology and human adaptability, and emphasizes the links between social inequalities and patterns of biological variation (Goodman and Leatherman 1998; Roseberry 1998). How larger processes at the global and national levels profoundly alter the social and material milieus of those living at the local are of particular concern (Smith and Thomas 1998). Labels such as "biology of poverty" (Thomas 1998) and "political-ecology of human biology" (Leatherman and Thomas 2001) are used to describe the relationship between the global and the local (see Leatherman 2005). A biocultural approach takes into account the historical contextual factors (e.g., policy changes) that structure social relationships, environmental use, and health outcomes (Thomas 1998). This historically situated, political-economic approach to understanding patterns of biological variation underscores the point made by Levins and Lewontin (1985), that the individual actively responds to and shapes their "spaces of vulnerability" (see Watts and Bohle 1993; also Leatherman 2005), and cannot be regarded "as a passive adjuster to environmental conditions [the individual] cannot really control" (Smith and Thomas 1998: 461). Thus, variation in human biological outcomes must not be tainted by slogans of "failure to adapt" but rather requires an in-depth examination of the processes that pattern such variation.

Scholars regularly put forward modifications to the biocultural model. While the political-economic circumstances of people's lives are an extremely important part of the "inequalities in health" equation, psychosocial stress plays a significant role in patterning variation in biological outcomes (Dressler et al. 2005; Pike and Williams 2006; see also Pike et al. 2010). Krieger (2001) integrated two social epidemiology frameworks for understanding inequalities in health. These include the psychosocial and the social production of disease models. The psychosocial model is concerned with the effects of the social environment, comprised of "psychosocial factors" (e.g., social disorganization, rapid social change, dominance hierarchies), on human biology (Cassel 1976 as cited in Krieger 2001: 669). The model uses concepts of psychosocial stress defined here as "a broad class of actions, real or imagined, which are *perceived* as threatening" (Thomas 1998: 52, emphasis mine). Psychosocial events disturb neuroendocrine function, which can become detrimental to health if prolonged over a period of time (see McEwen and Wingfield 2003). The psychosocial model, however, pays relatively little attention to who and what creates psychosocial stress, and does not attempt to assess how variation in psychosocial stress is patterned by social, political, and economic factors (Kreiger 2001). The social production of disease model (akin to the political economy model described above) tackles these issues by looking at the larger structural or "upstream" processes that shape and perpetuate social and economic inequalities. These inequalities are the fundamental or root causes of differences in health.

When these two models are combined we arrive at what Krieger (2001) calls an ecosocial perspective, which recognizes that health/disease is socially produced and is

guided by the following question: "Who and what drives current and changing patterns of social inequalities in health" (Krieger 2001: 672)? The major concept used within this model is embodiment (see also Krieger 2005). Embodiment refers to how people assimilate, biologically, the social and material worlds in which they live (Krieger 2001). The concept of embodiment is useful because it provides an understanding of how culture "gets inside" an individual (Hruschka et al. 2005), rather than assuming a Cartesian dualism that treats the mind and body as separate entities (Scheper-Hughes and Lock 1987).

Such a proposed modification to the biocultural model is not intended to marginalize the political-economic experiences of people's lives, although, by incorporating "…psychosocial experiences into broader materialist frameworks…a more nuanced perspective on human adaptability…" is permissible (Pike and Williams 2006: 729). There is no doubt that, as Goodman et al. (1988) state, multiple stressors— including those that are perceived—are generated by larger, structural processes. However, each person interprets her or his surroundings or position within their community, group, or household differently. Some feel in control and optimistic, while others feel "sick with thoughts" and hopeless. These emotional experiences impact how people respond to and shape the contexts in which they reside (Pike and Williams 2006).

Embodied emotions are the link between physical states and lived experience (Worthman 1999: 42; see also Scheper-Hughes and Lock 1987). Emotions can be considered "transitory adjustment reactions that function to return the [individual] to a stable, effective relationship with [their] environment when that relationship is disrupted"

(Plutchik 1997 as cited in Gallo and Matthews 1999: 227). Although emotions can assist the individual by restoring homeostatic balance, and thus are adaptive responses from an evolutionary perspective, they too can become pathogenic if experienced regularly, over long periods of time (Gallo and Matthews 1999). Psychosocial experiences can have real biological consequences in other words, and play a role in patterning variation in health. Accordingly, this dissertation incorporates both the psychosocial and political-economic experiences that structure inequalities in health in rural Zambia.

1.2.2 A Livelihoods Approach

Long (1997) explained that the livelihoods concept "best expresses the idea of individuals or groups striving to make a living, attempting to meet their various consumption and economic necessities, coping with uncertainties, responding to new opportunities, and choosing between different value positions" (as quoted in de Haan and Zoomers 2005: 32). Bebbington (1999: 2021) conceptualized rural livelihoods as being "the diverse ways in which people make a living and build their worlds." Material well-being is important, however, (and as these two scholars noted) there is more to livelihoods than just income (Lipton and Maxwell 1992).

One way of understanding the complexities surrounding the ways people navigate within their social and material environments is through the use of a livelihoods approach (e.g., Scoones 1998; Bebbington 1999; Ellis 1998, 2000; Whitehead 2002). A livelihoods approach aims to understand the links between social inequalities and the distribution of assets at the local level. The approach adopts an actor-oriented

perspective that highlights how people are able to survive in the face of inequity (de Haan and Zoomers 2005).

Many people in rural (and urban) areas of developing countries especially, broaden their livelihoods as a means to survive and better their conditions by constructing "…a diverse portfolio of activities and social support capabilities" (Ellis 1998: 4). Rural portfolios comprise of farm, off-farm, and/or non-farm activities that can enable people to secure a diversity of resources important to their livelihoods. When people in rural areas of developing countries lack access to agricultural inputs, nutrient-rich land, and labor that are necessary to produce such resources, their well-being can be jeopardized. Vulnerability to livelihood insecurity is even more pronounced when portfolios comprise of only one activity or income source, and thus by diversifying, people can decrease their likelihood of becoming vulnerable and increase resiliency (Ellis 1998).

While useful, one major critique of the livelihoods approach is that it fails to fully consider the impact that power relations have on people's ability to access livelihood opportunities (de Haan and Zoomer, 2005). The capacity to respond effectively to environments depends on people's access to a wide variety of assets and activities that are often constrained by larger political-economic processes (Ellis 2000; see also Crooks et al. 2007). The use of a livelihoods approach must therefore address not only the responses to or consequences of food insecurity, for example, but also the larger structural issues of poverty and inequality that limit people's abilities to respond during food shortages.

This dissertation draws on these two perspectives to gain a better understanding of how contexts matter, how they are molded by larger political-economic forces, how people might assimilate the diverse and ever-changing worlds they live in, and how livelihoods and biologies are impacted in different ways in rural Zambia by such experiences.

1.2.3 General background on Zambia

Zambia is a land-locked country, sharing boundaries with Tanzania and the Democratic Republic of Congo in the north, Botswana and Zimbabwe in the south, Malawi and Mozambique in the east, Angola in the west and Namibia in the southwest. Zambia is located between 20 and 35 degrees east longitude and 8 and 18 degrees south latitude. The land area in Zambia covers 752,612 square kilometers (roughly the size of Texas).

Bantu-speaking horticulturalists began occupying present-day Zambia sometime in the1500s. The British South Africa Company administered sections of land in the late nineteenth century of what eventually became Northern Rhodesia. The British Colonial Office took over responsibilities in 1924. Northern and Southern Rhodesia (present-day Zimbabwe) combined with Nyasaland (present-day Malawi) in 1953 to form the Central African Federation of Rhodesia and Nyasaland. The Federation was split in 1963 and soon thereafter Zambia gained political independence from Britain in October of 1964. Originally, Zambia adopted a multi-party system of government. In 1972 it changed to a single-party system and then back to a multi-party system in 1991.

There are nine provinces in Zambia. Two provinces are regarded as "urban" (Lusaka and Copperbelt Provinces) and the others predominately "rural." The economy of Zambia is "mixed," with an urban sector that is geographically located along the "line-of-rail" from Southern Province up into Copperbelt Province, and an agricultural sector that comprises mostly the rural population. The mining sector (specifically copper) dominates as Zambia's main source of export earnings. More recently there was a push to diversify in Zambia, which meant tapping into the strong potential of the agricultural sector. Nonetheless, copper mining continues today as the main economic thrust in Zambia and is responsible for the recent sustained economic growth (Negi 2011).

The climate and vegetation in Zambia is tropical. There are three very distinct seasons in Zambia. During the rainy season (November to April) it is relatively warm in Zambia. It is cool and dry during the winter season (May to August) and very hot and dry during the months of September and October.

1.2.4 The rural agricultural "climate"

Agricultural and ecological conditions heavily influence crop and livestock patterns in Zambia, although as is thoroughly reviewed below, political-economic factors played and continue to play a significant role as well. There are 3 major agro-ecological zones in Zambia (see Siegel and Alwang 2005: 37). Parts of Western and Southern Provinces comprise Region I, where the least amount of rainfall in Zambia occurs. Provinces situated in Region II are most ideal for agricultural production because of the adequate rainfall they receive, good soil conditions, and their proximity to urban

centers/markets and the line-of-rail. Commercial farmers in this region are located near the rail line, while small-scale farmers cultivate in more remote areas under less favorable conditions. The areas in Region II include most of Central, Eastern, Lusaka, and Southern Provinces. Northern, Luapula, Copperbelt, and Northwestern Provinces structure Region III, which is a major cassava producing area since maize production is relatively restricted due to high rainfall levels.

Households in rural Zambia tend to adopt an agricultural production strategy that can be characterized as "low-input/low-return" (Siegel and Alwang 2005) since the vast majority use hand hoes or draught power (oxen), incorporate minimal inputs into their crop production (e.g., fertilizer or hybrid seed), and produce relatively low yields as a result. Rural households cultivate the bulk of their agricultural produce under uni-modal rain-fed conditions. Crops such as maize, millet, sorghum, roots and tubers (e.g., cassava and sweet potatoes), and groundnuts are grown during the rainy season on less than 5 hectares of land (2 hectares using hand hoes and 4 hectares using draught power) and typically for own consumption (Siegel and Alwang 2005).

Rural infrastructure and transportation costs create considerable challenges to households living in more remote areas of Zambia. Zambia is landlocked with no direct easy access to ports in Tanzania, Mozambique, or South Africa, for example. Roads throughout rural areas are in poor condition and households are widely dispersed throughout the country. These factors converge to make the cost of distributing inputs and marketing agricultural produce in Zambia extremely expensive (Copestake 1997; GRZ 2002; Mwape 2004). Private traders generally focus their efforts in areas along the

line-of-rail and main roads. People living in more remote rural areas tend to either get excluded or exploited given their isolation. This all translates into incredible uncertainty for farmers concerning agricultural markets and leads to excessive transaction costs. Furthermore, it makes Zambia uncompetitive in international commodity markets (Siegel and Alwang 2005).

Medium- and large-scale farmers, on the other hand, have greater access to input and output markets and operate under better conditions infrastructure wise in Zambia. These types of farmers cultivate on title-to-lease state land. Most rural households cultivate instead on customary land allocated by headmen/chiefs. It is argued that increasing access to land would benefit small-scale farmers very little given that labor constraints ultimately prohibit most from expanding, unless access to cheap labor was also available (Siegel and Alwang 2005).

Labor markets are incredibly complex in rural Zambia and in sub-Saharan Africa in general (Fafchamps 1997), yet are highly predictable in some ways. The demand for labor is highest in rural Zambia during the rainy/cultivation season, which roughly coincides with the "hungry" season (or the time of year when households experience shortfalls in maize supplies). This means that plenty of short-term, casual labor (piecework) is available to better-off households to address their extra-domestic labor needs and that opportunities exist for poorer households to secure food or cash using their piecework labor. Devereux (2009: 12) argued that piecework (in Malawi) reflects "a failure of rural labor markets" since own-farm production can be severely neglected when

households use piecework as the predominate strategy to avoid hunger during the rainy/cultivation season.

This brief review provides a "snapshot" of current conditions households face as they attempt to carry out their main livelihood activity, farming, in rural Zambia. It falls short in one important way, however, in that it fails to account for the historically embedded, political-economic processes that undoubtedly shaped such circumstances. In the sub-section that follows, I provide a glance back at the various policies that influenced rural livelihoods in general in Zambia, paying particular attention to the reforms that impacted farming practices in rural areas. Changes since Independence have altered the rural landscape throughout Zambia. Most notably are the neo-liberal economic reforms that took place in the late 1980s and early 1990s. Guy Scott (2002), now the Vice President of Zambia, argued that households in rural areas benefited little from structural adjustment measures adopted in Zambia during this period (see also Geisler 1992; Jayne et al. 1999; Milimo et al. 2000; Evans 2001).

1.2.5 Historical underpinnings

The Zambian government implemented a number of structural adjustment measures since the late 1970s (Hanjra and Culas 2011). After Independence in 1964, the Government initially espoused market economy policies that privileged mining and urban Zambia. These policies were eventually deserted and state control dominated from the early 1970s to mid 1980s. Copper mines were nationalized and state-owned enterprises were expanded. The agricultural sector was of secondary importance as a source of

export exchange (Kydd 1988). Fixed consumer prices, regulatory policies, and producer subsidies were all instituted. Price controls essentially protected the welfare of the urban consumer, while negatively impacted investments that would have otherwise benefited national development such as improving infrastructure (Kydd 1988). Maize production was a focus, however, given that its role in the Zambian diet was (and is still today) paramount. Pan-territorial and pan-seasonal pricing were adopted to ensure that maize remained inexpensive. The promotion of other crops for which Zambia had a comparative advantage was mostly ignored.

In 1974 the Zambian national Gini coefficient (a measure of income inequality) was 0.59. This was a rather large increase from the pre-Independence figure of 0.48 (McCulloch et al. 2000). Little growth was achieved during the decade or so after Independence due in part to collapsing world copper prices, and in the late 1970s Zambia initiated the first of many structural adjustment measures. Food and agricultural subsidies that benefited both producers and consumers were considerably reduced. Agriculture became a major focus, an attempt by the Zambian government to expand its exports (Kydd 1988).

Starting from around the mid 1980s, Zambia implemented its second round of adjustment programs. The Zambian government was keen to diversify agricultural production and rectify price distortions (Thurlow and Wobst 2004; Siegel and Alwang 2005). Growing public criticism in urban areas due to price increases in maize/maize-meal set in motion a new wave of reforms that resembled past government controls of the economy (Kydd 1988). The production of cheap maize once more dominated

agricultural policy. By the late 1980s the third structural adjustment measures were introduced. Price controls on consumer goods were initially lifted excluding maize and fertilizer. Such policies were reversed due to pressures from the urban populace (Hanjra and Culas 2011), which ultimately thwarted rural development and agricultural diversification as well as increased poverty and inequality in Zambia on the whole (Thurlow and Wobst 2004; Siegel and Alwang 2005; World Bank 2008).

The fourth structural adjustment measures started in 1991. Numerous reforms were instituted including exchange rate liberalization, tax reforms, the induction of health and education user fees, privatization of government assets, public sector changes, and important agricultural reforms that removed food subsidies and reduced Government's involvement in input and output markets (see White 1997; Hanjra and Culas 2011). The private sector began to play a role in providing inputs and purchasing outputs. Agricultural production in the country shifted away from maize given the removal of input, credit, and processed maize (maize-meal) subsidies. Unsurprisingly, from 1990/91 to 1996/97 the area under maize cultivation dropped by 23% (International Monetary Fund 1999, as cited in McCulloch et al. 2000). The area under cultivation of other agricultural crops increased dramatically (e.g., groundnuts and cotton). Keyser (1996) argued that such changes in agricultural policies influenced agricultural production in the country in a way that reflected Zambia's comparative advantage.

Nonetheless, poverty increased substantially during the initial stage of neo-liberal economic reforms, and declined slightly thereafter (Thurlow and Wobst 2004; Siegel and Alwang 2005; World Bank 2008, 2009). Many households in rural areas were unable to

access credit and inputs and market their agricultural produce effectively (see Drinkwater et al. 1996; Francis et al. 1997). Moreover, the private sector's ability to fill the gap left by the Zambian government's reduced involvement in procuring input and marketing services was marginal. During the 1990s fertilizer prices increased dramatically, and as one would expect, the use of fertilizer dropped (GRZ 2002). From 1991 to 1996 rural inequality decreased yet climbed from 1996 to 1998 given an increase in growth in rural areas (McCulloch et al. 2000). Agricultural policies initiated during neo-liberal economic reforms in the early 1990s impacted rural smallholders in Zambia in very different ways. Those with access to key agricultural inputs, credit, and marketing services were the main beneficiaries of such change, partially explaining the more recent increase in levels of inequality in rural Zambia (McCulloch et al. 2000).

Poverty reduction initiatives in Zambia tend to center on increasing incomes in rural areas via agriculture (Siegel and Alwang 2005). In the early 2000s the Zambian government began providing maize and fertilizer subsidies once again. Such government programs were characteristic of poor loan recoveries, lacking transparency, and favoring local elites (Jayne et al. 2002, 2003). Private sector's distribution of commercial fertilizer was relatively ineffectual (Govereh et al. 2002) and fertilizer consumption declined on the whole (Jayne et al. 2003). Past governments instituted a number of other social and economic programs including the Poverty Reduction Strategy Plan and the Transitional National Development Plan from 2002-2005.

Other notable, past policy changes include those related to population growth control and health care. The National Population Policy was accepted in 1989, with the

aim of achieving steady population and economic growth (Zambia DHS 2009). The policy was revised in 2007 in order to address a number of key issues within Zambia including family planning, reducing fertility, morbidity, and mortality rates, improving sexual and reproductive health and HIV/AIDS-related issues, and maintaining a more even distribution of people living in rural and urban areas (Zambia DHS 2009). Health care policy in Zambia was re-formulated in the 1990s to enable better access to basic health care services. A lack of available government resources and capabilities put in motion reforms again in the early 2000s. Prioritizing was a key component of the reforms that were also initiated to help attain the Millennium Development Goals (Zambia DHS 2009). The new objectives focused on addressing important health service issues in Zambia such as maintaining effective and adequate staff at all levels, reducing morbidity and mortality rates with special attention to reducing and controlling the spread of HIV/AIDS, promoting and implementing interventions related to improving hygiene and access to safe food, water, basic sanitation, essential drugs and medical supplies, ensuring that all health facilities are adequately equipped to provide quality services, as well as working more closely with key stakeholders involved in health service delivery in Zambia (Zambia DHS 2009). Attention to improving mental health services in Zambia, like in most developing countries, was not part and parcel of such reforms (Sikwese et al. 2010) since the control and eradication of infectious diseases and child, maternal, and reproductive health issues tend to receive primary consideration (see Prince et al. 2007).

The extent to which past changes in policies had on lowering poverty rates or improving the overall well being of Zambians in both rural and urban areas seems rather

negligible. Maize production has increased in recent years due to a number of factors including the Zambian government's involvement in supplying subsidized fertilizer and maize marketing support (see Jayne et al. 2011 for further commentary), however, these programs provide few opportunities for resource-poor households to access the means to adequately secure their livelihoods (Sitko 2010). Undernutrition in Zambia is incredibly high (at 43%) compared to 26% prevalence in sub-Saharan Africa (FAOSTAT 2010). More recent estimates of food insecurity levels show little change since 2000-2002 (FAO 2010). Income inequality increased slightly in 2004 and 2006 (UNDP 2011). Over sixty percent of the roughly 13 million people who comprise the Zambian population live in rural areas (CSO 2011) and recent figures from the Zambian Central Statistics Office (CSO) indicate that rural poverty rates are high at 80%, while in urban Zambia poverty rates are considerably lower at 34% (Chapoto et al. 2011).

Given such conditions, this dissertation asks the following questions: 1) What is the relationship between food insecurity and mental health? 2) Is participation in piecework (a local coping strategy) a robust measure of household vulnerability to food insecurity? 3) Is relative deprivation associated with poor physical health, independent of material deprivation? I review the broader literatures that explore these topics in the next section.

1.3 A Review of the Literatures

1.3.1 Food insecurity and mental health

Mental health research in developing countries has notably increased over the past two decades. Determining what patterns poor mental health in developing countries has received the bulk of the recent attention. In a review of eleven community studies conducted in various middle- to low-income countries, Patel and Kleinman (2003) concluded that indicators of poverty (e.g., low educational status) most consistently explain poor mental health outcomes in developing countries. Das et al. (2007) questioned the universality of such a conclusion using household survey data from five developing countries. Hadley and Patil (2008) argued that approaches used to explore the correlates of poor mental health in developing countries need to identify those "forms of insecurity" that are most meaningful to people within their local environments. Most recently, Lund et al. (2010) conducted a systematic review of the poverty/mental health literature. The overall purpose of the review was to substantiate the association between poverty and poor mental health and move the debate to a renewed level that focuses instead on the components of poverty that strongly or weakly determine poor mental health outcomes.

Poverty is a multidimensional construct and includes not only low levels of education but also material deprivation and health, a lack of agency, and exposure to risk and vulnerability (see Hulme and Shepherd 2003). Various sources of risk, for instance, commodity price shocks, removal of subsidies, and poor weather conditions are major concerns of rural households in developing countries (Dercon 2005). Given that securing

access to food is a central component to ensuring livelihood security, it seems plausible that inadequate access to food would factor as well into the concerns of rural households in developing countries. Richards (1939) and Moore and Vaughn (1994), as examples, both documented hunger/food insecurity as a source of distress in rural Zambia (see Scheper-Hughes 1988; Shipton 1990 for other context-specific examples). Baro and Deubel (2006) underscored the importance of ameliorating food security in Africa, as it is the only continent where the percentage of its people facing hunger is on the rise. Determining the robustness of food insecurity as a predictor of poor mental health thus has both empirical and theoretical import.

Patel et al. (1999) found that women living in Harare, Zimbabwe who identified hunger as a concern were more likely to be diagnosed with common mental disorders. Moreno-Black and Guerron-Montero (2005), in their study in an Afro-Ecuadorian community, identified that the experience of hunger was associated with a variety of emotions including despair, suffering, and sadness. Interestingly, Chilton and Booth (2007) similarly found that the experience of food insecurity among African American women in Philadelphia, PA (USA) was correlated with poor mental health. Women identified two types of hunger, one being "hunger of the mind," which was associated with feelings of depression and hopelessness.

In a study by Pike and Patil (2006), women in rural Tanzania identified hunger as a major source of distress. Hadley and Patil (2008) determined that food insecurity was a locally salient concern in their rural-based longitudinal study in Tanzania. As such, they found that changes in food insecurity across seasons were highly correlated with changes

in poor mental health. Their findings were consistent with results from a prior study conducted in the same area that used cross-sectional data to investigate the relationship (Hadley and Patil 2006). Hadley et al. (2008) established that food insecurity and a variety of indicators of poor mental health were positively and significantly related in their study in Ethiopia. The study highlighted the substantial negative impact food insecurity can have on human health in general, rather than on nutritional outcomes exclusively.

