ABSTRACT

Title of Dissertation: THE ASSOCIATION OF ORPHAN AND
                                             VULNERABLE CHILD (OVC) PRIMARY
                                             CAREGIVING, HOUSEHOLD WEALTH, AND
                                             FEMALE AUTONOMY ON WOMEN'S BODY
                                             MASS INDEX IN NAMIBIA, SWAZILAND AND
                                             ZAMBIA

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Background: This dissertation investigates factors associated with orphan and

vulnerable child (OVC) caregivers' body mass index (BMI) in Namibia, Swaziland and

Zambia.

Methods: Secondary analyses were performed using cross-sectional data from

Demographic Health Surveys conducted in 2006 and 2007. Manuscript 1 included de

facto women from Namibia (n=6,638), Swaziland (n=3,285), and Zambia (n=4,497).

Manuscript 2 included de jure women from Namibia (n=6,305), Swaziland (n=2,786),

and Zambia (n=4,389). Manuscript 3 included married de jure women from Namibia

(n=2,633), Swaziland (n=1,395), and Zambia (n=2,920). Statistical analyses using data

from 20-49 year old women included weighted marginal means, logistic regression, and Sobel and Goodman tests.

Results: Manuscript 1. OVC caregivers' overweight prevalence ranged from 26.98% (Namibia) to 61.3% (Swaziland). Namibian OVC caregivers were less likely to be overweight than non-OVC caregivers and non-caregivers not living with OVC. Swazi and Zambian OVC caregivers were more likely to be overweight than non-caregivers. In Namibia, women's age modified the effect of the association between OVC caregiving and overweight status.

Manuscript 2. Namibian and Swazi OVC caregivers had lower Absolute Wealth Index (AWI) mean scores than non-OVC caregivers and non-caregivers. In Zambia, OVC caregivers had a lower mean AWI score than non-caregivers living with an OVC but a higher mean AWI score than non-OVC caregivers. In all countries, even small increases in household wealth (e.g., being a poorer women – 2 to 3 AWI items) were associated with higher odds for being overweight regardless of women's caregiving status.

Manuscript 3. Women's educational attainment increased the odds for being overweight in Swaziland and Zambia, and decreased the odds for being underweight in Namibia. Decision-making autonomy mediated the association between AWI and OVC caregivers' BMI in Zambia (Z=2.13, p=0.03).

Conclusions. As Africa is experiencing a nutritional and HIV/AIDS transition, overweight problems among OVC caregivers has emerged and should be addressed. These findings support the World Health Organization's recommendations that African countries should focus on addressing infectious diseases as well as the emergence of

chronic diseases. Some African public health systems and OVC programs may face a new overweight epidemic alongside existing ones such as HIV/AIDS, tuberculosis, and malaria.

THE ASSOCIATION OF ORPHAN AND VULNERABLE CHILD PRIMARY
CAREGIVING, HOUSEHOLD WEALTH, AND FEMALE AUTONOMY ON
WOMEN'S BODY MASS INDEX IN NAMIBIA, SWAZILAND AND ZAMBIA

By

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List of Abbreviations

AIDS   Acquired Immune Deficiency Syndrome

ART   Antiretroviral Therapy

AWI   Absolute Wealth Index

BMI   Body Mass Index

CDC   Centers for Disease Control and Prevention

CI   Confidence Interval

DHS   Demographic Health Surveys

GDP-PPP   Gross Domestic Product - Power Parity per Capita

HIV   Human Immunodeficiency Virus

NCBI   National Center for Biotechnology Information

NLM   National Library of Medicine

OVC   Orphan and Vulnerable Children

PEPFAR   President's Emergency Plan for AIDS Relief

SES   Socio-economic Status

STIs   Sexually Transmitted Infections

US   United States

UNESCO   United Nations Educational, Scientific and Cultural Organization

UNICEF   United Nations Children's Fund

USAID   United States Agency for International Development

VIF   Variance Inflation Factor

WB   World Bank

CHAPTER 1 – Introduction

Primary caregiving is considered an emerging public health concern.[1] Primary caregivers worldwide are facing the dilemma of maintaining their own health while addressing the physical and emotional needs of family members.[2] Perhaps the greatest need for primary caregiving is seen in the continent of Africa, where primary caregiving is associated with the Acquired Immune Deficiency Syndrome and the Human Immunodeficiency Virus (HIV/AIDS) pandemic as well as the increased number of orphan and vulnerable children (OVC).

This dissertation uses the Demographic Health Surveys' (DHS) definition for OVC: children with one or both parents deceased (orphans); and vulnerable children who a) have a chronically ill parent (sick for more than 3 consecutive months during the past 12 months), or b) live with an adult who was chronically ill or died during the past 12 months.[3] Widows as well as male and female siblings, aunts, uncles, and grandparents are acting as primary caregivers for around 12 million OVC in Africa.[4] Overall, OVC primary caregivers provide four types of care to the OVC: economic, physical, psychological, and educational.[5] This dissertation includes four OVC primary caregiving categories are included: a) OVC primary caregivers, b) non-OVC primary caregivers, c) non-primary caregivers of a child but living with an OVC, and d) non-primary caregivers of a child and not living with an OVC. We focus on 20-49 year old women since many 15-19 year old women would still be in the adolescent growth spurt period, some of them still in puberty.

The goal of this dissertation is to investigate factors associated with OVC primary caregivers' body mass index (BMI). Secondary analyses of cross-sectional data from reproductive age women were performed using DHS data conducted in 2006 and 2007. Following is a brief description of the dissertation manuscripts, research aims and hypotheses.

Manuscript 1. Overweight among orphan and vulnerable child caregivers in 3 Southern African countries: an emerging public health concern

AIM 1: Investigate the association between OVC primary caregiving status and women's overweight status and the possible modifying role of socio-demographic and household characteristics on this relationship.

Research questions:

1) Is the OVC primary caregivers' mean BMI different than the mean BMI of women from the other three child caregiving groups within countries?

   H1: OVC primary caregivers have different mean BMI than women from the other three caregiving groups.

2) Does the OVC primary caregivers' mean BMI vary significantly by country?

   H2: Mean BMI among 20-49 year old OVC primary caregivers would vary by country.

3) What is the association between OVC primary caregiving status and women's overweight status in each country?

H3: OVC primary caregivers would be less likely to be overweight than women from the other three caregiving groups.

4) Do socio-demographic and household characteristics modify the effect of the association between OVC primary caregiving status and women's overweight status in each country?

H4: Socio-demographic and household characteristics modify the effect of the association between OVC primary caregiving status and women's overweight status in each country.

Manuscript 2. The intersection among orphan and vulnerable child caregiving, household wealth disparities and women's overweight status in three Southern African countries: a cross sectional study.

AIM 2: Investigate the association between women's overweight status with household wealth and the possible modifying role of OVC primary caregiving status on this relationship.

Research questions:

1) Does the Absolute Wealth Index (AWI) mean vary significantly by women's OVC primary caregiving status within countries?

   H1: AWI means vary significantly by women's OVC primary caregiving status within countries.

2) Does the AWI mean vary significantly by country within the OVC primary caregiving status categories?

   H2: AWI means vary significantly by country within the OVC primary caregiving status categories.

3) What is the association between household wealth and women's overweight status?

   H3: Having more household wealth is associated with higher odds for being overweight.

4) Does OVC primary caregiving status modify the association between household wealth and women's overweight status?

   H4: OVC primary caregiving status modify the association between household wealth and women's overweight status

Manuscript 3. Orphan/vulnerable child caregiving moderates the association between women's autonomy and their BMI in three African countries

AIM 3: Investigate the association between women's BMI with women's autonomy, explore whether the effect of this relationship is modified by OVC primary caregiving status, and explore whether women's decision-making autonomy mediates the association between household wealth and women's BMI.

Research questions:

1) What is the association between women's autonomy and their underweight/overweight status?

   H1: Women's autonomy decreases the odds for being underweight and increases the odds for being overweight.

2) Does OVC primary caregiving status modify the effect of the association between women's autonomy and their underweight/overweight status?

   H2: OVC primary caregiving status modifies the effect of the association between women's autonomy and their underweight/overweight status.

3) Does autonomy mediate the association between household wealth and women's BMI?

   H3: Autonomy mediates the association between household wealth and women's BMI.

I.1. Background framework for OVC primary caregiver's BMI

This dissertation includes a background framework for OVC primary caregiver's BMI which incorporates the components of 10 theoretical frameworks (Tables 1.4, Figure 1.1). The goal for developing the background framework was to contextualize the focus of this dissertation. As such, this framework goes beyond the three components included in this dissertation: 1) women's primary caregiving status, 2) women's autonomy, and 3) household wealth. This background framework was developed using a systems thinking approach that is an approach used to study systems' components. According to the science systems' approach, the only way to fully understand why a problem or element occurs and persists is by understanding the parts in relation to the whole.[6] Appendix one includes information regarding the methodology used for developing this background framework.

According to this background framework, the causes of nutritional problems among OVC primary caregivers are multidimensional; embracing different components grouped in three cause levels (basic causes, underlying causes and immediate causes) that could operate independently or in combination. The following paragraphs list the components included in each of the three cause-levels. Appendix 2 includes four possible pathways (one for underweight and overweight, two for underweight only, and one for overweight only). These possible pathways are an adaptation from the available literature.

Figure 1.1. Background framework for OVC primary caregivers' BMI

Basic causes

National Level: Population Distribution, Education, Macro-economy, Policy Environment, Natural Resources, Agricultural Sector, Transport, Urbanization, Social Security, Mass Media, Education, and Market Conditions
Sub-National (Community) Level: Livelihood Systems, Social Institutions, Cultural Attitudes, Stigma/Discrimination, No Social Programs, Adequate Environment for Physical Activity, Public Transport, Public Safety, Health Care, Sanitation, Manufactured and Imported Products, and Agriculture.

Food availability — Stability of food supplies — Access to Food

Underlying causes

Underlying causes Individual level | Underlying causes Household level

OVC's Caregiving Status — HIV/AIDS Status — Presence of Sick Members — Intra-House Discrimination — Intra-House Food Distribution

Caregiving Intensity Length of Time Providing Caregiving — Women's Income and Access to Cash (Labor) — Poor Social Integration — Household Composition — No Social Support

Perceived Burden (Stress Appraisal) — Women's autonomy — Wealth / Bank Accounts — Household Food Security — Health Resources. Water, and Sanitation

Immediate causes

Mental Health
Psychological Distress
Physiological Stress

Health Behaviors
Food Consumption
Physical Activity
Energy and Nutrient Intake
Stress Related Behavior

Food utilization by the body
Energy Expenditure
Health Status

Increase Cortisol

Metabolism, Mood, Appetite, Genes

Socio-Demographic Characteristics
• Women's education
• Women's marital status
• Women's parity
• Women's age
• Region (urban/rural)
• Religion

Manifestations

BMI
Underweight and Overweight

———— Association
– – – – – Mediation
•••••••••• Confounding/Effect Modification

Adapted from: Bermudez and Dwyer (1999), Bradley and Mishra (2008), Chevassus-Agnes S. (1999), Glass and McAtee (2006), Ice et al. (2010), Kumanyika et al. (2002), Lartey A. (2008), Owen et al. (2009), the FIVIMS Technical Sub-Committee (2004), and UNICEF (1990).

Levels of the background framework for OVC primary caregivers' BMI

Basic Cause Level

The basic cause level is mainly an adaptation of Simon Chevassuss-Agnes's conceptual framework and identifies two stages of basic causes for BMI.[7] The highest stage includes the socio-economic and political environment divided into national and sub-national levels. The national level includes the following components: population distribution; education; macro-economy; policy environment; natural resources; agricultural sector; transportation; urbanization; social security; mass media; education; and market conditions. The sub-national or community level includes: livelihood systems; social institutions; cultural attitudes; stigma/discrimination; no social programs; adequate environment for physical activity; public transportation; public safety; health care; sanitation; manufactured and imported products; and agriculture.

The lower stage identifies three key determinants of food consumption: food availability (whether from local production or other sources), stability of supplies over time (obtaining a steady flow of food from an inherently irregular production), and people's access to that food (i.e. their capacity to produce or purchase).[7] Chevassuss-Agnes also recognizes the relevance of the stability of access to food (e.g. stable income) for food security.[7]

Underlying Cause Level

Components from the underlying cause level are grouped in two sub-levels: the individual and the household. The individual sub-level has seven components including: primary caregiving intensity/length of time providing primary caregiving; OVC's primary caregiving status; HIV/AIDS status; perceived burden (stress appraisal); women's income and access to cash (labor); poor social integration; and, women's autonomy. The household level includes eight components: presence of sick members; intra-house discrimination; household composition; no social support; household wealth and access to bank accounts; household food security; intra-house food distribution; and, health resources, water, and sanitation. All of the components from this dissertation are located in this level due to the nature of the DHS data.

Immediate Cause Level

The immediate cause level includes three main components. The first main component relates to mental health and embraces psychological distress and physiological stress. The second main component is health behavior and includes: food consumption, physical activity; energy and nutrient intake; and stress related behavior. The third component is food utilization by the body and includes energy expenditure and health status. This level also includes two secondary groups of components: 1) increase of cortisol levels, and 2) metabolism, mood, appetite, and genes.

Manifestations

BMI is included in the manifestation level and acts as the outcome of this background framework.

Potential Confounders and Effect Modifiers

The impact of OVC's primary caregiving on women's nutrition could be influenced by a variety of socio-demographic variables. This background framework identifies socio-demographic characteristics such as the age of the child, primary caregiver's marital status, relationship with the head of the house, women's age and education, geographic region, parity, religious affiliation, and the household absolute wealth index as variables that could potentially act as confounders or effect modifiers on this relationship.

I.2. The epidemiology of HIV/AIDS and OVC

This dissertation concentrates on countries located in Southern Africa, which currently has the highest prevalence of HIV/AIDS in Africa. Focusing on female adult OVC primary caregivers is important because HIV/AIDS has disproportionately impacted African women, who are traditionally the ones who end up taking care of OVCs.[8] In nearly all countries in sub-Saharan Africa, the HIV prevalence is higher among women, particularly ages 15 - 24 years.[9] Over 76% of all HIV positive adult women in the world live in the sub-Saharan Africa region. As seen in Table 1.1, the prevalence of HIV among 15-49 year old males and females is lower in Zambia as compared to

Swaziland.[3,10-12] HIV prevalence is higher among women and urban areas than men and

in rural areas compared to urban areas in Swaziland and Zambia.

Table 1.1. Prevalence of HIV among 15-49 year old adults by gender and prevalence of OVC

Country (year of data collection)	Male HIV (%)	Female HIV (%)	Rural HIV (%)	Urban HIV (%)	OVC (%)
Namibia (2009)	--	--	--	--	28
Swaziland (2006-07)	19.7	31.1	23.8	31.4	31.1
Zambia (2001-02)	12.9	17.8	10.8	23.1	19.2

Source: Demographic Health Survey Reports from Namibia, Swaziland and Zambia.

Between 2004 and 2009, the number of AIDS-related deaths decreased by 20% in sub-

Saharan Africa. But even where HIV prevalence has stabilized, it is expected that the

number of OVC will continue to grow or at least remain high for several years as a result

of the lag between HIV infection and death due to current antiretroviral therapy (ART).[13]

OVC are groups of children that experience negative outcomes, such as the loss of their

education, morbidity, and malnutrition, at higher rates than do their peers.[14] The

increasing OVC population has been considered as the most tragic and long-term legacy

of the HIV/AIDS pandemic, making OVC's primary caregiving an emerging public

health concern in Africa.[15] Nearly 12 million African children have been single or double

orphaned as a result of HIV/AIDS. More than four-fifths of all OVC due to HIV/AIDS

worldwide live in Africa.[5] Data from DHS reports by country demonstrate the OVC

prevalence among children younger than 18 years of age in Southern Africa to be very high: 28.0% in Namibia, 31.1% in Swaziland and 19.2% in Zambia (Table 3). In addition, other children have been orphaned due to reasons other than HIV/AIDS. For example, the concept of "social orphans" is sometimes used to describe children whose parents might be alive but are no longer fulfilling any of their parental duties (e.g., drug addicts who are separated from their children with little chance of reunion, parents who are sick or abusive or who, for other reasons, have abandoned or largely neglect their children).

I.3. The epidemiology of women's nutrition in Africa

As shown in Table 1.2, Namibia has the highest underweight prevalence among 15-49 year old women and Swaziland is identified as having the lowest underweight prevalence.[3,10-12] Overall, the underweight prevalence is higher in rural areas than in urban areas with the exception of Swaziland, which has the highest prevalence of overweight. In every country, the overweight prevalence among 15-49 year old women is significantly higher in urban areas.[3,10-12]

Table 1.2. Underweight and overweight prevalence among 15-49 year old women by country of residence

Country (year of data collection)	Underweight* (%)			Overweight± (%)		
	All Females	Urban	Rural	All Females	Urban	Rural
Namibia (2006-07)	15.9	11.8	19.7	28.0	37.3	19.4
Swaziland (2006-07)	3.2	3.0	3.2	50.6	55.5	48.8
Zambia (2007)	9.6	7.5	11.2	19.2	29.6	11.1

* BMI< 18.5, ± BMI≥ 25
Source: Demographic Health Survey Reports from Namibia, Swaziland and Zambia.

Figure 2-5 shows that the underweight prevalence is higher among 15 to 19 year old women, when compared to 20–49 year old women.[3,10-12] In these three countries, underweight prevalence is higher among the lowest wealth quintiles. Overall, the underweight prevalence is higher in Namibia than in the other two countries in every age group and wealth quintile.[3,10-12] The prevalence of overweight is higher for older age groups in every country.[3,10-12] Overweight prevalence is also positively associated with household wealth.[3,10-12]

Figure 1.2. Prevalence of underweight by age and country

	15-19	20-29	30-39	40-49
Namibia	30.4	14.3	8.1	10.5
Swaziland	7	2.5	1.4	1.1
Zambia	14.6	8.4	8.1	7.3
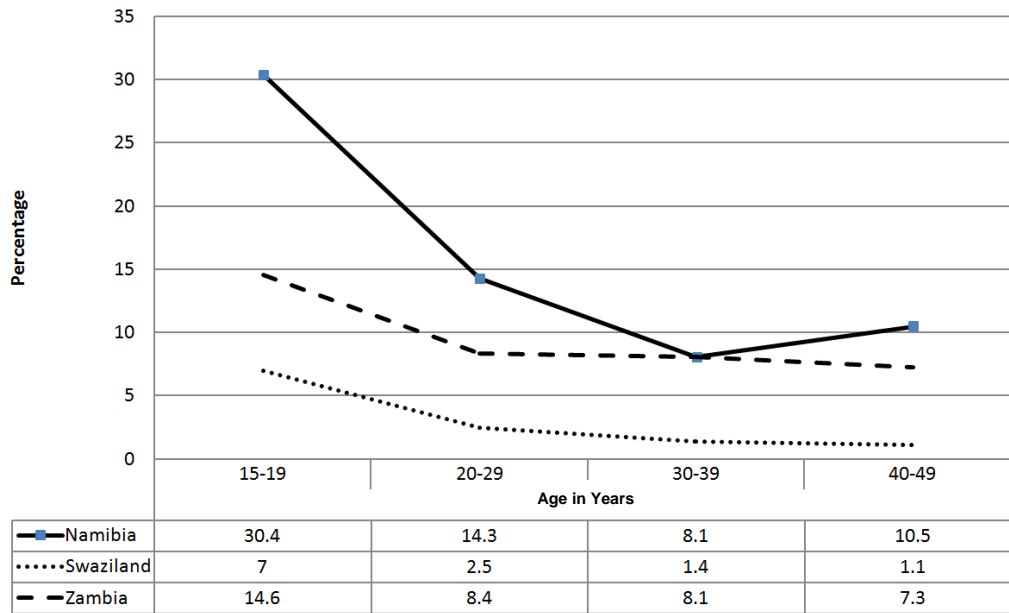
Source: Demographic Health Survey Reports from Namibia, Swaziland and Zambia.

Figure 1.3. Prevalence of underweight by wealth quintile and country

	Lowest	Second	Middle	Fourth	Highest
Namibia	22.2	22.6	15.8	11.2	11.4
Swaziland	4.6	3.9	2.9	2.8	2.3
Zambia	10.6	12.7	11.5	8.3	6.7

Source: Demographic Health Survey Reports from Namibia, Swaziland and Zambia.

Figure 1.4. Prevalence of overweight by age and country

	15-19	20-29	30-39	40-49
——Namibia	7.1	22.6	42.2	47.4
·····Swaziland	24.3	45.5	68.9	76.1
– –Zambia	8.2	16.2	25.6	31.8
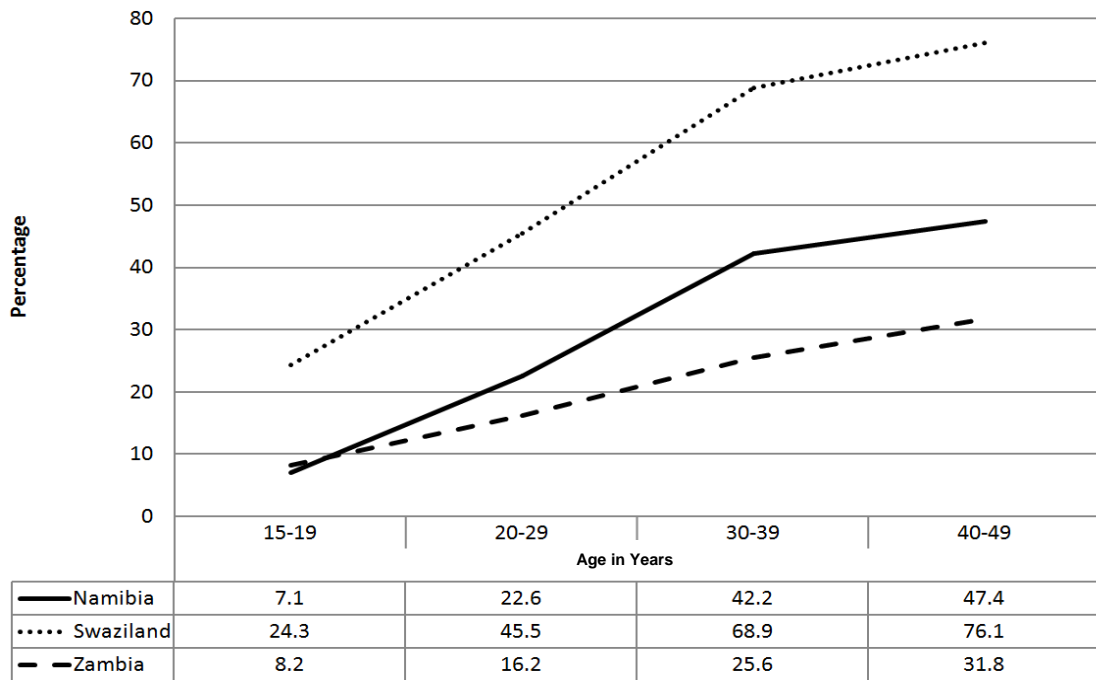
Source: Demographic Health Survey Reports from Namibia, Swaziland and Zambia.

Figure 1.5. Prevalence of overweight by wealth quintile and country
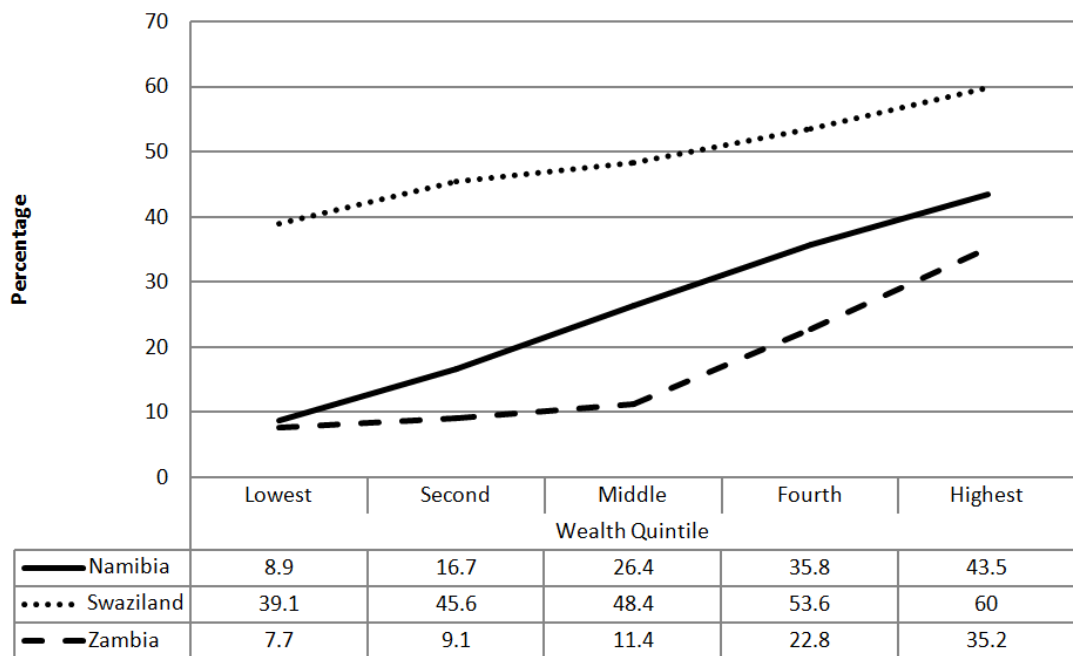
	Lowest	Second	Middle	Fourth	Highest
——Namibia	8.9	16.7	26.4	35.8	43.5
·····Swaziland	39.1	45.6	48.4	53.6	60
– –Zambia	7.7	9.1	11.4	22.8	35.2

Source: Demographic Health Survey Reports from Namibia, Swaziland and Zambia.

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A study conducted by Garenne (2011) investigated the long-term trends in BMI of African women between the ages of 15-49 years.[16] This study used DHS data from 33 African countries collected from 1992 to 2008. Garenne found that in countries of Southern Africa, average BMI was much higher than in other African regions.[16] Additional information available in DHS reports from Namibia, Swaziland and Zambia suggest that underweight has impacted Namibia disproportionally when compared to the other two countries included in this dissertation. As seen in Table 1.3, underweight prevalence among 15-49 year old women is 3.2% in Swaziland, 9.6% in Zambia, and 16.0% in Namibia. Overweight prevalence among 15-49 year old women is greater in Namibia and Swaziland (28.0%) than in Zambia (19.2%).

Garenne (2011) also found that the overall average BMI of young African women was rather favorable, and consistent with international standards.[16] However, his stratified analysis identified large disparities. More specifically, he found that in poor countries and in poor strata of most countries, mean BMI was rather low, indicating a deficit in both weight and nutrition. However, trends were suggestive that poorer groups' mean BMI were becoming more similar to the wealthier groups' mean BMI, and there was a moderate increase of weight with age, which the Garenne's study considered healthy. Garenne also found that for wealthier countries, urban areas, and for the wealthiest strata, the increase in weight with age was marked and increased over time, indicating the fast emergence of obesity. As Africa is experiencing a nutritional transition and many women are caring for children, this dissertation provides underweight and overweight prevalence among OVC primary caregivers.

I.4. African OVC primary caregivers' health and nutritional status

The reality of OVC primary caregivers differs from the reality of other women living in the same geographic area. For example, OVC primary caregivers are at a greater risk of poverty as a direct result of their involvement in supporting the health needs of their family members as a result of HIV/AIDS. Studies in several African countries have shown that income levels were approximately 20-30% lower in OVC households as compared to non-OVC households.[17-20] The stigma associated with HIV and AIDS may affect the social status of OVC primary caregivers and could lead to discrimination and further marginalization of the OVC and their families from the local community and other service providers.[17-19]

A longitudinal study by Littrell et al. (2011) in rural Malawi suggests that becoming a OVC primary caregiver is associated with a shift from good to poor self-reported health status (OR=2.29), and that elevated levels of self-reported distress and poor health persist over time in comparison with primary caregivers of non-orphans.[21] A qualitative study by Wangui (2009) in Kenya found that the ability to mobilize new sources of labor for food production and new social networks to facilitate other forms of food entitlement are critical livelihood strategies that influence the BMI of grandparents who are caring for children.[22]

A cross-sectional study by Muliira et al. (2011) in Uganda found that 65% of primary caregivers were caring for at least three orphans, 61% had been in the primary caregiver role for more than five years, and 61% stated that their health had been negatively impacted by primary caregiving.[2] This study also found that the most common new health problems OVC primary caregivers experienced since taking up the role of primary caregiver were chronic diseases (97%), social isolation (95%), and mental stress (92%). Results from a cross-sectional study by Howard et al. (2007) in rural eastern Zimbabwe (n= 371) indicated that OVC primary caregivers were disproportionately older females, tended to be poor, and did not have a spouse. Additionally, financial, physical, and emotional stress levels were high among OVC primary caregivers.[23] This study also identified that financial need may be greatest in single-orphan AIDS-impoverished households and that struggling families with an OVC are lacking external support.[23]

Previous studies on family primary caregiving for people living with HIV/AIDS including children and adults found negative implications for both primary caregiver's health and economic stability in Africa. For instance, in Botswana, Ama and Seloilwe (2011) found a 50% prevalence of physical burden (back pain and illness, such as headaches, stomach problems and the common cold), emotional burden (disrupted sleep as a result of primary caregiving, inability to keep their mind on what they were doing and worry about who will care for the primary caregiver when she or he becomes ill), social burden (feeling that the primary caregiver could not leave the relative or client alone, community rejection of HIV patients and inability of the primary caregiver to provide support from the family and social network), and financial burden (primary

caregiving affects resources negatively) among primary caregivers of people affected by HIV/AIDS.[24]

Studies in developed countries such as the U.S. and Canada also show an association between primary caregiving and health problems.[25] For instance, results from a large scale study (n=9,401 children and their primary caregivers) by Brehaut et al. (2009) using population based data from Canada suggested that the actual health of primary caregivers themselves who take care of children with health problems was significantly poorer than the health of primary caregivers of healthy children.[25] This included children with chronic conditions, activity limitations, poor general health, and symptoms of depression.[25] A variety of additional small-scale observational studies have also demonstrated that caring for a child with health problems increases the likelihood of the primary caregivers' health being negatively impacted with risky health habits (e.g., poor diet, sedentary behaviors), sleep problems, stress, distress, emotional issues, depression, and illness progression in persons with existing health problems.[5,25,26] Lee at al., (2004) found modest but significantly increased risks of low cognitive function on three out of six cognitive tests among 70-79 year old women who provided care to a disabled or ill spouse compared with women the same age who did not provide any care.[27] It has also been suggested that primary caregiving is associated with a decrease in preventive behaviors.[28]

The impact of OVC's primary caregiving on the primary caregivers' nutrition among 20-49 year old women in Africa remains inadequately understood due to the limited research conducted to date, which has had small sample sizes, lacked appropriate comparison groups, and was predominantly qualitative.[15] In addition, the majority of studies on caregiving and nutritional outcomes focused on adults 60 years and older caring for children and grandchildren.[29-31] The limited number of studies on the impact of OVC primary caregiving on primary caregivers' BMI in Africa may be due to limited access to relevant national data and researchers in the area.[32-34] Furthermore, research addressing women's nutrition in Africa has focused primarily on rural areas or specific regions of a country.[32,33]

I.5. Women's autonomy in Africa

The enhancement of women's autonomy has been recognized as a key factor for improving women's health status in general, and their BMI in particular.[35] Addressing women's autonomy would not only benefit primary caregivers' BMI. It would also lead to greater investments in the OVC's health, nutrition and education.

Primary caregivers' autonomy and household decision-making has also been called bargaining power or primary caregivers' authority.[36] According to Mason's (1995) broad definition, women's autonomy relates to their ability to make and execute independent decisions pertaining to personal matters of importance to their lives or their family, even

though men and other people may be opposed to their wishes.[37] Women's autonomy has been operationalized as a multidimensional construct including: 1) freedom of movement to visit families or relatives; 2) decision-making power for making large household and daily purchases; 3) access to economic resources (economic autonomy); 4) opportunity to participate in decisions (decision-making autonomy); 5) freedom within intimate relationships (emotional autonomy); 6) freedom to learn and possess knowledge (knowledge autonomy); and, 6) women's attitude toward domestic violence (i.e., wife beating).[37] This dissertation focuses on two dimensions of women's autonomy: their household decision-making autonomy and their educational attainment.

Previous studies have shown that some socio-demographic characteristics such as having an urban residence, having a partner living at home, being polygamous, number of members in the household, women's age, women's education, and women's employment are associated with women's autonomy in Sub-Saharan Africa.[38] The literature also suggests a significant association between women's autonomy and lower child mortality, improved child BMI, and child schooling.[39] Women's autonomy has also been associated with women's decision-power to have sex with their husbands as well as the use of contraceptive methods.[41] For these reasons, it has been implied that women's autonomy could play an important role in family planning and the reduction of HIV infection rates in women.[39] As Africa is experiencing a nutritional transition characterized by a shift toward a more energy dense diet, with increased fat, sugar, processed foods, and a reduction in physical activity;[42] it is crucial to understand the nature of the relationship between OVC primary caregivers' autonomy and women's overweight status.

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Previous studies have suggested that women with lower levels of autonomy within the household are more likely to experience underweight in Zimbabwe[43], Zambia,[38] Malawi,[38] and Ethiopia.[45] Hindin (2005) found that women in Zambia and Malawi who have less decision-making autonomy than their partners are also more likely to suffer from malnutrition.[38] When women from Zimbabwe had no say over household decisions, they had a 12% risk of malnutrition as compared to a 4% risk of malnutrition if they had some say in at least one of the decision-making domains. A study in Ethiopia found that women with low decision-making autonomy were 1.54 times more likely to be underweight than those with high decision-making autonomy.[35] In Zimbabwe, women's health could be adversely affected if they lacked autonomy (were unable to negotiate for themselves), particularly in resource constrained settings.[43] Berhane et al (2001) found that poor decision-making power was a socio-cultural factor that potentially affect the health of women in the rural town of Butajira in Ethiopia.[45] A study in rural Ethiopia by Broussard (2012) found that families that are beneficiaries of food aid support tended to invest the majority of aid receipts for the male household members, and that the nutrition of women with little autonomy suffered the most.[47]

There are few published studies addressing women's autonomy and women's overweight. One study by Elfhag and Rössner (2005) found that weight loss maintenance has been associated with autonomy as well as with internal motivation to lose weight, social support, better coping strategies and ability to handle the stress of daily life, self-efficacy, assuming responsibility for one's life, and overall stronger psychological strength and stability.[48]

I.6. Household wealth and women's health and nutrition in Africa

The economic development that Africa is experiencing is embracing a new classification of households based on their access to wealth that includes families in extreme vulnerability that are characterized by having very low cash income, no access to modern goods, and no ability to accumulate even the smallest modern capital; families able to buy cheaper goods such as a radio or a bicycle; and wealthy families who can afford living in a household with all western commodities.[49] Hohmann and Garenne (2011) use a measurement called the Absolute Wealth Index (AWI) to capture this wide range of household wealth distribution.[49] AWI was developed using the approach from Filmer and Pritchett (1999).[50] Findings from one of Hohmann and Garenne's studies that pooled data from 36 African countries suggest that overall Africa is at the beginning of the economic transition that is reflected in a majority of households with very few modern items (0 or 1 item) and very few households with 8 or more modern items. However, it is important to take into account each country's underlying characteristics in order to have a clear understanding of the level of disparity regarding individual wealth of citizen in each nation. As presented in Table 1.3, only Swaziland and Namibia have higher income/capital (GDP-PPP) than the continental average income/capital. The absolute AWI at the national level ranged from 2.84 to 6.22, reflecting the large differences in wealth and in GDP-PPP among these countries.

Table 1.3. Characteristics, and distribution of wealth in 3 African countries

Country (Survey Year)	Population year 2000 (million)	Income/capita (GDP-PPP)	Absolute wealth index (AWI)	Proportion very poor (AWI < 2)	Gini Coefficient* exp (AWI)
Namibia (2007)	1.894	3,795	6.01	19.4%	0.61
Swaziland (2006)	1.044	2,606	6.22	8.7%	0.55
Zambia (2007)	10.419	666	4.77	19.1%	0.61
Africa	**627.623**	**1,134**	**3.13**	**35.4%**	**0.56**

* Gini coefficient measures the inequality among values of a frequency distribution. A Gini coefficient of zero expresses perfect equality where all values are the same (for example, where everyone has an exactly equal income). A Gini coefficient of one (100 on the percentile scale) expresses maximal inequality among values (for example where only one person has all the income) Source: Hohmann, S. & Garenne, M. Health and wealth in Uzbekistan and sub-Saharan Africa in comparative perspective. 2010.

Poverty is the main underlying cause of undernutrition and its determinants.[51] Uthman (2008), using meta-analytic procedures to synthesize the results of DHS data from 11 countries in sub-Saharan Africa, found that the prevalence of HIV-related malnutrition among women varied by wealth status, education attainment, occupation, and type of residence (rural/urban).[52] It has been suggested that lack of education and poverty play a part in malnutrition in Malawi.[53]

A study including data from 7 countries in Africa indicated that overweight prevalence is increasing by about 5% per year.[54] Previous studies have shown that Zimbabwean women living in a household with higher levels of wealth are more likely to have higher BMI when analyzing BMI as a continuous variable.[43] However, this significant association disappeared when BMI was included as a dichotomous dependent variable (BMI<18.5 vs. other BMI). A study by Keding et al., (2011) in rural Tanzania found that

wealth was positively associated with high consumption of meat, eggs, and/or milk.[55] Adebowale et al., (2011) found that the risk of overweight was significantly higher among urban women than their rural counterparts (p<0.05) and increased consistently with increasing wealth and levels of education. Women who work at home were approximately fifty percent more likely to be underweight than those who work away from home (p<0.001).[56]

I.7. The structure of the dissertation

Chapter 2 presents information regarding the methodology used. Chapter 3 includes information for manuscript 1 that studies the association between OVC primary caregiving status and women's overweight status and the possible modifying role of demographic characteristics. Chapter 4 presents information for manuscript 2 that focuses on the association between women's overweight status with household wealth and the possible modifying role of OVC primary caregiving status on this relationship. Information for manuscript 3 is included in chapter 5. Manuscript 3 explores the association between women's BMI with women's autonomy, explore whether the effect of this relationship was modified by OVC primary caregiving status, and explore if women's decision-making autonomy mediates the association between household absolute wealth and OVC primary caregivers' BMI. Chapter 6 concludes with information related to the public health significance of the dissertation, as well as policy implications and long term relevance.

Appendix 1.1. Methodology used for developing the background framework

A background framework for OVC primary caregivers' BMI was developed using the following methodology. Articles and reports relevant for the development of the background framework were gathered using an online search with the key words: "BMI, orphan and vulnerable children, primary caregiver, Africa and nutrition;" "under nutrition, orphan and vulnerable children, primary caregiver, Africa and nutrition;" "overweight, obesity, orphan and vulnerable children, primary caregiver, Africa and nutrition;" "theoretical framework, Africa and nutrition;" and, "theoretical framework and BMI." This search was performed from May 23rd to June 4th 2012 using PubMed, Google scholar, and the Global Health database.

Using these three databases, a total of 410 reports/manuscripts were identified and analyzed. Of these studies, 104 documents were deemed eligible for further review as they included information on OVC primary caregiving, BMI or theoretical frameworks related to caregiving. From these documents, 10 documents included relevant theoretical frameworks. Data were abstracted for the following information: article's title, year of publication, principal investigator's name, target country, target population, levels of the theoretical framework (basic level, underlying cause level, immediate cause level, and manifestation level), and components for each level.

Table 1.4. Conceptual frameworks considered during the development of the background framework for OVC primary caregivers' BMI

	Author	Year	Region	Target Population	Outcome
1	UNICEF[57]	1990	General	General	Malnutrition
2	Owen et al.[58]	2009	Sub-Saharan Africa	OVC	Malnourishment Poor Health
3	Chevassus-Agnes S.[7]	1999	Developing Regions	Children and Adults	BMI
4	Bermudez and Dwyer[59]	1999	US	Older Persons	BMI
5	Ice et al.[60]	2010	Africa	Elder Primary caregivers	Physical Health: BMI, Glucose, BP, Perceived Health and Hemoglobin
6	Kumanyika et al.[61]	2002	General	General	Obesity
7	Glass and McAtee[62]	2006	General	General	Obesity
8	Bradley and Mishra[63]	2008	Sub-Saharan Africa	Adult Women	HIV Status / BMI
9	The FIVIMS Technical Sub-Committee[64]	2004	Asia	Vulnerable Populations	Food Insecurity/BMI
10	Lartey A.[65]	2008	Sub-Saharan Africa	Adult Women	Malnutrition

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Biotechnology Information (NCBI) at the National Library of Medicine® (NLM).[66]

PubMed provides free access to MEDLINE, NLM's database of citations and abstracts in

the fields of medicine, nursing, dentistry, veterinary medicine, health care systems, and

preclinical sciences.

Google Scholar is an online search engine for scholarly literature. The order in which

Google Scholar's search are presented takes into account the full text of each document,

the data of publication, authorship, date of publication, and number of citations in other

scholarly literature.[67]

Global Health is a database specializing in public health, human nutrition, parasitic,

communicable and tropical diseases and medicinal plants.[68] It provides access to abstracts

of the world's research literature from 1973 to present with coverage of English and

foreign language journals, books, research reports, patents and standards, dissertations,

conference proceedings, annual reports, developing country information and other

difficult to obtain literature. The database contains over 1.41 million records with 90,000

records added annually.

Appendix 1.2. Pathways linking OVC primary caregiving and women's BMI

The following paragraphs describe four possible pathways that linked OVC's primary caregiving and women's BMI. This is not an exhaustive list of potential pathways.

Pathway 1. OVC primary caregiving and women's BMI incorporating basic causes at the national and sub-national levels and health behaviors

In Figure 1.6., this pathway includes components located in the basic-cause, underlying-cause and immediate-cause levels. Components and associations for this pathway have been adapted from the Chevassuss-Agnes' framework.[7]

- Step 1: National and sub-national basic causes influence OVC's primary caregiving. The Chevassuss-Agnes framework emphasizes the association between primary caregiving and intra-house food distribution. This adapted pathway assumes that all other components included in the underlying cause level would interact among them and that this interaction would influence OVC's primary caregiving.

- Step 2: OVC's primary caregiving influences health behaviors, especially food consumption including energy and nutrient intake.

- Step 3: Food consumption influences primary caregivers' BMI. The result of this pathway could be an increase or a decrease of BMI. However, it is important to take into account that metabolism, mood, appetite and genes can act as potential confounders or effect modifiers on this relationship.

Figure 1.6. Pathway 1: OVC primary caregiving and women's BMI incorporating basic causes at national and sub-national levels; health resources, water and sanitation; and food expenditure by the body.
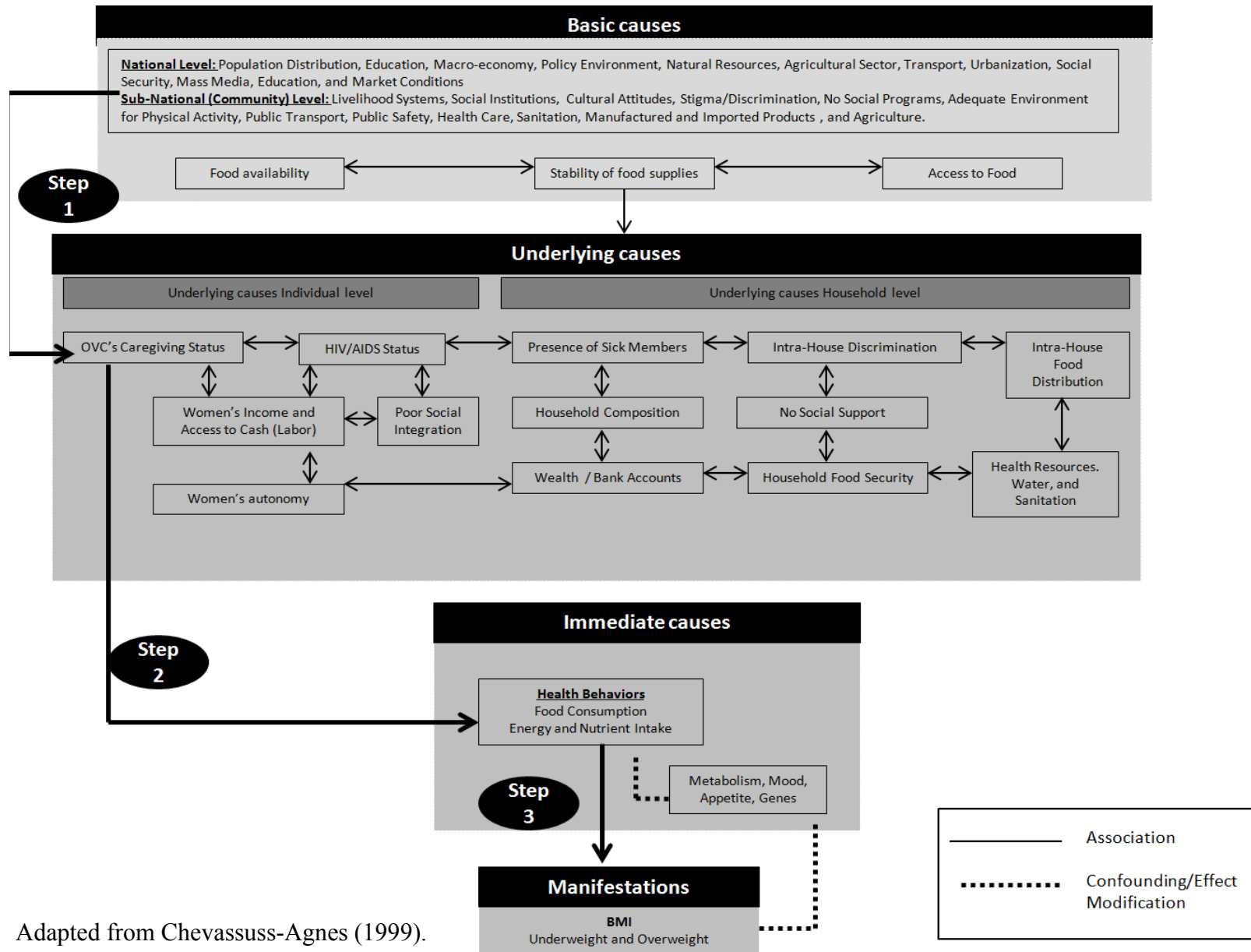
Adapted from Chevassuss-Agnes (1999).