Using longitudinal data collected over three survey waves, Maes et al. (2010) found that a positive relationship existed between food insecurity and poor mental health among community health AIDS care volunteers in Addis Ababa, Ethiopia. Sorsdahl et al. (2010) found that food insufficiency was positively associated with poor mental health outcomes using national survey data from South Africa. Finally, Lund et al. (2010) cited additional evidence from developing country studies that demonstrated a positive association between measures of food insecurity and common mental disorders.

In their timely review of food insecurity and mental health in developing countries, Weaver and Hadley (2009) concluded that prior studies demonstrated in various ways support for an association between food insecurity and poor mental health, although major gaps within the literature exist (p. 277-279). First, few longitudinal studies were conducted that investigate the food insecurity/poor mental health relationship. The issue of causality comes into question when a cross-sectional study design is used, since an analysis cannot discern whether food insecurity leads to poor mental health or the reverse using cross-sectional data. Second, only a small number of

studies explored the mechanisms linking food insecurity with poor mental health. Third, there is need to account for other "forms of insecurity" (e.g., water insecurity or housing insecurity) when exploring the relationship between food insecurity and poor mental health as a means of both validating the relationship and investigating the salience of other types of insecurities within a given locale. They also encouraged more inquiries into the mental health correlates of consuming foods in culturally inappropriate ways and more studies that include both women and men in their designs to offset the mostly female-centered studies that comprise the literature. Finally, future studies should make use of both quantitative and qualitative methods to "…better understand the experience of food insecurity and its relationship with mental health" (p. 280).

Food insecurity continues to be a major concern to rural households throughout Zambia, and to further compound the issue, access to formal, government-run mental health services is non-existent in rural areas (see Sikwese et al. 2010). Rural Zambia thus provides an important context in which to address some of the gaps in the food insecurity/mental health literature.

1.3.2 Piecework and household vulnerability

The term vulnerability is widely used by a variety of disciplines and traditions (Adger, 2006). An often-cited definition of the term is the one conceptualized by Chambers (1989: 1). He defined vulnerability as the "exposure to contingencies and stress, and difficulty in coping with them." Two dimensions to vulnerability therefore exist: the external (the risks, shocks, or stressors a household encounters) and the internal

(the inability of a particular entity to respond to perturbations). Households throughout rural sub-Saharan Africa frequently encounter numerous risks, shocks, or stressors that can impact their level of vulnerability (Casale et al. 2010). For instance, droughts, flooding, pests, disease, political instability, institutions that enforce structural adjustment measures and the subsequent removal of agricultural subsidies, and/or trade policies that differentially improve the welfare of certain individuals in society can all increase a household's vulnerability (see Leichenko and O'Brien 2002; Dercon 2005). Once households are exposed to a shock or stressor they use the entitlements or assets they obtain or possess (Sen 1981). The fewer the assets households own the more sensitive they are to a shock or stressor, which makes them less likely to respond effectively, and in turn, more vulnerable (Moser 1998).

While the multidimensional nature of vulnerability is now well established, scholars have only recently come to appreciate and explore its more dynamic side. Leichenko and O'Brien (2002: 3) argued that patterns of vulnerability are becoming more dynamic due to rapidly changing institutional, environmental, and socioeconomic contexts. They conceptualized *dynamic vulnerability* as "the extent to which environmental and economic changes influence the capacity of regions, sectors, ecosystems, and social groups to respond to various types of natural and socio-economic shocks." Additionally, vulnerability as a concept is inherently "forward looking," describing how "close to the edge" households are to *X* given their lack of capacity to respond (see Ellis 2003, Devereux 2006; Hart 2009). Vulnerability "makes a prediction

about future poverty (or other outcomes)," and thus, the use of a multi-period lens to view vulnerability's dynamism is paramount (Devereux et al. 2006: 2).

Various approaches to understanding the complexities of vulnerability exist. Watts and Bohle's (1993) "space of vulnerability" model is particularly useful because it not only recognizes the risk of exposure to shocks or stressors and the risk of having insufficient means to cope, but also the risk of becoming severely burdened and incapable of fully recovering from crises. Their approach essentially maps out a more robust means of identifying the (most) vulnerable since it addresses specifically the consequences of being vulnerable, or those "who suffer the most from crisis impact and who are endowed with the most circumscribed capacity for recovery" (*ibid*: 118).

The use of Moser's (1998) "asset vulnerability framework" is also beneficial as it helps to distinguish between the many material and non-material assets that households draw on to avoid or lessen the impact of shocks or stressors. The framework "seeks to identify what the poor have rather than what they do not have" (*ibid*: 1), which inevitably is a more optimistic approach to exploring vulnerability and poverty (Ellis 2003). From the urban studies that informed the framework (one was undertaken in Lusaka, Zambia), Moser (1998: 4) identified the following classification of tangible and intangible assets people use to respond to larger structural, macroeconomic difficulties: labor, human capital (e.g., skills, health and educational status), productive assets (e.g., housing), household relations (as a means of pooling resources and sharing food and other expenses), and social capital. All of these categories of assets are surely appropriate for use in rural settings of developing countries as well.

Another important component to the "asset vulnerability framework" is its recognition of the assets that people use to buffer against or mitigate risk and those used to cope once an adverse shock occurs. In the vulnerability/livelihoods lexicon, the terms "*ex ante* risk management strategies" and "*ex post* coping strategies" are utilized to help organize these concepts (see Ellis 1998, 2000, 2003; Devereux 2001). Within a rural developing country context, *ex ante* risk management strategies involve "forward planning" and "diversifying" into farm, off-farm, or non-farm activities that enable households to spread risk. *Ex post* coping strategies, on the other hand, consist of approaches households take to "survive" an unusual event or address seasonal scarcities in food and cash.

As one might imagine, coping strategies could be interpreted as either being "non-erosive" (e.g., eliminating purchases of non-food items such as clothes, cell phones, or "talk time") or "erosive" (see Ellis 2003). Erosive responses are of particular concern since they can further perpetuate levels of vulnerability or poverty (e.g., when households sells off their ploughs, land, or housing materials). Typically, patterns have households drawing on their savings or consuming fewer meals first, disposing of more productive assets (e.g., tools) next, and finally responding in ways that merely enable their survival such as migrating to another area for assistance (Corbett 1988; see also Devereux 2001).

In short, rural households throughout sub-Saharan Africa disproportionately possess the means to help them respond to their ever-changing environments. Consequently, some mitigate risk by engaging in a wide variety of farm and non-farm activities. Others cope after the fact, and do so in varying ways. Ultimately, this means

that some improve or maintain their vulnerability or poverty status, while others become gradually (or abruptly) more vulnerable, destitute, and/or entangled in a complex web of poverty.

1.3.2.1 Piecework as "coping strategy"

Piecework is a short-term, casual labor arrangement common in rural Zambia and in neighboring countries where labor is typically exchanged for food or cash. Historically, piecework was a significant institution in rural Zambian society, and in particular, an important strategy of exchange used by women. Audrey Richards (1939) described piecework in her classic ethnography entitled *Land, Labour and Diet in Northern Rhodesia*. Piecework and the role it played for women in the 1930s received considerable attention by Moore and Vaughan (1994) in their follow-up study in the late 1980s. This was because Richards regarded piecework as a sign of women's destitution. In her view women were essentially forced into piecework arrangements given the exodus of male labor from rural areas to the copper mines [see Vail (1977) for a similar explanation]. Women were seen as incapable of producing a sustained food supply using own means, and therefore, relied on *ukupula*[1]. According to Richards (1939: 145),

> Only an absolutely destitute person or an imbecile would reckon to subsist in this way as a regular thing; but as a temporary form of support, *ukupula* has become very common lately as one of the means by which the very large percentage of deserted wives can eke out an existence during the bad times of the year.

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[1] *Ukupula* means "begging" in *Cibemba*, but was also used to describe a piecework arrangement (Richards 1939).

Moore and Vaughan (1994) argued instead that piecework and other "redistributive strategies" (e.g., sharing food) were part of the rural landscape well before a formidable migrant labor economy was established during colonization. Given the gendered nature of agricultural production in rural society together with unpredictable yields (as well as surpluses), the redistribution of food and labor was of utmost importance to women. Only with the increase in male labor migration and a more pressing need for cash did women's reliance on piecework intensify. Women short of food would supply their labor by helping others cultivate in their fields or harvest their crops. In return for their labor they received food (millet). To meet the ever-increasing need for cash, women also utilized the grain they received to brew beer and would then sell to acquire cash or exchange with male labor to assist with clearing new land or other tasks.

Moore and Vaughan (1994) showed how piecework continued to provide women in rural Zambia with an opportunity to exchange labor and food into the late-1980s. National survey data indicated that piecework actually gained in importance as a coping strategy since the mid-1990s (CSO 2006). Whether piecework is now a more significant strategy than say during the colonial or post-Independence period remains open for debate. However, more recent events considerably altered the contexts in which rural farmers live in Zambia. It could be argued that the various changes (or lack of change) that transpired over the past 30 to 40 years greatly impoverished many and created significant gaps between rural households. This includes the structural adjustment measures carried out during the 1980s and 1990s and the numerous Government (and

non-government) policies and programs that had little success improving small-scale farmers' access to the resources necessary to adequately cultivate and diversify their livelihoods (see Geisler 1992; Hoon 2007; Sitko 2010). Quoting Hoon (2007: 188), "The 'shock-therapy' of structural adjustment provided a shock, but little therapy." Thus, many in rural Zambia are now "forced" to adopt piecework as their primary coping strategy, particularly during the rainy/cultivation season.

Women especially faced an unfair disadvantage during the structural adjustment period including a lack of integration into cash-crop production, lack of control of earnings from whatever source (on or off-farm), and being relegated to "food-crop" producers (Geisler 1992). Women responded by engaging primarily in piecework as a strategy to survive.

Sitko (2010) argued that greater access to material goods together with neo-liberal economic reforms created a more "business-like" ethos in rural Zambia (see also Hoon 2007). Better-off farmers now make calculated decisions about how they distribute food (maize) to relatives or neighbors in need. Previously, a greater quantity of maize was exchanged for piecework labor, but today less maize is provided given that social relations have changed. Better-off farmers use a "farming as a business" discourse (a slogan that was promoted by agricultural development/poverty reduction programs) to justify their smaller payment sizes. According to Sitko (2010), agricultural policies that were originally intended to improve food security are now exacerbating seasonal food shortages for households in rural Zambia.

Richards (1939) envisioned that social relations used in piecework arrangements would eventually change and become rooted in principles of the market, due in part to the emergence of the cash economy (Moore and Vaughan 1994). Much like Sitko (2010), many scholars now view contemporary piecework labor arrangements as being more contractual, individualistic, or reflective of increasing rural differentiation in Southern Africa (e.g., Geisler 1992; Devereux 1999; Ponte 2000; Bezner Kerr 2005; Bryceson 2006; Peters 2006; Hoon 2007; Mueller 2011). Others noted its important role as coping strategy in rural Zambia (Evans and Young 1988; Geisler 1992; Moore and Vaughan 1994; Crooks et al. 2007; Ito 2010).

One insidious feature of piecework that most scholars and researchers recognize is the lack of attention to own-farm production that can result when piecework is employed as a main strategy to cope during the rainy/cultivation season. This is piecework as an "erosive" response to seasonal food insecurity since involuntary neglect can undoubtedly limit a household's ability to cultivate a sustained food supply. As such, Bezner Kerr (2005) argued that reliance on piecework during the rainy season is an indicator of a household's vulnerability to food insecurity. Dependence on piecework in the dry season, instead, may signify greater access to income generating opportunities since supplying piecework labor does not compete with primary food production during this time of year. This dissertation addresses this latter claim and argues that we must take into account seasonal change in piecework status if we are to adequately determine the robustness of piecework as a measure of household vulnerability.

1.3.3 Economic inequality and physical health

The relationship between absolute income and health is well established in developed countries (Wagstaff and van Doorslaer 2000; Lynch and Kaplan 2000; Subramanian et al. 2002; Marmot and Wilkinson 2005); on average, those with elevated incomes experience better health outcomes. Beyond a certain threshold of income the positive health consequences from an increase in income become less significant, and according to Wilkinson (1996), income inequality is a better predictor of poor health outcomes.

Macinko et al. (2003) provided a helpful synopsis of the arguments for why income inequality and health might be linked. First, there is the psychosocial explanation. Income inequality generates negative feelings via social comparisons that socioeconomic hierarchies perpetuate, eventually causing poor health outcomes for those lower in the income distribution. As Wilkinson and Pickett (2007: 1974) pointed out, "If income differences are important, this implies the importance of processes of social comparison." These same negative feelings could also alter people's social environments by promoting anti-social behavior, decreasing social capital, or impacting the ways people participate in civic activities, with obvious health-deteriorating outcomes.

Second, is the neo-material hypothesis that highlights how material deprivation among the poor can lead to ill health. Additionally, income inequality results in fewer investments that promote health among the poor (e.g., proper schools, health facilities, housing, and the like). Third, some have argued that the link between income inequality and health is a statistical artifact and thus an area with a high level of income inequality

naturally contains more poor people who have poorer health. Finally, poor health decreases opportunities for people to generate money, and therefore, poor health causes poverty or contributes to income inequality.

In their review of the income inequality/health literature, Wilkinson and Pickett (2006) confirmed that most prior studies (70%) provide evidence in support of the argument that societies with larger income differences have poorer health. Wilkinson and Pickett (2007) argued that income inequality (or more generally social status differentiation) impacts health and other social outcomes negatively at the societal level rather than at more local levels (e.g., neighborhoods or towns). Larger-scale studies of income inequality, they claimed, are better able to capture the level of social stratification in the respective society, and thus, establish a relationship with poor health outcomes.

Numerous other reviews exist that illustrate the level of attention the income inequality/health link received and that controversy surrounding the relationship between income inequality and health is still pulsating (e.g., Wagstaff and van Doorslaer 2000; Lynch et al. 2000; Macinko et al. 2003; Subramanian and Kawachi 2004; Kondo et al. 2009). My aim is to provide a mix of this literature, ending with a group of studies rarely mentioned within the broader income inequality/health literature. These studies take place in small-scale, rural developing country contexts where the issue of "scale" is arguably one factor that prevents their wider coverage.

Diez-Roux et al. (2000) used multilevel models to explore the association between body mass index and state income inequality (measured using the Robin Hood Index) in the United States and found that state income inequality was related with body

mass index in women although not in men. Subramanian and Kawachi (2004) argued that the use of multilevel models together with longitudinal data "…may provide a better handle on the *causal* nature of the relation between income inequality and health" (p. 87, their emphasis). In a smaller, metropolitan-level study consisting of over 100,000 men and women from the United States, Lopez (2004) established that income inequality was positively associated with fair/poor self-rated health.

Larrea and Kawachi (2005) explored whether economic inequality (measured using the Gini coefficient of household per capita consumption) and child malnutrition were related in Ecuador using national data (n = ~2,800 children under five). Importantly, they found that a negative relationship existed between economic inequality and child malnutrition (stunting), although only at the provincial scale and not at the municipal or local levels. In a study involving 65 countries and 251,158 people, Cifuentes et al. (2008) found a positive relationship between income inequality (measured using the Gini coefficient) and major depressive episodes. Interestingly, this relationship existed only among those countries that were considered highly developed by the United Nation's human development index.

In a very different light, Chen and Meltzer (2008) examined the impact income inequality had on obesity (measured using body mass index) in a sample of rural and urban Chinese. They used panel data and employed a multilevel model that accounted for the possible non-independence among observations at the individual, household, and community levels. They found a positive relationship between income inequality and obesity in both the rural and urban samples. Henriksson et al. (2010) investigated the

relationship between income inequality at the municipality level in Sweden and risk of myocardial infarction using data on adults, aged 40-64 (n = 1,284,955). They found that risk was actually lower in municipalities that had a higher level of income inequality, which the authors explained was the result of "residential segregation" or the clustering together of more affluent people. Layte (2011) tested the three main hypotheses used to explain the income inequality/health link in a multi-country study involving over 35,000 people. He found convincing evidence that supports the psychosocial and social capital hypotheses, while little evidence supporting the neo-material hypothesis.

According to Subramanyam et al. (2009: 327), "The theory of relative deprivation deals with the emotions due to social comparisons involving inequality." Kondo et al. (2008) examined this hypothesized pathway using a large sample that included Japanese men (22,871) and women (24,243) and found that higher relative deprivation (measured using the Yitzhaki Index) was positively related with poor self-rated health. Similarly, Subramanyam et al. (2009) established that relative deprivation (in income) was strongly associated with poor health in their US-based sample, thus providing additional evidence that supports relative deprivation as a determinant of health.

Subjective socioeconomic status (SES) is considered a measure of relative deprivation (Kondo et al. 2008: 985). Cohen et al. (2008) found that higher subjective SES was associated with decreased susceptibility to the common cold in their small sample from the United States. Singh-Manoux et al. (2005) confirmed that subjective SES as opposed to objective measures was the better predictor of a change in health status of individuals (British civil servants) from the highly regarded Whitehall II study.

They provided three reasons for their finding. First, subjective SES may be a more accurate measure of SES because "…it is a better synthesis of the different elements of SES at the individual level" (p. 860). Second, subjective SES indicates an individual's "relative" social or economic position instead of their "absolute" position. Lower social position impacts health either through physiological and neuroanatomic processes or indirectly via unhealthy behaviors (e.g., smoking, over consumption of alcohol). Third, without the use of longitudinal data the relationship between subjective SES and health could be the reverse (spurious) in that poor health could cause people to poorly evaluate their health status.

Few smaller-scale studies exist that also explored such relationships in a rural, developing country context. Ricardo Godoy and colleagues are one exception. They have amassed a number of studies that explored the association between social and economic inequalities and health. Their use of ethnography together with panel data collected from a foraging-farming society (Tsimane') in the Bolivian Amazon has helped to broaden our global understanding of the complex relationship between inequality and health (Dressler 2010).

Godoy et al. (2005) examined the relationship between income inequality and adult nutritional status among Tsimane'. The authors hypothesized that income inequality may not harm individual health given that strong forms of social capital typically exist in small-scale, developing country societies. Social capital (sharing, trust, reciprocity) may protect individual health against the harmful impacts of income inequality or, if strong forms of social capital and income inequality co-exist, then health

and income inequality may be positively related in that the better-off would likely assist their less privileged neighbor or relative. Village income inequality was not statistically correlated with nutritional status in their study. They attributed the lack of an association to the omission of social capital variables in their models.

Godoy et al. (2006) explored the association between income inequality and negative emotions such as anger, fear, and sadness among Tsimane'. They established that village income inequality (measured using the Gini coefficient) was positively related with negative emotions. Brabec et al. (2007) examined how the interaction between measures of income and social capital impact adult nutritional status among Tsimane'. They found that social capital and income are complementary to health in that those who are rich and generous have higher body mass index (their indicator of nutritional status), and that an increase in income may lower people's motivation to build social capital.

Reyes-Garcia et al. (2008) explored the relationship between social rank and male nutritional status among Tsimane'. They found a positive relationship between social rank and all three indicators of nutritional status used including body mass index, mid-arm circumference, and the sum of four skinfolds, while also controlling for a number of variables (e.g., village fixed effects, job autonomy, income, and education). Reyes-Garcia et al. (2009) again investigated the relationship between social rank and male nutritional status, but also included variables representing village inequality in social rank [both dominance (or power) and prestige] in their models. They established that village inequality in dominance, but not prestige, predicted poorer nutritional outcomes.

Undurraga et al. (2010) found that individual wealth rank was negatively related with lower subjective poor health among Tsimane' in the Bolivian Amazon.

Two studies from sub-Saharan Africa have explored the relationship between subjective SES and health. A study from South Africa looked at the association between lower subjective social status and adult depressive symptoms and perceived stress (Hamad et al. 2008). The authors found that lower subjective social status was positively related to both mental health outcomes. In a study from rural Ethiopia, Hadley et al. (2008) found that higher subjective SES was protective of symptoms of poor mental health.

Together these small-scale, rural developing country studies broadly demonstrate that even amid high levels of material deprivation, social and economic differences can have real biological consequences, and thus, the link between health and relative deprivation or economic inequality is not purely a Western or developed country phenomenon. They also suggest that alternative indicators of social and economic differences may be more appropriate for use in smaller-area studies (e.g., subjective SES) given the issue of scale put forward by Wilkinson (1996; see also Wilkinson and Pickett 2007). This dissertation addresses these matters in a small rural setting in Zambia as a means of contributing to the broader income inequality/health literature, and does so by also reflecting on two other important points made by Wilkinson and Pickett (2007: p. 1975): "Relativities and comparisons beyond the local seem more important than purely local ones" and "…the salience of income distribution involves something much deeper than comparisons of income."

Briefly, there are marked differences in incomes between those living in rural versus urban areas of Zambia. Rural, local-level relationships, however, are incredibly interactive. For example, homes in villages are located next to each other, people farm where all can see, maize and groundnuts are stored in granaries in plain sight when passing through a village, and everyone knows who supplies their piecework labor and who recruits it. In this local context, income differences are surely apparent. The question then is whether or not local social comparisons take place at all, and if they do, whether or not they are influential in determining health outcomes as opposed to say those comparisons made across larger scales (e.g., district, provincial, or national/global). Additionally, social comparisons seem to involve more profound matters than only income. Thus, it could be argued that smaller-scale studies are uniquely positioned to play an important role within the literature, since they typically tend to matters deemed most salient within a particular context.

1.4 Explanation of the Dissertation Format

This final section provides a brief explanation of the following: 1) why I chose to pursue the alternate format permitting inclusion of papers published or accepted for publication in scholarly journals and 2) that the papers were not part of a larger collaborative project, with a description of my research project and papers to date as evidence.

I chose to pursue the publication format for a number of reasons. First and foremost, my professional goals are to find employment within a global or local research

institute where I can continue writing grant proposals to fund research, carry out research, analyze data, and publish, and therefore, I wanted to demonstrate that I could publish before I completed my degree. I believe that publishing is important and reflects how well one can organize their research, their findings, and their contributions within a broader playing field, as judged by one's peers. Looking back (I'm writing this roughly two years after I made the decision to pursue this format) I am fortuitously grateful. I never imagined this process would advance my learning and practical experience in so many important ways.

Second, I feared that my professional goals would prohibit me from publishing my dissertation research in scholarly journals if I pursued the traditional format (e.g., a series of chapters in book style). Typically, research institutes have their own goals, no doubt dictated by funding. This could have complicated future efforts time wise to write a manuscript worthy of publication. Third, publishing before receiving my degree could make me more competitive on the job market.

The papers produced from the dissertation research were not a part of a larger collaborative project. In December of 2007, National Science Foundation informed me that my dissertation proposal was funded. I secured Human Subjects approval in January of 2008 and after finishing a commitment I had in Belize as a research assistant I began my dissertation research in Zambia in December of 2008. I immediately applied for my study permit, affiliation at the University of Zambia (UNZA), and ethical clearance from UNZA's Research Ethics Committee. I carried out my research in a rural area of Katete District, Eastern Province, Zambia from January to mid-December 2009. I moved to

Chipata (the provincial capital of Eastern Province) immediately thereafter. I began entering and cleaning my data in January 2010.

My first paper was submitted in February 2011 and accepted for publication in July of that same year. Dr. Gelson Tembo, a member of my dissertation committee and a professor of Agricultural Economics at the University of Zambia, was the co-author on the paper. He provided statistical guidance, read each draft of the manuscript, provided comments on how to improve the manuscript, and most importantly made time to meet with me to discuss various analytical issues each time I was in the Zambian capital, Lusaka. Dr. Ivy Pike, my main advisor, and five anonymous reviewers also provided constructive feedback on each draft of the manuscript.

My second paper was accepted for publication in July 2012. Its co-author is an assistant professor of Political Science at Virginia Tech, Dr. Parakh Hoon. Dr. Hoon provided important insight that improved the paper's main argument and supplied comments on each draft of the manuscript. Both Drs. Ivy Pike and Deborah Crooks (an associate professor of Anthropology at Kentucky University and also a member on my dissertation committee) offered comments on earlier drafts of the manuscript as well as a colleague of mine, Dr. Nicholas Sitko (a research fellow at Michigan State University), who conducted his dissertation research on similar topics in southern Zambia. The constructive feedback provided by three anonymous reviewers considerably improved the quality of the manuscript.

The third paper included in this dissertation is under review as of July 2012. I am the sole author on this paper. I received valuable feedback from Drs. Ivy Pike and

Gelson Tembo, an associate professor of Anthropology at Emory University, Dr. Craig

Hadley, and two anonymous reviewers.

CHAPTER TWO: PRESENT STUDY

2.1 Introduction to the Present Study

The methods, results, and conclusions of this research are presented in the three papers appended to this dissertation. I will first detail the methods used and the various types of data collected throughout the duration of the dissertation research, with the aim of providing a comprehensive overview of the research methodology. I will then present a description of the research setting followed by summaries of each paper. I conclude with implications of the dissertation for future research.

2.2 Methodology: General overview

The methodology used to carry out the research for this dissertation was "mixed" in that it utilized both qualitative and quantitative methods from within and outside the field of anthropology. Qualitative tools were employed as a means of collecting a variety of data. Focus group discussions and in-depth/semi-structured and key informant interviews provided a wealth of information that also assisted in "localizing" the quantitative survey questionnaire. The survey was conducted at the household-level, and included individual-level questions to capture intra-household variation on certain socioeconomic and health outcomes. The theoretical approaches described in the introductory chapter assisted greatly with ensuring that topics important to people's livelihoods were included in the survey. To achieve this end, questions were formulated and included in the survey under "livelihood" sections such as food and nutrition, economic, social network, and health security. Many of the questions on the household-

level survey were adapted from prior research to fit the local context. For example, focus groups were created to determine local coping strategies used during times of food insecurity (Maxwell 1996). The seven most important strategies were then included in the survey under the section "food security."

A random sample of households was drawn to make sure the sample was representative of and the findings were generalizable to the larger population of Chiyembekezo. A total household population census of Chiyembekezo was conducted by collecting the names of all household heads in each village. Local experts in the research area were then asked to categorize each village based on its member's wealth status. Six strata were designated in total, ranging from "better-off" to "worse-off" plus one "other" stratum made up of teachers and individual farmers not living in a village. The wealth ranking exercise was an important step in the sampling design for a couple of reasons. First, participants classified each village using broad categories and their own definitions of "wealth," rather than merely ranking a village as "rich" or "poor." This provided unanticipated, detailed information that was very useful when constructing the six strata. Second, the use of broader categories maximizes the between-group variance and minimizes the within-group variance of the sample (Bernard 2002). This helps ensure that the sample of households drawn represents the full range of differences in say wealth, food security, or health outcomes that exist in the area (see Ellis and Freeman 2004). After the wealth ranking exercise, each household name was put under its respective wealth stratum, numbered, and the proportion of households in each stratum,

based on the total household population, was obtained. The percentage was used to draw a random sample of 99 households proportionately based on the wealth ranking exercise.

Survey construction involved multiple steps. After localizing the survey, it was translated locally into *Cichewa*. Consensus translation and back-translation by a group of three research assistants (two female, one male) occurred next. Slight modifications were made and then piloting of the questionnaire was carried out. Confusion with certain questions and clarification that required attention were noted, changes made, and the final *Cichewa* version was agreed upon.

The first of two waves of survey interviews began in April and lasted through to the beginning of July 2009. The second wave started in early October and ended in late November 2009, just after the rainy season began. Eighty-three households (25.8% of the total household population) took part in the first wave of interviews. The response rate was close to eighty-four percent. Each interview was conducted with all heads of the household. This means that in dual-headed households both the wife and husband were asked to respond collectively to household-level questions (e.g., food insecurity) and individually when asked about their own health status, for example. Overall, a total of 151 individuals participated in survey interviews during the first wave, although not all of these individuals agreed to participate in anthropometric measurements.

The University of Arizona's Human Subjects Protection Program approved the research procedures and the University of Zambia's Research Ethics Committee granted ethical clearance. In addition, before the research started I met formally with the chief

and all other local leaders from Chiyembekezo. I was granted permission to live and work full-time in their area during the course of the research.

2.2.1 Household survey

The survey consisted of questions that inquired about a wide variety of information salient to rural livelihoods. I collected basic demographic information on marital status, occupation (or the main way of finding cash), ethnicity and nationality, religion, educational level, age, and composition of the household. Anthropometric measurements on all individuals living in the household at the time of survey interviews were taken including height, weight, triceps skinfolds, and mid-upper arm circumference. I conducted 24-hour dietary recalls, assessed household food insecurity, collected data on both food and cash crops, total land size, fertilizer use and livestock ownership. A household's participation in piecework was evaluated as well as household asset ownership and perceived economic position. Group participation, trust, and aspects of community cohesion/support were assessed. I also inquired about illnesses within the household (all members). I asked household heads to subjectively evaluate their physical and mental health and assessed, objectively, mental health status of each household head using a World Health Organization (WHO) instrument. Finally, data were collected on house characteristics, latrine ownership, and source of drinking water.

2.2.2 Focus group discussions

Many of the topics discussed with focus groups were similar to those included in the household-level survey, only explored in greater depth. Focus group discussions centered on agricultural production, food insecurity and *njala* (hunger), local coping strategies used when households experience food insecurity, piecework and other labor arrangements, access to agricultural inputs, "briefcase" buyers, how households improve upon their livelihoods, common challenges households face in each village, and consensus discussions on local prices of a variety of household assets. I conducted focus group discussions with men and women (both separately and together), village elders, local elites, and people from specific villages, the local agricultural cooperative, and religious groups.

2.2.3 In-depth/semi-structured interviews

I carried out both in-depth and semi-structured interviews throughout the duration of the research. Primarily, these interviews provided the details necessary to help complement the information collected during survey interviews. The qualitative interviews significantly improved my understanding of certain responses to questions included in the household-level survey. In-depth and semi-structured interviews also assisted in clarifying particular patterns that I began to observe throughout the course of the research and confusion I had with certain agricultural practices or labor arrangements, for example.

I conducted qualitative interviews with headmen on their village histories and wealth status, typical food and cash crops produced by households in their villages, and general resource availability in their villages (e.g., improved water sources). Interviews were also carried out with people from diverse backgrounds on piecework and other labor arrangements, development projects, problems farmers face when trying to access agricultural inputs, food insecurity and *njala*, health and disease, social comparisons, credit and interest, exploitation, agricultural marketing concerns, gender-specific income-generating strategies, and "budgeting."

2.2.4 Key informant interviews

Key informant interviews were carried out as one means of substantiating my level of understanding of a certain topic or phenomena. For example, one of my key informants is a piecework recruiter, local elite, cattle owner, and grocery store owner. He is a father of eight children, a village headman, and he and his wife achieved their current wealth status in part raising cash by supplying their piecework labor. I conducted other key informant interviews with individuals who were cognizant of local coping strategies, local definitions of hunger/food insecurity, and local idioms of distress. I had extensive conversations with one headwoman that were instrumental in improving my understanding of *nkhawa* (anxiety/worry), and the local connections the emotion has with food insecurity, material deprivation, among other commonly experienced forms of insecurity. I spent a considerable amount of time with prominent farmers living within the study area, although not attached to any particular village. These interviews enabled

me to gain a more intricate understanding of some of the complexities surrounding their involvement in rural labor markets, larger-scale agricultural production, shaping rural differentiation as well as their persistent access to agricultural inputs.

2.2.5 Participant observation

I began living in Chiyembekezo in January of 2009 and completed my research in mid-December 2009. Throughout the research period, I lived in a brick house with iron sheets in one of the sixteen villages in Chiyembekezo. I relied on a local bicycle or walked to move around. I biked into town every two weeks to purchase supplies, check emails, make photocopies, or print out surveys. I traveled to the provincial or national capital to withdraw money or attend to an urgent matter every three months or so. The vast majority of my time, however, was spent in the field. Consequently, I collected a rather diverse and large amount of data each month of the year in 2009 using participant observation. Participant observation no doubt deepened my understanding of matters important to me, and for the most part, to the people of Chiyembekezo.

I observed people working in their fields (e.g., planting, weeding, spraying cotton, clearing trees), harvesting their crops, consuming own-farm production, collecting wild fruits, insects, and field mice, participating in community development activities and labor arrangements of various sorts, molding bricks, attending blood drives, and children receiving high protein porridge at school that was donated by the World Food Program. I observed couples getting married and attending a public divorce gathering and was present at numerous funerals. I observed people attempting to diversify their income

base by learning how to make bamboo furniture, purchasing groundnuts locally and selling after shelling to make a small profit, and young men being hired to purchase goods in or escort teachers to town using their bicycles. I observed numerous agricultural transactions between "briefcase" buyers who purchase farm produce piecemeal and those in need of cash well before larger-scale traders entered the market.

I gardened daily in the dry season alongside five women who grew manure-fed vegetables for consumption and to generate cash to purchase cooking oil, salt, soap, and other basic household items. A neighbor of mine lost his most powerful, well-trained ox that choked on a mango right before the cultivation season began. Before the sun rose the following morning, the entire animal was cut into pieces and was ready for sale. He later purchased another oxen half the size with the less than adequate money he raised. I observed husbands providing their wives with a 25kg bag of hybrid maize to trade for a new shirt, pot, or pair of sandals. Once the exchange was completed, wives were restricted from trading again. I also observed that most households had little access to outside markets that would provide them with a better price for their produce. At the same time, I observed a relatively vibrant local market with people selling anything from cow's milk, homebrew, vegetables and fruits, baskets, and timber, to sugar cane, cassava, and a local favorite, field mice.

2.2.6 A description of the research area

Chiyembekezo is a relatively small area located roughly 22 kilometers down a dirt road from the main business center of Katete town. Katete District is in the Eastern

Province of Zambia. Chewas are the main ethnic group living in Chiyembekezo. Chewas are a matrilineal group occupying parts of eastern Zambia, Malawi, and Mozambique. According to oral histories obtained from village elders, people first settled in Chiyembekezo in the early 1930s. In-migration continued during the mid-1950s, but not again until the early 1980s through to the late 1990s. The household population census conducted in February and March of 2009 counted 322 households within a total of 16 villages.

Each village in Chiyembekezo is rather unique. Some are relatively better-off or "average," others are "below-average" or very impoverished. Certain villages are located in the local forest, are situated along the main feeder road to Katete town, or are difficult to access during the rainy season, while others are located closer to the rural health center, school, or maize mill. A few villages consist of households who seem to be of similar socioeconomic status. The scale of differentiation in other villages is rather obvious as indicated by the different sizes of maize granaries, the number of cattle and other livestock owned, the assorted sizes of houses and the materials used to build them, or whether a solar panel is outside resting on a kitchen wall at a proper 45 degree angle.

Differences in field sizes and the heartiness of crops are also apparent when wondering from field to field throughout Chiyembekezo. Light green maize stalks standing less than a meter tall during the tail end of the rainy season is the most obvious sign that a household lacks access to nutrient-rich land or synthetic fertilizers. Households who farm inside the local forest avoid having to purchase fertilizer for some years after clearing new land, although pay the costs of living further from the main

center come marketing season when traders come to purchase agricultural goods. Maize, groundnuts, and sunflower are the main food crops cultivated in Chiyembekezo. A variety of other food crops are grown in smaller amounts. Cow peas, pumpkins, local cucumbers and squash, tomatoes, okra, watermelons, and beans can all be found inter-cropped with maize, but sometimes with cotton or sunflower. Small portions of land are also dedicated to planting cassava and sweet potatoes. Consequently, consumption of these minor food crops tends to end a few weeks or a couple months after harvest season. Cash cropping is the most common way households generate income in Chiyembekezo. Cotton, groundnuts, and hybrid maize predominate as the main cash crops, while few grow tobacco (the other cash crop cultivated in Eastern Province).

Dried maize is harvested starting in late April or early May. Households begin picking and selling their cotton as well in early May. The harvesting of groundnuts follows. Households are well aware of the gap between when the last rains fell and when they must begin digging up their groundnuts. Waiting too long can make harvesting difficult given dry soil conditions and can lead to losses in yields. Minor food crops and sunflower are usually harvested after harvesting the main crops, but potential losses due to birds, cattle grazing, and field mice accelerate the pace at which farmers harvest altogether. Certain farmers can afford to recruit piecework labor to assist with harvesting and transporting crops from field to village. Households in some villages assist each other when harvesting maize, which opens up more time to harvest other food and cash crops. Others are less fortunate, and time becomes a major factor when harvesting. For example, a herd of cattle consumed a household's groundnut harvest one day during the

dry season as it lay unattended drying in their field. While uncommon, it can be a source of conflict between households. Small boys no older than 10 years of age are commonly in charge of herding cattle in groups of 30 strong, and at times, loose track of or are unable to control their herds. Pigs and goats seldom wonder into fields, as tree boundaries between villages and fields for the most part restrict their movements.

Gardening is a popular activity in the dry season once field crops are harvested. Some gardeners start nurseries mid-rainy season in anticipation of their field tomatoes and pumpkin leaves drying up a month or two after the final rains. Tomatoes, rape, mustard greens, Chinese cabbage, okra, and onions can all be found in gardens where owners have access to expensive seed, otherwise, beds of rape add green to the brown, dry season landscape. Women, younger men, and adolescent boys primarily garden. Their gardens are located near dried-up streams. Water is acquired by digging a shallow hole in the streambed. Livestock regularly free ride on water sources, and therefore, bamboo fences surrounding gardens are a must. Most garden produce is sold or traded locally. Some women grow surplus rape or tomato and exchange with dried maize to lessen the extent of food insecurity or hunger during the rainy season.

One rural health center provides local residents of Chiyembekezo with a certain level of health service. Throughout the research period, staff at the health center consisted of one government-trained nurse and a local resident who performed multiple tasks including dispensing medicine and cleaning inside and outside the center. I visited the health center regularly and observed that mild antibiotics (e.g., amoxicillin) and painkillers/fever reducers were typically available, while anti-malarials were not,

especially during the rainy season. A child's health status seemed a daily concern to most parents in Chiyembekezo. My research assistant and I would regularly find men and women escorting sick children to the health center as we traveled to and from households conducting interviews. The center is located roughly 5 kilometers from the closest point of entry into Chiyembekezo and some 15 to 20 kilometers from those living in villages near the outskirts. A community health worker (a volunteer position) supplies antibiotics, painkillers, cotton swabs, and antiseptic to patients in need of basic health care services given such distances. Prenatal and under-five outreach is provided by the health center as well. Attendance is compulsory. Children are weighed, under-five cards updated, and the status of pregnant women evaluated. Each trimester, women and their husbands undergo HIV testing and counseling as a precautionary measure to avoid HIV transmission to child during delivery. Deliveries occur at the health center, which is also mandatory. Occasionally women fail to make the journey to the center and rely on a trained midwife living in close proximity to assist with the delivery. When illness or emergencies occur that are simply too overwhelming for the rural health center to handle, patients are referred on to Saint Francis Hospital in Katete town.

A primary school (now a basic school up to Grade 9) exists at the center of Chiyembekezo. When I first arrived in January 2009 there were four teachers in charge of teaching 298 pupils [according to the 2008 attendance numbers I obtained from the headmaster's (principal) office wall]. A month later a young male teacher arrived for his first-ever teaching assignment. An established teacher who was transferred from a neighboring district followed, yet was typically unable to perform his duties given his

addiction to alcohol. A retired teacher who did not received her government-issued "end of service" package in 2008 was still residing (and is still residing today) in one of three government-built teacher houses. Her presence ultimately limits the number of teachers who can come and teach in Chiyembekezo.

Households in Chiyembekezo carry out their livelihoods under relatively harsh conditions. Few have the capacity to make ends meet using the food and cash derived from farm production, and therefore, rely on support from local kin, sons or daughters living in town, or cash derived from charcoal production, broom making, honey production, carpentry, brick laying, per diems obtained when traveling to a non-government organization workshop in town, mending clothes, brewing beer, repairing radios, phone charging, or the other strategies mentioned throughout this dissertation. Of course not all households possess a member who can repair radios, produce honey, or make brooms, and thus, resort to the skills that most everyone in Chiyembekezo possesses, weeding and harvesting using piecework labor. Participation in piecework is one thread that ties the papers appended to this dissertation together, as demonstrated next in the paper summaries.

2.3 Paper Summaries
2.3.1 Paper one

The first paper included in this dissertation is entitled "The effect of food insecurity on mental health: Panel evidence from rural Zambia." The paper was published in the journal *Social Science & Medicine*. Most prior studies that explored the association between food insecurity and poor mental health employed a quantitative or

qualitative research design and utilized cross-sectional data to investigate the association (Weaver and Hadley 2009). The paper used both qualitative and longitudinal survey data, included both men and women in the study design, and pursued a potential mechanism linking food insecurity and poor mental health. In so doing, the paper made important contributions to the food insecurity/mental health literature.

Methods: The research sampling design required the use of a multilevel linear regression model during statistical analysis with repeated measures nested within individuals living in households nested within villages. Adult mental health was the dependent variable used and was measured using the Self-Reporting Questionnaire, a 20-item retrospective survey with yes/no answers that includes both somatic and psychological items (WHO 1994). Household food insecurity was assessed utilizing a modified 7-item scale based on local coping strategies used during food shortages (Maxwell 1996). An interaction term between the household food insecurity scale and a dummy variable that represented survey period two was created and permitted the estimation of the effect of household food insecurity on mental health at both wave one and wave two. Regression analysis controlled for additional variables including household asset worth, perceived household social support, household size and dependency ratio, and the physical health status, martial status, age, gender, and educational level of an individual. Complete data on 145 individuals were used in wave one and 135 individuals in wave two (280 observations in total).

Focus groups were created to gain a better understanding of local coping strategies employed during times of food scarcity. Structured and unstructured

interviews were conducted to investigate sources of distress in the research area and how such distress could lead to poor physical or mental health. People were observed regularly throughout the research area working in their fields and gardens, participating in a variety of activities, and interacting with neighbors and relatives.

Main statistical and qualitative results: At wave one, household food insecurity was positively related to poor mental health at the five-percent level. The magnitude of the coefficient estimate was 0.290. The effect of household food insecurity on mental health at wave two was 0.290 plus the estimate of the coefficient on the variable representing the interaction term (0.448). Thus, the size of the coefficient estimate at wave two was 0.738. The coefficient estimate on the interaction term assesses the change in the effect of household food insecurity on mental health over the two survey periods. The difference in the effect was statistically significant at the 5% level. These results demonstrate that household food insecurity was positively associated with poor mental health. In the dry season (wave two) household food insecurity had a greater effect on mental health than during wave one (the rainy season).

The qualitative findings indicated that food insecurity, illness, and having a lack of cash to purchase basic household items were all sources of distress in the research area. Many households in the research area cope during times of food and cash shortages by supplying their piecework labor, although households tend to have fewer means to recruit piecework labor when the rainy (or "hungry") season approaches/begins. A local leader explained how such concerns could make a person *kudwala na maganizo* (or "sick with thoughts"). She used the *Cichewa* term *nkhawa* (anxiety/worry) to link food

insecurity and other kinds of scarcity with poor mental health. Together, these results suggest that experiencing food insecurity in rural Zambia, especially in the dry season, can bring about *nkhawa* and the resultant poor mental health.

Conclusion: The paper found that household food insecurity and poor mental health were positively correlated. The complementary qualitative data provided some evidence that implicates *nkhawa* as an important mechanism linking food insecurity and poor mental health in this context. The results presented in the paper support agricultural policy reforms and applied programs that aim to improve food security in rural areas of Zambia. Mental health care resources are severely lacking in Zambia and in most African countries (Lund 2010; Sikwese et al. 2010). Improving access to key agricultural resources (e.g., fertilizer, seed, draught power) as one way of increasing agricultural output, might produce beneficial mental health outcomes in rural Zambia and other developing countries where food insecurity is widespread.

2.3.2 Paper two

The second paper included in this dissertation is entitled "Piecework (*ganyu*) as an indicator of household vulnerability in rural Zambia." The paper was accepted for publication in the journal *Ecology of Food and Nutrition*. The main aims of the paper were to examine the importance of piecework as a seasonal coping strategy and explore whether reliance on piecework labor during the rainy season is a robust measure of a household's vulnerability to food insecurity (Bezner Kerr 2005) in this context.

Methods: Household-level panel data were collected on a variety of livelihood outcomes in order to examine differences between households based on their level of participation in piecework. Eighty-three households participated in wave one of survey interviews and 81 households in wave two. Basic descriptive statistics were provided in the paper and *t* tests were conducted to determine whether differences between means were statistically significant

Focus group discussions and in-depth interviews were conducted to better understand some of the complexities inherent in local piecework arrangements. Piecework arrangements between individuals and households from different backgrounds were observed throughout the rainy and dry seasons. The qualitative data were used to describe local piecework arrangements and highlight the influence piecework labor has on rural livelihoods in the research area.

Main statistical and qualitative results: The qualitative results suggest that piecework largely provides households with a chance to address an immediate food or non-food need and a means to acquire extra-domestic labor during times of the year when precision in agricultural production tasks is key (e.g., when weeding or harvesting), while occasionally, exploited as a source of cheap labor by larger-scale farmers. The quantitative results presented demonstrate convincingly that households who exclusively supplied their piecework labor during both the rainy and dry seasons, compared to those who supplied piecework labor only in the rainy season, performed poorer on outcomes under food security. As such, their reliance on piecework during the rainy season more accurately reflects households vulnerable to food insecurity.

The results also demonstrated that there was a clear gender component to piecework in that female-headed households proportionately were more involved in the supply of piecework labor. There were few significant differences in livelihood outcomes found between female- and male-headed households, however, especially between those households who supplied their piecework labor across seasons. The lack of variation found suggests that dependence on piecework across seasons and the gender of the household head were unrelated. Poverty thus propelled households above all reasons to supply their piecework labor during both the rainy and dry seasons.