Pathway 2: OVC primary caregiving and women's BMI incorporating basic causes at national and sub-national levels; health resources, water and sanitation; and food expenditure by the body

Pathway 2 includes components located in the basic-causes, underlying-causes and immediate-causes levels (Figure 1.7). Components and associations for this pathway have been adapted from Chevassuss-Agnes' framework.[7]

- Step 1: Basic causes influence household access to health resources, water and sanitation that would in turn be influenced by OVC's primary caregiving as well as its interaction with the other underlying cause level components.

- Step 2: Household access to health resources, water and sanitation influence food utilization by the body that is associated with women's health status.

- Step 3: Food utilization by the body influence primary caregivers' BMI. The result of this pathway would be a decrease in BMI.

Figure 1.7. Pathway 2: OVC primary caregiving and women's BMI incorporating basic causes at national and sub-national levels; health resources, water and sanitation; and food expenditure by the body
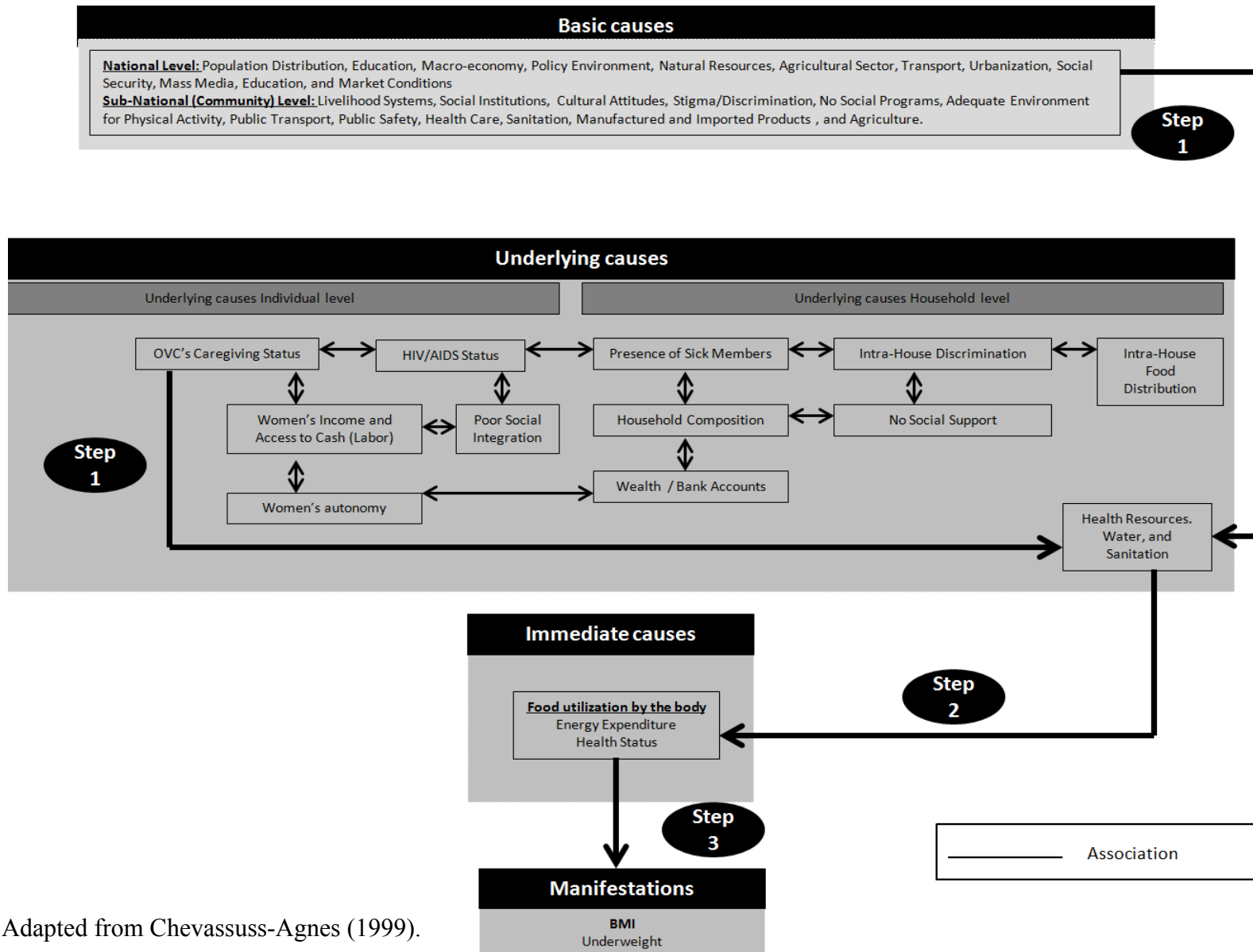
Adapted from Chevassuss-Agnes (1999).

Pathway 3: OVC primary caregiving and women's BMI incorporating HIV status; presence of sick members and community stigma/discrimination; women's income and access to cash; poor social integration; wealth/bank accounts; social support; health resources, water and sanitation; household food security; and, food utilization by the body.

In Figure 1.8., pathway 3 includes components located in the basic cause, underlying cause and immediate cause levels. Components and associations for this pathway have been adapted from Owen et al. and Ice et al. frameworks.[58,60]

- Step 1: The OVC's primary caregiving status is associated with HIV/AIDS status and the presence of sick family members. Due to this situation, OVC primary caregivers could face stigma and discrimination in the community.

- Step 2: Stigma and discrimination impact women's income and access to cash (labor) and lead to poor social integration.

- Step 3: Lower income, lack of access to cash and poor social integration influence the household wealth, decrease the probability of having a bank account, and reduce social support.

- Step 4: Factors from steps 2 and 3 would compromise women's access to health resources, water and sanitation as well as household food security.

- Step 5: At this point, women would have a limited access to food. This situation would compromise their food intake. Insufficient consumption of protein and calories could lead to frequent infections.

- Step 6: At this stage, the health of the women would be compromised.

- Step 5: The poor health of the women could potentially lead to a decrease of her BMI.

Figure 1.8. Pathway 3: OVC primary caregiving and women's BMI incorporating HIV status; presence of sick members and community stigma/discrimination; women's income and access to cash; poor social integration; wealth/bank accounts; social support; health resources, water and sanitation; household food security; and, food utilization by the body.
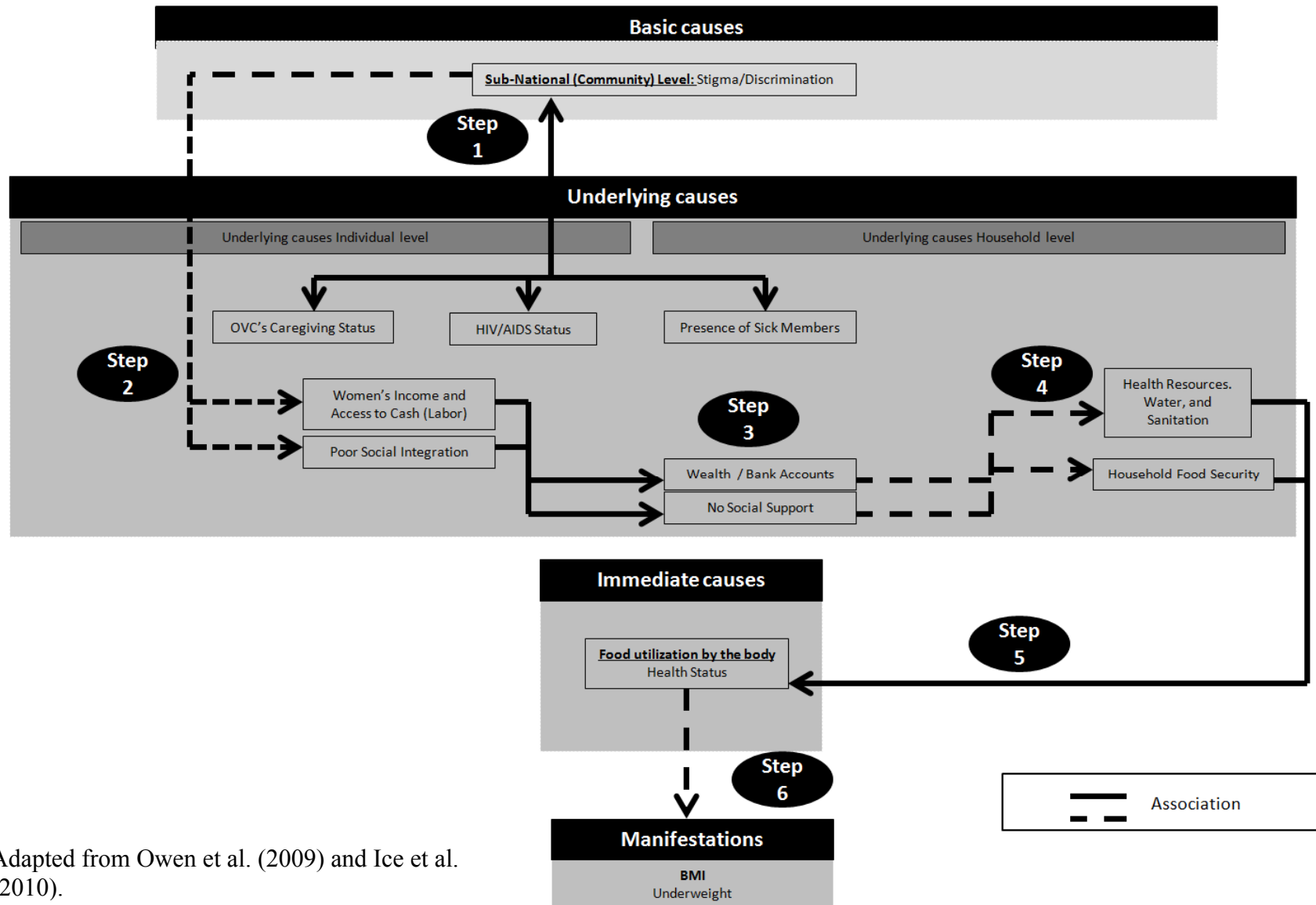
Adapted from Owen et al. (2009) and Ice et al. (2010).

Pathway 4: OVC primary caregiving and women's BMI through mental health

This pathway includes components located in the underlying-cause and immediate- cause levels (Figure 1.9).[60]

- Step 1: OVC's primary caregiving can be perceived as a burden that could in turn create psychological distress.

- Step 2: Physiologically, chronic stress would increase cortisol and catecholamine.

- Step 3: Stress could lead to unhealthy behaviors (e.g., smoking, drinking, and eating poorly). Unhealthy behaviors could impact health. On the other hand, stress through the action of cortisol could lead to an increase in BMI.

Figure 1.9. Pathway 4: OVC primary caregiving and women's BMI through mental health
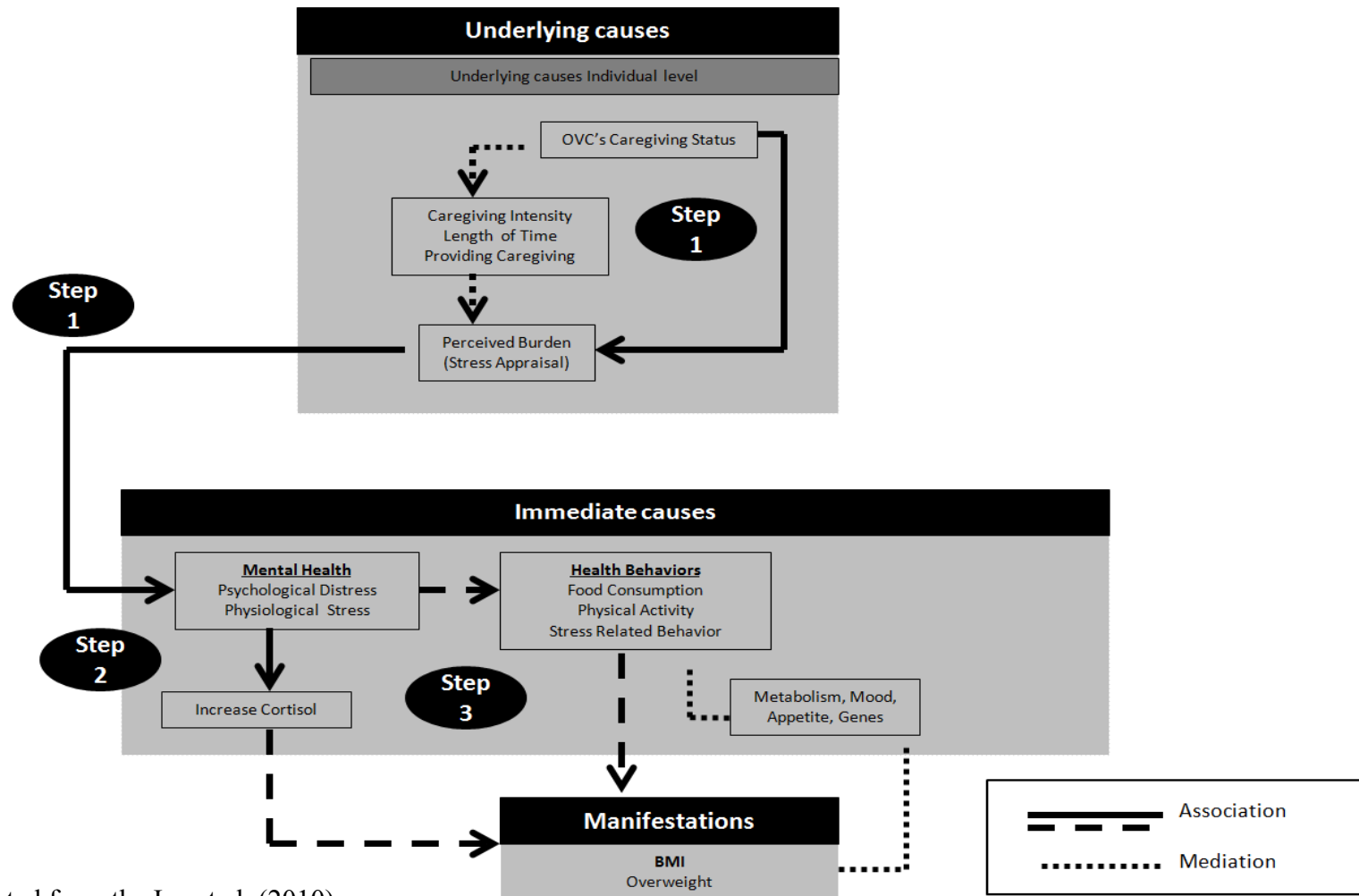
Adapted from the Ice et al. (2010)

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Chapter II. Methods

Overall study design - Data source

The goal of this dissertation is to investigate factors associated with OVC primary caregivers' body mass index (BMI). Secondary analyses of cross-sectional data from reproductive age women were performed using Demographic Health Survey (DHS) data from the following countries (years): Namibia (2006-2007), Swaziland (2006-2007), and Zambia (2007). These are large-scale household sample surveys conducted by governments, with support from international organizations and institutions, such as Macro International, specific United Nations agencies, and the United States Agency for International Development (USAID).

DHS surveys are carried out at periodic intervals in approximately fifty countries across Africa, Asia, the Middle East, Latin America, and the former Soviet Union. In each country, the DHS program collects information about a large number of health, nutrition, population and health service utilization measures (e.g., HIV/AIDS), as well as data on respondents' demographic, social and economic characteristics. DHS uses a standard set of questionnaires and data are collected at individual, household and community levels. DHS includes a sampling frame based on each country's Population and Housing Census to provide estimates of key population and health indicators, including fertility and mortality at country, rural/urban, and regional levels.

This dissertation used information from two DHS questionnaires: the Household and the Woman's Questionnaires. Information from the following datasets was combined in a single SPSS file: Household Recode, Individual Recode and Household Member Recode. DHS questionnaires have been adapted to reflect the population and health issues relevant to each country. Questionnaires were available in English and local languages.

The Household Questionnaire was used to list all of the usual members and visitors of selected households. Basic information was collected on the characteristics of each person listed, including his or her age, sex, education, and relationship to the head of the household. For children under age 18, the survival status of their parents was determined. If a child in the household had: a) a parent who was sick for more than three consecutive months in the 12 months preceding the survey, or b) a parent who died during the 12 months preceding the survey, then additional questions relating to support for orphans and vulnerable children were asked. Further, a) if an adult in the household was sick for more than three consecutive months in the 12 months preceding the survey, or b) an adult in the household had died in the past 12 months, questions were asked relating to support for sick people or those who have died.

The co-residency of the OVC or OVC status of the primary caregiver was determined by the number of OVC living in the household. The data on the age and sex of household members obtained in the Household Questionnaire was used to identify women and men who were eligible for the individual interview. Additionally, the Household

Questionnaire collected information on characteristics of the household's dwelling unit, such as the source of water, type of toilet facilities, materials used for the floor of the house, ownership of various durable goods, and ownership and use of mosquito nets (to assess coverage of malaria prevention programs). The Household Questionnaire was also used to record height and weight measurements for eligible women.

The Woman's Questionnaire was used to collect information from all eligible women. These women were asked to self-report on the following topics: 1) background characteristics (education, residential history, media exposure, etc.); 2) birth history and childhood mortality; 3) knowledge and use of family planning methods; 4) fertility preferences; 5) antenatal, delivery, and postnatal care; 6) breastfeeding, and infant feeding practices; 7) women's and children's BMI; 8) vaccinations and childhood illnesses; 9) marriage and sexual activity; 10) women's work and husband's background characteristics; 11) malaria prevention and treatment; 12) awareness and behavior regarding; 13) AIDS and other sexually transmitted infections (STIs); 14) adult mortality, including maternal mortality; and 15) domestic violence.

Data collection and response rates

All DHS teams started fieldwork in the same general geographical location (e.g., same province) when possible in order for senior survey staff to supervise when needed. DHS survey teams were assigned sample areas taking into account languages spoken and other

requirements and the need to ensure that the travel times per team were minimized as much as possible. Generally, DHS teams worked six days per week and worked away from home for several weeks or months at a time. If an interview was not completed on the first visit, further attempts were made with the sampled household or respondent (up to three times and over three different days) before classifying the case as non-response. The subsequent contacts were scheduled at times when the respondent was more likely to be at home. There was no replacement for a household or an individual that refused to be interviewed or was otherwise classified as non-response. Table 2.1 shows that the eligible women response rates in every country and region studied for this dissertation reached at least 94%.

Table 2.1. Response rates for households and eligible 15-49 year old women by country and region

	Household response rate (%)	Eligible women response rate (%)
Namibia 2006-07		
Urban	96.8	92.9
Rural	98.5	96.2
Total	97.8	94.7
Swaziland 2006-07		
Urban	92.7	91.8
Rural	96.9	95.1
Total	95.2	94.1
Zambia 2007		
Urban	98.0	95.7
Rural	97.6	97.1
Total	97.8	96.5

Source: Macro International Inc, 2012. MEASURE DHS STATcompiler. http://www.measuredhs.com, June 8 2012.

Participants and criteria for selection

Women were included in this dissertation if they were 20-49 years old and provided oral

consent for participation. Similar to previous studies addressing BMI of adult women

from Sub-Saharan countries, this study excluded pregnant and three months or less

postpartum women to avoid the impact of the fetus and lactation on the BMI.[1] Women

with BMI less than 12.0 or greater than 60.0 were also excluded as these might be cases

of extreme anthropometric measures or resulting from data errors.[2]

- Analyses for manuscript one included women who slept in the household the
  night before the survey (de facto household residence).
- Analyses for manuscript two included de jure household resident women because
  information regarding household wealth was only available for de jure residents.
- Analyses for manuscript three included married women who usually lived in the
  household (de jure household residence) because information regarding household
  wealth was only available for de jure residents. Information regarding women's
  decision-making autonomy was only available for married women or women who
  were living together with a partner.

Table 2.2. Analytic sample size by country

	Namibia (n)	Swaziland (n)	Zambia (n)
Manuscript 1	6,638	3,285	4,497
Manuscript 2	6,305	2,786	4,389
Manuscript 3	2,633	1,395	2,920

Namibia, Swaziland and Zambia share common characteristics such as being located in

Southern Africa where the highest prevalence of HIV/AIDS in Africa is located, belong

to the Southern African Development Community, had economies linked to South Africa,

had HIV prevalence of at least 5% or orphan prevalence of at least 8% among children

age 0-17 years (i.e., one or both biological parents have died), had available DHS data for

primary caregiving status and women's anthropometrics, had less than 20% missing data

for women's BMI, and had women's response rates that were at least 94% (Swaziland

94.1%, Namibia and Zambia 97.8%). This dissertation used the DHS definition for OVC:

children with one or both parents deceased (orphans); and vulnerable children who a)

have a chronically ill parent (sick for more than 3 consecutive months during the previous

12 months) or b) live with an adult who was chronically ill or died during the previous 12

months.

Variables

Table 2.3 includes the independent variable, the dependent variable, confounding or control variables, effect modifier or interaction variables, and mediator variables included in each manuscript. The following paragraphs describe each variable.

Table 2.3. Variables included in the dissertation by manuscript

	Manuscript 1				Manuscript 2				Manuscript 3				
	Dependent variable	Independent variable	Confounder	Effect modifier	Dependent variable	Independent variable	Confounder	Effect modifier	Dependent variable	Independent variable	Confounder	Effect modifier	Mediator
Body Mass Index (continuous)	x				x				x				
Body Mass Index (categorical)	x								x				
OVC primary caregiving		x									x	x	
Decision-making autonomy										x			x
Educational attainment						x	x			x			
Women's education			x	x		x					x		
Absolute Wealth Index			x	x			x				x		
Presence ≤5 year old child in house			x	x			x				x		
Women's marital status			x	x			x						
Women's age			x	x			x				x		
Women's work status			x	x			x				x		
Region of residence			x	x			x				x		
Parity			x	x			x				x		
Religion							x				x		
Women's relationship with household head			x	x			x				x		
Number of household members			x	x			x				x		
Number of 18-49 year old women in the household			x	x			x				x		
Number of 18-49 year old men in the household			x	x	x						x		

Body Mass Index (BMI) was defined as weight in kilograms divided by height squared in meters (kg/m^2). BMI was categorized in three groups: underweight (BMI < 18.5), normal weight (18.5 ≥ BMI < 25.0), and overweight (BMI ≥ 25.0). BMI has been widely used as an anthropometric indicator of health, especially regarding nutrition-related disease among adult women from Sub-Saharan countries[1] and other regions.[3] Weight was measured by using a solar-powered scale (Uniscale) with an accuracy of ± 100g. Height was measured with an adjustable wooden measuring board (Shorr Height boards) to the nearest 0.1 cm.

The Centers for Disease Control and Prevention (CDC) considers that BMI is one of the best methods for population assessment of overweight because calculation requires only height and weight, and it is inexpensive and easy to use for clinicians and for the general public.[4] A significant drawback with BMI is that it does not take into account a person's body fat content, which is an indicator of the risk of future health problems. Even though the correlation between the BMI number and body fatness is fairly strong, it is important to consider that this correlation varies by sex, race, and age.[4] For example, at the same BMI, women tend to have more body fat than men and older people tend to have more body fat than younger adults. Highly trained athletes may have a high BMI because of increased muscularity rather than increased body fatness.[5] A BMI measurement is not as accurate if the individual is an athlete or very muscular (muscle weighs more than fat) since this can push the person into a higher BMI category even if he/she has a healthy level of body fat. Because BMI does not measure body fat directly, it should not be used

as a diagnostic tool. Instead, BMI should be used as a measure to track weight status in populations and as a screening tool to identify potential weight problems in individuals.[4]

OVC primary caregiving status. Primary caregivers were women who lived with a biological child under the age of 18 and/or who were primary caregivers of a non-biological child under the age of 18. We focused on children less than 18 years of age because the official orphan definition used by UNICEF, UNAIDS and USAID is 0-17 year old child whose mother (maternal orphans) or father (paternal orphans) or both (double orphans) are dead.[6] The primary caregiving status of the woman was based on the question: "How many orphans and vulnerable children live in your household?" **OVC primary caregivers** were women categorized as primary caregivers who lived with at least one OVC child. **Non-OVC primary caregivers** were women categorized as primary caregivers who did not live with any OVC children. **Non-primary caregivers living with an OVC** were women categorized as non-primary caregivers who lived with at least one OVC child. **Non-primary caregivers not living with an OVC** were women categorized as non-primary caregivers who did not live with an OVC child. For manuscript three, a combined category of **non-primary caregivers** (non-primary caregivers regardless if they were or were not living with an OVC) was created due to the small number of cases for each of the two non-caregiving categories.

Household decision-making autonomy included five situations (yes/no) to determine whether a woman had the final say on: (1) her own health care, (2) large household purchase, (3) making purchases of everyday household items, (4) making visits to family or relatives, and (5) what to do with the money the husband earns. **Educational attainment** included the following categories: no education, primary, secondary and higher education.

Women's work status included the following categories: not working, working in agriculture, and working in any field other than agriculture. This classification takes into account that the African agricultural sector has a different economic growth rate as compared to other sectors such as industrial and service business. Analyses for assessing collinearity between region and work status were performed.

Wealth was assessed with the **Absolute Wealth Index (AWI),** a measure developed by Hohmann and Garenne (2011) based on the previous work by Pritchett and Filmer (1999) that captures a wide range of household wealth distribution, (Appendix 1).[7] AWI was used as: 1) a continuous variable that included a score from 0 to 14, 0 indicating no modern goods, and 12+ indicating all modern comforts (e.g., running water, flushing toilet, electricity, radio, television, refrigerator, means of transportation, telephone, etc.); and, 2) a categorical variable (poorest: 0-1, poorer: 2-3, medium: 4-5, wealthier: 6-7, and wealthiest: 8+).[2, 7, 8] The variable **access to cash** (Yes/No) was excluded from the study due to collinearity with other economic indicators.

Presence of a **child 5 years old or younger in the house** was measured with a dichotomous variable (yes/no).

Women's marital status (self-reported) included the following categories: married or living together, divorced/separated, widowed, never married and never lived together.

Women's age (self-reported) included the following categories: 20-29, 30-39 and 40-49 years old.

Region of residence (assessed during the stratified sample configuration) was a dichotomous variable: rural/urban.

Parity (self-reported) or the number of births the woman had included the following categories: 0, 1, 2, 3 or more births. These categories have been previously used in other studies in Africa.[9]

Religion (self-reported) included three categories "Catholic", "Protestant", and 'other religion."

Number of household members (self-reported) included the following categories: less than 3, 4 to 6, and 7 or more.

Number of 18-49 year old women in the household (self-reported) included the following categories: 1, 2, 3, 4 or more.

Number of 18-49 year old men in the household (self-reported) included the following categories: 0, 1, 2 or more.

Religion was considered a potential confounder for the following reasons. A study by Bitew (2011) in Ethiopia found an association between women's underweight status and their religious affiliation.[1] Previous studies have suggested that religions could impact differently on the health of individuals (i.e., having HIV/AIDS) because religions have different beliefs regarding high risk behaviors such as extramarital and premarital sexual partners. For example, Gregson (2011) suggested that in rural Zimbabwe, members of the "spirit-type" churches had lower adult mortality and were less affected by HIV as a result of their strict teachings about avoiding extramarital and premarital sex.[10] Trinitapoli and Regnerus (2006) also provided some evidence that members of Pentecostal churches in South Africa, Zimbabwe, and Brazil, had a lower risk of HIV infection, due in part to their reduced likelihood of having extramarital partners when compared with members of other religious groups.[11]

Some potential measurement issues should be acknowledged regarding the self-reporting nature of the measurements. Some respondents may have been too embarrassed to reveal private details of the family members' nutritional status due to a social desirability bias. The person's feelings at the time they answered the questionnaire may have also influenced their responses. For example, a person who felt ill during the interview may have answered the questions in a more negative way than participants who were feeling well. On the other hand, if the respondent was feeling positive at the time of the interview, her answers may have been more positive. Due to the retrospective nature of some of the questions, some respondents may answer a question incorrectly simply because they had a poor memory. Questions such as educational degree were not verified with school transcripts. Finally, some participants may have provided polite answers that were inaccurate because they did not want to be impolite or to offend the interviewer.

Conceptual Frameworks

Conceptual framework for manuscript 1

Figure 2.1. Conceptual framework for manuscript 1
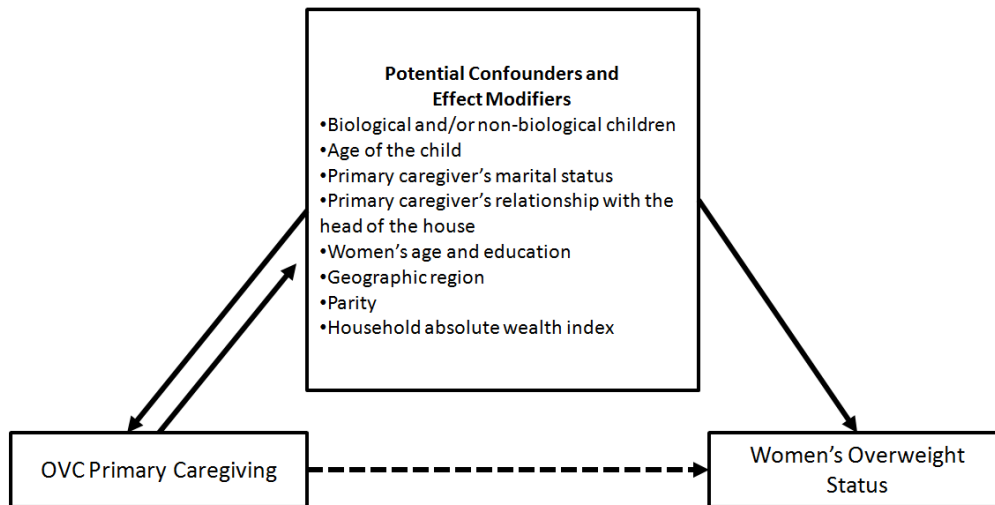
The exposure of manuscript one was primary caregiving of an OVC, and overweight status was the outcome. Several factors were considered as potential confounders or effect modifiers. Confounding was assessed using adjusted and unadjusted logistic regression models. A variable was included as a confounder if the adjusted odds ratio (OR) varied by more than 10% than the unadjusted OR. In addition, the presence of effect measure modification was indicated when the association between primary caregiving (exposure) and BMI (outcome) differed according to the level of a socio-demographic variable (potential effect modifier). It is also important to mention that according to this conceptual framework, a demographic variable may be: a) a confounder

but not an effect modifier, 2) an effect modifier but not a confounder, 3) both a

confounder and an effect modifier, or 4) neither a confounder nor an effect modifier.

Conceptual Framework for Manuscript 2

Figure 2.2. Conceptual Framework for Manuscript 2
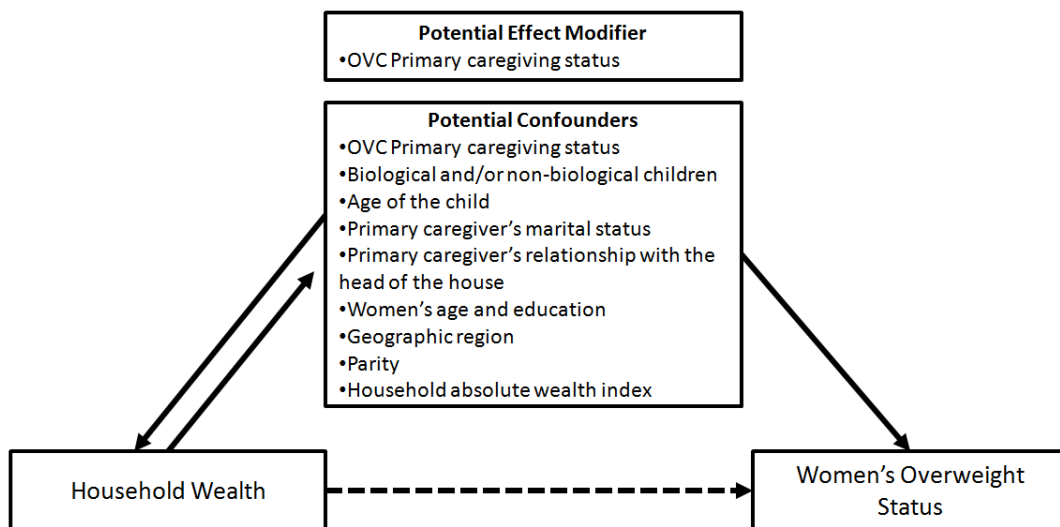
The conceptual framework for manuscript 2 included household wealth as the exposure,

and women's overweight status remained as the outcome. This framework also

considered that OVC primary caregiving status could modify the effect of the association

between socio-economic indicators and women's overweight status.

Conceptual Framework for Manuscript 3

Figure 2.3. Conceptual Framework for Manuscript 3
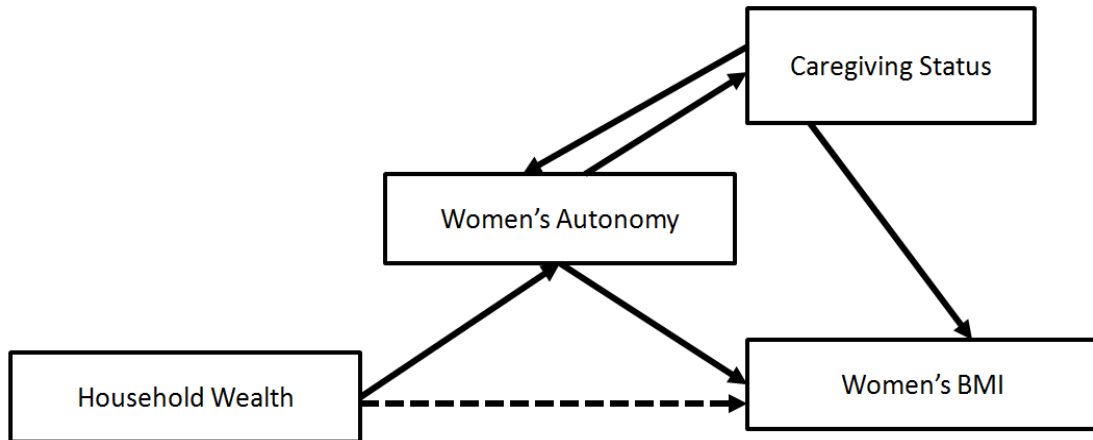
The conceptual framework for manuscript 3 considered women's autonomy as the exposure and BMI as the outcome. In addition, OVC primary caregiving status was considered a potential effect modifier for the association between women's autonomy and women's BMI. A potential mediating role of women's autonomy on the association between household wealth and women's nutrition was also included.

Power calculation

This section presents a sample of three power calculations for the research question 3 of manuscript 1 "What is the association between OVC primary caregiving status and women's BMI in each country?" for Namibian women.

In order to calculate the power for comparing the proportions of overweight by primary caregiving status in Namibia, a total of 3 comparison pairs were taken into consideration, because the research question addresses differences on proportions of overweight between women who were OVC-primary caregivers and each one of the other three primary caregiving groups separately. Assuming a conservative Bonferroni adjustment to account for the three possible pairwise comparisons, the Type I error rate was 0.017 (0.05/3). These analyses were performed using the IBM SPSS Sample Power software. Resulted in power estimates ranged from 80-99%.

Example 1. OVC Primary caregivers vs. OVC non-primary caregivers

These analyses tested the equality of overweight proportions in the group OVC primary caregivers and the group non-OVC primary caregivers. For OVC primary caregivers the overweight prevalence was 38% and for non-OVC primary caregivers the overweight prevalence was 44%. The analysis included a total of 4,066 subjects, assigned as follows: 37.7% OVC primary caregivers and 62.3% non-OVC primary caregivers. The Type I error rate was set at 0.017. For this scenario, power was 0.915. This means that the proportion test would detect a significant difference 91.5% of the time given that the two proportions are different.

Example 2. OVC Primary caregivers vs. non-caregivers living with an OVC.

These analyses tested the equality of overweight proportions in the group OVC primary caregivers and the group non-caregivers living with an OVC. For OVC primary caregivers the overweight prevalence was 38% and for non-caregivers living with an OVC the overweight prevalence was 27%. The analysis included a total of 2,140 subjects, assigned as follows: 71.5% OVC primary caregivers and 28.5% non-caregivers living with an OVC. The Type I error rate was set at 0.017. For this scenario, power was 0.992. This means that the proportion test would detect a significant difference 99% of the time given that the two proportions are different.

Example 3. OVC Primary caregivers vs. non-caregivers not living with an OVC

These analyses tested the equality of overweight proportions in the group OVC primary caregivers and the group non-caregivers not living with an OVC. For OVC primary caregivers the overweight prevalence was 38% and for non-caregivers not living with an OVC the overweight prevalence was 32%. The analysis included a total of 2,684 subjects, assigned as follows: 57.1% OVC primary caregivers and 642.9% non-caregivers not living with an OVC. The Type I error rate was set at 0.017. For this scenario, power was 0.796. This means that the proportion test would detect a significant difference 80% of the time given that the two proportions are different.

Quality assurance

The research firm ICF Macro entered the data using CSPro, a software package designed and implemented by ICF Macro, the US Census Bureau, and others specifically to process survey and census data. The DHS program has also adopted a policy of editing and imputation which results in a data file that accurately reflects the population studied and may be readily used for analysis. The quality of the DHS data was assured by several processes implemented by ICF Macro:

- Questionnaires were checked when they first arrived from the field, for the correct numbers of questionnaires retrieved and selection of eligible respondents. Responses that were open-ended (such as 'other' responses) or those that require coding (such as occupation) were also coded at this point.

- All questionnaires were checked after data entry to ensure that all that were expected were in fact entered. The numbers of questionnaires were also checked against the sample design.

- All questionnaires were entered twice and verified by comparing both data sets. All discrepancies were resolved.

- The entered data were checked for inconsistencies and where possible, they were resolved. Some missing data, such as dates of events, were imputed where possible.

- A set of quality control tables was generated on a regular basis. These tables indicated potential problems in the field. The tables included information on response rates, age displacement, and completeness of data. This information was

then relayed to the field teams to help them improve the quality of data in the field.

- Data were screened to check for outliers and errors. Women with BMI less than 12.0 or BMI greater than 60.0 were also excluded as these might be cases of extreme anthropometric measures or resulting from data errors.[2]

Missing data

For all manuscripts, cases that had missing information on their BMI and the presence of OVC at home were excluded from analysis. In addition, cases that had household decision-making autonomy information were excluded for manuscript 3 (Chapter 5). Missing data were addressed using the listwise deletion approach, also known as complete case analysis. This technique omitted those cases with missing data. Although listwise deletion could result in a substantial decrease in the sample size available for analysis, it does have important advantages. In particular, under the assumption that data are missing completely at random, it leads to unbiased parameter estimates.

The assumption of missing completely at random was checked using the SPSS missing value analyses procedures including: univariate statistics (number of non-missing values, mean, standard deviation, number of missing values, and number of extreme values); t-tests with groups formed by indicator variables; cross tabulation of categorical and indicator variables; pattern analyses including tabulated cases grouped by missing value

patterns; and the Little's MCAR test with EM results. These procedures were performed

with variables that had more than 10% of missing information.

Table 2.4. Missing data for women from all marital status categories [a]

	Namibia n=6,829 (%)	Swaziland n=3,382 (%)	Zambia n=4,497 (%)
-Missing data for BMI	(2.9%)	(2.9%)	(1.2%)
-Missing data for the presence of OVC at home	(0.0%)	(12.5%)	(0.0%)
-Sample size without missing data	6,638	3,285	4,553

[a] Women were included if they were married, 20-49 years old, slept in the household the night before the survey (de facto household residence), and provided oral consent for participation. Women were excluded if they were pregnant, gave birth three months or less before the interview, and/or if they had a BMI less than 12.0 or greater than 60.0.

Table 2.5. Missing data for women's autonomy indicators including only married women[a]

	Namibia n=3,277 (%)	Swaziland n=1,891 (%)	Zambia n=3,283 (%)
-Missing data for sex of the head of household	0.0	0.0	0.0
-Missing data for household size	0.0	0.0	0.0
-Missing data for presence of a child less than 6 years old	0.0	0.0	0.0
-Missing data for the final say on her own health care	0.4	2.3	0.1
-Missing data for large household purchase	0.4	2.2	0.1
-Missing data for making purchases of everyday household items	0.4	2.2	0.1
-Missing data for what to do with the money the husband earns	6.5	15.5	4.4
-Missing data for education	0.0	0.0	0.0

[a] Women were included if they were married, 20-49 years old, slept in the household the night before the survey (de facto household residence), and provided oral consent for participation. Women were excluded if they were pregnant, gave birth three months or less before the interview, and/or if they had a BMI less than 12.0 or greater than 60.0.

Missing value analyses for the presence of an OVC in the household in Swaziland

Our analyses showed that if a respondent was from a rural area in Swaziland, a measure regarding the presence of an OVC in the household was more likely to be missing (Table 2.4). For example, 16.3% of missing data for rural areas and 5.2% for urban areas were found for the variable "presence of an OVC in the household". There did not seem to be other missing data discrepancies for other socio-demographic characteristics. Also, it appeared that the mean Absolute Wealth Index and the mean BMI were similar between the whole dataset (including missing and not missing cases) and the dataset only including missing cases for the presence of an OVC in the household. In order to confirm the data were missing at random, Little's MCAR tests was performed. Because the p-value was above 0.05, it was concluded that the assumption was not violated and it was appropriate to listwise delete cases with missing data for the presence of an OVC in the household in Swaziland.

Missing value analyses for "final say on what to do with the money the husband earns" in Swaziland

The percentage missing cases for the variable "Final say on what to do with the money the husband earns" appear to vary greatly by regions. A higher percentage of missing cases was found among women living in rural areas and/or women with less than secondary education. Women's work status was not associated with missing cases for this variable.

Table 2.6. Comparison of missing percentages by socio-demographic characteristics and mean of women's age, mean of Absolute Wealth Index, and mean of BMI by missing and non-missing cases.

	Swaziland Missing data for the presence of OVC at home % of missing cases
Region	
Urban	5.2
Rural	16.3
Women's education	
No education	11.8
Primary education	11.9
Secondary education	13.5
Higher education	10.4
Marital status	
Never married	14.0
Married	12.0
Widowed	9.4
Divorced	10.0
Work status	
Not working	13.4
Agriculture	8.1
Other than agriculture	12.2
Women age (mean)	
Missing and non-missing cases	32.04
Only missing cases	31.79
Household Wealth Index (mean)	
Missing and non-missing cases	6.21
Only missing cases	5.86
BMI (mean)	
Missing and non-missing cases	29.53
Only missing cases	30.07
Little's MCAR Test	Chi-square=5.37, DF=3, p-value=0.15

Table 2.7. Comparison of missing percentages of household decision-making autonomy by socio-demographic characteristics[a]

	Swaziland Final say on what to do with the money the husband earns %
Region	
-Urban	10.0
-Rural	18.1
Women's education	
-No education	24.0
-Primary education	19.1
-Secondary education	12.8
-Higher education	5.4
Work status	
-No working	16.8
-Agriculture	13.9
-Other than agriculture	14.4

[a]These analyses were performed for variables that had more than 10% of missing cases as shown in Table 2.5.