Conclusion: A more precise framing of vulnerability resulted when a household's participation in piecework was assessed longitudinally. Supplying piecework labor cross-seasonally signified vulnerability to food insecurity in this context. Misclassifying a household who exclusively supplies their piecework labor only in the rainy season as "vulnerable" would distort the severity of insecurity in an area. The results underscore how important piecework labor is to rural livelihoods in Zambia. Many households utilize piecework labor to carry out their livelihoods and address seasonal food and labor shortages. For some households, however, participation in the supply of piecework labor is no longer seasonal. Policy makers and applied programs must recognize that while piecework labor can greatly assist these households, their chronic dependence on piecework should not be regarded as a substitute for their secure livelihood.

2.3.3 Paper three

The third paper included in this dissertation is entitled "The relationship between relative deprivation and adult nutritional status in rural Zambia." The paper is under review at the *American Journal of Human Biology*. The main objective of the paper was to examine statistically the association between adult nutritional status and relative deprivation.

Methods: A multilevel model was used to account for the non-independence among observations. Body mass index (BMI) was employed as the dependent variable in the regression model. The key independent variables included in the model were asset worth per capita (a proxy for individual absolute income) and subjective SES (measured subjectively by asking study participants to position their households relative to other in the community socioeconomic hierarchy). Subjective SES is considered a measure of relative deprivation (Singh-Manoux et al. 2005; Kondo et al. 2008) and may more accurately reflect a person's relative social position compared to an objective measure of SES (Singh-Manoux et al. 2005: 860). The model controlled for other correlates of health including age, gender, and educational level. A total of 254 observations were available for use in the model.

Main results: A positive relationship was determined between individual absolute income and adult BMI at the 1% level. A negative and statistically significant relationship at the one-percent level was found between adult nutritional status and lower subjective SES. Lower perception of place within the socioeconomic hierarchy was on average associated with a 0.44 decrease in adult BMI.

Conclusion: A negative relationship between lower subjective SES and adult nutritional status was found, independent of absolute income. The result provides evidence that lower perception of place within the local socioeconomic hierarchy was an important determinant of adult short-run nutritional status in this context. The relationship between health and subjective and objective measures of relative deprivation should be explored in greater depth in developing countries, where research tends to focus on material instead of relative deprivation as a key determinant of individual health.

2.4 Implications for Future Research

This dissertation explored the intricate relationship between adult health and both material and relative deprivation in a developing country context where rural households are often lumped together and characterized as "poor," "food insecure," and "disadvantaged." The dissertation research collected a wide variety of data across both the rainy and dry seasons in 2009 using a mixed methodology that aimed to diversify the tool kit utilized to evaluate the health consequences of social and economic inequalities in rural Zambia. The theoretical approaches used were equally "broad," "holistic," and "mixed" to ensure that aspects of people's livelihoods and overall well-being were considered. I lived full-time in the research area, trained and employed local research assistances, and participated in or attended numerous events perceived as "unrelated" to my research [e.g., playing in the Independence Day football match between older men of Chiyembekezo (my team) and Grade 7 pupils]. In short, I left my research site feeling like I had the means to produce a solid dissertation.

After months of data entry and cleaning, it became evident that limitations existed in the ways I captured certain phenomena or drew my study sample. This required an in-depth examination of parts of literatures that I failed to notice previously. Certain limitations were overcome using more sophisticated statistical analyses, for example, using multilevel models instead of fixed-effects. Others were reserved for sub-sections in the papers labeled (rather unoriginally) "study limitations." Like most experiences though, the analysis, write up, and attempts at publishing the papers in scholarly journals taught me more than I ever imagined. This growth (if I may) forms the bulk of the content that comprises this last section of the dissertation.

First, the mental health score created and used as a dependent variable assumed that all items (the 20 questions on the mental health questionnaire) equally determine a person's mental health status. It could be argued that certain somatic items deserve less/more weight than certain psychological items. As a result, Dr. Tembo and I used principal components analysis (PCA) to determine higher weights for the questions that varied the most across individuals. However, the "mental health index" computed using PCA and the raw mental health score were almost perfectly correlated. Alternatively, locally derived weights could be computed using various strategies. One strategy would be to use focus group discussions to help determine which symptoms most appropriately distinguish those with poor mental health in a particular context. The symptoms that emerge most frequently would be weighted more when constructing a mental health index.

Second, throughout this dissertation examples exist that suggest my preferred unit of analysis is the household-level. While I believe that data collected at the household level is incredibly important for use during certain types of analyses, the data may not reflect individual-level realities. One very obvious example is participation in piecework at the household versus the individual level. Future research should determine whom in the household supplies their piecework labor, the level at which each member of the household participates in piecework (e.g., the number of days in the past month or season), why each member participates, and how earnings are distributed (or not) within the household. The same applies for measures that aim to assess subjective SES or food insecurity, for example, when simply asking people to comment on these phenomena more generally at their household level. This is of particular concern when studies intend to collect both household- and individual-level data from all household heads (e.g., wife and husband). The experience of one member of a household may be totally different from that of another, and therefore, could shape biologies very differently. Future research should attempt to discern whether such intra-household variation exists on many of the topics explored in this dissertation including participation in piecework, subjective SES, food insecurity, social support, asset ownership, land ownership, crop production, among others.

Third, this dissertation employed a longitudinal study design, although survey data was only collected once in the rainy season and once in the dry season. It would be ideal if future research could collect survey data during other times of the year including before and after the "hungry" season, during and after the harvest season and before the

rainy/cultivation season begins. Obviously such a design would require more funding, more time, and more involvement by study participants who may not be interested in being studied under these terms. However, in order to better understand seasonality as a potent stressor in rural areas in the context of current changes at the global, national, and local levels, as well as climate change, longitudinal studies must include more frequent assessments within their study designs whenever possible.

Fourth, rural areas of Zambia are no doubt diverse. For example, in Northwestern Province many households cultivate cassava as their primary staple food, while in Eastern Province cassava is only consumed as a breakfast food or a snack. Cassava is commonly regarded as a "food security" crop or an inferior good in the literature (see Haggblade and Zulu 2003), and thus its market value and local significance in certain provinces of Zambia could arguably impact rural livelihoods very differently. Future research should investigate such possibilities by collecting comparative data in multiple provinces of Zambia where different primary staple foods are cultivated including cassava, maize, sorghum, millet and rice. And related, future research should consider other important and sometimes ignored factors such as the lineage system of a particular ethnic group and how land inheritance or residence patterns (e.g., virilocal versus uxorilocal) shape piecework arrangements, agricultural production including cash cropping, women's decision making, social support, and household food security.

Fifth, people living in rural areas are surely not the only population in Zambia exposed to many of the hardships highlighted in this dissertation. Individuals and households residing in urban settings throughout Zambia face very similar circumstances

(e.g., hunger or food insecurity), yet at the same time, carry out their livelihoods within a very different context. I wrote this dissertation in Chipata, the provincial capital of Eastern Province, Zambia. Pieceworkers visited my home on a daily basis asking for work slashing grass, gardening, digging rubbish pits, or any other task I could create to assist them for the day. One might ask whether enough opportunities exist to find piecework in urban Zambia, who is hiring/recruiting and supplying piecework labor, and why? While jogging throughout newly developed neighborhoods of Chipata, I observed regularly women and their children sharing a single room in large, half-built homes, making fritters (doughnuts) or hammering stones for sale to help pay rent and secure food for their families. Does food insecurity or hunger in an urban context of a developing country have a similar impact on people's mental health? Future research must begin to address many of the issues pursued in this dissertation, but instead with populations living in urban Zambia.

Finally, the results from this dissertation should encourage researchers and scholars working in developing countries to explore both the material and psychosocial experiences that play key roles in patterning variation in health. Anthropologists interacting with rural households in developing country contexts are ideally situated to examine the many complexities that shape biologies today. However, this dissertation has taught me that a global initiative, one that tackles poverty and social inequalities using a variety of lenses, is needed if we are to improve the health of those who are less fortunate.

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APPENDIX A: PAPER ONE

Cole, S.M. and Tembo, G. (2011). The effect of food insecurity on mental health: Panel evidence from rural Zambia. *Social Science & Medicine*, 73(7), 1071-1079.

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The Effect of Food Insecurity on Mental Health: Panel Evidence from Rural Zambia

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Abstract

A growing number of studies show support for a positive association between food insecurity and poor mental health in developing countries. Few of these studies, however, explore the relationship statistically employing longitudinal data. This study combines ethnography with randomly sampled household-level panel data (two waves) collected in 2009 to examine the association between food insecurity and mental health in rural Zambia. Mental health was measured using the Self-Reporting Questionnaire and food insecurity was assessed utilizing a modified 7-item scale based on local coping strategies used during food shortages. A multilevel linear regression model was employed with repeated measures nested within individuals (N = 280 observations) living in 81 households nested within 16 villages. Regression results confirm the postulated positive association between poor mental health and food insecurity. Food insecurity during the dry season, the time of year in rural Zambia when many households are typically food secure, had a subsequent greater effect on mental health than food insecurity during the rainy season. The difference in the effect was statistically significant at the five-percent level. In a country where mental health care resources are severely lacking, policy and applied efforts aimed at improving access to key agricultural resources, thereby increasing agricultural output, could potentially produce beneficial mental health outcomes.

Introduction

There is a recent surge in studies examining the relationship between food insecurity and common mental disorders (CMD) in developing countries (see Weaver and Hadley, 2009; Lund et al., 2010; also Hadley et al., 2008; Sorsdahl et al., 2010; Maes et al., 2010). This is not surprising given that the World Health Organization (WHO) 2020 estimates place depression, a CMD along with anxiety and somatoform disorders, as the second most common cause of long-term disability (WHO, 2001). Additionally, the most recent Food and Agriculture Organization (FAO) figures estimate that close to a billion people are hungry (or undernourished) in the world, the vast majority (98%) coming from developing countries and the highest proportion (30%) from sub-Saharan Africa (FAO, 2010). Hunger means a discomfort experienced from an involuntary lack of food consumption, while definitions of food insecurity emphasize that it occurs when both a sufficient quantity and quality of food cannot be accessed on a sustainable basis (see Weaver and Hadley, 2009). The experience of being hungry or food insecure is documented as a major source of distress in developing country contexts (e.g., Scheper-Hughes, 1988; Piaseu et al., 2004) and in many African countries specifically (Shipton, 1990; Pike and Patil, 2006; Hadley and Patil, 2006).

Prior studies demonstrate support for a positive association between food insecurity and CMD in developing countries (Weaver and Hadley, 2009; Lund et al., 2010), although in their review of food insecurity and mental health, Weaver and Hadley reveal a number of major gaps within the literature (2009: 277-280). Most notably, few longitudinal studies exist that also employ both quantitative and qualitative designs.

Quantitatively speaking, utilizing cross-sectional data to explore the relationship makes determining causality or the direction of influence difficult, and therefore, the possibility that poor mental health actually leads to or precedes food insecurity cannot be ruled out. By analyzing the relationship statistically using longitudinal data, inferences surrounding the relationship between food insecurity and CMD are permissible. Also, studies that include a qualitative component to their design are better equipped to detail the lived experience or gain a more nuanced understanding of what it means to be food insecure (e.g., see Moreno-Black and Guerron-Montero, 2005), and ultimately, provide important insight into why being food insecure could or could not translate into poor mental health.

Studies that begin addressing this gap would make inroads in determining whether the positive association between food insecurity and CMD in developing countries is as robust as is currently suggested. This is important for a number of reasons, but especially for policy makers and applied programs working at the local level because of the potential gains to both mental *and* physical health by means of improving access to sufficient, safe, and nutritious food (see Weaver and Hadley, 2009). Given the current level of attention and resources allocated to tackling food insecurity by the international community (e.g., the US government's global hunger and food security initiative, *Feed the Future*), substantiating whether food insecurity is a key determinant of CMD may also help rationalize the inclusion of mental health into government and non-government agencies' overall social welfare agendas. This is particularly salient for countries in Africa, where mental health is grossly under-prioritized (Lund, 2010).

This study uses survey data from a longitudinal sample of households in rural Zambia to quantitatively assess the relationship between adult mental health status and food insecurity and determine whether the relationship differs across seasons (e.g., Hadley and Patil, 2008). Seasonal food insecurity while occurring for a limited period of time is generally predictable, and thus conceptually, an intermediate of transitory and chronic food insecurity (see Devereux, 2006; FAO, 2008). In rural Zambia, shortfalls in food supply regularly occur in the rainy (or cultivation) season, whereas during the dry season many households, but certainly not all, tend to be food secure. The ethnographic data from the study area indicate that food insecurity can bring about *nkhawa* (anxiety/worry), resulting in someone becoming *kudwala na maganizo* (sick with thoughts), one local idiom used to describe mental distress in *Cichewa*. *Nkhawa*, as a possible conduit linking CMD with food insecurity across seasons, is further explored below.

Methods

Study area

This study was carried out from January through December 2009 in a rural setting in Katete District of the Eastern Province of Zambia. The study area, comprising over 320 households in 16 villages, was chosen mainly because of the seemingly large inter-household disparities in agricultural production, asset ownership, and other key indicators of livelihood security. Chewas are the predominant ethnic group living in the area.

Chewas cultivate maize as their main food crop, which is processed into maize-meal, cooked, and consumed as *nsima* (a thick porridge), the primary staple. Subsidized fertilizer and hybrid seed disproportionately accessed through the government-funded input programs provide the resources needed to help cultivate maize, and for some, a surplus to be sold as an added cash crop along with groundnuts and cotton. Rocky soil conditions in the area make hoe cultivation extremely difficult. Those who own plows and cattle are at a distinct advantage. Cattle are a sign of wealth and are rarely consumed. Instead they are used to help with various agricultural and non-agricultural tasks. Goats, pigs, and chickens are used for home consumption, but also sold to generate income or purchase supplementary maize during periods of hunger, to feed people during various occasions, among other reasons. Lacking access to these key agricultural resources makes securing one's livelihood challenging.

Some households experience shortfalls in food supply during the rainy season (November – April), which roughly coincides with the cultivation season. In the study area, field preparation starts in late October or early November, with the planting of maize commencing either right before or after the first rains. Chewas then begin planting cash and other food crops. Weeding starts in December and lasts through February or early March, depending on the crop. This period, when labor demands increase, is regarded as the height of the hunger season. Locally, Chewa-speaking people use the term *njala* (hunger) when someone's food stock, specifically maize, becomes depleted. One strategy employed to cope during periods of hunger or food shortages is to ask another household for assistance, typically through *ganyu* (casual labor). In exchange for

weeding in someone's field, for example, maize, maize-meal, or money is paid. While *ganyu* helps solve people's immediate food needs, attention to people's own fields diminishes. As hunger persists so too does the neglect for people's fields, creating a similar if not worse condition the following year [as Whiteside (2000) suggests is the case in rural Malawi].

Dried maize is the first crop harvested starting in late April/early May followed by cotton, groundnuts, and minor food crops. Cotton is the only agricultural commodity with a highly established private sector presence. Small-scale vendors, also known as briefcase buyers, flood the maize/groundnut markets purchasing at mostly inequitable prices. Since many Chewas rely solely on local market conditions, the disadvantaged sell the little they have to meet their basic needs, while others are forced to sell part of their food stock resulting in early food shortages/hunger.

Sample and survey design

Based on a total household population census of the area, a proportionate stratified random sample was drawn. Key informant interviews were used to designate six village wealth strata including "better-off," "above-average," "average," "below-average," and "worse-off," as well as one "other" stratum made up of teachers and individual farmers not living in one of the 16 villages[i]. Each household name was put under its respective wealth stratum and numbered. The proportion of households in each stratum, derived from the total household population, was then obtained. The

percentages were used to draw a random sample of 99 households (30.7% of the total household population).

Based on focus group discussions, a compilation of questionnaires, and consensus translation and back-translation by a group of three research assistants (two female, one male), a pilot test of the survey was conducted. The final questionnaire took into account any confusion with certain questions or clarification that required attention during the piloting phase. The first of the two waves of interviews began near the end of the rainy season in April 2009 and lasted to the beginning of July. The second wave started in early October and ended in late November 2009, just before the beginning of the rainy season. Eighty-three households took part in the interviews in wave one (an 83.8% response rate). A household here is defined as "a family-based co-residential unit that takes care of resource management and the primary needs of its members" (Niehof, 2004: 323). Each interview was conducted with all heads of the household (e.g., both husband and wife). Individual- and household-level data were collected. It is important to note that the individual-level data (e.g., on mental health and physical illness) were collected in the presence of the spouse or other household head(s).

A total of 151 individuals (or household heads) were interviewed in wave one. Ten of these individuals discontinued participation in wave two. Four moved from the study area and another six discontinued due to a lack of interest (3), divorce (2), and one participant died shortly after wave one. There were some missing data for one participant who did not answer any of the questions pertaining to mental health. Ten observations (individuals from two households) were determined points of high leverage because of

their extreme values on one of the independent variables used in the regression model, value of assets owned, and therefore were dropped from the data analysis. After pooling the data from both waves the total number of observations was 280. Logistic regression analysis was conducted to test for attrition bias. Those who participated in both waves did not differ significantly from attriters on key characteristics including food insecurity, household wealth, gender, age, physical health status, education, and the mental health outcome variable described below. This implies that the data did not need to be corrected for attrition.

The ethnographic data were collected using a variety of methods. Focus group discussions were used to help localize the survey instrument and explore coping strategies people employ in times of food insecurity. Structured and unstructured interviews were carried out in order to gain an in-depth understanding of the various sources of distress in the area, and how such distress might lead to poor physical or mental health. Participant observation was conducted throughout the study period, including regular visits to people's fields and gardens, villages and homes, and to the rural health center. The first author also attended agricultural meetings, school functions, sporting matches, funerals, weddings, and observed people participating in community development projects. The University of Arizona's Human Subjects Protection Program approved the research procedures and the University of Zambia's Research Ethics Committee granted ethical clearance. Local leaders granted permission for the first author to live and work full-time in the area during the course of the study.

Variable construction

Mental health – the dependent variable

Individual mental health was assessed using the Self-Reporting Questionnaire (SRQ), a 20-item retrospective (in the past month) survey with yes/no answers that measures psychiatric symptomatology. The questionnaire was designed by the WHO and is a relatively easy-to-administer screening device for common mental disorders (WHO, 1994). The SRQ includes both somatic items (e.g., headaches, loss of appetite, tiredness) and psychological items (e.g., feeling unhappy, nervous, worthless). It is used throughout the developing world (Harpham et al., 2003), including in many African settings (Hanlon et al., 2008; Pike et al., 2010) and specifically in Lusaka, Zambia (Aidoo and Harpham, 2001) and with the Chewas of Malawi (Stewart et al., 2009). Internal consistency of the SRQ in this sample was measured using Cronbach's α and was acceptable at 0.84.

A score for the SRQ is obtained by adding up all the affirmative responses. Typically a cut-off point to distinguish "cases" of poor mental health is determined by a mental health professional. In developing countries a cut-off point of ≥8 is common (Harpham et al., 2003), although a number of studies in sub-Saharan Africa have determined a range of cut-off points. For example, a cut-off point of ≥4 in Sudan (Harding et al., 1980), ≥7 in urban Zambia (Aidoo and Harpham, 2001), ≥8 in rural Malawi (Stewart et al., 2009), and ≥10 in South Africa (Freeman et al., 1991). No cut-off point was determined for use in this rural setting, and therefore, we follow Hadley and Patil (2008) and use the SRQ score as a continuous dependent variable, the idea being

that a higher score indicates poorer mental health status [see Hanlon et al. (2008: 259) for additional support for using a continuous score].

Using the raw score, however, assumes that the items included in a given questionnaire equally determine an individual's mental health status. Another strategy we considered, consequently, was to compute a "mental health index" by performing principal components analysis (PCA) of the different questions that structure the SRQ. In PCA, each question (or variable) is weighted according to its contribution to the phenomenon being assessed, in this case, mental health. Those questions that vary the most across individuals are allocated higher weights. Spearman's rank correlation between the mental health index and the SRQ score was positive and highly significant (r = 0.9963, p-value < 0.0001), and therefore we opted for the use of only the SRQ score as the dependent variable in our regression analysis.

Independent variables

Household food insecurity

Household food insecurity was assessed using a modified 7-item scale proposed by Maxwell (1996). The scale is based on coping strategies employed during food insecurity. Hadley et al. (2007) utilized the scale to look at the relationship between food insecurity and social support in rural Tanzania, where it showed adequate internal consistency and was considered a valid measure of food insecurity. While the movement toward experienced-based measures of food insecurity is gaining more and more support

(Hadley and Wutich, 2009), indicators based on coping strategies seem to capture similar information (Usfar et al., 2007; Maxwell et al., 2008; Hadley and Wutich, 2009).

The scale used in this study was constructed first using a number of focus group discussions to identify local coping strategies used in times of food insecurity. The following were identified as the seven most common strategies: 1) consuming relish (a side dish, i.e., pumpkin leaves) without *nsima* (the staple food); 2) borrowing money or food from relatives or friends; 3) selling/trading livestock or personal items to get more food; 4) doing *ganyu* (piecework) for food or money to buy/get food; 5) gathering wild foods or cooking bananas to eat in place of *nsima*; 6) going to sleep hungry; and 7) sitting the entire day without food. Household heads were asked if they employed each strategy "never," "some days," "many days," or "every day" over the course of the rainy or the dry season. Scoring ranged from 0 if a household head responded "never" to 3 if they responded "every day." Weights can be applied to strategies to reflect the severity of using such a strategy (see Maxwell, 1996). Weights used in this study were informed by the ethnographic data; going to sleep hungry and sitting the entire day without food were weighted 1.5 and 2.0, respectively. Higher values of the scale signify increased severity of household food insecurity. The result of Cronbach's alpha statistic ($\alpha = 0.81$) suggests reasonable internal consistency of the household food insecurity scale in this sample.

Interaction Term

A variable was constructed using the household food insecurity scale, an interaction term between the scale and a survey period two indicator variable equal to one if the observation comes from wave two of survey interviews and zero if the observation comes from wave one. By including the interaction term in the regression model described below, we are able to estimate the effect of household food insecurity on the SRQ score at wave one and wave two, and thus estimate the change in the effect between the two survey periods.

Value of Household Assets

Given the extreme value Chewas place on livestock ownership in the study area, household heads were asked how many total cattle, pigs, goats, chickens, and ducks the household owned along with a number of important household assets including ox carts, ploughs, cotton sprayers, hoes, axes, bicycles, sewing machines, couches, mattresses, wood chairs and tables, radios, and cell phones. The number of each household asset and livestock owned was multiplied by its local market price and the variable representing the combined value of assets owned by the household was created.

Perceived household social support

Social support operates as a potential buffer against distress (Dressler, 1991; Berkman, 1995), and is regarded as a psychosocial resource (Taylor and Seeman, 1999). Hadley et al. (2007) showed a positive relationship between social support and food

security in rural Tanzania, suggesting that social support may mitigate the impact of seasonal food insecurity. We are not aware of any study that explores statistically the relationship between food insecurity and mental health while also controlling for social support.

This study assessed perceived social support by asking household heads if people in their community would help them with food in times of hunger. Responses were scored so that "no" received a 0, "sometimes" a 1, and "yes" a 2. Responses "sometimes" and "yes" were combined and a dichotomous variable was created that represents simply, support in times of hunger.

Control variables

Variables previously shown to impact mental health such as gender, marital status, age, educational level, and physical health status (e.g., see WHO, 2001; Patel and Kleinman, 2003; Das et al., 2007) were assessed in this study. Physical health status was measured by asking each household head if they experienced illness in the past two weeks. A dichotomous variable was created: yes = 1, no = 0. The variable representing age is how many years old the individual was at the time of the interview. The female dummy variable represents 1 for female, 0 for male. The married dummy means 1 if married and 0 otherwise (e.g., divorced/widowed). Educational attainment is the number of total years of education. The variable household size indicates the current number of people living in the household and the variable dependency ratio represents the proportion of people living in the household less than 15 and greater than 59 years of age.

Data analysis

Given the nature of the sampling design, a multilevel model was used to explore the relationship between household food insecurity and adult mental health. A multilevel model accounts for the clustering in the observations at the village, household, and individual levels. By estimating a model with "fixed effects" (the independent variables described above) and villages, households, and individuals all specified as "random effects", the possible non-independence among observations within each level of clustering is accounted for in the model. Stated differently, the error terms between individuals within the same level of clustering (either at the village or the household) or within the individual (due to repeated measures) could be correlated because of the shared heterogeneity and thus a multilevel model is required. Figure 1 presents schematically the four-level model with repeated measures (SRQ scores) nested within individuals living in households nested within villages.

--Figure 1 approximately here--

Data analysis was carried out using STATA 10.0. The descriptive statistics are presented as means for the binary data and as medians with 25th and 75th percentiles for the continuous data. Differences by wave of measurement for the continuous data were assessed using the Wilcoxon rank-sum test and a *t* test was used for the binary data. Spearman's rank correlation was utilized to ascertain whether an association between key variables existed.

The multilevel model was estimated using maximum restricted likelihood. The intraclass correlation (ICC) was used to determine the proportion of the total variance in SRQ scores at a given level, defined as: variance$_{\text{between-level}}$ / total variance. Although households with only one individual (23.5% of the households in the sample at wave one) and individuals with only one measure (6.9% of the individuals in the sample at wave one) were unable to contribute to the household- or individual-level variance estimates, we follow Chandola et al. (2005) and include them in the analysis because they did contribute to the fixed effects estimates.

Results

Table 1 provides the descriptive statistics by wave of measurement. The overall median SRQ score in the sample was 7.0. The median SRQ score at wave one was significantly higher at 9.0 compared to 5.0 at wave two (p-value < 0.0001). As a way of further substantiating the utility of the SRQ score as a suitable indicator of mental health status, a Wilcoxon rank-sum test was carried out to determine whether the SRQ score differed for those individuals who self rated their mental health status as "poor" and those who rated their status as "good/excellent". The median SRQ score for those who self rated their status as "poor" was significantly higher at 10.0 compared to 5.0 for those who self rated their mental health status as "good/excellent" (p-value < 0.0001).

--Table 1 approximately here--

The overall median score of the household food insecurity scale was 1.0. The median score indicating the level of household food insecurity over the course of the

rainy season was significantly higher than the median score indicating the level of household food insecurity over the course of the dry season (p-value < 0.0001). Overall, 36.1% of the sample was food secure, 17.5% was considered low food insecure, 21.1% medium food insecure, and 25.4% of the sample was high food insecure. Observing individuals based on their household's food insecurity classification across the two seasons revealed a rather expected, but important result. Over 44% of the sample was classified as high food insecure over the rainy season, 29.0% as medium, 12.4% as low, and only 14.5% as food secure. The inverse occurred over the dry season, with 59.3% classified as food secure, 23.0% as low food insecure, 12.6% as medium, and slightly over 5% as high food insecure. Additionally, there was a significant and positive correlation between the food insecurity scale and the SRQ score (r = 0.39, p-value < 0.0001).

Besides physical health status, very few differences existed across the waves with regards to support in times of hunger, value of assets owned, dependency ratio, household size, age, marital status, and educational status (all differences non-significant except for dependency ratio). This was a somewhat expected result given the relatively short time period between waves. The median SRQ score for those who were ill in the past two weeks, however, was significantly higher at 8.0 compared to 6.0 for those who were not ill (p-value < 0.0001).

Table 2 presents the regression results for the multilevel regression model. First, graphical methods were employed to help inspect the distribution of the dependent variable (see Figures A1-A2 in Appendix). Both the kernel density estimate and the Q-Q

plot indicate only minor departure from normality, and thus we opted for the use of a multilevel linear model. We then examined the distributions of the residuals of the random village, household, and individual effects after running the fully specified multilevel linear model (see Figures A3-A8 in Appendix). The histograms and Q-Q plots show that the standardized residuals were approximately normally distributed and suggest that our choice in modeling strategy was justified.

--Table 2 approximately here--

Second, the individual and village ICCs indicate that 3.8% and 3.0% of the total variance in SRQ scores occurred at the village and individual levels, respectively, while 50.0% of the total variance was at the household level. Only the estimated household-level variance was statistically significant.

Third, we present the results from the fixed effects part of the multilevel linear model[ii]. The presentation of the results requires some care because we included the interaction term in the model. The effect of household food insecurity on mental health at wave one is simply the coefficient estimate on household food insecurity (0.290), while the effect of household food insecurity at wave two is the coefficient estimate on household food insecurity plus the interaction term coefficient estimate, 0.290 + 0.448 = 0.738. Thus, a one-unit increase on the household food insecurity scale was associated with a 0.290 increase in the SRQ score at wave one, and at wave two, the effect of household food insecurity on mental health status increased to 0.738. The coefficient estimate on the interaction term (0.448) measures how the effect of household food insecurity on mental health changed over the two survey periods. Since the z statistic on

the interaction term was $0.448/0.196 \approx 2.279$, the difference in the effect was statistically significant at the 5% level. None of the coefficients on any of the other variables were significant except for the coefficient representing illness. Being ill over the two weeks prior to the survey was on average associated with a 1.323 increase in the SRQ score, regardless of the survey period.

Discussion

This study builds on the existing mental health literature by using randomly sampled household-level panel data from rural Zambia to investigate the relationship between food insecurity and poor mental health. The main result from this study is that a positive and significant association between household food insecurity and poor mental health was found. The effect of household food insecurity on mental health was greater at wave two (the dry season) than at wave one (the rainy season). The difference in the effect was statistically significant at the five-percent level. We must bear in mind that the recall period on the measure of food insecurity was the rainy season or the dry season, while the assessment of mental health began near the end of each of these seasons and the recall period was one month. This could be viewed as a limitation of the data, and therefore, a more precise framing of the main result is that household food insecurity in the dry season had a subsequent greater effect on mental health than household food insecurity in the rainy season.

The complementary qualitative data provide some insight into why being food insecure during the dry season could then translate into poorer mental health. Shortly

after the last rains fall, Chewas begin harvesting their crops. For many, this is a time of relative abundance and thus food security. Some households, however, fail to harvest an adequate amount of food and must adopt a variety of strategies to cope including relying on support from their food secure neighbors (e.g., *ganyu*). Their circumstances can change as the rainy season approaches, because gradually, fewer and fewer households have money or maize to pay for *ganyu*. There are the additional concerns associated with cultivating their own fields, with illness, or with trying to secure basic goods like salt or soap. Perhaps most distressing is the realization that the next harvest season is still distant. One local leader in the study area explained, quite compellingly, how such concerns can make someone *kudwala na maganizo* (sick with thoughts) through the conduit, *nkhawa*:

> "When you worry too much about something *nkhawa* arrives in the heart
> and then the heart sends [*nkhawa*] to the head where the head translates
> the information, which impacts the workings of the body. Even if you felt
> hunger a day or two before, because of *nkhawa* you no longer have an
> appetite because of the way [*nkhawa*] affects your body."

Miller and Rasmussen (2010) argue that stressful life events do not necessarily need to be traumatic or extraordinary in nature (e.g., living in an armed conflict setting) to profoundly affect mental health. Rather, "…the less dramatic but more enduring stressful conditions of everyday life that eventually take the greatest toll on people's psychological wellbeing" (*ibid*., 12). In rural Zambia experiencing *njala*, particularly

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during the dry season, can bring about *nkhawa* for some and the resultant poor mental health.

Additionally, there is the "relative food insecurity" hypothesis put forward by Hadley and Patil (2006). They borrowed from the income inequality/health literature and suggested that the effect of food insecurity on mental health may be even greater during the dry season when many households tend to be food secure. This is because comparisons made by those who are food insecure can produce negative emotions, which are translated "inside" the body and can contribute to poor mental health (Wilkinson, 1996).

The second key result is that a positive and significant association between poor physical health and poor mental health was found. The comorbidity result found in this study is consistent with past findings (e.g., see Patel et al. 1999; Patel and Kleinman, 2003; Das et al., 2007). One explanation of a possible link between poor physical health and poor mental health in this study is implicit in one woman's words: "I feel worried especially when the rainy season approaches because I fear that illness will hinder me from cultivating enough food." Here, the upcoming rainy season brings uncertainty about her physical health, which becomes a source of anxiety because it may affect her future food production.

The third key result is that the household was an important context in which the clustering of mental health took place. This is also consistent with past studies that showed that individuals living in the same household share similar mental or physical health (e.g., Weich et al., 2003; Subramanian et al., 2003; Chandola et al., 2005; Das et

al., 2007). In this study, the contextual mechanism that helped explain the clustering of mental health within households was food insecurity. This finding suggests that policy and applied programs aimed at improving access to food at the household level, as opposed to the village or individual level, may have a greater impact on mental health.

Study strengths and limitations

The main strength of this study is that it employed household-level panel data together with ethnography to examine the mental health consequences of food insecurity across seasons in a developing country context. As a result, inferences take into account changes in access to food, in illness, and in household wealth, all of which are common experiences in rural settings throughout the developing world. This study included all heads of the household in its sampling design, an atypical feature of past study designs. This allowed for a broader analysis of adult mental health. It also required the use of a multilevel model to account for the various levels of clustering at the household as well as the village and individual level. Consequently, this study was able to provide additional support that the context in which an individual resides matters to mental health.

The study is not without limitations. As was already mentioned, survey interviews were conducted towards the latter part of the rainy and dry seasons and there was some degree of mismatch between the recall periods on the measure of mental health and food insecurity. Ideally, the assessment of mental health would occur at the beginning and end of the seasons to truly gain a robust understanding of the change in the

effect of food insecurity on mental health. Second, and as Stewart et al. (2009) point out in their study with the Chewa-speaking people of Malawi, the use of mental health questionnaires like the SRQ may attribute somatic symptoms related to depression to those related to physical illness, particularly in contexts where physical disease is common. Given the pervasiveness of diseases like malaria, tuberculosis, and HIV/AIDS in rural Zambia, this could explain why the median score on the SRQ (7.0) was relatively high compared to scores from some other studies. Third, interviewing couples together during the collection of the individual-level data may have influenced the way both groups responded to some of the questions, particularly the questions that comprise the SRQ. When piloting the survey the first author observed that husbands and wives were uncomfortable being separated. The severity of mental health, especially that of women, may actually be underestimated in this sample as a result. Finally, the use of only two panels and the relatively short time period between survey waves obviously prohibits any long term assessment of change. Future research should incorporate a greater number of survey waves (e.g., more than three) and a longer follow-up between waves when designing their studies.

Briefly before concluding, this study explored the use of a "mental health index" weighted by principal components. Future research should begin developing alternative techniques to weighting items on a given mental health questionnaire. As one possibility, Okello and Ekblad (2006) asked focus-group participants to identify subtypes of depression using case vignettes that represented someone with a variety of depressive symptoms. Group participants could instead develop vignettes that describe individuals

within their community who are "sick with thoughts" or who "think too much" (Patel and Mann, 1997). The symptoms that emerge more frequently or that differentiate between those with "severe" versus "mild" CMD, for example, would accordingly be allocated higher weights when constructing an index.

Conclusion

The ethnographic data used in this study indicate that food insecurity is a source of distress for Chewas. In the study area people talked about the constant challenges associated with securing an adequate amount of food year round, along with those related to illness and having a lack of money to buy basic household goods or to process maize for consumption. Regression results for the most part corroborate these qualitative findings, enabling this study to conclude that household food insecurity and poor mental health were positively related, although the relationship varied across seasons.

Policies and applied programs that improve access to key agricultural inputs in rural areas where people cultivate the land as a primary means of securing food, could potentially improve mental health through the increase in agricultural output. Adequate targeting of households who lack access to these key resources would be a foremost requirement. This same line of thinking applies to improving access to better health care along with government and non-governmental agencies beginning to incorporate mental health into their overall program designs (see Prince et al., 2007). This includes not only agencies working under health, but those working to improve the quality of people's livelihoods in general. This is especially urgent given the "…alarming scarcity of trained

mental health care professionals within the mental health care sector in Zambia" (Sikwese et al., 2010: 555).

This study also highlights the need for carefully designed studies that use contextually relevant, culturally sensitive approaches when exploring the factors shaping mental health in developing countries today; what is salient to mental health in one setting may be completely independent of mental health in another, echoing the point made by Hadley and Patil (2008). In so doing, applied efforts together with policy are better equipped to assist in reducing disparities between people, thereby creating a more balanced condition for all.

Endnotes

[i] Only one household (a teacher) from the "other" stratum participated in the study. During data analysis this household was included in the village located next to the school.

[ii] We also ran a multilevel Poisson regression as a test of sensitivity of the results to our modeling choice. The full model failed to converge. This could be due to a number of reasons including estimating random effects that are approximately or equal to zero (see Hox, 2002). When we excluded the level of the village the model converged. The results (not shown) were similar to those from the multilevel linear model.

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Appendix

Kernel density estimate and Q-Q plot of the SRQ score and histograms and Q-Q plots of the standardized residuals for the random village, household, and individual effects (see Figures A1-A8).

--Figures A1-A8 here--

Figure Captions

Figure 1. Diagram of the various levels specified in the regression model.

Figure A1. Kernel density estimate of SRQ score.

Figure A2. Quantiles of SRQ score against quantiles of normal distribution.

Figure A3. Histogram of standardized residuals (village-level).

Figure A4. Quantiles of standardized residuals (village-level) against quantiles of normal distribution.

Figure A5. Histogram of standardized residuals (household-level).

Figure A6. Quantiles of standardized residuals (household-level) against quantiles of normal distribution.

Figure A7. Histogram of standardized residuals (individual-level).

Figure A8. Quantiles of standardized residuals (individual-level) against quantiles of normal distribution.

Figures and Tables

Figure 1

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           ┌─────────────┐
           │  Level 4:   │
           │  Villages   │
           └─────────────┘
                  ▲
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           ┌─────────────┐
           │  Level 3:   │
           │ Households  │
           └─────────────┘
                  ▲
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           │  Level 2:   │
           │ Individuals │
           └─────────────┘
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           │  Level 1:   │
           │ SRQ scores  │
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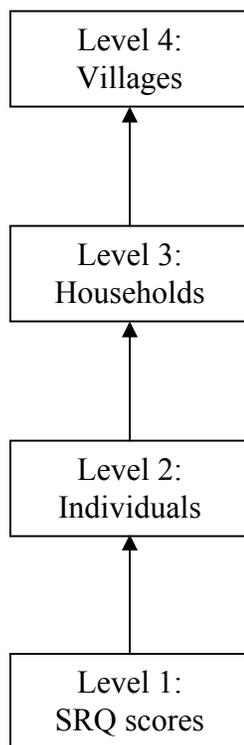
Table 1. Descriptive statistics, by wave of measurement; see notes.

	Both Waves	Wave 1	Wave 2	
	(n = 280)	(n = 145)	(n = 135)	p-value[a]
SRQ score	7.0 (4.0,10.0)	9.0 (5.0,12.0)	5.0 (2.0,8.0)	<0.0001
Food insecurity scale	1.0 (0.0,4.5)	3.0 (1.0,6.5)	0.0 (0.0,1.0)	<0.0001
Food secure	0.361	0.145	0.593	<0.0001
Low food insecure	0.175	0.124	0.230	0.020
Medium food insecure	0.211	0.290	0.126	0.001
High food insecure	0.254	0.441	0.052	<0.0001
Support in times of hunger	0.546	0.552	0.541	0.854
Value of assets owned	2.1 (0.9,5.5)	2.2 (0.9,5.5)	2.0 (0.9,5.5)	0.854
Dependency ratio	0.50 (0.4,0.7)	0.50 (0.4,0.7)	0.50 (0.4,0.6)	0.028
Household size	5.0 (3.0,7.0)	5.0 (3.0,7.0)	5.0 (4.0,8.0)	0.460
Age	40.8 (25.5,51.4)	40.7 (25.4,51.0)	41.0 (25.5,51.8)	0.703
Married dummy	0.843	0.848	0.837	0.797
Illness dummy	0.329	0.372	0.281	0.106

Notes: Values for the continuous variables are provided as the median (25th,75th percentiles in parentheses). Values for the binary variables are provided as means.

[a]Values obtained either by Wilcoxon rank-sum or t tests, where applicable.
The variable "value of assets owned" was divided by K1,000,000 (kwacha).

Table 2. Multilevel linear regression results for the SRQ score model; see notes.

Random effects estimates	Variance	SE		ICC
Level 4: between villages	0.577	(0.945)		0.038
Level 3: between households	7.549	(1.856)	**	0.500
Level 2: between individuals	0.446	(0.808)		0.030

Fixed effects estimates	Coeff.	SE	
Constant	6.332	(1.754)	**
Food insecurity scale	0.290	(0.098)	**
Wave (survey period two =1)	-2.276	(0.484)	**
Food insecurity scale X wave	0.448	(0.196)	*
Support in times of hunger	-0.523	(0.467)	
Value of assets owned	-0.059	(0.094)	
Dependency ratio	0.806	(1.584)	
Household size	0.012	(0.144)	
Age	0.007	(0.023)	
Married dummy	-0.470	(0.955)	
Illness dummy	1.323	(0.407)	**
Female dummy	0.567	(0.413)	
Education (years)	0.127	(0.080)	

Notes: Total number of observations=280.
Total number of individuals=145, households=81, and villages=16.
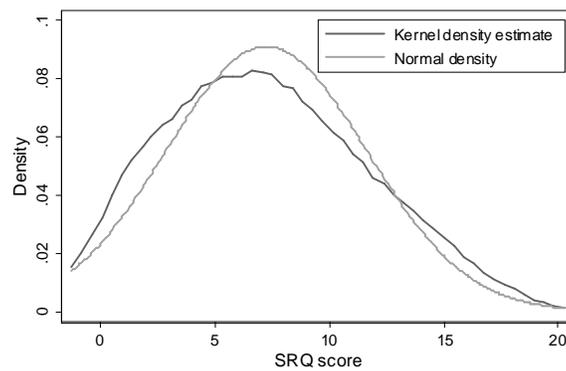The variable "value of assets owned" was divided by K1,000,000.
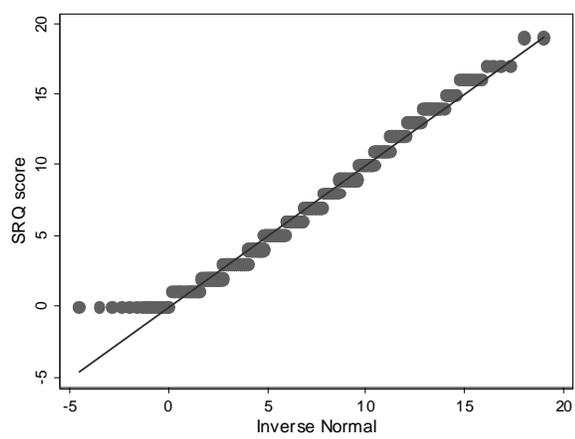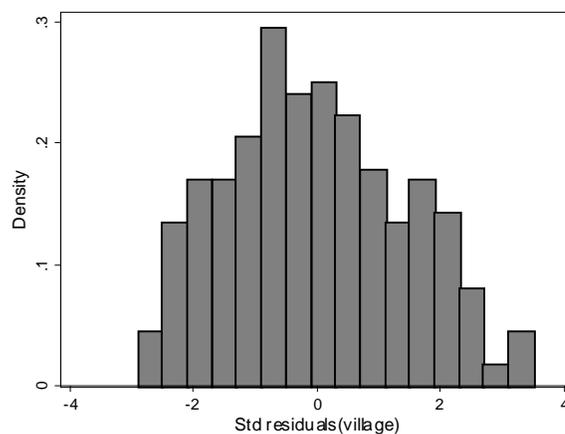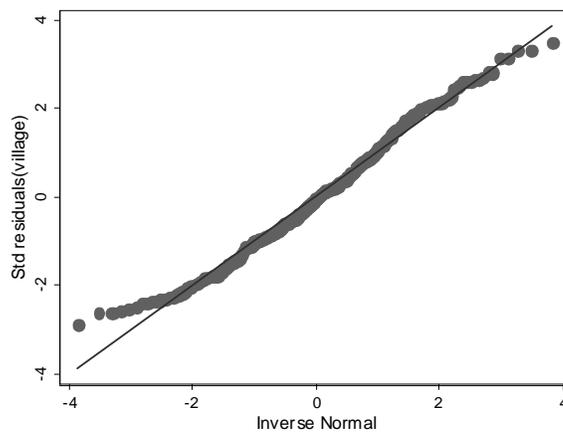Significance, **<0.01, *<0.05.
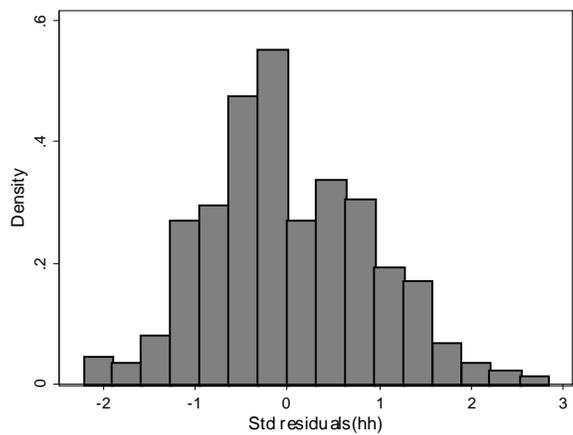
Figure A1

Figure A2

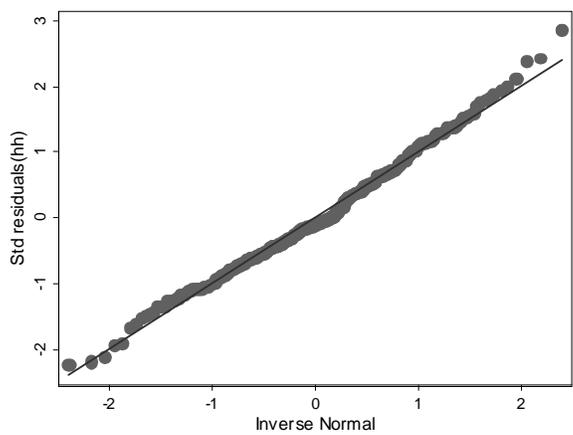Figure A3

Figure A4

Figure A5

Figure A6

Figure A7
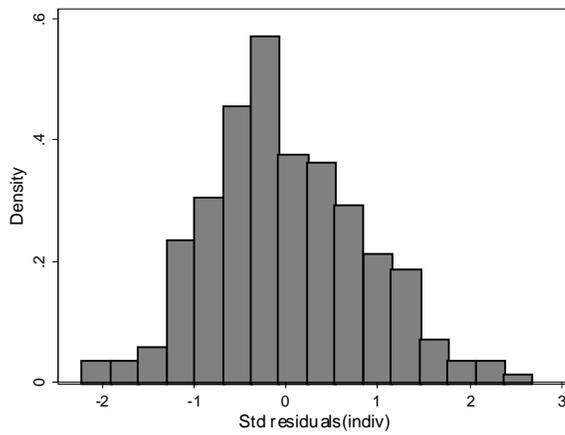
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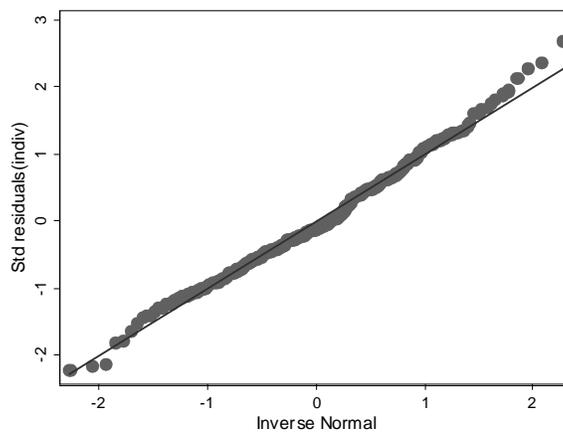
APPENDIX B: PAPER TWO

Cole, S.M. and Hoon, P.N. (*in press*). Piecework (*ganyu*) as an indicator of household vulnerability in rural Zambia. *Ecology of Food and Nutrition*.