Conclusions of the missing value analyses

Based on our descriptive analyses for missing value analyses for the presence of OVC at home in Swaziland, it was concluded that mean BMI and mean AWI were not different between the total sample (cases with missing and non missing information) and the subsample including only cases with missing data. As such, data were missing at random and it was appropriate to listwise delete cases with missing values for the variable related to the presence of OVC at home in Swaziland.

Our analyses using the subsample of married women determined that missing values for the variable "final say on what to do with the money the husband earns" in Swaziland

seems to not be missing at random. However, due to the relevance of the question, this variable was kept in the study.

Descriptive statistics

Statistical analyses included data screening to check for outliers and errors. Descriptive statistics for continuous variables were calculated (number of cases, mean, standard deviation, minimum and maximum values). Descriptive statistics for discrete variables included the number of cases and the percentages for each category. The significance of these differences was assessed using 95% confidence intervals and p-values (< 0.05). Analyses were performed using SPSS® 19.[12]

Estimating weighted marginal means

Weighted marginal means were estimated by performing general linear model analyses using SPSS complex sample analyses. Estimated weighted marginal means and their respective 95% confidence intervals were then plotted using Excel. Analytic weights were used to correct for over-sampling and variations in survey response rates by region. Table 2.6 includes research questions that were answered by calculating weighted marginal means.

Analyses of potential confounders

Simple and adjusted logistic regression models were used for selecting the variables to be
included in each model as confounders. A variable was included as a confounder if the
adjusted odds ratio was 10% different than the unadjusted odd ratio.

Collinearity

Collinearity between each pair of independent variables was tested by using Phi
coefficients when both variables were dichotomous and Cramer's V for variables with
three or more levels. A pair of independent variables with a Phi or Cramer's V value of at
least .70 was considered to have substantial collinearity, and one of the two variables was
removed from the analysis. Multicollinearity among the independent variable and all
potential confounders entered in the model was tested using two collinearity statistics: the
tolerance value and the variance inflation factor (VIF). A tolerance value less than 0.1
was considered as an indication for a serious collinearity problem and a VIF greater than
10 was also considered as a cause for concern.[13]

Logistic regression models

Table 2.8 includes a list of logistic regression models that were used in this dissertation.
These logistic regression models were performed after assessing confounding and

collinearity. The following procedures were performed before executing each model. First, bivariate logistic regression models were performed. Then, a logistic regression model including all selected potential confounders and interactions was performed. A final logistic regression model including only significant potential confounders and interactions was developed in order to present the most parsimonious models. As recommended in the guide for DHS statistics by Rutstein and Rojas (2006), logistic regression analyses did not include sampling weights.[13]

Table 2.8. Logistic regression models by manuscript and research question

Manuscript 1/research question 3 "what is the association between OVC primary caregiving status and women' overweight status in each country?"

Model 1: logit[E(overweight)]= α*+ β*$_1$X$_1$ + β*$_2$X$_2$

Where α was the intercept, X$_1$ was the OVC primary caregiving status, X$_2$ were socio-demographic and household characteristics. This model included normal weight (18.5 $\geq$ BMI < 25.0) and overweight (BMI $\geq$ 25.0).

Manuscript 1/research question 4 "Do socio-demographic and household characteristics modify the effect of the association between OVC primary caregiving status and women's overweight status in each country?"

Model 1: logit[E(overweight)]= α*+ β*$_1$X$_1$ + β*$_2$X$_2$ + β_3X$_3$

Where α was the intercept, X$_1$ was the OVC primary caregiving status, X$_2$ were socio-demographic and household characteristics, and X$_3$ were the interactions between OVC primary caregiving status and one socio-demographic and household characteristic . Stratified logistic regression models were performed for models that had a significant interaction term. This model included normal weight (18.5 $\geq$ BMI < 25.0) and overweight (BMI $\geq$ 25.0).

Manuscript 2/research question 3 "What is the association between household wealth and women's overweight status?"

Model 1: logit[E(overweight)]= α*+ β*$_1$X$_1$ + β*$_k$X$_k$

Where α was the intercept, X$_1$ was AWI, and X$_k$ were the set of potential confounders. This model included normal weight (18.5 $\geq$ BMI < 25.0), and overweight (BMI $\geq$ 25.0).

Manuscript 2/ research question 4 "Does OVC primary caregiving status modifies the association between household wealth and women's overweight status?"

Model 1: logit[E(overweight)]= α*+ β*$_1$X$_1$ + β*$_k$X$_k$ + β*$_i$X$_i$

Where α was the intercept, X$_1$ was OVC primary caregiving status, X$_2$ was AWI, X$_k$ were the set of potential confounders, and X$_i$ was an interaction between AWI and OVC primary caregiving status. Stratified logistic regression models were performed for models that had a significant interaction term. This model included normal weight (18.5 $\geq$ BMI < 25.0), and overweight (BMI $\geq$ 25.0) women.

Table 2.8 continues on next page

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Table 2.8. Logistic regression models by manuscript and research question (continuation)

Manuscript 3/research question 1 "What is the association between married women's autonomy and their underweight and overweight status?"

Model 1: logit[E(underweight)]= $\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_i X_i$
Model 2: logit[E(overweight)]= $\alpha^* + \beta^*_1 X_1 + \beta^*_2 X_2 + \beta^*_i X_i$

Where α was the intercept, X_1 were household decision-making autonomy factors, X_2 was educational attainment, X_i were potential confounders. Model 1 included underweight (BMI < 18.5) and normal weight (18.5 ≥ BMI < 25.0) women. Model 2 included normal weight (18.5 ≥ BMI < 25.0) and overweight (BMI ≥ 25.0) women.

Manuscript 3/research question 2 "Does OVC primary caregiving status modify the effect of the association between married women's autonomy and their underweight and overweight status?"

Model 1: logit[E(underweight)]= $\alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_k X_k + \beta_x X_x$
Model 2: logit[E(overweight)]= $\alpha^* + \beta^*_1 X_1 + \beta^*_2 X_2 + \beta^*_3 X_3 + \beta^*_k X_k + \beta^*_x X_x$

Where α was the intercept, X_1 were household decision-making autonomy factors, X_3 was educational attainment, X_k were potential confounders, X_x was an interaction between OVC primary caregiving and one household decision-making autonomy factor or educational attainment. Stratified logistic regression models were performed for models that had a significant interaction term. Model 1 included underweight (BMI < 18.5) and normal weight (18.5 ≥ BMI < 25.0) women. Model 2 included normal weight (18.5 ≥ BMI < 25.0) and overweight (BMI ≥ 25.0) women.

Mediation Analyses

Mediation analyses were performed for answering research question 3 from manuscript 3 "Does autonomy mediate the association between married women's AWI and their BMI?" The assumption of normal distribution was calculated using Skewness and Kurtosis analyses included in SPSS descriptive statistics. Skewness and Kurtosis less than ±1.0 identified that a variable did not violate the assumption of normal distribution. These analyses were performed for the variables included in the mediation analyses: household decision-making autonomy (continuous), BMI and AWI. As shown in Table

2.9, the AWI and decision making autonomy factors in Namibia as well as the BMI in all

countries violated the assumption of normal distribution. In order to address this issue,

mediation analyses were performed using the SPSS syntax written by William Dudley

PhD and Jose Benuzillo MA from the University of Utah College of Nursing that was

developed in 12/13/2002 and updated in 12/02/2004

(http://www.ats.ucla.edu/stat/spss/faq/mediation/Example1.SPS). This procedure allows

the use of non-normally distributed data for mediation analyses.

Table 2.9. Analyses of normal distribution for AWI and BMI by country

	Skewness (S.E. of Skewness)	Kurtosis (S.E. of Kurtosis)
Analyses for AWI		
-Namibia	0.21 (0.03)	-1.30 (0.06)
-Swaziland	0.19 (0.04)	-0.86 (0.8)5
-Zambia	0.68 (0.04)	-0.68 (0.07)
Analyses for BMI		
-Namibia	2.65 (0.03)	21.44 (0.06)
-Swaziland	4.09 (0.04)	18.59 (0.08)
-Zambia	1.62 (0.04)	4.92 (0.87)
Analyses for decision-making autonomy		
-Namibia	-1.30 (0.05)	0.43 (0.09)
-Swaziland	-0.54 (0.07)	-0.74 (0.14)
-Zambia	-0.64 (0.05)	-0.72 (0.09)

S.E. = Standard Error

A mediation analyses followed Baron & Kenny's approach.[14] The following steps were

executed to assess whether women's decision-making autonomy mediated the association

between married women's AWI and their BMI. Women's decision-making autonomy

was regressed on women's AWI. Then, BMI was regressed on women's AWI. BMI was

regressed on women's decision-making autonomy and women's AWI. An examination of

the results determined whether women's AWI and women's decision-making autonomy

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had a significant association, whether women's AWI and BMI had a significant association, and whether women's AWI and BMI had a significant association in the presence of women's decision-making autonomy. Sobel tests were performed to estimate the percentage of the total effect that was mediated and the ratio of the indirect to the direct effect. These analyses included the simplest model in which there was only one mediator, one independent variable and one outcome variable, all of which were continuous variables.

Human subjects protection

Information provided by Measure DHS showed that data collection followed a strict methodology in order to protect participants' confidentiality. For example, at the beginning of each interview participants were requested oral consent for study participation. The interview ended if the individual did not provide his/her consent for study participation. In order to request dataset access, the author of this dissertation first registered as a user in the DHS website. I created a new research project request that included a project title and a description of the proposed analyses.

Downloaded datasets were not passed on to other researchers. All data were summarized and reported in aggregate form. Research data were presented anonymously and was not tied to individual subject's names or other identifying information. All data were stored in a password protected database and I was the only person with access to the dataset.

Individual identifiers were not collected or stored. The University of Maryland College Park (UMCP) IRB reviewed the protocol and determined that "this dissertation does not meet the definition of human subject research under the purview of the IRB according to federal regulations."

Appendix 1. Factors included in the Absolute Wealth Index

Figure 2.4. Factors included in the Absolute Wealth Index

Variable Description		YES	NO
Adequate source of drinking water	→	Piped water; Piped into dwelling; Piped to yard/plot; Public tap/standpipe; Bottled water; Tanker truck	Unprotected well; Surface water; Unprotected spring; River, dam, lake, ponds, stream, canal, irrigation channel; Rainwater; Cart with small tank; Tube well water; Tube well or borehole; Dug well (open/protected); Protected well; Protected spring
Adequate time to get to water source	→	On premises	Other
Adequate type of toilet facility	→	Flush toilet; Flush - to piped sewer system; Flush - to septic tank; Flush - to pit latrine; Flush - to somewhere else; Flush - don't know where	No facility; No facility, bush, field; Bucket toilet; Hanging toilet/latrine; Pit toilet latrine; Pit latrine - ventilated improved pit (VIP); Pit latrine - with slab; Pit latrine - without slab / open pit; Composting toilet
Has electricity	→	Yes	No
Has radio	→	Yes	No
Has television	→	Yes	No
Has refrigerator	→	Yes	No
Has bicycle	→	Yes	No
Has motorcycle	→	Yes	No
Has car/truck	→	Yes	No
Adequate floor material	→	Finished; Parquet, polished wood; Vinyl, asphalt strips; Ceramic tiles; Cement; Carpet	Natural; Earth, sand; Dung; Rudimentary; Wood planks; Palm, bamboo"; other
Adequate wall material	→	Finished; Cement; Stone with lime, cement; Bricks; Cement blocks; Covered adobe; Wood planks, shingles; Metal	Natural; No walls; Cane, palm, trunks; Dirt; Animal dung; Rudimentary; Bamboo with mud; Stone with mud; Uncovered adobe; Plywood; Cardboard; Reused wood; Metal (iron or zinc sheet); Corrugated asbestos; other
Adequate roof material	→	Finished; Metal; Wood; Calamine, cement fiber; Ceramic tiles; Cement; Roofing shingles; Corrugated asbestos	Natural; No roof; Thatch, palm leaf; Sod; Rudimentary; Rustic mat; Palm, bamboo; Wood planks; Cardboard
Has telephone	→	Yes	No

Appendix 2. IRB official determination of not research

UNIVERSITY OF
MARYLAND
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1204 Marie Mount Hall
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DATE: August 20, 2012

TO: Olivia Carter-Pokras, PhD
FROM: University of Maryland College Park (UMCP) IRB

PROJECT TITLE: [365688-1] The effects of orphan and vulnerable child primary caregiving, economic factors, and female autonomy on women's body mass index in Eastern and Southern Africa

SUBMISSION TYPE: New Project

ACTION: DETERMINATION OF NOT RESEARCH
DECISION DATE: August 20, 2012

Thank you for your submission of New Project materials for this project. The University of Maryland College Park (UMCP) IRB has determined this project does not meet the definition of human subject research under the purview of the IRB according to federal regulations.

We will retain a copy of this correspondence within our records.

If you have any questions, please contact the IRB Office at 301-405-4212 or irb@umd.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within University of Maryland College Park (UMCP) IRB's records.

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Chapter III. Overweight among orphan and vulnerable child caregivers in 3

Southern African countries: an emerging public health concern

Keywords

- Caregivers
- Child, orphaned
- Africa south of the Sahara
- Body Mass Index
- Women
- Overweight

Abstract

Objective. This cross-sectional study investigated the association between African orphan and vulnerable children (OVC) caregiving, women's overweight status, and sociodemographic characteristics.

Methods. Demographic Health Survey data collected during 2006-2007 from 20-49 year old women in Namibia (n=6,638), Swaziland (n=2,875), and Zambia (n=4,497) were analyzed using weighted marginal means and logistic regressions.

Results. OVC caregivers' overweight prevalence ranged from 26.98% (Namibia) to 61.3% (Swaziland). Namibian OVC primary caregivers were less likely to be overweight than non-OVC caregivers (OR=0.59, 95% CI=0.37-0.93) and non-caregivers not living with OVC (OR=0.39, 95% CI=0.23-0.64). Swazi and Zambian OVC caregivers were more likely to be overweight than non-caregivers living with OVC (Swaziland: OR=1.56, 95% CI=1.04-2.34; Zambia: OR=2.62, 95% CI=1.80-3.79) or not living with OVC (Swaziland: OR=1.92, 95% CI=1.46-2.54; Zambia: OR=1.94, 95% CI=1.44-2.60). In Namibia, women's age modified the effect of the association between OVC primary caregiving and overweight status.

Conclusions. Although programs for OVC families generally focus on undernourishment, overweight also exists among OVC caregivers. African public health systems/OVC programs may face an overweight epidemic alongside existing ones (e.g., HIV/AIDS, tuberculosis, malaria). Future studies/interventions to curb overweight should consider OVC caregiving status and address country-level differences.

Introduction

Primary caregivers worldwide are facing the dilemma of maintaining their own health while addressing the physical and emotional needs of family members.[1] Perhaps the greatest need for primary caregiving is seen in the continent of Africa, where primary caregiving is associated with the Acquired Immune Deficiency Syndrome and the Human Immunodeficiency Virus (HIV/AIDS) pandemic as well as the increased number of orphan and vulnerable children (OVC). More than four-fifths of all OVCs (nearly 12 million) live in Africa. The prevalence of OVC varies widely across countries and across different population sub-groups—with countries and sub-regions with a higher prevalence of HIV having a higher prevalence of OVC as well.[2]

The majority of programs for OVC families focus on undernourishment.[3] However, Africa is facing a nutritional transition where underweight and overweight coexist, as more energy dense diets are adopted with increased fat, sugar, and processed foods, along with a reduction in physical activity.[4] In urban African areas, the prevalence of overweight increases by an average of 5% per year.[5] Caring for a child with health problems in developed countries increases the likelihood of the primary caregivers' BMI being negatively impacted by unhealthy behaviors related to overweight (e.g., poor diet, sedentary behaviors, sleep problems, stress, emotional issues and depression).[6,7] Overweight is a risk factor for chronic disease (e.g., cardiovascular disease, hypertension,

stroke, type 2 diabetes mellitus, osteoarthritis, cancer), premature death, and reduced quality of life.[8] Therefore, studying overweight problems among OVC primary caregivers is crucial for having a comprehensive understanding of the specific nutritional conditions of OVC child primary caregivers during this time of nutritional transition.

To the best of our knowledge, no previously published studies have investigated the association between overweight status and reproductive age OVC primary caregivers in Africa. In order to address this research gap, this cross-sectional study investigates the association between OVC primary caregiving status with women's overweight status among women in Namibia, Swaziland and Zambia. Four OVC primary caregiving categories are included: a) OVC primary caregivers, b) non-OVC primary caregivers, c) non-primary caregivers of a child but living with an OVC, and d) non-primary caregivers of a child and not living with an OVC. The following research questions guided this study. First, is the OVC primary caregivers' mean body mass index (BMI) different than the mean BMI of women from the other three child caregiving groups within countries? Second, does the OVC primary caregivers' mean BMI vary significantly by country? Third, what is the association between OVC primary caregiving status and women's overweight status in each country? Fourth, do socio-demographic and household characteristics (e.g., age, work status, number of household members, household wealth) modify the effect of the association between OVC primary caregiving status and women's overweight status in each country?

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Methods

This cross-sectional study was based on secondary analyses of Demographic Health Survey (DHS) data from Namibia (2006-2007), Swaziland (2006-2007), and Zambia (2007). DHS uses a two-stage sampling frame based on each country's Population and Housing Census to provide estimates of key population and health indicators. For the purposes of this paper, the country inclusion criteria were: located in Southern Africa (the region most heavily affected by the HIV epidemic), HIV prevalence of at least 5% or orphan prevalence of at least 8% among 0-17 year old children (i.e., one or both biological parents have died), had less than 20% missing BMI data, belong to the Southern African Development Community, had economies linked to South Africa, and had available DHS data for primary caregiving status and women's anthropometry. Women were included if they were 20-49 years old, slept in the household the night before the survey (de facto household residence), and provided oral consent for participation. This study excluded pregnant and three months or less postpartum women to avoid the impact of the fetus and lactation on the BMI.[9] Women with BMI less than 12.0 or BMI greater than 60.0 were also excluded as these might be cases of extreme anthropometric measures or resulting from data errors.[10]

Measures

Dependent Variable

The dependent variable was women's BMI also known as the Quetlet index. BMI was defined as weight in kilograms divided by height squared in meters (kg/m^2). BMI was analyzed as a continuous variable (research questions 1 and 2) and as a categorical variable (research questions 3 and 4) using two categories: normal weight ($18.5 \geq BMI < 25.0$) and overweight ($BMI \geq 25.0$). BMI has been widely used as an anthropometric indicator of health, especially for nutrition-related disease among adult women from Sub-Saharan countries and other regions.[9] Weight was measured using a solar-powered scale (Uniscale) with an accuracy of $\pm$ 100g.[9] Height was measured to the nearest 0.1 cm with an adjustable wooden measuring board (Shorr Height boards).

OVC primary caregiving variable

Primary caregivers were women who lived with a biological child under the age of 18 and/or who were primary caregivers of a non-biological child under the age of 18. The OVC primary caregiving status of a woman was based on the question: "How many orphans and vulnerable children live in your household?" This study uses the DHS definition for OVC: children with one or both parents deceased (orphans); and vulnerable children who a) have a chronically ill parent (sick for more than 3 consecutive months

during the past 12 months) or b) live with an adult who was chronically ill or died during the past 12 months. *OVC primary caregivers* were women categorized as primary caregivers who mentioned one or more children lived in their house. *Non-OVC primary caregivers* were women categorized as primary caregivers who did not live with an OVC. *Non-primary caregivers living with an OVC* were non-primary caregivers who mentioned that one or more OVC lived in their house. *Non-primary caregivers not living with an OVC* were women categorized as non-primary caregivers who did not live with an OVC.

Socio-demographic and household characteristic variables

The following variables were considered as potential confounders or effect modifiers: presence of a child 5 years old or younger living in the house (yes, no), w*omen's marital status* (married or living together, divorced, widowed, never married, and not living together); *women's age* (20-29, 30-39 and 40-49 years old); *women's education* (no schooling, primary school, secondary education, and higher education); *region of residence* (rural, urban); *parity* (0, 1, 2, and ≥3 births); *women's relationship with the household head* (head, wife, daughter, other); *sex of the household head* (male, female); *number of household members (less than 3, 4 to 6, ≥7); number of 18-49 year old women in the household (1, 2, 3, ≥4); number of 18-49 year old men in the household (0, 1, ≥2); and, women's work status* (not working, working in agriculture, and working in any field other than agriculture). We also measured *household wealth* using the

Absolute Wealth Index (AWI), a continuous measurement ranging from 0 (no modern

goods) to 12+ (all modern comforts, for example flushing toilet, electricity, means of

transportation, telephone, etc.) For the purpose of this study, we used a categorical AWI:

poorest (0-1, reference group), poorer (2-3), medium (4-5), wealthier (6-7), and

wealthiest (8+).[10,11]

Analysis

Statistical analyses included data screening to check for outliers and errors as well as

descriptive statistics for continuous and discrete variables. Simple adjusted and

unadjusted logistic regressions were performed to select the variables to be included in

each model as confounders. A variable was included as a confounder if the adjusted odds

ratio (OR) varied by more than 10% than the unadjusted OR. Collinearity between each

pair of independent variables was tested by using Phi analyses when both variables were

dichotomous and Cramer's V for variables with three or more levels (a value $\geq$.60

showed substantial collinearity and one variable was removed from the analysis).

Multicollinearity among the independent variable and all potential confounders entered in

the model was tested using the tolerance value and the variance inflation factor (VIF). A

tolerance value less than 0.1 was considered as an indication for a serious collinearity

problem and a VIF greater than 10 was also considered as a cause for concern and one

variable was removed from the analysis.[12]

The estimation of marginal means used analytic weights to correct for over-sampling and variations in survey response rates by region. Logistic regression analyses controlled for potential confounders and interactions, and did not include sampling weights as recommended in the guide for DHS statistics by Rutstein and Rojas (2006).[13] Significant associations were assessed using 95% confidence intervals and p-values ($\alpha \leq 0.05$). Analyses were performed using SPSS® 19.

Results

Sample characteristics

Analyses were performed using data from 20-49 year old women in Namibia (n=6,638), Swaziland (n=2,875), and Zambia (n=4,497). The percentages of OVC primary caregiving were similar among countries and ranged from 26.6% in Namibia to 28.6% in Zambia. While the majority of Namibian and Zambian women had normal weight; the majority of women in Swaziland were overweight (Table 3.1). In all countries, more than half of women were living with a child less than 6 years old. A higher proportion of women had secondary education in Namibia and Swaziland than in Zambia. The majority of women in Swaziland lived in rural areas; and, around half of Namibian and Zambian women resided in rural areas.

Table 3.1 here

Mean BMI differences by women's primary caregiving status within countries

OVC caregivers had lower mean BMI than non-OVC caregivers in Namibia, and the inverse situation was found in Zambia (Figure 3.1). OVC primary caregivers had higher mean BMI than non-primary caregivers living with an OVC and non-primary caregivers not living with an OVC in Swaziland and Zambia.

Figure 3.1 here

Mean BMI differences by country within OVC primary caregiver status

Among OVC primary caregivers, women from Swaziland had higher mean BMI than women from Namibia and Zambia. The mean BMI and its 95% confidence interval (C.I.) for OVC primary caregivers from Swaziland were in the overweight range. The mean BMI and its 95% C.I. for Namibian and Zambian OVC primary caregivers were in the normal weight range.

Logistic regression models of overweight status regressed on OVC primary caregiving status

In Namibia, OVC primary caregivers were less likely to be overweight than non-OVC primary caregivers and non-caregivers not living with an OVC. In Swaziland and Zambia, OVC primary caregivers were more likely to be overweight than non-caregivers regardless if they were or were not living with an OVC.

Table 3.2 here

Test for effect modification

In Namibia, women's age modified the effect of the association between OVC primary caregiving with overweight status. Namibian OVC primary caregivers were less likely to be overweight than non-OVC caregivers not living with an OVC only among women ages 21-29 years old (AOR=0.41; 95% CI=0.18-0.94) and 41-49 years old (AOR=0.36; 95% CI= 0.15-0.84).

Discussion

This study found that overweight problems among OVC primary caregivers have emerged and should be addressed. Our findings align with the proposed African nutritional paradox that includes an increase in overweight prevalence coupled with a relatively steady underweight prevalence resulting in some households where underweight and overweight coexist.[14] In this context, we found that among OVC primary caregivers, the prevalence of overweight (Namibia: 33.2%, Swaziland: 61.3% and Zambia: 26.9%) was higher than the prevalence of underweight (Namibia: 13.1%, Swaziland: 1.7% and Zambia: 7.2%) in these countries. Given the chronic nature of most diseases associated with overweight and the huge cost of treatment, our findings suggest that some African public health systems as well as the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) and other programs targeting OVC families should be prepared to face a new overweight epidemic alongside existing ones such as HIV/AIDS, tuberculosis, and malaria.[5]

Our results suggest that the specific characteristics of OVC primary caregivers' nutritional status vary by country. Logistic regression analyses showed that OVC primary caregiving was associated with women's overweight status. However, the direction of the odds ratios suggested that the role of OVC primary caregiving was a protective factor for overweight in Namibia and a risk factor for overweight in Swaziland and Zambia. While the mechanisms underlying OVC primary caregiving and overweight status remain unclear, further studies should analyze possible determinants that could explain

differences on the direction of the odds ratios. For example, OVC primary caregivers'

household composition could influence the direction of the odds ratios. In comparison to

Swaziland and Zambia, a higher percentage of OVC primary caregivers in Namibia were

never married (Namibia: 41.2%, Swaziland: 28.6% and Zambia: 6.5%), and/or were

living without a male household member (Namibia: 70.5%, Swaziland: 33.5% and

Zambia: 23.4%). Interestingly, we found that the mean number of children ever born

among OVC primary caregivers was similar in these countries (Namibia: mean=3.33,

S.D.= 2.17; Swaziland: mean=3.74, S.D.=2.63; Zambia: mean=4.16, S.D.=2.62).

Researchers have posited that the association between OVC primary caregiving and the

mental health of elder caregivers may be a result of psychological distress.[15]

Physiologically, chronic stress could increase cortisol and catecholamine and/or lead to

unhealthy behaviors (e.g., eating poorly) that could increase caregivers' BMI.[15] It has

also been suggested that differences in women's height and body shape could be related

to the interaction between genetic factors and diet.[16] Perhaps Swazi and Zambian

households are more likely to own agricultural land than Namibian households in both

urban (Namibia: 9.2%, Swaziland: 21.6% and Zambia: 30.7%) and rural areas (Namibia:

46.1%, Swaziland: 86.0% and Zambia: 89.7%).[17-19] In some cases, herder societies that

have more access to milk due to their possession of domestic animals and their residence

on pasture lands have inhabitants who are taller than other groups living in areas where

cattle are not possible.[16]

The possible effect of alcohol on the association between OVC primary caregiving and women's overweight status requires further examination due to large differences in beer consumption among adults (15+ years) in Namibia (67.1%) as compared to Swaziland and Zambia (32.5% and 18.1% respectively).[20] Due to the high prices of alcohol, people are more likely to use their grains to brew beer rather than cooking reducing access to starchy foods.[21]

Further studies should also explore if accessing anti-retroviral therapy (ART) could impact OVC primary caregivers' overweight problems. Even though the current prevalence of ART treatment among HIV-infected people is above 80% in these three countries,[22] in 2005 the prevalence of ART was considerable lower (71% in Namibia, 31% in Swaziland and 27% in Zambia).[23] A study of people living with HIV in South Africa found that after one year on ART, the prevalence of overweight increased from 21% to 36% and the prevalence of obesity increased from 12% to 22%.[24] As patients on ART live longer, the overweight prevalence may increase.[25] Finally, caregiving could influence the adoption of healthy behaviors linked to having normal weight because being in charge of a child could be emotionally rewarding and could give purpose to life.[21]

Additional studies should also explore determinants that decrease the odds for being overweight among 20-29 and 40-49 year old Namibian OVC primary caregivers as compared to non-OVC primary caregivers not living with an OVC. Previous studies have

shown differences in the magnitude of chronic energy deficiency among women at different ages revealing how BMI varies during the reproductive years.[9] A study by McGuire et al., (1989) suggested that the stresses women experience during pregnancy and lactation periods could lead to considerable reduction of nutrient levels.[26] These could be possible explanations why among 20-29 year old women, OVC primary caregivers were less likely to be overweight than non-caregivers not living with an OVC.

Published strategies aimed at offering OVC families integrated financial, health and social support are rare and few scholars have documented their lessons learned. It has been suggested that the most effective delivery systems for OVC families include a family-centered approach using a referral system that provides healthcare, nutrition, formal education, livelihood training, protection, and psychological and socioeconomic support.[28] Another strategy includes OVC day care centers that provide some relief from the caregiving burden and facilitate caregivers' ability to work or care for relatives with HIV.[29] Training volunteer youth caregivers operating in schools has also been found to be a successful health and nutrition strategy.[30] Finally, self-help groups created through local groups such as burial societies have shown to be important for creating social capital because OVC families become more inter-connected, self-confident, and willing to help each other.[30] Programs should document how these strategies mainly used to fight undernourishment could be complemented or adapted for addressing overweight problems.

Strengths and Limitations

This study is unique because it included a large sample size to examine the association between reproductive age OVC primary caregiving and the primary caregivers' BMI in communities located in Sub-Saharan Africa. Strengths of this study include the diversity and representativeness of the population of reproductive age women in three Sub-Saharan countries with different overweight prevalence. DHS surveys contain core questions that are identical across countries, and height and weight were measured rather than relying on self-reported information.

This study presents some important limitations which should be acknowledged. Women's health status and dietary food intake were not available. Only one nutritional measurement (BMI) was available. The cross-sectional nature of the study did not allow: 1) determining whether overweight preceded OVC's primary caregiving or vice versa; 2) assessing whether the child might have moved to live in a wealthier household to receive care; and, 3) assessing the length of time the person was providing primary caregiving. Schulz and Sherwood (2008) described the primary caregiving process starting with the primary caregivers' experience of distress and depression, which were followed by physiologic changes and impaired health habits that ultimately lead to illness and possibly death.[31] Previous studies have shown lower probabilities for a negative impact in the primary caregiver's health during the early stages of primary caregiving.[32] This study also did not measure the intensity of primary caregiving by the type or quantity of

assistance provided. Due to contextual differences among African countries, our results may not be generalized to other countries.

The World Health Organization (WHO) suggests that African countries should not just focus on addressing infectious diseases affecting their communities but should also deal with the emergence of chronic diseases.[23] Our study found that while the prevalence of overweight is on the increase in southern Africa,[4] in some countries such as Swaziland and Zambia, OVC primary caregivers were more likely to be overweight as compared to non-child caregivers.

Our results also suggest that the specific nutritional conditions of OVC primary caregivers during this time of nutritional transition in Africa differ by country. As such, it may be a better alternative to study OVC primary caregivers' nutritional status by country instead of using pooled data from several African countries.

Although programs for OVC families generally focus on undernourishment, we found that overweight also exists among OVC primary caregivers. Currently, OVC data is only available in 15 of the 44 sub-Saharan African countries where DHS is implemented. Our findings imply the need for additional nutritional studies focusing on OVC primary caregivers in other African countries to understand the nature of overweight problems among OVC primary caregivers in the entire African continent. Further studies should

perform the same analysis using different definitions of child vulnerability. In order to

assess the validity of our findings, future research with additional nutritional

measurements should be performed.

Table 3.1. Sample Socio-demographic characteristics by country.

	Namibia (n=6,638)	Swaziland (n=2,875)	Zambia (n=4,497)
	n (%)	n (%)	n (%)
Nutritional status[a]			
-Underweight	814 (12.3%)	52 (1.8%)	381 (8.5%)
-Normal Weight	3,554 (53.5%)	1,112 (38.7%)	3,122 (69.4%)
-Overweight	2,270 (34.2%)	1,711 (59.5%)	994 (22.1%)
OVC caregiving status			
-OVC primary caregiver	1,764 (26.6%)	783 (27.2%)	1,285 (28.6%)
-Non-OVC primary caregiver	2,842 (42.8%)	1,616 (56.2%)	2,549 (56.7%)
-Non-primary caregiver living with OVC	711 (10.7%)	125 (4.3%)	253 (5.6%)
-Non-primary caregiver not living with OVC	1,321 (19.9%)	351 (12.2%)	410 (9.1%)
Women's Education			
-No Education	620 (9.3%)	296 (10.3%)	543 (12.1%)
-Primary Education	1,807 (27.2%)	886 (30.8%)	2,400 (53.4%)
-Secondary Education	3,742 (56.4%)	1,373 (47.8%)	1,243 (27.6%)
-Higher Education	469 (7.1%)	320 (11.1%)	311 (6.9%)
Women's Age			
Mean (standard deviation)	32.18 (8.39)	32.03 (8.61)	31.70 (8.29)
Women's marital status			
-Never Married	3,112 (46.9%)	1,008 (35.1%)	592 (13.2%)
-Married/living together	2,911 (43.9%)	1,500 (52.2%)	3,117 (69.3%)
-Widowed	249 (3.8%)	236 (8.2%)	293 (6.5%)
-Divorced	86 (1.3%)	17 (0.6%)	371 (8.2%)
-Not living together	277 (4.2%)	114 (4.0%)	124 (2.8%)
Women's work status[b]			
-Not working	2,580 (39.2%)	1,225 (42.7%)	1,581 (35.2%)
-Working in agriculture	684 (10.4%)	170 (5.9%)	1,314 (29.3%)
-Working other than agriculture	3,323 (50.4%)	1,477 (51.4%)	1,593 (35.5%)
Region of Residence			
-Urban	3,114 (46.9%)	1,053 (36.6%)	2,018 (44.9%)
-Rural	3,524 (53.1%)	1,822 (63.4%)	2,479 (55.1%)
Religious affiliation			
-Protestant	5,056 (76.3%)	507 (17.6%)	3,550 (79.0%)
-Roman Catholic	1,463 (22.1%)	14 (0.5%)	862 (19.2%)
-Other/no religion	106 (1.6%)	2,353 (81.9%)	79 (1.8%)
Children ≤5 years old in Household			
-Yes	4,099 (61.8%)	1,789 (62.2%)	3,281 (73.0%)
Parity (# of children ever born)			
Mean (standard deviation)	2.54 (2.19)	3.04 (2.54)	3.80 (2.77)
Absolute Wealth Index			
Mean (standard deviation)	5.76 (4.05)	6.20 (3.38)	4.24 (3.44)

[a] Underweight (BMI < 18.5), normal weight (18.5 ≥ BMI < 25.0), and overweight (BMI ≥ 25.0).
[b] Non-agricultural jobs include the following: professional, technical, management,
clerical, sales, household and domestic services, skilled or unskilled manual jobs.
Agricultural jobs include self-employed as well as employed people.

Figure 3.1. Body Mass Index by country and OVC primary caregiving status
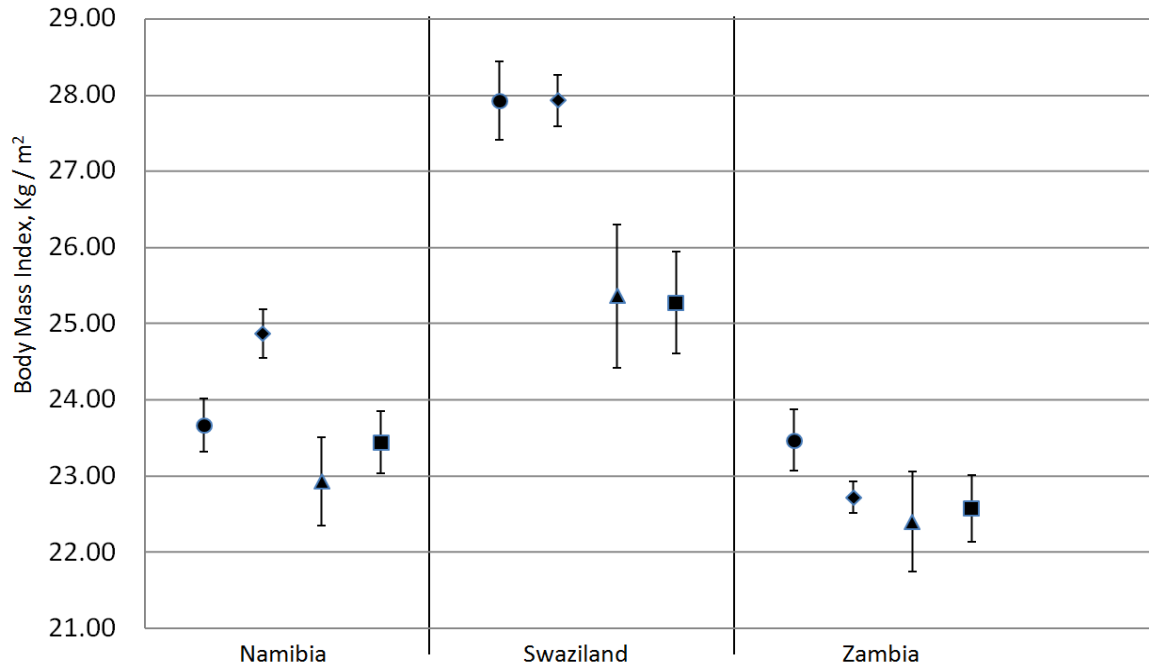
- ● OVC primary caregivers
- ◆ Non-OVC primary caregivers
- ▲ Non-primary caregivers living with an OVC
- ■ Non-primary caregivers not living with an OVC

Note. Bars indicate 95% confident intervals.

Table 3.2.
Association between OVC primary caregiving status and women's overweight status.[a]

	Namibia [b] (n=6,638)			Swaziland [c] (n=2,875)			Zambia [d] (n=4,497)		
	OR	95% CI		OR	95% CI		OR	95% CI	
Unadjusted Models									
Model 1									
-OVC primary caregivers	0.49	(0.40-0.59)	**	0.91	(0.76-1.09)		1.44	(1.23-1.69)	***
-Non-OVC primary caregivers	1.00			1.00			1.00		
Model 2									
- OVC primary caregivers	1.64	(1.33-2.02)	***	1.98	(1.35-2.92)	***	0.59	(1.13-2.25)	**
-Non-primary caregiver living with an OVC	1.00			1.00			1.00		
Model 3									
- OVC primary caregivers	1.09	(0.93-1.28)		2.14	(1.65-2.77)	***	1.34	(1.03-1.76)	*
-Non-primary caregiver not living with an OVC	1.00			1.00			1.00		
Adjusted Models									
Model 4									
- OVC primary caregivers	0.59	(0.37-0.93)	*	0.97	(0.80-1.17)		1.16	(0.98-1.37)	
-Non-OVC primary caregivers	1.00			1.00			1.00		
Model 5									
- OVC primary caregivers	0.74	(0.41-1.34)		1.56	(1.04-2.34)	*	2.62	(1.80-3.79)	**
-Non-primary caregiver living with an OVC	1.00			1.00			1.00		
Model 6									
- OVC primary caregivers	0.39	(0.23-0.64)	***	1.92	(1.46-2.54)	***	1.94	(1.44-2.60)	**
-Non-primary caregiver not living with an OVC	1.00			1.00			1.00		

*p value <0.05, ** p value <0.01, *** p value <0.001.
[a] Underweight (BMI < 18.5), normal weight ($18.5 \geq BMI < 25.0$), and overweight ($BMI \geq 25.0$).
[b] Adjusted for the number of children 5 years of age or younger in the household, region of residence, parity, age, the Absolute Wealth Index, the interaction between OVC primary caregiving and the number of children 5 years of age or younger in the household, the interaction between OVC primary caregiving and age, and the interaction between OVC primary caregiving and the Absolute Wealth Index.
[c] Adjusted for age and the Absolute Wealth Index.
[d] Adjusted for the number of children 5 years of age or younger in the household, women's education and the Absolute Wealth Index.

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Chapter IV. The intersection among orphan and vulnerable child caregiving, household wealth disparities and women's overweight status in three Southern African countries: a cross sectional study

Keywords

Abstract

Background. Overweight problems have emerged in Africa. At the same time, household wealth disparities are present in Africa and a high proportion of people are still very poor. Since nearly 12 million orphan and vulnerable children (OVC) reside in Africa, focusing on the health and nutritional status of primary caregivers of OVC younger than 18 years of age is important. We explored whether OVC primary caregivers are facing household wealth disparities as compared to other women from their communities. We also investigated the association between household wealth and women's overweight status, and the modifying role of OVC primary caregiving status on this relationship.

 Methods. Data from Demographic Health Surveys collected during 2006-2007 from 20-49 year old women in Namibia (n=6,305), Swaziland (n=2,786), and Zambia (n=4,389) were analyzed using weighted marginal means and logistic regressions. Household wealth was measured with the Absolute Wealth Index (AWI).

Results. The prevalence of overweight among OVC primary caregivers was 33.2% in Namibia, 61.3% in Swaziland and 26.9% in Zambia. OVC primary caregivers in Namibia and Swaziland had a lower mean AWI than other women in the same country. In Zambia, OVC primary caregivers had a lower mean AWI score than non-caregivers living with an OVC but a higher mean AWI score than non-OVC primary caregivers. In Swaziland and Zambia, even small increases in household wealth (e.g., being a poorer women – 2 to 3 AWI items) was associated with higher odds for being overweight regardless of women's child caregiving status. Only in Namibia, OVC primary caregiving modified the effect of

the previous association. Among Namibian OVC primary caregivers, women who had at least medium household wealth (4 or more AWI items) were more likely to be overweight than their poorest counterparts (0 or 1 AWI items).

Conclusions. OVC primary caregivers are facing household wealth disparities as compared to other women from their communities. Overweight exists among OVC primary caregivers. Future studies/interventions in Swaziland and Zambia should consider using population based approaches to reach women from every household wealth level to curb overweight. Additional studies should examine specific household wealth characteristics that are associated with Namibian OVC primary caregivers' overweight status.

Background

Since nearly 12 million orphan and vulnerable children (OVC) reside in Africa (more than four-fifths of all OVCs worldwide), focusing on the health and nutritional status of primary caregivers of OVC younger than 18 years of age is important.[1] The increasing size of the OVC population has been considered the most tragic and long-term legacy of the HIV/AIDS pandemic on this continent.[1] Southern African countries have high prevalence of OVC younger than 18 years of age (e.g., 19.2% in Zambia, 28.0% in Namibia, and 31.1% in Swaziland).[2-4] Despite the large number of women who are primary caregivers of these children, current studies related to OVC have focused on children's needs and ignored challenges their primary caregivers face on a daily basis.

Sub-Saharan Africa is facing a nutritional transition where underweight or/and overweight coexist.[5, 6] In this context, focusing on the overweight status of OVC primary caregivers in Africa is important because child caregiving could serve as an additional stressor and lead to psychological distress that may increase cortisol and catecholamine, lead to unhealthy behaviors (e.g., eating poorly), and result in increased BMI.[7] While increased attention has been placed on the nutritional transition that African populations are experiencing as a whole, the association between household wealth and the overweight status of reproductive age OVC primary caregiving remains unclear.

Household wealth disparities remain apparent in Africa.[8] Some people cannot access basic services such as water and sanitation.[9] On the other hand, there are families who are able to buy cheaper goods (e.g., a radio or a bicycle), as well as wealthy families who access all western commodities.[9] In some cases, wealthy women may adopt an OVC that would in turn make their families an OVC family. In other cases, OVC primary caregivers may be less wealthy than other members from their communities as a direct result of their involvement in supporting the health needs of their family members due to HIV/AIDS. The stigma associated with HIV and AIDS could affect the social status of OVC primary caregivers, and could lead to discrimination and further marginalization of the OVC and their families from the local community and other service providers.[10, 11] Therefore, it is important to understand the specific household wealth conditions of OVC child primary caregivers.

Household wealth is considered a more consistent proxy measure than either income or consumption.[8] This study focuses on a specific aspect of household wealth: household integration into the modern economy. More specifically, this study used the Absolute Wealth Index (AWI), a powerful tool for measuring poverty and inequalities and for assessing household wealth differences in various health and demographic outcomes (e.g., fertility, mortality, nuptiality, education, nutritional status).[12] The rationale behind the AWI is that as soon as a family gets involved in the modern economy (e.g., non-agrarian activities), it can accumulate goods and equipment, benefit from a variety of modern services (health services, education services, etc.), and change its behavior, imitating the upper classes (marriage, contraception, etc.)