TITLE PAGE

Title:
Piecework (*ganyu*) as an indicator of household vulnerability in rural Zambia

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Abbreviated Title:
Piecework as a measure of vulnerability in Zambia

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ABSTRACT

Piecework (*ganyu*) is short-term, casual labor common in rural Zambia and neighboring countries. Reliance on piecework as a strategy to cope during food shortages in the rainy/cultivation season can restrict own-farm production, and thus, is regarded as an indicator of a household's vulnerability to food insecurity. Based on a household's level of participation in piecework, we explore this claim in rural Zambia using survey data collected during the rainy and dry seasons in 2009. We argue that seasonal assessments are essential if such dependence on piecework is used as a robust measure of a household's vulnerability to food insecurity.

Keywords: Zambia; Piecework; Vulnerability; Food insecurity; Coping strategies; Seasonality.

INTRODUCTION

In Eastern Province, Zambia many rural households experience food insecurity during the rainy season as food stocks produced during the previous cultivation season become exhausted some three to four months prior to the upcoming harvest season. One strategy used to respond to this "hunger gap" (Devereux, 2009) is to supply short-term, casual labor or *ganyu* (piecework in *Cichewa*). Labor is typically exchanged for cash or an in-kind payment (e.g., maize), and while the exchange enables those short of food to navigate through the rainy (also the cultivation) season, supplying piecework labor during this time of year can bring about longer-term consequences. When households depend too heavily on piecework as a strategy to secure food their ability to cultivate a sustained food supply becomes restricted (see Hirschmann and Vaughan, 1983; Geisler, 1992; Moore and Vaughan, 1994; Devereux, 1999; Whiteside, 2000). Reliance on piecework labor during the rainy season is therefore regarded as both a coping strategy (Devereux, 1999; Whiteside, 2000) and a measure of a household's vulnerability to food insecurity (Bezner Kerr, 2005).

Piecework as a coping strategy is now well established in the literature. In contrast, no study has empirically evaluated whether dependence on the supply of piecework labor in the rainy season is a sound indicator of household vulnerability in this context. Vulnerability is a dynamic concept. "What is vulnerable in one period is not necessarily vulnerable in the next period" (Adger, 2006: 275-276). Accordingly, the use of a multi-period lens to view vulnerability's dynamism is paramount.

This study circumvents one of the main pitfalls that occur when cross-sectional data are used to make inferences regarding household vulnerability. Survey data collected in rural eastern Zambia during the rainy and dry seasons were examined based on a household's level of participation in piecework. Results show that the food security situation of households who supplied their piecework labor across seasons differed significantly from that of households who supplied their piecework labor only in the rainy season. This paper argues that we must take into account seasonal change in piecework status if we are to adequately determine the robustness of piecework as a measure of a household's vulnerability to food insecurity.

The paper is organized as follows: next, the concepts of livelihood security and vulnerability are reviewed as well as the literatures on piecework as a seasonal coping strategy and as an indicator of household vulnerability to food insecurity. In section two we detail the research methods used in the study and highlight the significance of piecework in the study setting. In section three we present and discuss the survey results utilized to support the study's main argument. The paper concludes by examining the broader implications of piecework as a measure of household vulnerability.

Tracking household vulnerability: Piecework as a coping strategy to seasonal food insecurity

This study evaluates household vulnerability to food insecurity using a livelihoods-based approach (e.g., Scoones, 1998; Bebbington, 1999; Ellis, 1998, 2000; Whitehead, 2002). Bebbington (1999: 2021) conceptualized rural livelihoods as being

"the diverse ways in which people make a living and build their worlds." Importantly, food security is just one of many components of the overall concept of livelihood security (Maxwell and Smith, 1992). Livelihoods are secure when adequate access to cash and other resources is maintained or improved upon over time such as access to safe and nutritious foods, health services, schooling, safe water sources, and opportunities to build social networks (Frankenberger, 1996). Livelihoods become vulnerable when people are exposed to "contingencies and stress" and are unable to cope (Chambers, 1989: 1). There are thus two dimensions to vulnerability: the external (exposure to risks) and the internal (inability to respond to perturbations).

Households throughout rural sub-Saharan Africa frequently encounter numerous risks that can impact their level of vulnerability (Casale et al., 2010). One rather predictable and salient risk is seasonality, as many rural households depend on uni-modal rain-fed agriculture to secure their livelihood needs (Adams, 1994; Kigutha et al., 1998; Ndekha et al., 2000; Devereux, 2009). Annegers (1973) noted the significance of seasonal food shortages in sub-Saharan Africa over forty years ago. Households respond during these times using the entitlements or "assets" they possess including those they acquire or exchange via social interactions (Sen, 1981). In general, the fewer assets households own or can mobilize the more sensitive they are, which makes them less likely to respond effectively when exposed to seasonal food insecurity, and in turn, more vulnerable (see Moser, 1998). Vulnerability is therefore recognized as a cause and symptom (as well as a component) of poverty (see Prowse, 2003).

Shipton's (1990) comprehensive review of strategies used in times of food scarcity and famines highlights the diverse ways rural households in Africa respond during food shortages (see also Baro and Deubel, 2006). Households in rural Zambia cope using a number of strategies such as shifting consumption patterns by eating less preferred foods, adopting more conservative food preparation techniques (e.g., grinding grain instead of pounding it), trading or selling livestock or personal belongings, and sending children to more fortunate kin residing in other areas (Colson, 1979; Cliggett, 2005). Several studies in Zambia also noted the significance of piecework labor as a means of coping during seasonal food insecurity. Audrey Richards (1939) observed how piecework labor assisted women in securing food in colonial Zambia (Northern Rhodesia) more than seventy years ago. Moore and Vaughan (1994) showed how piecework provided women in northern Zambia with an opportunity to exchange labor and food well into the late 1980s. Piecework was a substantial "survival strategy" used by households in rural Zambia during the height of neo-liberal economic reforms in the 1990s (Geisler, 1992).

More recently, Crooks et al. (2007, 2008) noted that poorer households in southern Zambia coped with food insecurity by exchanging their piecework labor with maize (see also Sitko, 2010). Ito (2010) found that piecework labor was primarily supplied to earn cash and address food shortages in her study in Southern Province, Zambia. Piecework is by no means unique to Zambia; studies in rural Malawi, Zimbabwe, and Tanzania have all detailed the important role piecework labor plays during times of food insecurity (e.g., Hirschmann and Vaughan, 1983; Adams, 1991a,

1991b; Devereux, 1999; Englund, 1999; Whiteside, 2000; Bezner Kerr, 2005; Bryceson, 2006; Peters, 2006; Takane, 2008; Mueller, 2011).

While piecework labor provides a means to avoid seasonal food shortages or reduce hunger, over-reliance on piecework during the rainy season could result in a lack of attention to own-farm production. This is piecework as an "erosive" response to seasonal food insecurity (Devereux, 1999) given that involuntary neglect would likely limit a household's ability to cultivate a sustained food supply (see Orr et al., 2009 for a counter argument). It is for this reason Bezner Kerr (2005) argued that dependence on piecework labor in the rainy season indicates a household's vulnerability to food insecurity. In the dry season, on the other hand, reliance on piecework may signify greater access to income generating opportunities as involvement in piecework does not compete with primary food production during this period. However, a household's vulnerability status is *not* static (see Alwang et al., 2001; Ellis, 2003; Devereux et al., 2006; Adger, 2006; Hart, 2009). According to Devereux et al. (2006: 2),

> To fully understand vulnerability it is not enough to simply take a one-period view; we need [to] know what happens in the next period. Vulnerability needs to be forward-looking, as it makes a prediction about future poverty (or other outcomes). Vulnerability does not simply refer to those who are likely to become poor in the future due to an unexpected shock, but also those who will remain poor, those who will fall deeper into poverty and those who may fall into poverty due to predicable fluctuations such as seasonality.

This study measured a number of outcome variables based on a household's level of involvement in piecework during the rainy and dry seasons to determine whether the supply of piecework labor in the rainy season indicates a household's vulnerability to food insecurity in rural eastern Zambia. Such an inquiry is relevant given that national

survey data indicate that piecework as a coping strategy has actually gained in significance in Zambia since the mid-1990s (CSO, 2006). In 1996, twenty-two percent of households in Zambia supplied piecework on-farm and 20% supplied off-farm, and in 2004, the proportion of households who supplied their piecework labor on- and off-farm increased to 34 and 37 percent, respectively. Establishing who in this context is vulnerable to food insecurity or at risk of becoming further entrenched in poverty is thus of utmost importance.

METHODS

Sitko et al. (2011) recently showed that the Eastern Province of Zambia is a major agricultural producer, contains few large-scale farmers (68 total) compared to other provinces in the country (e.g., Central Province has 534), and consists of the greatest number of rural households with less than one hectare (roughly 2.5 acres) of land. The current population size of Eastern Province is around 1.7 million people (CSO, 2011). In 2004, ninety-two percent of all households in Eastern Province lived in rural areas (CSO, 2006). Twenty-four percent of households were headed by women in 2004, the second-highest percentage in the country. Seventy percent of the population in Eastern Province was considered "poor," with 57% considered "extremely poor" and the other 13% regarded as "moderately poor." In brief, mostly rural smallholders live in eastern Zambia whose livelihoods depend on agriculture and are carried out under rather impoverished conditions.

The setting for this study is located in a rural area roughly 22 kilometers down a dirt road from Katete town in the Eastern Province of Zambia. Chewas are the main ethnic group living in the study setting. A household population census of the study setting was conducted in February – March 2009 and counted 322 households within 16 villages. A total of 99 households were then randomly sampled to participate in the study. Eighty-three households agreed to participate in the first wave of survey interviews that commenced toward the end of the rainy season in April 2009. Heads in each household (e.g., both wife and husband) were interviewed. Two households did not participate in the second wave of interviews that started in the dry season (early October) because of relocating from the study setting.

During survey interviews, household heads were asked about their participation in piecework, common forms of exchange, and if applicable, their motivation for supplying piecework labor across the rainy and dry seasons. Various livelihood outcomes were also measured to examine differences between households based on their level of involvement in piecework. Mean differences were assessed using t tests. See First Author and Tembo (2011) for additional details about the study's sampling design and other quantitative data collected.

The qualitative data derived from 12 months of fieldwork observing piecework arrangements. Focus group discussions and in-depth interviews were conducted to probe some of the complexities inherent in local piecework arrangements such as issues related to food and livelihood security, seasonality, gender, common piecework tasks, and the

apparent wealth disparities between recruiters and laborers. The qualitative data were primarily used during the descriptive analysis of the study setting.

The University of Zambia's Research Ethics Committee and the University of Arizona's Human Subjects Protection Program approved the study's protocol. Informed consent was obtained prior to conducting interviews.

Descriptive analysis: The significance of piecework in the study setting

Households in the study setting begin cultivating their primary food and cash crops in late November when the rains start to fall. Various agricultural tasks are carried out before and during the rainy season including land preparation, plowing and ridging, planting, weeding and banking, and applying fertilizer. Local maize is the main food crop cultivated in the study setting, while cotton, hybrid maize, and groundnuts are the dominant cash crops. Cash cropping is the most common way households generate income. Households harvest their dried maize starting in late April to early May, a few weeks after the last rains fall. Households pick and sell their cotton as well in early May. The tasks of digging groundnuts and drying/removing the pods follow.

Piecework labor is recruited to assist with many of the agricultural tasks that require completion during the rainy and dry seasons. Additional tasks that may necessitate the recruitment of piecework labor during the dry season include molding bricks, building new homes or fences around gardens, constructing granaries to store maize or groundnuts, cutting trees to open new fields, among others. It should be noted briefly that households in the study setting engage in other labor practices apart from

piecework. Group *ganyu* involves the voluntary pooling of people's labor in order to raise funds for a particular purpose[1] (see also Hoon, 2007). Groups or clubs are generally recruited to quickly complete a task such as dig a large portion of groundnuts or pick an entire field of cotton. In a reciprocal labor practice known locally as *chibili*, households assist each other with harvesting crops (specifically maize). Takane (2008) described an identical labor exchange in his study on labor use in Malawi. Work parties, whereby a household brews beer, *tobwa* (non-alcoholic maize drink), or kills a pig and invites people to come to their field to assist with harvesting or weeding, are also found in the study setting. Bezner Kerr (2010) noted a similar kind of labor arrangement in northern Malawi called *ulimizgo*. Much like in Malawi, work parties and other forms of communal and reciprocal labor practices are much less common in the study setting these days compared to piecework.

Piecework labor is most often recruited by those farmers who lack own-household labor during times of the year when precision in the completion of agricultural tasks is key or who want to ease the burden of work and also have the means (e.g., surplus maize) to recruit piecework labor. Others hire simply out of obligation to a friend or relative in need, which can undoubtedly become burdensome at times (see also Moore and Vaughan, 1994). Those who supply piecework labor are typically trying to address an immediate food or non-food need in their household (see more below), although

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[1] People living in a village, for example, may form a group to raise cash to purchase the inputs required to construct a well or a religious group can do piecework in order to buy building materials to improve a structure in which they congregate. Rarely do people pool their labor, however, to meet their individual food needs.

piecework labor is at times supplied for more personal reasons such as when men do piecework to raise cash to purchase alcohol.

From our observations, salaried government or non-government employees working in the area, retirees who moved to their "home of record" to farm, recent migrants, and local residents who are very successful farmers tend to recruit piecework labor to specifically increase farm productivity and profits. While relatively few in number, most of these farmers own scores of cattle and other livestock and live in well-built permanent structures, slightly distant from any village. They engage in a variety of non-farm income-generating activities and their farming practices closely emulate those employed by larger-scale commercial farmers.

Interactions between such farmers and the piecework laborers they recruit can at times be considered exploitative, especially in the rainy (or "hungry") season. People in the study setting often use the term *njala* (hunger) in the rainy season when maize stocks become exhausted (First Author and Tembo, 2011) even though they may have access to pumpkins, mangoes, wild fruits, or insects to eat. During this time of year, certain piecework employers bake buns (rolls) or even use processed packaged biscuits (cookies) bought from town to pay laborers because it is more cost effective compared to paying with maize, maize-meal, or cash. When maize is used, piecework employers can reduce payment sizes due to supply shortages and price increases that occur before the upcoming maize crop is harvested. Less maize paid for piecework can generate more frequent exchanges, which can prohibit certain laborers from working in their own fields. As one thirty-four year old woman in the study setting candidly summarized: "*Ganyu* helps with

obtaining money, [maize]-meal, and salt. It brings problems because people are always doing *ganyu* and unable to do work for their home."

Piecework thus provides households in the study setting with an important means of carrying out their livelihoods and addressing seasonal labor, food, and cash shortages. Participation in piecework, however, represents gradients of vulnerability and security. Those who regularly supply piecework labor and those who heavily recruit it occupy the more extreme spaces of vulnerability and security, respectively (see also Crooks et al., 2007). The quantitative results presented below, in many ways, corroborate these characterizations of piecework.

SURVEY RESULTS AND DISCUSSION

Piecework participation

Piecework participation was assessed by asking household heads whether they recruited or supplied labor "never," "some days," "many days," or "every day" over the course of the rainy or dry season. These data were further partitioned (see Table 1) based on whether a household exclusively recruited labor, supplied labor, recruited and supplied labor, or did neither since some households simultaneously recruit and supply labor or neither recruit nor supply labor in the study setting. Forty-two percent exclusively supplied labor in the rainy season and 27.2% did so in the dry season (*p*-value = 0.0478). For nearly half of the households (16 out of the 34) who exclusively supplied their labor in the rainy season participation in piecework was seasonal, while the other 18

households continued supplying in the dry season[2]. A greater number of households recruited labor in the dry season (a total of 22) compared to nineteen in the rainy season (p-value = 0.5905) and only 9 households exclusively recruited piecework labor in both seasons. Over 17% both recruited and supplied labor in the rainy season and 2.4% did both in the dry season (p-value = 0.0014). The same percentage of households (17.3%) neither recruited nor supplied labor in the rainy season, yet 43.2% did neither in the dry season (p-value = 0.0003).

-Table 1 approximately here-

The results demonstrate that the percentage of households who recruited piecework labor remained relatively constant across seasons. This finding is important because it indicates that there was a lack of a seasonal component to the recruitment of piecework labor. The need to complete certain agricultural tasks like weeding in the rainy season and harvesting in the dry season created a steady demand for piecework labor during both seasons. In contrast, the percentage of households who exclusively supplied piecework labor decreased significantly from the rainy to the dry season. However, over 50% of households who exclusively supplied piecework labor in the rainy season continued supplying their labor during the dry season. These results illustrate that while seasonal variation in the supply of piecework labor was clearly evident, a considerable percentage of households supplied their labor across seasons. The reasons

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[2] Thirty-six households exclusively supplied labor in the rainy season. However, in order to determine whether a household supplied piecework in both seasons or only in the rainy or the dry season knowledge about their piecework status in the dry season is necessary. This information obviously does not exist for the two households who moved from the study setting prior to the second wave of survey interviews, and therefore, they were dropped from these analyses.

why these households supplied their piecework labor are examined next along with the forms of exchange used in piecework arrangements.

Forms of exchange and motivations behind supplying piecework labor

Figure 1 presents common forms of exchange used in piecework arrangements during the rainy and dry seasons. How laborers were remunerated provides insight into their need(s) and their subsequent decision to engage in piecework arrangements. Cash was the primary form of exchange. Maize-meal was exchanged for labor in the rainy season, while dried maize[3] was exchanged in both seasons as not all households produced an adequate supply of maize during the rainy season (see more below). Livestock (pigs and goats), other foodstuffs such as bananas, and clothes were also forms of exchange in the dry season.

-Figure 1 approximately here-

Table 2 presents the reasons why households supplied their piecework labor based on whether a household exclusively supplied piecework labor in both seasons or in either the rainy or the dry season. During the rainy season, most households supplied piecework labor because of food shortages or hunger (85.3%). A smaller percentage supplied piecework labor to acquire basic household items such as salt or soap (26.5%) or to raise cash to mill maize (14.7%). In the dry season, the percentage of households who mentioned food shortages or hunger as a motivation declined significantly to 40.9% (*p*-value = 0.0003) and from 88.9% to 44.4% (*p*-value = 0.0037) for those households who

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[3]Dried maize is first milled into maize-meal. Maize-meal is then used to cook the staple food, *nsima*.

supplied their piecework labor across seasons. Acquiring basic household items was an equally important reason for supplying piecework labor in the dry season (36.4%). Over 27% of households mentioned they supplied piecework labor to obtain cash to specifically mill their maize in the dry season along with a number of additional reasons including to address a cash need, to purchase maize for future use, to pay for a child's school fees/books, to buy goats or pigs, and to pay back a loan that was obtained in the rainy season (see Table 2).

-Table 2 approximately here-

The key result presented in this sub-section is that a large percentage of households who supplied their piecework labor in the rainy season and on into the dry season (44.4%) were motivated to do so because of food shortages or hunger, thus partially corroborating Bezner Kerr's (2005) claim that reliance on piecework in the rainy season indicates a household's vulnerability to food insecurity. The livelihoods analysis carried out below, however, revealed that the food security situation of this group of households differed significantly from that of those households who supplied their piecework labor only in the rainy season. It is only by tracking a household's piecework status over time that we are able to establish more precisely who in this context is vulnerable to food insecurity.

Participation in piecework and its implications for livelihood (in)security

Data on a variety of outcome variables were collected during household-level survey interviews including outcomes under food, economic, and social network security

as well as data on the size of the household, and the nutritional status, educational level, and gender of the household head. Together these outcomes provide some indication of how livelihood (in)secure households were in the study sample (see Frankenberger et al., 2000).

A few outcome variables require a description before providing results. Dietary diversity score represents the total number of food groups (out of 12) the household consumed the previous day. Body mass index (BMI) of the household head is an indicator of nutritional status and was calculated using (kilograms/meters^2). A score between 18.5 and 24.9 indicates normal weight for height. Asset worth per capita represents the value of a number of household assets divided by the size of the household. Access to cattle indicates whether or not the household used cattle during the rainy or dry season. Social network security was assessed by asking household heads whether or not they borrow/exchange with or trust members in their community. The variable "maize in granary" indicates whether or not the household still had maize available when the survey interview took place in the late dry season.

Tables 3 and 4 present the descriptive statistics on the outcome variables based on whether a household exclusively supplied or recruited piecework labor during the rainy and dry seasons, respectively. Table 5 presents the same statistics for the 34 households who exclusively supplied piecework labor in the rainy season, and Table 6 tracks these households as they maintained/changed their piecework status in the dry season.