To the best of our knowledge, no previously published studies have investigated

overweight problems associated with household wealth among OVC primary caregivers.

For this paper, we focused on 20-49 year old women since many 15-19 year old women

would still be in the adolescent growth spurt period and some of them still in puberty.

Four OVC primary caregiving categories were included: a) OVC primary caregivers, b)

non-OVC primary caregivers, c) non-primary caregivers of a child but living with an

OVC, and d) non-primary caregivers of a child and not living with an OVC. The

following research questions guided this study: 1) Does the AWI mean vary significantly

by women's OVC primary caregiving status within countries?; 2) Does the AWI mean

vary significantly by country within the OVC primary caregiving status categories?; 3)

What is the association between AWI and women's overweight status? and, 4) Does

OVC primary caregiving status modify the association between AWI and women's

overweight status?

Methods

Nationally representative Demographic Health Survey (DHS) data from Namibia (2006-

2007), Swaziland (2006-2007), and Zambia (2007) were analyzed for this cross-sectional

study. The DHS provides estimates of key population and health indicators by using a

two-stage sampling frame based on each country's Population and Housing Census.

Countries selected for this paper met these inclusion criteria: located in Southern Africa

(regions with the highest HIV/AIDS prevalence) had either an HIV prevalence of at least

5% or orphan prevalence of at least 8% among 0-17 year old children (orphan is defined as having lost one or both biological parents), had less than 20% missing data for BMI, belong to the Southern African Development Community, had economies linked to South Africa, and had available DHS data on women's primary caregiving status and anthropometry. This study included 20-49 year old women who gave oral consent for participation and reported de jure household residency. Pregnant and three months or less postpartum women were excluded to avoid the impact of the fetus and lactation on BMI.[13] Women with BMI less than 12.0 or BMI greater than 60.0 were excluded as these might be cases of extreme anthropometric measures or resulting from data errors.[14]

Measures

Dependent Variable

The dependent variable was **women's BMI** also known as the Quetlet index. BMI is defined as weight in kilograms divided by height squared in meters (kg/m^2). BMI was analyzed using two categories: normal weight ($18.5 \geq BMI < 25.0$) and overweight ($BMI \geq 25.0$). BMI has been widely used as an anthropometric indicator of health, especially for nutrition-related disease among adult women from Sub-Saharan countries and other regions.[13, 15] Weight was measured using a solar-powered scale (Uniscale) with an

accuracy of ± 100g.[13] Height was measured to the nearest 0.1 cm with an adjustable

wooden measuring board (Shorr Height boards).

Independent Variable

Wealth was assessed with the **AWI,** a measure developed by Hohmann and Garenne

(2011) that captures a wide range of household wealth distribution.[9] AWI was used as:

1) a continuous variable that included a score from 0 to 14 with 0 indicating no modern

goods and 12 or higher indicating all modern comforts (e.g., running water, flushing

toilet, electricity, radio, television, refrigerator, means of transportation, telephone, etc.);

and, 2) categorical variable [poorest: 0-1 reference group], poorer: 2-3, medium: 4-5,

wealthier: 6-7, and wealthiest: 8 or higher.[8, 14]

Effect Modifier

The effect modifier, **OVC primary caregiving status**, included 4 categories. Primary

caregivers were women who lived with a biological child under the age of 18 and/or who

were primary caregivers of a non-biological child under the age of 18. The OVC status of

the primary caregiving was based on the question: "How many orphans and vulnerable

children live in your household?" This study uses the Demographic Health Surveys'

(DHS) definition for OVC: children with one or both parents deceased (orphans); and

vulnerable children who a) have a chronically ill parent (sick for more than 3 consecutive months during the past 12 months) or b) live with an adult who was chronically ill or died during the past 12 months. **OVC primary caregivers** were women categorized as primary caregivers who mentioned that one or more children under the age of 18 who lived in their house. **Non-OVC primary caregivers** were women categorized as primary caregivers of 0-17 year old children who mentioned that no OVC lives in their house. **Non-primary caregivers living with an OVC** were non-primary caregivers who mentioned that one or more OVC lived in their house. **Non-primary caregivers not living with an OVC** were women categorized as non-primary caregivers who mentioned that no OVC lived in their house.

Socio-demographic and household characteristic variables

The following variables were considered as potential confounders: **presence of a child 5 years old or younger living in the house** (Yes/No), **women's marital status** (married or living together, divorced, widowed, never married, and not living together); **women's age** (20-29, 30-39 and 40-49 years old); **region of residence** (rural, urban); **parity** (0, 1, 2, and ≥3 births); **religion** (Catholic, Protestant, and other/no religion); **sex of the household head** (male, female); **number of household members** (less than 3, 4 to 6, ≥7); **number of 18-49 year old women in the household** (1, 2, 3, ≥4); and**, number of 18-49 year old men in the household** (0, 1, ≥2).

Analysis

Statistical analyses included data screening to check for outliers and errors as well as descriptive statistics for continuous and discrete variables. Research questions 1 and 2 were answered by estimating weighted marginal means and their respective 95% confidence intervals. Analytic weights were used to correct for over-sampling and variations in survey response rates by region. Research questions 3 and 4 were answered using adjusted logistic regression models including potential confounders and interaction terms. Significant associations were assessed using 95% confidence intervals and p-values ($\alpha \leq 0.05$). Analyses were performed using SPSS® 19. Simple and adjusted logistic regression models were used for selecting the variables to be included in each model as confounders. A variable was included as a confounder if the adjusted odds ratio was 10% different than the unadjusted odd ratio.

Collinearity between each pair of independent variables was tested by using Phi analyses when both variables were dichotomous and Cramer's V for variables with three or more levels. A pair of independent variables with a Phi or a Cramer's V value of at least .60 was considered to have substantial collinearity and one of the two variables was removed from the analysis. Multicollinearity among the independent variable and all potential confounders entered in the model was tested using two collinearity statistics: the tolerance value and the variance inflation factor (VIF). A tolerance value less than 0.1

was considered as an indication for a serious collinearity problem and a VIF greater than 10 was also considered as a cause for concern.[16, 17]

Results

Sample characteristics

This study included data on 20-49 year old de jure women from three countries: Namibia (n=6,638), Swaziland (n=2,875), and Zambia (n=4,497). OVC primary caregiving prevalence ranged from 27.0% in Namibia and Swaziland to 28.6% in Zambia (Table 4.1). The majority of women in Swaziland were overweight but in Namibia and Zambia the majority of the women had normal weight. Over half of the women were living with a child younger than 6 in all four countries. In Namibia and Zambia, women were distributed evenly between rural and urban settings. Namibian and Swazi women were better educated than their counterparts from Zambia.

Table 4.1 here

Mean AWI differences by women's primary caregiving status within countries

OVC primary caregivers from Namibia and Swaziland had lower mean AWI scores than women from the other three caregiving groups (Figure 4.1). In Zambia, OVC primary caregivers had a lower mean AWI score than non-primary caregivers living with an OVC but a higher mean AWI score than non-OVC primary caregivers.

Figure 4.1 here

Mean AWI differences by country within OVC primary caregivers

OVC primary caregivers from the three countries had mean AWI scores that were categorized as medium wealth (4-5 items). Swazi OVC primary caregivers had a higher mean AWI score than their counterparts from Namibia and Zambia. While half of OVC primary caregivers in Namibia had adequate sources of drinking water and toilet facilities, only fifteen percent of Swazi OVC primary caregivers had an adequate source of drinking water and less than ten percent of them had adequate toilet facilities. A higher proportion of OVC primary caregivers had electricity in Namibia and Zambia (41.70% and 37.5% respectively) than their counterparts from Swaziland (17.3%). Regarding OVC primary caregivers' means for transportation, Zambia had the highest proportion of them owning a bicycle and Namibia had the highest proportion of OVC primary

caregivers who owned a motorcycle, a car or a truck. In all countries, around one third of OVC primary caregivers lived in a house that had adequate floor (e.g., parquet, polished wood, vinyl, asphalt strips; ceramic tiles; cement; carpet) and adequate roof materials (e.g., metal, wood, calamine, cement fiber, ceramic tiles, cement, roofing shingles, corrugated asbestos). Regarding their access to mass media, a lower proportion of Swazi OVC primary caregivers had access to television and radio than their counterparts from Namibia and Zambia. However, a higher proportion of Namibian OVC primary caregivers had access to radio as compared to their counterparts from Zambia. A considerably higher proportion of OVC primary caregivers had a telephone in Namibia than in Swaziland or Zambia (70.0%, 19.2% and 10.7%).

Logistic regression models of overweight status regressed on AWI

Adjusted models showed that AWI was associated with women's overweight status in the three countries. In Zambia, the poorest women were less likely to be overweight than women from the other four AWI categories. In Namibia and Swaziland, the poorest women were less likely to be overweight than women who had medium wealth or more.

Test for effect modification

OVC primary caregiving status modified the effect of the associations between AWI and women's overweight status in Namibia (Table 4.3). Among OVC primary caregivers,

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only those women who had medium wealth or more were more likely to be overweight than their counterparts who were poorest.

Discussion

Our first research interest was to explore whether OVC primary caregivers were facing household wealth disparities. Previous studies have suggested that OVC primary caregivers may be at greater risk of poverty as a direct result of their involvement in supporting the health needs of their family members due to HIV/AIDS.[10, 11, 18, 19] Indeed, this study found that OVC primary caregivers in Namibia and Swaziland had a lower mean AWI than other women in the same country. In Zambia, OVC primary caregivers had a lower mean AWI score than non-caregivers living with an OVC but a higher mean AWI score than non-OVC primary caregivers.

This study found that overweight problems exist among OVC primary caregivers. Among OVC primary caregivers, the prevalence of overweight (Namibia: 33.2%, Swaziland: 61.3% and Zambia: 26.9%) was higher than the prevalence of underweight (Namibia: 13.1%, Swaziland: 1.7% and Zambia: 7.2%). Studies in developed countries have shown that lacking household wealth is associated with a higher prevalence of overweight and chronic disease.[20, 21] In contrast, our study as well as other studies in Africa has demonstrated the opposite: positive associations between having more wealth and being overweight.[22, 23]

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Interestingly, we found that OVC primary caregiving modified the association between AWI and women's nutritional status only in Namibia. In order to have an objective interpretation of our main effect and effect modification analyses, we recommend further studies using other household wealth measurements and performing the analyses for each AWI item separately. These studies could also include additional approaches for creating a household wealth indicator using DHS data such as the multiple correspondence analysis, factor analysis, and/or principal components analysis to reduce the number of variables in a data set into a smaller number of domains/dimensions.[24, 25] These analyses can test these domains/dimensions and determine if domains have different strength of associations with overweight status. Looking at this was beyond the scope of this article.

In these three countries, the percentage of OVC primary caregiver households with adequate floor (Namibia: 28.8%, Swaziland: 32.2% and Zambia: 33.9%) was considerably lower than the percentage of households with adequate floor for the whole country (Namibia: 47.6%, Swaziland: 87.3% and Zambia: 38.9%).[2-4] Inadequate housing could potentially affect women's health and nutrition. People living in houses with inadequate floor, wall and roof materials could be exposed to injuries, could be victims to violence, and could experience high levels of certain infectious diseases such as tuberculosis and hepatitis.[26] People living in households without electricity are exposed to burns as they store kerosene and flammable materials to be used in homemade stoves, substandard heating systems, or bottle lamps.[27] Research has shown that the prevalence of people who have experienced sexual and/or physical abuse is very high

among people who are roofless.[26] This has major implications for their state of mental health and well being. In addition, people who are living in inadequate housing could be exposed to noise and damp that could create feelings of stress and irritation and could limit adequate sleep.[26] Stress could increase the risk for being overweight.[28]

OVC primary caregivers' houses need to be tailored according to their reality including adequate materials that correspond to religious or cultural traditions and way of living.[29] In this context, social action funds (or cash transfers) could be an alternative for improving OVC primary caregivers' houses as it has been suggested that this strategy can strengthen social capital at a community level.[30] Social action fund programs have provided the participating communities with power and control to address some of the challenges that OVC families are facing.[31] For example, these initiatives have allowed communities to build classrooms and rural dispensaries as well as improve access to drinking water and food, means of communication, maintenance of roads and the construction of small-scale irrigation dams.[31] Organizations working with OVC can provide money for buying materials and the community can provide the labor for building or improving houses. It has been suggested that in order to be successful, social action plan programs should use a community definition of shared objectives or circumstances rather than geographical village borders.[31]

Strengths and Limitations

A major strength of this study is its representativeness and large sample size of reproductive age women including OVC primary caregivers in communities located in Sub-Saharan Africa. Our study was able to assess mean AWI differences by women's primary caregiving status within countries, and by country within primary caregiver status. DHS surveys contain core questions that are identical across countries, and height and weight were measured rather than relying on self-reported information.

One strength of using the AWI is that this index measures absolute poverty (or wealth), and produces gradients with respect to health indicators, which are more stable and more robust than those given by wealth quintiles.[8] However, AWI means should be interpreted cautiously. Even though OVC primary caregivers' mean AWI scores fell in the medium wealth category in these three countries, only nine percent of Swazi OVC primary caregivers had adequate toilet facilities and less than twenty percent of Swazi OVC primary caregivers had an adequate source of drinking water. In Zambia, around one third of OVC primary caregivers had access to adequate toilet facilities and/or adequate source of drinking water. Our results also suggest that the characteristics of their wealth varied by country. Overall, Namibian OVC primary caregivers had greater access and Swazi OVC primary caregivers had less access to AWI items.

A major weakness of this study comes from its cross-sectional study design that does not allow it to: 1) determine whether underweight or overweight preceded household wealth indicators; 2) assess whether the child might have moved to live in a wealthier household to receive care; and, 3) assess the length of time the person was providing primary caregiving. Previous studies have shown that caregiving is less likely to impact the caregivers' health during the early stages of caregiving.[32, 33] Another limitation is that the variable religion only included Roman Catholic, Protestant and other or no religion. This study did not measure the intensity of primary caregiving by the type or quantity of assistance provided. Women's health status and dietary food intake were not assessed. The DHS only included one nutritional measurement (BMI) and polygamy was not addressed. Due to different contextual factors, our findings cannot be generalized outside these countries.

Conclusions

We found that higher levels of household wealth were positively associated with being an overweight woman in these three countries. Future studies/interventions in Swaziland and Zambia should consider using population based approaches to reach women from every household wealth level to curb overweight. Additional studies should examine specific household wealth characteristics that are associated with Namibian OVC primary caregivers' overweight status. These studies are important because OVC primary caregivers are facing overweight problems while experiencing household wealth disparities as compared to other women from their communities.

Table 4.1 . Socio-demographic characteristics by country.

	Namibia (n=6,305) n (%)		Swaziland (n=2,786) n (%)		Zambia (n=4,389) n (%)	
Nutritional status[a]						
-Underweight	756	(12.0%)	51	(1.8%)	373	(8.5%)
-Normal Weight	3,372	(53.5%)	1,077	(38.7%)	3,049	(69.5%)
-Overweight	2177	(34.5%)	1,658	(59.5%)	967	(22.0%)
OVC caregiving status						
-OVC caregiver	1,709	(27.1%)	760	(27.3%)	1,255	(28.6%)
-Non-OVC caregiver	2,737	(43.4%)	1,574	(56.5%)	2,500	(57.0%)
-Non-caregiver living with OVC	655	(10.4%)	118	(4.2%)	239	(5.4%)
-Non-caregiver not living with OVC	1,204	(19.1%)	334	(12.0%)	395	(9.0%)
Women's Education						
-No Education	586	(9.3%)	291	(10.4%)	539	(12.3%)
-Primary Education	1,744	(27.7%)	854	(30.7%)	2,343	(53.4%)
-Secondary Education	3,537	(56.1%)	1,328	(47.7%)	1,207	(27.5%)
-Higher Education	438	(6.9%)	313	(11.2%)	300	(6.8%)
Women's Age						
Mean (standard deviation)	32.37	(8.38)	32.13	(8.60)	31.75	(8.29)
Women's marital status						
-Never Married	2,897	(46.0%)	976	(35.0%)	570	(13.0%)
-Married/living together	2,820	(44.7%)	1,453	(52.2%)	3,054	(69.6%)
-Widowed	241	(3.8%)	233	(8.4%)	286	(6.5%)
-Divorced	83	(1.3%)	17	(0.6%)	357	(8.1%)
-Not living together	261	(4.1%)	107	(3.8%)	122	(2.8%)
Women's work status[b]						
-Not working	2,434	(38.9%)	1,186	(42.6%)	1,543	(35.2%)
-Working in agriculture	653	(10.4%)	164	(5.9%)	1,294	(29.5%)
-Working other than agriculture	3,168	(50.6%)	1,433	(51.5%)	1,544	(35.2%)
Region of Residence						
-Urban	2,934	(46.5%)	1,019	(36.6%)	1,959	(44.6%)
-Rural	3,371	(53.5%)	1,767	(63.4%)	2,430	(55.4%)
Religious affiliation						
-Protestant	4,804	(76.4%)	499	(17.9%)	3,466	(79.1%)
-Roman Catholic	1,390	(22.1%)	14	(0.5%)	839	(19.1%)
-Other/no religion	98	(1.6%)	2,272	(81.6%)	78	(1.8%)

[a] Underweight (BMI < 18.5), normal weight (18.5 ≥ BMI < 25.0), and overweight (BMI ≥ 25.0).
[b] Non-agricultural jobs include the following: professional, technical, management, clerical, sales, household and domestic services, skilled or unskilled manual jobs. Agricultural jobs include self-employed as well as employed people.

Figure 4.1. Absolute Wealth Index by country by OVC primary caregiving status

*wealthiest (8+)

wealthier
(6-7),

medium
(4-5)

poorer
(2-3)

*Poorest (0-1)

● OVC primary caregivers
♦ Non-OVC primary caregivers
▲ Non-primary caregivers living with an OVC
■ Non-primary caregivers not living with an OVC
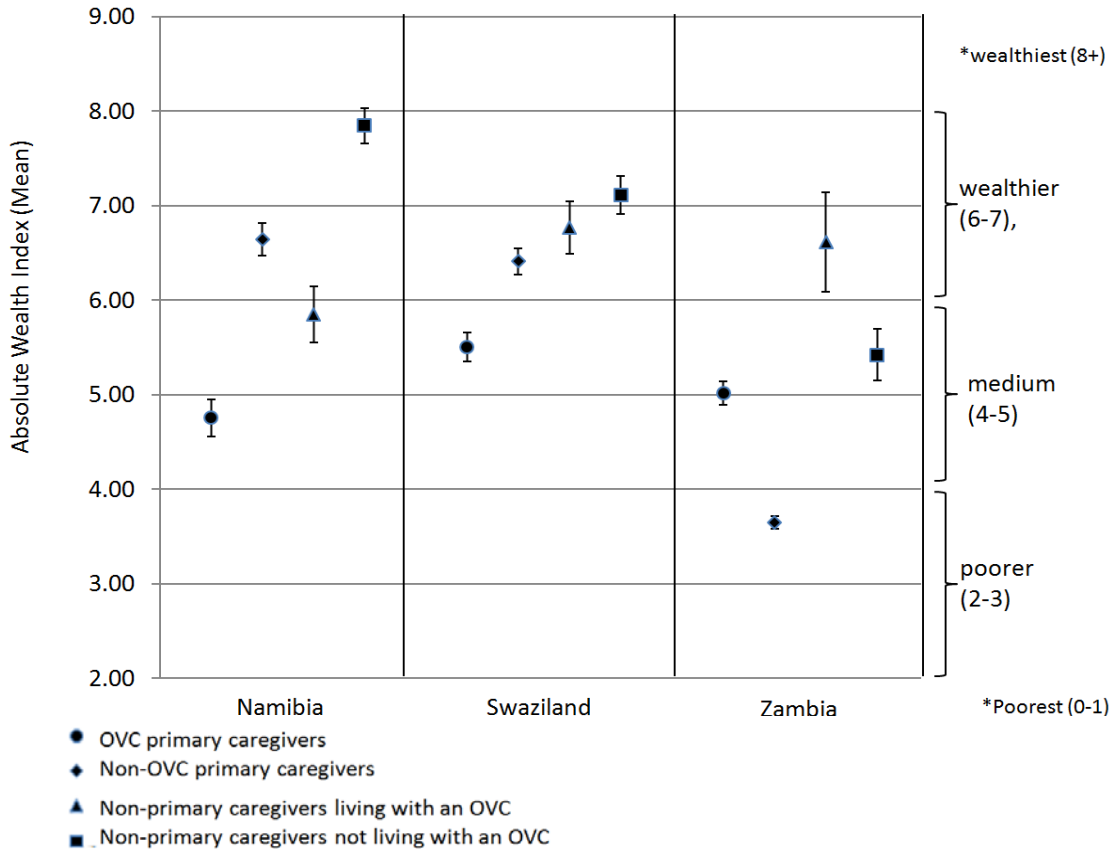
Note. Bars indicate 95% confident intervals.

Table 4.2. Association between AWI and women's overweight status.

	Namibia (n=6,638) n (%)			Swaziland (n=2,875) n (%)			Zambia (n=4,497) n (%)		
	Overweight vs. Normal Weight								
Unadjusted Models									
Poorest (0-1 AWI items)	1.00			1.00			1.00		
Poorer (2-3 AWI items)	1.93	(1.51, 2.48)	***	1.32	(0.90, 1.94)		1.45	(1.10, 1.90)	**
Medium wealth (4-5 AWI items)	3.44	(2.66, 4.44)	***	1.56	(1.09, 2.23)	*	3.40	(2.57, 4.49)	***
Wealthier (6-7 AWI items)	4.29	(3.31, 5.55)	***	2.17	(1.48, 3.17)	***	4.85	(3.63, 6.47)	***
Wealthiest (8+ AWI Items)	6.39	(5.09, 8.02)	***	2.56	(1.80, 3.64)	***	6.85	(5.32, 8.81)	***
Adjusted Models									
Poorest (0-1 AWI items)	1.00			1.00			1.00		
Poorer (2-3 AWI items)	1.40	(0.95, 2.07)		1.45	(0.97, 2.17)		1.37	(1.04, 1.80)	*
Medium wealth (4-5 AWI items)	2.91	(1.92, 4.43)	***	1.77	(1.21, 2.58)	**	2.74	(2.02, 3.71)	***
Wealthier (6-7 AWI items)	4.07	(2.62, 6.33)	***	2.77	(1.86, 4.14)	***	3.67	(2.63, 5.11)	***
Wealthiest (8+ AWI Items)	8.32	(5.70, 12.16)	***	3.56	(2.44, 5.19)	***	5.10	(3.68, 7.06)	***

*p value <0.05, ** p value <0.01, *** p value < 0.001

Ц Reference is poorest category – 0-1 AWI items.