In comparison to the households who recruited piecework labor, those who supplied labor on average cultivated a smaller area of major food and cash crops (*p*-value

= 0.0009) including maize (p-value = 0.0133), and had a lower dietary diversity score (p-value = 0.0395) in the rainy season (see Table 3). They owned less land (p-value = 0.0327), their per capita asset worth was significantly lower (p-value < 0.0001), they had less access to cattle (p-value = 0.1196), and a smaller percentage grew cash crops (p-value = 0.0133). Only 3% of households who supplied their piecework labor had access to fertilizer in contrast to 37% of households who recruited piecework labor (p-value = 0.0006). No statistically significant differences were found at or below the 10% level for any of the other outcome variables measured in the rainy season.

-Table 3 approximately here-

During the dry season (see Table 4), average maize yields (kg) differed significantly for these two groups of households (p-value = 0.0002), with households who recruited piecework labor harvesting almost four times the maize of that harvested by households who supplied their labor. Exactly 50% of households who supplied piecework labor indicated they harvested less maize in 2009 than in 2008 compared to 19% of the households who recruited labor (p-value = 0.0337). Only 64% of households who supplied their piecework labor still had maize in their granaries at the time of survey interviews (October/November) in contrast to 91% of households who recruited labor (p-value = 0.0311). Mean dietary diversity score for households who recruited piecework labor was significantly higher than the score for households who supplied their labor (p-value = 0.0011). Much like in the rainy season, the other outcome variables measured in the dry season were similarly different except for the variation found between mean

educational levels of heads from the two groups of households. There was a 2.41 years difference that was statistically significant at the five-percent level.

-Table 4 approximately here-

These results clearly demonstrate that households who exclusively supplied their piecework labor were more livelihood insecure on average than households who exclusively recruited piecework labor, a finding that is consistent with others found in the literature (e.g., see Adams, 1991b; Whiteside, 2000; Peters, 2006). However, when the data were further disaggregated we attained a more nuanced picture of insecurity. In Tables 5 and 6 presented below, the means of virtually all livelihood variables were poorer in the rainy and dry seasons for households who supplied piecework labor across seasons. Differences in means were statistically significant for outcomes under food and economic security in the rainy season (see Table 5) and for outcomes under food security in the dry season, specifically those related to maize production (see Table 6).

-Tables 5 and 6 approximately here-

Such differences otherwise go unnoticed when a cross-sectional study design is used. For the households who exclusively supplied labor only in the rainy season, piecework provided them with an opportunity to address their food and/or non-food needs. In the dry season, their needs were met using strategies other than supplying piecework labor such as consuming and/or selling their crops, gardening, trading, selling groceries or fruits, mending clothes, brewing beer, cutting and selling timber, making baskets for sale, etc. Those who continued supplying their labor into the dry season

perhaps lacked such opportunity, and thus, it is their reliance on piecework during the rainy season that more accurately reflects households vulnerable to food insecurity.

Gender component to piecework?

Various scholars have argued that female-headed households (FHH) generally depend more on piecework (see Vaughn, 1987; Adams, 1991b; Whiteside, 2000; Bezner Kerr, 2005; Takane, 2008).   This may be due to the presence of fewer adults in their homes, being remunerated less compared to men, having lower income levels, or because of more "up-stream" structural reasons such as the barriers women face when trying to enter into cash crop production or wage labor opportunities.

Female-headed households in this study comprised roughly 32% of households who supplied piecework labor and only 10% of those who did not (p-value = 0.0004). Close to 36% of households who exclusively supplied piecework labor (as defined above) were FHH compared to only 11.3% of those who exclusively recruited piecework labor, both recruited and supplied, or did neither (p-value = 0.0002).   Female-headed households made up roughly 44% of households who supplied their piecework labor in the rainy and dry seasons in contrast to only 16.7% of households who did or did not participate in another type of piecework arrangement in both seasons (p-value = 0.0051).

These results demonstrate that there was a clear gender component to the supply of piecework labor since FHH comprised only 20% of the study sample.   With that stated, when the same livelihoods analysis conducted above was again carried out to investigate whether gender differences existed between households who supplied their

piecework labor, there were few significant differences found between female- and male-headed households. The key differences were that FHH who supplied their piecework labor in the rainy season had on average less access to land, cultivated a smaller area of food and cash crops, and had fewer members comprising their households. Cultivating smaller portion sizes and having fewer household members to assist with farming (and domestic) tasks would seemingly influence the agricultural output of female-headed households. However, in the dry season FHH produced on average 475 kg of maize compared to 550 kg produced by male-headed households (p-value = 0.5389). Women are typically regarded as the "food crop producers" in most parts of Africa, while men are in charge of cash crop production (see Gladwin et al., 2001). If women from MHH tend to their maize fields with little assistance from their husbands whilst supplying their piecework labor, their maize yields would essentially look much like those harvested by female-headed households. In short, gender norms associated with agricultural production may be adversely impacting MHH households who supply their piecework labor during the rainy season. An alternative explanation draws on the qualitative data from the study setting. Female-headed households may be supplementing their smaller labor forces by exchanging their piecework labor for draught power (oxen). For instance, one woman in the study setting who heads her own household planted a relative's maize field using her piecework labor, and in exchange, the relative plowed in her field (cotton) putting to use his own cattle.

Finally, there were virtually no significant gender differences between FHH and MHH who exclusively supplied their piecework labor across seasons. Female heads had

3.5 years less education on average than male heads (*p*-value = 0.0090) and a smaller portion of FHH felt they could borrow/exchange with fellow community members (*p*-value = 0.0651) in the dry season. The overall lack of variation in outcomes found suggests that the dependence on piecework across seasons and the gender of the household head were unrelated. Thus, poverty above all reasons propelled households to supply their piecework labor cross-seasonally.

CONCLUSION

This study demonstrated how a more accurate framing of household vulnerability is possible when participation in piecework is evaluated across seasons. The conclusion is based on two key findings. One, households who supplied piecework labor performed poorer on a wide range of livelihood outcomes compared to households who recruited piecework labor, regardless of the season. Two, the food security situation of households who supplied piecework labor in the rainy and dry seasons was worse-off than that of households who supplied piecework labor only in the rainy season. Together, these findings suggest that on average households who supplied piecework labor in the rainy season were relatively poor, yet within this group of households, those who supplied their piecework labor across seasons were distinctly food insecure. Thus, by accounting for seasonal change associated with piecework participation we were better able to determine who in this context was vulnerable to food insecurity.

The study also showed that female-headed households relied significantly on piecework as a strategy to secure their food and/or non-food needs, although few gender

differences were detected between female- and male-headed households who supplied their piecework labor and none that were connected to food insecurity in the dry season. These findings imply that the gender of the household head was important in determining who proportionately was more involved in piecework labor arrangements, yet seemed to factor little in making a statistically significant distinction between the food and socioeconomic status of those households who supplied their labor across seasons. These findings matter because they single out poverty as the core characteristic of those households who depended on piecework, and not the gender of their head of households. This does not infer that the relationship between piecework and women who head their own households is unimportant. Instead, the findings shed more positive light on their participation in the supply of piecework (see also Moore and Vaughan, 1994; Gladwin et al., 2001) in that piecework may enable them to "catch up" given their labor constraints and lack of access to land and non-farm income-generating opportunities.

Nevertheless, policies that aim to improve the livelihoods of rural households in Zambia and elsewhere in southern and eastern Africa must recognize that for certain households, participation in piecework is no longer seasonal, the "hungry" season starts much earlier or never ends at all, and own-farm production is rapidly becoming a thing of the past (see Bryceson, 2002). Piecework surely affords these households with an opportunity to reduce their hunger and destitution in the short term, but their continuous involvement in piecework is in no way acceptable as a long-term substitute for a secure livelihood.

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TABLES

Table 1. Level of piecework participation (%).

	Total (n = 162)	Rainy season (n = 81)	Dry season (n = 81)	p-value[1]
Exclusively supplied	56 (34.5)	34 (42.0)	22 (27.2)	0.0478
Supplied both seasons	…	18 (22.2)	18 (22.2)	…
Supplied rainy only	…	16 (19.8)	…	…
Supplied dry only	…	…	4 (5.0)	…
Exclusively recruited	41 (25.3)	19 (23.4)	22 (27.2)	0.5905
Recruited both seasons	…	9 (11.1)	9 (11.1)	…
Recruited rainy only	…	10 (12.3)	…	…
Recruited dry only	…	…	13 (16.1)	…
Recruited and supplied	16 (10.0)	14 (17.3)	2 (2.4)	0.0014
Neither recruited nor supplied	49 (30.2)	14 (17.3)	35 (43.2)	0.0003

[1]Values obtained by t tests.

Table 2. Why households supplied piecework labor in the rainy and dry seasons (%).

Rainy Season	Total (n=34)	Supplied both seasons (n=18)	Supplied rainy only (n=16)
Food shortage/hunger	29 (85.3)	16 (88.9)	13 (81.3)
Basic household items	9 (26.5)	5 (27.8)	4 (25.0)
Mill maize	5 (14.7)	2 (11.1)	3 (18.8)
School fees/books	2 (5.9)	1 (5.6)	1 (6.3)
Assistance with farming	1 (2.9)	0	1 (6.3)

Dry Season	Total (n=22)	Supplied both seasons (n=18)	Supplied dry only (n=4)
Food shortage/hunger	9 (40.9)	8 (44.4)	1 (25.0)
Basic household items	8 (36.4)	7 (38.9)	1 (25.0)
Mill maize	6 (27.3)	6 (33.3)	0
Cash shortage	3 (13.6)	3 (16.7)	0
Buy maize for future use	3 (13.6)	2 (11.1)	1 (25.0)
Clothes	2 (9.1)	1 (5.6)	1 (25.0)
School fees/books	1 (4.5)	1 (5.6)	0
Animals	1 (4.5)	1 (5.6)	0
Pay back loan	1 (4.5)	0	1 (25.0)

Table 3. Means of livelihood outcomes, by level of piecework participation in the rainy season; see notes.

Rainy Season	Total[1] (n=81)	Supplied only (n=34)	Recruited only (n=19)	p- value[2]
Food security				
Area major crops planted (acres)	5.47 (4.81)	3.68 (2.86)	8.63 (7.33)	0.0009
Area maize planted (acres)	2.57 (2.17)	1.97 (1.31)	3.69 (3.53)	0.0133
Dietary diversity score	5.62 (1.39)	5.44 (1.40)	6.32 (1.53)	0.0395
Economic security				
Total land area owned (acres)	13.27 (18.51)	9.30 (8.99)	22.59 (33.44)	0.0327
Asset worth per capita	8.48 (9.96)	3.79 (4.68)	14.77 (10.87)	<0.0001
Access to cattle	0.79 (0.41)	0.71 (0.46)	0.89 (0.32)	0.1196
Use fertilizer	0.14 (0.34)	0.03 (0.17)	0.37 (0.50)	0.0006
Grew cash crop	0.88 (0.33)	0.74 (0.45)	1.00 (0.00)	0.0133
Health security				
BMI HH head[3]	20.61 (2.20)	20.63 (2.32)	21.08 (1.86)	0.4843
Social network security				
Borrow / exchange	0.75 (0.43)	0.68 (0.47)	0.84 (0.37)	0.1967
Trust community members[3]	0.33 (0.47)	0.30 (0.47)	0.39 (0.50)	0.5436
Demographics				
Edu. level (years) HH head	4.65 (3.61)	4.09 (2.92)	5.21 (5.00)	0.3052
Household size	5.27 (3.05)	5.32 (2.88)	5.05 (3.42)	0.7602

Notes: Values are provided as means (standard deviations); the variable "asset worth per capita" was divided by K100,000 (kwacha); BMI=body mass index and HH=household.

[1]Results for HHs who supplied and recruited (n=14) and did neither (n=14) were excluded from the table for simplicity reasons.

[2]Values obtained by *t* tests. [3]Some missing data.

Table 4. Means of livelihood outcomes, by level of piecework participation in the dry season; see notes.

Dry Season	Total[1] (n=81)	Supplied only (n=22)	Recruited only (n=22)	p- value[2]
Food security				
Maize yield (kg)	1,239 (1,163)	523 (267)	1,943 (1,623)	0.0002
Maize yield 2009 vs. 2008[3]				
Less	0.36 (0.48)	0.50 (0.51)	0.19 (0.40)	0.0337
Same	0.04 (0.19)	0.05 (0.21)	0.05 (0.22)	0.9739
More	0.60 (0.49)	0.45 (0.51)	0.76 (0.44)	0.0402
Maize in granary	0.84 (0.37)	0.64 (0.49)	0.91 (0.29)	0.0311
Dietary diversity score	5.51 (1.28)	4.91 (1.23)	6.18 (1.18)	0.0011
Economic security				
Asset worth per capita	8.62 (11.35)	2.39 (2.03)	11.18 (10.55)	0.0004
Access to cattle	0.88 (0.33)	0.73 (0.46)	0.86 (0.35)	0.2727
Use fertilizer	0.27 (0.45)	0.05 (0.21)	0.55 (0.51)	<0.0001
Health security				
BMI HH head[3]	21.18 (2.29)	20.96 (2.52)	22.02 (2.34)	0.1672
Social network security				
Borrow / exchange	0.79 (0.41)	0.77 (0.43)	0.91 (0.29)	0.2257
Trust community members[3]	0.41 (0.49)	0.36 (0.49)	0.45 (0.51)	0.5506
Demographics				
Edu. level (years) HH head	4.65 (3.61)	4.41 (3.35)	6.82 (4.01)	0.0362
Household size	5.63 (3.24)	5.41 (2.72)	6.09 (3.91)	0.5059

Notes: Values are provided as means (standard deviations); the variable "asset worth per capita" was divided by K100,000 (kwacha); BMI=body mass index and HH=household.
[1]Results for HHs who supplied and recruited (n=2) and did neither (n=35) were excluded from the table for simplicity reasons.
[2]Values obtained by *t* tests. [3]Some missing data.

Table 5. Means of livelihood outcomes if household supplied piecework in both seasons or in the rainy season only (rainy season data); see notes.

Rainy Season	Supplied both seasons (n=18)	Supplied rainy only (n=16)	p-value[1]
Food security			
Area major crops planted (acres)	2.67 (1.75)	4.82 (3.46)	0.0263
Area maize planted (acres)	1.47 (0.86)	2.53 (1.51)	0.0160
Dietary diversity score	5.72 (1.41)	5.13 (1.36)	0.2185
Economic security			
Total land area owned (acres)	6.96 (5.88)	11.92 (11.17)	0.1097
Asset worth per capita	2.27 (2.47)	5.49 (5.95)	0.0429
Access to cattle	0.61 (0.50)	0.81 (0.40)	0.2099
Use fertilizer	0.00 (0.00)	0.06 (0.25)	0.2959
Grew cash crop	0.61 (0.50)	0.88 (0.34)	0.0863
Health security			
BMI HH head[2]	20.46 (2.46)	20.80 (2.24)	0.6875
Social network security			
Borrow / exchange	0.72 (0.46)	0.63 (0.50)	0.5594
Trust community members[2]	0.22 (0.43)	0.40 (0.51)	0.2829
Demographics			
Edu. level (years) HH head	3.94 (3.00)	4.25 (2.91)	0.7656
Household size	4.83 (2.46)	5.88 (3.28)	0.2993

Notes: Values are provided as means (standard deviations); the variable "asset worth per capita" was divided by K100,000 (kwacha); BMI=body mass index and HH=household.

[1]Values obtained by *t* tests. [2]Some missing data.

Table 6. Means of livelihood outcomes if household supplied piecework in both seasons or in the rainy season only (dry season data); see notes.

| Dry Season	Supplied both seasons (n=18)	Supplied rainy only (n=16)	p-value[1]
Food security			
Maize yield (kg)	522 (285)	1,036 (726)	0.0091
Maize yield 2009 vs. 2008			
Less	0.44 (0.51)	0.31 (0.48)	0.4448
Same	0.06 (0.24)	0.06 (0.25)	0.9341
More	0.50 (0.51)	0.63 (0.50)	0.4789
Maize in granary	0.67 (0.49)	0.94 (0.25)	0.0533
Dietary diversity score	4.83 (1.20)	5.19 (1.28)	0.4107
Economic security			
Asset worth per capita	2.41 (2.24)	4.78 (6.14)	0.1357
Access to cattle	0.78 (0.43)	0.81 (0.40)	0.8098
Use fertilizer	0.06 (0.24)	0.19 (0.40)	0.2462
Health security			
BMI HH head[2]	21.31 (2.62)	21.42 (2.61)	0.9070
Social network security			
Borrow / exchange	0.72 (0.46)	0.75 (0.45)	0.8599
Trust community members	0.33 (0.49)	0.44 (0.51)	0.5470
Demographics			
Edu. level (years) HH head	3.94 (3.00)	4.25 (2.91)	0.7656
Household size	5.17 (2.68)	6.44 (3.14)	0.2124

Notes: Values are provided as means (standard deviations); the variable "asset worth per capita" was divided by K100,000 (kwacha); BMI=body mass index and HH=household.

[1]Values obtained by t tests. [2]Some missing data.

FIGURES

Figure 1. Common forms of exchange received by and paid to piecework laborers in the rainy and dry seasons.
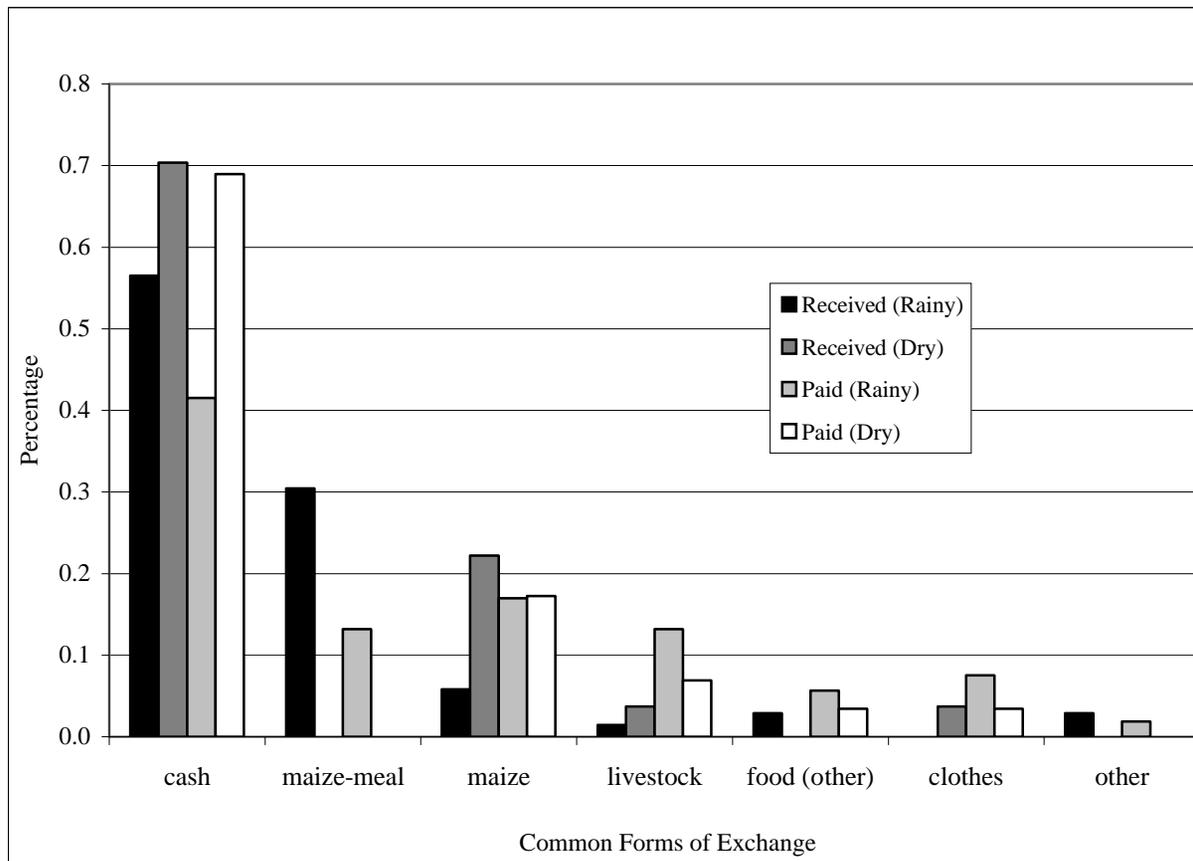
APPENDIX C: PAPER THREE

Cole, SM. (*under review*). The relationship between relative deprivation and adult nutritional status in rural Zambia. *American Journal of Human Biology*.

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The relationship between relative deprivation and adult nutritional status in rural Zambia

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Title:
The relationship between relative deprivation and adult nutritional status in rural Zambia

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Relative deprivation and adult health in Zambia

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The author is not affiliated with any organization that has a direct interest, particularly a financial interest, in the subject matter or materials discussed in this manuscript.

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There are no potential sources of conflict of interest.

ABSTRACT

Objectives: To explore statistically the relationship between adult short-run nutritional status [body mass index (BMI)] and a measure of relative deprivation [subjective socioeconomic status (SES)] using panel data collected in a developing country where there is a high degree of poverty and a very uneven distribution of income.

Methods: Study participants included men and women from a random sample of households located in a rural setting in Zambia. The data were collected during two waves of survey interviews in 2009. A multilevel model was used to estimate the relationship between subjective SES and adult BMI and controlled for individual absolute income as well as other correlates of adult health. The sample size included 254 observations.

Results: A positive relationship was established between individual absolute income and adult BMI at the one-percent level. A negative and statistically significant association was found at the one-percent level between lower subjective SES and adult BMI. Lower perception of place within the socioeconomic hierarchy was on average associated with a 0.44 decrease in adult BMI.

Conclusions: This study found that, independent of individual absolute income, lower subjective SES was negatively related with adult BMI in rural Zambia. The result provides evidence that lower perception of place within the *local* socioeconomic hierarchy matters to health. Future studies should continue exploring the relationship between subjective and objective measures of relative deprivation and health in developing countries, where the bulk of the research focuses on material not relative deprivation as a key determinant of individual health.

Key Words: Zambia; Nutritional status; Relative deprivation; Subjective socioeconomic status (SES); Income inequality.

INTRODUCTION

In developed nations the relationship between socioeconomic status (SES) and health reflects a gradient whereby on average those with a lower level of income have poorer health (Adler et al., 1994; Marmot, 2004). People who occupy lesser positions in the socioeconomic hierarchy lack the material resources to access adequate health care, housing, and safe and nutritious foods that could assist them in maintaining or improving their health. People of lower SES are also more likely to make upward social comparisons that could generate negative emotions such as anger or envy that if sustained over prolonged periods could translate into poorer health via neuroendocrine processes[1] (Wilkinson, 1996; McEwen and Seeman, 1999; Worthman, 1999; Sapolsky, 2004, 2005). As a concept, relative deprivation "deals with the emotions due to social comparisons involving inequality" (Subramanyam et al., 2009: 327), and can be assessed subjectively by asking people to position themselves relative to others in the socioeconomic hierarchy or objectively using mathematical formulas (e.g., the Yitzhaki Index). Several recent studies found that poor health outcomes in developed countries were associated with subjective SES (Adler et al., 2000; Ostrove et al., 2000; Singh-Manoux et al., 2003, 2005; Goodman et al., 2007; Cohen et al., 2008; Wolff et al., 2010; Karvonen and Rahkonen, 2011) as well as with more objective measures of relative deprivation (Stewart, 2006; Kondo et al., 2008; Subramanyam et al., 2009).

There are few studies from developing countries that explored the relationship between relative deprivation and health, perhaps because material deprivation so often explains poor health outcomes in such contexts. Hadley et al. (2008) established that

higher subjective SES was protective of symptoms of poor mental health in their study in rural Ethiopia. Hamad et al. (2008) looked at the association between lower subjective SES and adult depressive symptoms and perceived stress in South Africa. They found a positive relationship between lower subjective SES and both mental health outcomes in low-income adults. In studies from rural Bolivia, Reyes-Garcia et al. (2008) established that relative social rank (a subjective measure) was positively associated with male adult nutritional status (see also Reyes-Garcia et al., 2009) and Undurraga et al. (2010) found that individual wealth rank (an objective measure) was negatively related with self-rated poor health in their longitudinal study.

This study explores the relative deprivation/health link in Zambia where there is a high degree of poverty and a very uneven distribution of income in the country. The 2011 Human Development Index, a composite measure of income, education, and health, positioned Zambia toward the bottom (164 out of 187 countries) of their annual national development rankings (UNDP, 2011). Overall life expectancy at birth is a dismal 49 years of age (UNDP, 2011) and more than five million Zambians are considered undernourished (FAO, 2011). Rural poverty rates are high at 80% compared to 34% in urban Zambia (CSO, 2006). Chapoto et al. (2011) recently found that the Gini coefficient (a measure of income inequality) increased in Zambia from 0.64 in 2001 and 2004 to 0.67 in 2008. Other national survey data show that income inequality is slightly lower at 0.57 (CSO, 2006), yet still high compared to international levels.

The study asks "Do those who consider their socioeconomic status to be lower relative to others have poorer health?" It utilizes household-level panel data collected

from rural Zambia during the rainy and dry seasons of 2009 to estimate the relationship between subjective SES and adult short-run nutritional status (body mass index). In rural Zambia, mean body mass index (BMI) of women aged 15-49[2] was low at 21.6 in contrast to that of women in urban Zambia (23.7) (CSO, 2009) and much lower relative to mean BMI values of women (and men) from developed countries (see Finucane et al., 2011). As such, it can be argued that lower/higher levels of BMI reflect poorer/better health in this context (Reyes-Garcia et al., 2008). Individual absolute income and other important correlates of health were controlled for during regression analysis. Given the high levels of poverty and economic imbalance in Zambia, this study hypothesizes that measures of material and relative deprivation will have independent effects on adult nutritional status.

MATERIALS AND METHODS

Study background

This study was carried out in 2009 in a rural area in the Katete District of Eastern Province, Zambia. The study area consisted of over 320 households in 16 villages. See Author and Tembo (2011) for additional details about the study area, the sampling design used, and the types of data collected, although briefly, a proportionate stratified random sample was drawn at the village level based on a total household population census of the area. Eighty-three households out of 99 agreed to participate in the first wave of survey interviews that started in early April 2009, or toward the conclusion of the rainy season. The second wave of interviews began near the end of the dry season in early October 2009. Accounting for seasonality was an important component of the study given that a

household's health, food, and economic situation can be more precarious during the rainy season in such a rural setting (see Huss-Ashmore and Johnston, 1985; Bogin, 1999; Gillett and Tobias, 2002; Devereux, 2009).

Individual- and household-level data were collected for this study on a variety of topics important to people's livelihoods. Livelihood differences between households in the study setting and throughout rural Zambia are all too apparent to outsiders and local community members alike. Some households own numerous cattle, cultivate large fields, and reside in permanent structures roofed with iron sheets, while others are less fortunate and cultivate a small portion of land using hand hoes and depend regularly on piecework (casual labor) to solve their pressing needs. Other households are somewhere in-between and perhaps produce enough food to get through the annual "hungry" period that occurs during the rainy/cultivation season, yet struggle to acquire cash to purchase new farming equipment and wonder constantly if their condition will ever improve.

All heads of households (e.g., both wife and husband) were interviewed when administering the survey questionnaire, although a small number of individuals did not participate in anthropometric assessments during the first and/or the second wave of survey interviews (see more below). The [anonymized for review] Human Subjects Protection Program approved the research protocol. The University of Zambia's Research Ethics Committee granted ethical clearance and all local leaders permitted the author to carry out the research in their area.

Dependent variable: adult nutritional status

Anthropometric data were collected on household heads following Lohman et al. (1988). Individuals were measured without shoes, socks, hats, and wearing only lightweight clothing (e.g., no jackets). Body weight was measured to the nearest 0.20 kilogram using a Seca digital standing scale. Standing height was assessed to the nearest millimeter using a Seca portable stadiometer. Body mass index (BMI), an indicator of adult nutritional status, was calculated using (kilograms/meters^2). A score of 18.5 to 24.9 indicates normal weight for height. Body mass index was employed as the dependent variable in regression analysis. It should be noted that the data of six women who were pregnant during wave one of anthropometric evaluations were not used during statistical analysis. A woman's pregnancy status was unfortunately not determined during wave two of anthropometric assessments.

Key independent variables

Individual absolute income. Following a similar strategy as Undurraga et al. (2010), household heads were asked about a number of important household assets including the number of cattle, pigs, goats, chickens, ducks, ox carts, ploughs, cotton sprayers, hoes, axes, bicycles, sewing machines, couches, mattresses, wood chairs and tables, radios, and cell phones the household owned. The number of each asset owned by the household was multiplied by its local market price and then divided by the number of people living in the household at the time of the interview. The variable represents asset worth per capita, a proxy for individual absolute income.

Relative deprivation. Subjective SES is considered a measure of relative deprivation (Singh-Manoux et al., 2005; Kondo et al., 2008). Many past studies assessed subjective SES using the "ladder" approach (see Adler et al., 2000). Individuals are asked to indicate on a 10-rung ladder where they stand in comparison to others in society in terms of occupation, education, and income. Hadley et al. (2008) used the scale in rural Ethiopia, and while their sample easily grasped the ladder concept, responses contained very little variation. This study assessed relative deprivation by asking household heads whether their income was higher, lower, or about the same as that of others in their community. Across the two survey waves, 3% of the sample responded "higher" to the question about their household's relative socioeconomic position, 30% responded "same," and 67% responded "lower." Responses "same" and "higher" were therefore combined and a dichotomous variable was created that represents 1 for lower subjective SES and 0 otherwise.

Social capital. The same negative emotions generated when people of lower SES make upward social comparisons could also alter people's social environments by promoting anti-social behavior, decreasing social capital, and impacting the ways people participate in civic activities; all of which have obvious "health-deteriorating" corollaries (see Kaplan et al., 1996; Kennedy et al., 1996; Kawachi and Berkman, 2000). Although numerous definitions exist for social capital, the term generally evokes thoughts of pro-social behavior such as trusting, sharing, and taking part in groups that help promote

cooperative action amongst people (see Coleman, 1990; Putnam, 1993). Two different indicators of social capital were employed in this study, trust and group participation. The dummy variable trust indicates 1 if household heads believed that most people in their community could be trusted and 0 if they could not. A group participation scale was created and comprises the sum of the groups, clubs, or organizations all household heads were apart of when survey interviews took place.

Control variables. A number of individual-level variables were controlled for during regression analysis including the age, gender, marital status, educational level, and physical health status of each household head. Past studies exploring the link between subjective SES or objective measures of relative deprivation and health controlled for many of these same variables in their regression models (e.g., see Reyes-Garcia et al., 2008; Kondo et al, 2008; Cohen et al., 2008; Subramanyam et al., 2009; Undurraga et al., 2010; Wolff et al., 2010). Age represents how old the individual was (years) at the time of survey interviews. The variable education is the total number of years the individual attended school. The dummy variable married indicates 1 if the individual is married and 0 if divorced or widowed. The illness dummy represents 1 if the individual was sick in the past two weeks prior to survey interviews. Two other variables were included in the model. The variable household dependency ratio represents the proportion of people living in the household less than 15 and greater than 59 years of age. The dummy variable signifying wave two of survey interviews was included to control for various unobservable temporal effects between the two survey waves.

Statistical analysis

The statistical analysis was carried out using STATA (version 10.0, College Station, TX, USA). Due to the nature of the study's sampling design, adult BMI scores could be correlated in the same individual (because of repeated measures), household, and village. The possible non-independence among observations within each level of clustering was accounted for using a multilevel model, and thus, repeated measures of BMI were nested within individuals who were nested within households nested within villages. The levels of clustering in the multilevel (also known as a "mixed") model were specified as the "random effects" and the independent variables were specified as the "fixed effects." Maximum restricted likelihood was used to estimate the multilevel model.

Descriptive statistics were obtained for the variables used in the regression model and seasonal differences were assessed using either a *t* test or Wilcoxon rank-sum test. Spearman's rank correlation was used to determine the extent of the relationship between lower subjective SES, individual absolute income, and years of educational attainment. Graphical tools including histograms and Q-Q plots were employed to inspect the distributions of the dependent variable and the residuals of the random village, household, and individual effects. Since not all household heads participated in both waves of anthropometric measurements a test for attrition bias was carried out using a logistic regression.

RESULTS

Complete data were available for analysis for 254 observations (wave one = 134 individuals, wave two = 120). The test result for attrition bias indicated that those who participated in both waves of anthropometric measures did not differ significantly from attriters on key characteristics such as BMI, individual absolute income, lower subjective SES, social capital, age, and gender. Table 1 provides the medians or means of variables used in the regression model. Median BMI scores differed significantly across seasons at the one-percent level. There were statistically significant differences in median household dependency ratio values and the mean/median values of the social capital variables across seasons as well. Median values of individual absolute income did not differ across the rainy and dry seasons nor did the means of any of the responses from the subjective SES question, perhaps due in part to the short time period between survey waves.

--Table 1 approximately here--

Figure 1 presents median BMI scores by tertiles of individual absolute income and subjective SES. Median BMI scores followed a gradient when evaluated against tertiles of subjective SES, although, no median BMI scores were statistically different between tertiles. As for individual absolute income, median BMI scores were statistically different between the "average" and "high" income tertiles ($p < 0.03$). Note also that mean BMI for women (aged 15-49) was 21.2, which is congruent with the mean BMI score of rural women (21.6) reported in the Zambian Demographic Health Survey report (CSO, 2009).

--Figure 1 approximately here--

There was a negative and significant correlation between lower subjective SES and individual absolute income ($r = -0.15$, $p < 0.02$). The correlation between lower subjective SES and education was slightly higher at -0.24 ($p < 0.0001$).

Table 2 presents the results from the multilevel linear regression model. Histograms and Q-Q plots demonstrated that the dependent variable and the residuals of the random effects were approximately normally distributed. Focusing on the two key fixed effects estimates in Table 2 we see that the proxy variable for individual absolute income (asset worth per capita) was positively related with adult BMI at the 1% level and that lower perception of place within the local socioeconomic hierarchy was on average associated with a 0.444 decrease in adult BMI. The coefficient estimate representing lower subjective SES was significant at the one-percent level.

--Table 2 approximately here--

To test the robustness of these results, two other regression models were estimated using different criteria (see Table 3). In the first model [1], a variable representing the extent of income inequality at the village level was included to determine the impact income inequality had on adult BMI holding individual absolute income and lower subjective SES constant. Asset worth per capita was used to estimate the Gini coefficient of income inequality in each village[3]. The Gini coefficient of the overall survey sample was 0.57, which is in line with Gini coefficients estimated using national survey data. The value of the Gini coefficient implies there is a high level of income inequality in the study setting. The results from the regression model, however,

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show that the coefficient estimate on the variable representing village income inequality was not statistically significant. Note that the associations between adult BMI and individual absolute income and lower subjective SES were virtually unchanged when village income inequality was included in the model.

--Table 3 approximately here--

In the second model [2], an alternative measure of adult nutritional status, mid-upper arm circumference (MUAC), was used as the dependent variable. Individual absolute income was positively related with adult MUAC at the five-percent level, while lower subjective SES was not statistically associated with MUAC at or below the 10% level ($p < 0.24$).

DISCUSSION

Using panel data collected during the rainy and dry seasons in rural Zambia in 2009, this study explored the association between lower subjective SES, a measure of relative deprivation, and adult nutritional status. A negative relationship was found between lower subjective SES and adult BMI, which infers that BMI declined for those who perceived their household's socioeconomic status to be lower relative to others in their community. The relatively weak but significant association found between individual absolute income and lower subjective SES was an important side result because it showed that the two variables were statistically correlated but represented different constructs. The finding was somewhat expected since subjective SES "…capture[s] a household's position within the socio-economic hierarchy but cannot

measure absolute poverty" (Howe et al., 2011: 230). These results provide evidence in support of the claim that, independent of individual absolute income, perception of place within the socioeconomic hierarchy matters to health (Wilkinson, 1996).

Lower subjective SES was negatively associated with adult BMI even after including village income inequality in the regression model. Small-scale studies that explored statistically the relationship between economic inequality and adult health in a developing country context are rarely found in the literature other than those from rural Bolivia. Likewise, these studies did not find a statistically significant association between village income inequality and adult health outcomes (Godoy et al., 2005; Undurraga et al., 2010) but did find a significant relationship between adult health and social rank and wealth rank (Reyes-Garcia et al., 2008, 2009; Undurraga et al., 2010). These results together with the findings from this study suggest that perhaps inequalities need to be evaluated using a variety of measures (both subjective and objective) before we can determine whether or not "[r]elativities and comparisons beyond the local seem more important than purely local ones" (Wilkinson and Pickett, 2007: 1975). Quantitative measures of income inequality simply assess the extent of economic differentiation in a particular area or society, and thus, cannot (obviously) get at the subjective evaluation a person makes about his or her own household's position within the (local or global) socioeconomic hierarchy. If Undurraga et al. (2010: 540) were correct when underscoring that "[f]eeling poorer or of lower status may be at the core of predicting why being poor might worsen health", then we must continue to expand the ways we evaluate and model the complex relationship between relativities and health.

To date, studies (both large and small) from developed and developing countries show that subjective measures of relative socioeconomic status are predictive of health outcomes. In contrast, mostly larger-scale studies from developed countries provide evidence that income inequality and health are linked (Wilkinson and Pickett, 2006). As such, the "local" tends to get sidelined in broader discussions about economic relativities and health (see Dressler, 2010 as one important exception). Gini coefficients for only 14 villages were available for use in this study but did range from 0.20 to 0.67 (mean = 0.45, standard deviation = 0.11). This suggests that enough variation around mean measures of village income inequality existed. It could be argued, however, that income inequality was measured at too small a geographical area to detect a statistically significant association between income inequality and adult nutritional status (see Subramanian and Kawachi, 2004; Godoy et al., 2005; Wilkinson and Pickett, 2006, 2007) or simply that the scale of economic difference at the village level is unrelated to adult nutritional status in this context, as the result seems to imply. Instead, lower perception of place within the socioeconomic hierarchy was the statistically significant predictor of poorer adult health, thus providing evidence that upward social comparisons made *at the local level* matter to health. Nonetheless, this study remains cautious about making such a claim given that lower subjective SES was not associated with mid-upper arm circumference, an alternative measure of nutritional status.

Study limitations

A couple limitations in the study warrant discussion before concluding. First, subjective SES was assessed at the household level, and therefore, the variable may not reflect individual-level realities for those who cohabit compared to those who alone head their households. Household heads were asked to subjectively position their household within the community socioeconomic hierarchy. In some cases married couples could have disagreed, but given the nature of the question, were essentially "forced" to correspond in order to provide a joint response. It would be fruitful to determine whether household heads' subjective responses to questions about their household's relative SES actually match or not. Related, subjective SES could be assessed using alternative scales that capture more variation in people's perception of their relative SES, yet that also take into account important contextual/cultural factors. In a rural developing country context where agricultural production dominates as the primarily means of securing people's livelihoods, including more salient topics into a scale's construction such as ownership of livestock or food and cash crop yields may improve our understanding of the factors people take into consideration when subjectively evaluating their relative socioeconomic position. Second, since women's pregnancy status was not determined during wave two of anthropometric assessments, the weights used to construct the BMI of a small but unknown portion of women were possibly inflated. Last, the Gini coefficient estimates were perhaps estimated imprecisely in this study given the small sample sizes used (see Godoy et al., 2005). Ideally, income should be measured in more households per village and across more villages (or communities).

CONCLUSION

The results presented in this study provide evidence in support of the claim that processes other than just material circumstances pattern variation in health (see Pike and Williams, 2006). A negative relationship between lower subjective SES and adult body mass index was found, independent of individual absolute income. As subjective SES is considered a measure of relative deprivation, the negative association between lower subjective SES and adult nutritional status that was found suggests that the "relative deprivation" pathway may be playing out at the local most level in rural Zambia. Future studies should continue to explore the relationship between subjective and objective measures of relative deprivation and health in developing countries, where much of the research focuses on people's material circumstances to explain patterns of variation in health.

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FOOTNOTES

[1] The terms "allostasis" and "allostatic load" (see McEwen, 2000) can be used to assist in describing how such comparisons could lead to poorer health outcomes (Adler and Stewart, 2010). Allostasis is when the body maintains homeostasis (or stability) by adapting to a stressful situation through the release of stress hormones. If say upward social comparisons become regular, damage to the stress hormone response system could result, and thus, adversely impact the body by making the body more vulnerable to disease. This is allostatic load.

[2] These same data were not presented for men.

[3] The Gini coefficient is frequently used to measure the extent of income inequality within a given area (see Subramanian and Kawachi, 2004) and is based on the cumulative distribution of income, ranking a village in this study from the richest to the poorest person and ranges from 0 (perfect equality) to 1 (perfect inequality). Two households from two separate villages were combined with households from a village directly adjacent because they were the only households in their respective villages with complete income data or who agreed to participate in the study. Consequently, only 14 village Gini coefficients were estimated instead of sixteen.

TABLES

Table 1. Descriptive statistics, by wave of survey interviews; see notes.

	Both Waves (n=254)	Wave 1 (n=134)	Wave 2 (n=120)	p-value[1]
Body mass index (BMI)	20.7 (19.5, 22.3)	20.5 (19.3, 22.0)	21.1 (19.8, 22.6)	0.01
Asset worth per capita[2]	0.4 (0.2, 1.2)	0.5 (0.2, 1.2)	0.4 (0.2, 1.1)	0.72
Subjective socioeconomic status				
Lower	0.67	0.63	0.71	0.21
Same	0.30	0.32	0.28	0.43
Higher	0.03	0.04	0.02	0.20
Social capital				
Trust dummy	0.35	0.31	0.41	0.09
HH group participation score	1.0 (0.0, 2.0)	1.0 (0.0, 2.0)	1.0 (1.0, 2.0)	0.06
Dependency ratio	0.5 (0.4, 0.7)	0.6 (0.4, 0.7)	0.5 (0.4, 0.7)	0.03
Married dummy	0.85	0.86	0.85	0.85
Female dummy	0.53	0.54	0.52	0.74
Illness dummy	0.32	0.35	0.28	0.25
Age	40.8 (26.2, 51.0)	40.8 (25.9, 50.9)	40.4 (26.2, 51.3)	0.79
Education (years)	4.0 (0.0, 6.0)	4.0 (0.0, 6.0)	4.0 (0.0, 6.5)	0.86

Notes: Values for the continuous variables provided as the median (25th,75th percentiles in brackets).

Values for the binary variables provided as means.

[1]Values obtained by Wilcoxon rank-sum or t tests, where applicable.

[2]Asset worth per capita was divided by K1,000,000 (kwacha).

Table 2. Multilevel results for BMI model; see notes.

	Coeff.	SE	
Fixed effects estimates			
Asset worth per capita	0.388	(0.143)	***
Lower subjective SES	-0.444	(0.174)	***
Trust dummy	0.113	(0.152)	
HH group participation score	0.094	(0.117)	
Dependency ratio	0.394	(0.684)	
Married dummy	1.122	(0.467)	**
Female dummy	0.310	(0.403)	
Illness dummy	-0.219	(0.135)	*
Age	0.002	(0.015)	
Education (years)	0.041	(0.068)	
Wave (survey period two =1)	0.662	(0.098)	***
Constant	18.961	(1.061)	***
Random effects estimates	Variance	SE	
Level 4: between villages	0.100	(0.257)	
Level 3: between households	0.731	(0.714)	
Level 2: between individuals	4.027	(0.786)	

Notes: BMI=body mass index and SES=socioeconomic status.

Estimates obtained using a multilevel linear model (standard errors in brackets).

Total number of: observations=254, individuals=134, households=78, and villages=16.

The variable "asset worth per capita" was divided by K1,000,000.

Significance, ***<0.01, **<0.05, *<0.10.

Table 3. Multilevel results for adult nutritional status models using different criteria; see notes.

	Coeff.	SE	
Fixed effects estimates			
[1][1]			
Asset worth per capita	0.386	(0.143)	***
Lower subjective SES	-0.450	(0.176)	***
Village income inequality (Gini coefficient)	0.297	(1.177)	
Constant	18.855	(1.130)	***
[2][2]			
Asset worth per capita	0.315	(0.135)	**
Lower subjective SES	-0.189	(0.161)	
Constant	24.288	(1.058)	***

Notes: Estimates obtained using a multilevel linear model (standard errors in brackets).

[1]Body mass index (n=254) was used as the dependent variable.

[2]Mid-upper arm circumference (n=250) was used as the dependent variable.

All "asset" variables were divided by K1,000,000 (kwacha). SES=socioeconomic status.

Controls not shown include trust, group participation, dependency ratio, gender, illness, age, education, and wave of measurement.

Significance, ***<0.01, **<0.05.

FIGURES

Figure 1. Median BMI by tertiles of individual absolute income and subjective SES.
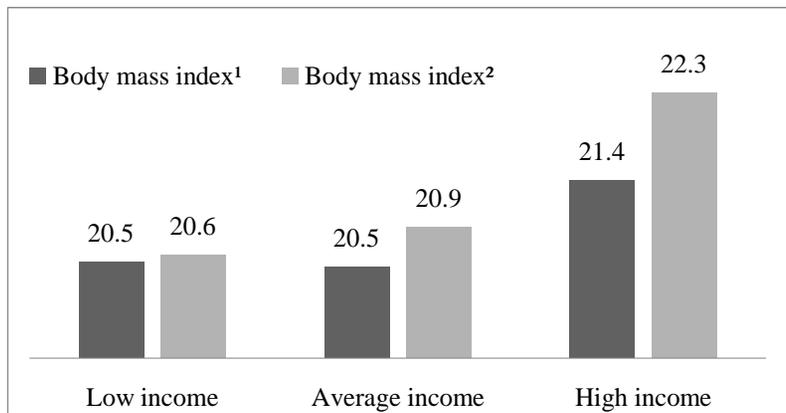
[1]BMI according to individual absolute income.
[2]BMI according to subjective SES.