¥ Controlled for OVC primary caregiving status, parity and the interaction between OVC primary caregiving status and AWI.

Ⅱ Controlled for OVC primary caregiving status, women's parity and age.

Γ Controlled for women's education, parity, region and marital status.

Table 4.3. Association between AWI and women's overweight status stratified by OVC primary caregiving status in Namibia.

	OVC primary caregivers			Non-OVC primary caregivers			Non-primary caregivers living with an OVC			Non-primary caregivers not living with an OVC		
Namibia **Adjusted Models**[II]												
Poorest (0-1 AWI items)	1.00			1.00			1.00			1.00		
Poorer (2-3 AWI items)	1.41	(0.95, 2.08)		2.52	(1.71, 3.72)	***	5.00	(1.45, 17.22)	*	2.50	(1.11, 5.62)	*
Medium wealth (4-5 AWI items)	2.94	(1.94, 4.48)	***	4.32	(2.91, 6.42)	***	7.52	(2.05, 27.66)	**	3.13	(1.40, 6.98)	**
Wealthier (6-7 AWI items)	4.14	(2.66, 6.45)	***	5.97	(4.02, 8.89)	***	12.64	(3.56, 44.91)	***	3.10	(1.39, 6.92)	***
Wealthiest (8+ AWI Items)	8.63	(5.86, 12.72)	***	9.81	(6.89, 13.96)	***	13.05	(3.84, 44.30)	***	5.45	(2.60, 11.43)	***

*p value <0.05, ** p value <0.01, *** p value < 0.001

[II] Adjusted for parity.

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Chapter V. Orphan/vulnerable child caregiving moderates the association between women's autonomy and their BMI in three African countries

Research highlights

- Overweight exists among married women who are caring for an orphan and vulnerable child.

- Women's autonomy increased the odds for being overweight in Swaziland and Zambia.

- High autonomy decreased the odds for being underweight in Namibia.

- In Zambia, OVC primary caregiving modifies the effect of the associations between married women's educational attainment and overweight, and between having the final say on making purchases of everyday household items and overweight.

Keywords

Abstract

Background. Enhancement of women's autonomy is a key factor for improving women's health and nutrition. With nearly 12 million orphan and vulnerable children (OVC) in Africa due to HIV/AIDS, the study of OVC primary caregivers' nutrition is fundamental. We investigated the association between married women's autonomy and their nutritional status; explored whether this relationship was modified by OVC primary caregiving; and, analyzed whether decision-making autonomy mediated the association between household wealth and body mass index (BMI).

Study Design. This cross-sectional study used data from Demographic Health Surveys collected during 2006-2007 from 20-49 year old women in Namibia (n=2,633), Swaziland (n=1,395), and Zambia (n=2,920). Analyses included logistic regression, Sobel and Goodman tests.

Results. Women's educational attainment increased the odds for being <u>overweight</u> in Swaziland and Zambia and decreased the odds for being <u>underweight</u> in Namibia. In Zambia, *having at least primary education* increased the odds for being overweight only among child primary caregivers regardless of the OVC status of the child, and *having autonomy for buying everyday household items* increased the odds for being overweight only among OVC primary caregivers. *Decision-making autonomy* mediated the association between *household wealth* and OVC primary caregivers' *BMI* in Zambia (Z=2.13, p-value0.03).

Conclusions. Our findings suggest that women's autonomy is associated with underweight and overweight status. Depending on each country's contextual

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characteristics, having education can decrease the odds for being an underweight woman or increase the odds for being an overweight woman. OVC primary caregiving could modify the effect of the association between educational attainment and overweight status. Further studies should explore why in Namibia, education has an effect on women's overweight status only among women who are caring for a child.

Background.

This study focuses on orphan and vulnerable child (OVC) primary caregivers' autonomy and its association with nutritional status of the caregiver. With nearly 12 million OVC in Africa due to HIV/AIDS, the study of OVC primary caregivers' nutrition is fundamental (UNAIDS, UNICEF & WHO, 2008). OVC primary caregivers are facing the dilemma of maintaining their own health while addressing the physical and emotional needs of family members (Muliira, 2011). These women are experiencing more severe economic and social problems (e.g., discrimination, stigma due to HIV/AIDS and lower income) than other women from their own towns (Miller et al., 2006; Tarimo et al., 2009).

The ongoing African nutritional transition is characterized by a shift toward a more energy dense diet, with increased fat, sugar, processed foods, and a reduction in physical activity (Food and Agriculture Organization, 2006). The BMI of women between the ages of 15-49 years is much higher in southern Africa than in other African regions (Garenne, 2011). According to 2006-2007 Country Reports from the Demographic Health Surveys, the overweight prevalence among 15-49 year old women is greater in Namibia and Swaziland (28.0%) than in Zambia (19.2%).

Previous studies in Africa have shown that women with lower levels of education and/or household decision-making autonomy are more likely to be underweight (Woldemicael, 2007; Elfhag & Rossner, 2005; Hindin, 2000). For this reason, promoting women's autonomy has been identified as a critical and cost-effective nutritional intervention for helping households break the cycle of intergenerational deprivation (United Nations Development Programme, 2012). When women have more autonomy,

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they have the ability to make and execute independent decisions pertaining to personal matters of importance to their lives or their family, although other people may be opposed to their wishes (Woldemicael, 2007). When women have less autonomy than men, household food security deteriorates and access to healthcare decreases (United Nations Development Programme, 2012). When women have more influence on household choices, the likelihood for nutritional improvements in the household increases (United Nations Development Programme, 2012). To the best of our knowledge, no previously published studies have investigated the association between women's autonomy and their overweight status.

The broad objective of this study was to investigate the association between married women's autonomy and their nutritional status and to explore whether this relationship was modified by OVC primary caregiving. This study focused on two dimensions of women's autonomy: decision-making about a variety of household issues and knowledge autonomy measured by educational attainment (Woldemicael, 2007). Three OVC primary caregiving categories were included: a) OVC primary caregivers, b) non-OVC primary caregivers, and c) non-primary caregivers. Our research questions were: 1) What is the association between married women's autonomy and their underweight/overweight status? 2) Does OVC primary caregiving status modify the effect of the association between married women's autonomy and their underweight/overweight status? and, 3) Does OVC primary caregivers' decision-making autonomy mediate the association between AWI and their BMI?

Methods

A cross-sectional study was conducted using secondary analyses of data from the Demographic Health Surveys (DHS). The DHS comprises large-scale household sample surveys conducted by governments, with support from international organizations and institutions, such as Macro International, specific United Nations agencies, and the United States Agency for International Development (USAID). This study used DHS data from Namibia (2006-2007), Swaziland (2006-2007), and Zambia (2007). These countries share common characteristics such as being located in Southern Africa (an area with the highest prevalence of HIV/AIDS in Africa), had HIV prevalence of at least 5% or orphan prevalence of at least 8% among children age 0-17 years (i.e., one or both biological parents have died) in 2006-2007, had available DHS data for primary caregiving status and women's anthropometrics, belong to the Southern African Development Community, had economies linked to South Africa, and had less than 20% missing data for women's body mass index (BMI).

This study included 20-49 year old married women who gave oral consent for participation and reported de jure household residency. Pregnant and three months or less postpartum women were excluded to avoid the impact of the fetus and lactation on BMI (Bitew, 2010). Women with BMI less than 12.0 or greater than 60.0 were also excluded as these might be cases of extreme anthropometric measures or resulting from data errors (Garenne, 2011).

The dependent variable, BMI, was defined as weight in kilograms divided by height in meters squared (kg/m^2). BMI was categorized in three groups: underweight (BMI < 18.5), normal weight ($18.5 \geq$ BMI < 25.0), and overweight (BMI $\geq$ 25.0). BMI

has been widely used as an anthropometric indicator of health, especially regarding nutrition-related disease among adult women from Sub-Saharan countries and other regions (Bitew, 2010; Allen Furr & Nandita, 2006). Weight was measured by using a solar-powered scale (Uniscale) with an accuracy of ± 100g. Height was measured with an adjustable wooden measuring board (Shorr Height boards) to the nearest 0.1 cm.

The independent variable, **household decision-making autonomy** included five situations (yes/no) to determine whether a woman had the final say on: (1) her own health care, (2) large household purchases, (3) purchases of everyday household items, (4) visits to family or relatives, and (5) what to do with the money the husband earns. The response options were: (a) respondent alone, (b) respondent and husband/partner, (c) respondent and other person, (d) husband/partner alone, (e) someone else, f) other. For each question, a value of 1 was assigned if the response was (a), (b), or (c), and 0 for (d), (e), or (f). Decision-making autonomy was included as a dichotomous variable for each of the five situations as well as a continuous measurement (the values were added resulting in a score from 0 to 5), (Rahman, 2012). **Educational attainment** was collected using the following DHS categories: no education, primary, secondary and higher education.

The potential effect modifier, **OVC primary caregiving status**, included three categories. **Primary caregivers** were women who lived with a biological child under the age of 18 and/or who were primary caregivers of a non-biological child under the age of 18. This study uses DHS's definition for OVC: children with one or both parents deceased (orphans); and vulnerable children who a) have a chronically ill parent (sick for more than 3 consecutive months during the past 12 months) or b) live with an adult who was chronically ill or died during the past 12 months. The OVC status of the primary

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caregiving was based on the question: "How many orphans and vulnerable children live in your household?" **OVC primary caregivers** were primary caregivers who mentioned that one or more children living in their house. **Non-OVC primary caregivers** were primary caregivers who mentioned that no OVC lives in their house. **Non-primary caregivers** were women who did not live with a biological child under the age of 18 and/or who were primary caregivers of a non-biological child under the age of 18.

The **Absolute Wealth Index** (AWI) used in the mediation analyses is a measure developed by Hohmann and Garenne (2011) and adapted from the Filmer and Pritchett's approach which captures a wide range of household wealth distribution (Filmer & Pritchett, 1999; Filmer & Pritchett, 1998; Garenne, 2011; Hohmann & Garenne, 2011; Hohmann, 2010). AWI was used as a continuous variable that included a score from 0 to 14, with 0 indicating no modern goods, and 12+ indicating all modern comforts (e.g., running water, flushing toilet, electricity, radio, television, etc.).

The following variables were considered as potential confounders: *women's age* (20-29, 30-39 and 40-49 years old); **parity** (number of births in the last five years**), region of residence** (rural, urban); **work status** (not working, working in agriculture, and working in any field other than agriculture); **religion** (Catholic, Protestant, and other/no religion); **presence of a child 5 years old or younger living in the house** (yes, no), **women's education** (no schooling, primary school, secondary education, and higher education); **women's relationship with the household head** (head, wife, daughter, other); **sex of the household head** (male, female); **number of household members** (less than 3, 4 to 6, ≥7); **number of 18-49 year old women in the household** (1, 2, 3, ≥4); and, **number of 18-49 year old men in the household** (0, 1, ≥2).

Statistical analyses included data screening to check for outliers and errors, as well as descriptive statistics for continuous and discrete variables. The estimation of marginal means used analytic weights to correct for over-sampling and variations in survey response rates by region. Logistic regression analyses controlled for potential confounders and interactions. Additional simple and adjusted logistic regression models were used for selecting confounders. A variable was included as a confounder if the adjusted odds ratio was 10% different than the unadjusted odd ratio.

Collinearity between and within independent variables and potential confounders was tested by using Phi analyses when both variables were dichotomous, and Cramer's V for variables with three or more levels. A pair of independent variables with a Phi or and Cramer's V value of at least .70 was considered to have substantial collinearity and one variable was removed from the analysis. Multicollinearity among the independent variable and potential confounders was tested using two statistics: the tolerance value and the variance inflation factor (VIF). Multicollinearity was also considered to exist if a tolerance value less than 0.1 or a VIF greater than 10 were found (Menard et al., 2006; Myers et al., 2006).

Mediation analyses were performed using Baron & Kenny's approach (1986). First, women's decision-making autonomy was regressed on women's AWI. Then, BMI was regressed on women's AWI. BMI was regressed on women's decision-making autonomy and women's AWI. An examination of the results determined whether women's AWI and women's decision-making autonomy had a significant association, whether women's AWI and BMI had a significant association, and whether women's AWI and BMI had a significant association in the presence of women's decision-making

autonomy. Sobel tests were performed to estimate the percentage of the total effect that was mediated and the ratio of the indirect to the direct effect. As recommended in the guide for DHS statistics by Rutstein and Rojas (2006), analyses for research questions 1-2 did not include sampling weights. Significant associations were determined using 95% confidence intervals and p-values (α <0.05). Analyses were performed using SPSS® 19.

Results

Sample characteristics

This study included 20 to 49 year old married women from Namibia (n=2,633), Swaziland (n=1,395), and Zambia (n=2,920), (Table 5.1). The prevalence of OVC caregiving among married women ranged from 27.7% in Namibia and Swaziland to 30.4% in Zambia. Higher proportions of women were overweight, had secondary education, and/or worked in agriculture in Namibia and Swaziland than in Zambia. More women in Swaziland and Zambia lived in rural than in urban areas.

Insert Table 5.1 here

Mean household decision-making autonomy differences by women's primary caregiving status within countries

OVC primary caregivers from Zambia had higher mean household decision-making autonomy scores than women from the other two caregiving groups (Figure 5.1).

Figure 5.1 here

Mean household decision-making autonomy differences by country within OVC primary caregivers

Swazi OVC primary caregivers had a lower mean household decision-making autonomy score than their counterparts from Namibia and Zambia. A higher proportion of OVC primary caregivers from Namibia had autonomy to make decisions regarding their own health (Namibia: 84.2%, Swaziland: 65.8% and Zambia: 70.9%) and to buy large household purchases (Namibia: 73.1%, Swaziland: 59.0% and Zambia: 63.4%) when compared to their counterparts from Swaziland and Zambia (Figure 5.2). A higher proportion of OVC primary caregivers from Zambia had autonomy for making purchases for everyday household items than their counterparts from Namibia (85.5% vs. 80.3% respectively). Compared to OVC primary caregivers from Swaziland, a higher proportion of Namibian and Zambian OVC primary caregivers had autonomy for deciding when to visit family or relatives (Swaziland: 47.5%, Namibia: 75.5%, and Zambia: 74.1%) as well as autonomy for deciding what to do with the money their husband earns (Swaziland: 44.1%, Namibia: 59.8%, and Zambia: 64.0%).

Figure 5.2 here

Logistic regression models of underweight and overweight status regressed on women's autonomy

Adjusted models including normal weight and underweight women showed that having at least secondary education decreased the odds for being underweight in Namibia as compared to not having any education (Table 5.2). In Zambia, women who could decide what to do with their husband's salary were less likely to be underweight than women who could not make this decision.

Insert table 5.2 here

Adjusted models including normal weight and overweight women demonstrated that in Namibia, women's decision-making and educational attainment were not associated with being overweight. In Swaziland, having at least secondary education increased the odds for being overweight as compared to not having any education. In Zambia, having at least primary education, having the final say on making purchases of everyday household items, having the final say on large household purchases, or having the final say on what to do with their husband's salary increased the odds for being overweight compared to women who lacked these autonomy indicators.

Test for interactions

In Zambia, OVC primary caregiving modified the effect of the associations between married women's educational attainment and overweight, and between having the final say on making purchases of everyday household items and overweight (Table 5.3). Having at least primary education increased the odds for being overweight among child primary caregivers regardless of the OVC status of the child. Having the final say on making purchases of everyday household items increased the odds for being overweight only among OVC primary caregivers.

Insert Table 5.3 here

Mediation tests

Among OVC primary caregivers, autonomy partially mediated the association between AWI and married women's BMI in Zambia (Z=2.13, p=0.03), (Figure 5.3).

Insert Figure 5.3 here

Discussion

Our findings demonstrate the important role that educational attainment has in the nutritional status among African married women. Having education decreased the odds for being an underweight woman in Namibia, and increased the odds for being an overweight woman in Swaziland and Zambia. In Namibia, women who had at least a secondary education were less likely to be underweight as compared to women with no education. Education has been identified as crucial for poverty reduction; improvement in gender equality, health and nutrition; reductions in infant and child mortality; and a reduction in the prevalence of HIV/AIDS transmission in sub-Saharan Africa (Fotso et al., 2009). It has been suggested that education protects women's nutritional status because educated women are more likely to have better skills that could benefit their children and/or their own health and nutrition (e.g., use health care facilities; keeping their places clean; access to health and nutrition information from knowledge gleaned from reading newspapers, listening to the radio and watching television; effective interaction with doctors and nurses; better compliance with treatment recommendations), (Joshi, 1994; Thomas et al., 1990).

In developed countries, education has also been associated with eating more frequently out of the home and lower adherence to the WHO recommended daily intake of vegetables (Krige et al., 2012). Further work should explore whether the association between education and these health behaviors is a possible explanation why our study also found that being a woman with at least primary education (Zambia) or at least secondary education (Swaziland) increased the odds for being overweight.

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We wanted to know whether OVC primary caregiving status modified the effect of the association between education and overweight status. In Zambia, having at least a primary education increased the odds for being overweight only among child primary caregivers. Further studies should explore the reasons why education is not associated with overweight status among non-child caregivers in Zambia.

Previous studies have shown that a school setting provides a platform to reach a large number of OVC and their families with critical health information (e.g., HIV/AIDS prevention), (Nelson et al, 2008). School-based health and nutrition education and support programs are a good way to reach OVC and their families in communities with high prevalence of HIV/AIDS that are experiencing difficulties in meeting the diverse needs of these orphans and vulnerable children (e.g., education, psychosocial and nutritional support, livelihood opportunities, help with caring for household members living with HIV), (Nelson et al., 2008). In addition, other strategies can be implemented in school settings for supplementing and enhancing the work being done Departments of Education. For example, training volunteer youth caregivers operating in a school-based setting has been found to be a successful strategy for improving HIV-related knowledge, attitudes, and communication among program participants as well as in their communities (Nelson et al., 2008). Nutritional strategies implemented at the school level should address socio-economic factors, socio-cultural beliefs and adverse school environments (Odaga, 1995). These strategies should also capitalize on political and institutional conditions that could be used as a platform for fighting the increasing overweight problem in Africa (Odaga, 1995).

This study found that Namibian women who had the final say on what to do with their husband's salary were less likely to be underweight. This finding supports UNESCO guidelines for addressing undernutrition problems in Africa including the fight against traditional stereotypes in the minds of both men and women that are reinforcing gender inequality (United Nations Development Programme, 2012). The acquisition of basic literacy and numeracy is essential to promote women's capacity for taking charge of the household income and budgeting. Our analyses including OVC primary caregivers showed that decision-making autonomy mediated the association between AWI and women's BMI in Zambia. Previous studies did not find women's autonomy to mediate the association between socio-economic factors and pre-natal and child delivery care services (Woldemicael, 2007).

As documented in DHS's country reports from 2006-2007, the reasons why we found significant interaction and mediation effects only in Zambia could be related to the comparatively lower prevalence of households in Zambia than in the other two countries that have a female headship, a higher percentage of men with two or more wives, and lower women's mean age (years) at first marriage in urban (Namibia: 29.1, Swaziland: 27.9 and Zambia: 19.6) as well as rural areas (Namibia: 27.4, Swaziland: 22.8 and Zambia: 17.8). These factors could reflect different reasons and motivations for getting married, their levels of decision-making autonomy and their likelihood of continuing with higher education. Finally, another important rationale could be the differences in women's status in society by country as measured by the levels of tolerance for violence against women. DHS reports from 2006-2007 show that a much higher percentage of women and men in Zambia than the other two countries consider that a husband is

justified in hitting or beating his wife in several situations (e.g. his wife burns the food, argues with him, goes out without telling him, neglects the children or refuses to have sexual intercourse with him).

Strengths and Limitations

To our knowledge, this is the first study that examined the role of OVC primary caregiving as a potential effect modifier on the association between women's autonomy and their underweight and overweight status in communities located in Southern Africa as well as the mediating role of women's decision-making autonomy on the association between household absolute wealth and women's BMI. Strengths of this study include the use of two different dimensions of women's autonomy: household decision-making and educational attainment. This study used diverse and representative data of reproductive age women in three southern African countries with different underweight and overweight prevalence. DHS surveys contain core questions that are identical across countries, and height and weight were measured rather than relying on self-reported information.

This study had important limitations that should be acknowledged when interpreting the results. Because this was a cross-sectional study, it was not possible to determine which occurred first: the OVC caregiving status of the woman or her underweight or overweight status. This study did not assess whether children who moved to the caregivers' home came from homes with lower or higher socio-economic status nor the length, intensity and type of primary caregiving. For instance, it has been suggested that primary caregiving may not produce severe consequences on the health of the caregiver during the early stages of primary caregiving (Burton et al., 2003; Hirst, 2005).

For example, according to DHS's country reports, the prevalence of marriage/ living together varies by country (e.g., Namibia: 43.9%, Swaziland: 52.2% and Zambia: 69.3%). This study focused on married women. Due to the limited number of women, we were unable to examine non-caregivers by their current residence with OVC. The variable religion only included "Roman Catholic", "Protestant" and "other or no religion" categories. Data related to women's health status, dietary food intake, intensity of primary caregiving by the type or quantity of assistance provided were not available in the DHS dataset used. Only one nutritional measurement (BMI) was available. Due to contextual differences for African countries, findings may not be generalized outside these countries and with non married women. The variable "final say on what to do with the money the husband earns" in Swaziland seems to not be missing at random (more missing data from rural and non-educated women). However, due to the relevance of the question, this variable was kept in the study.

African cultural values regarding polygamy, HIV prevalence, ideal family size and the social importance of fertility could differentiate the meaning that women's autonomy has in Africa as compared to other regions (Upadhyay & Karasek, 2012). Because women's autonomy may have different meaning due to the variation in cultural contexts, further studies should explore the validity of using DHS measurements for autonomy in each African country (Upadhyay & Karasek, 2012). Additional work should examine other dimensions of women's autonomy including freedom of movement, differences in age and education between marital partners, and the process of spouse selection (Upadhyay & Karasek, 2012).

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Further studies should also investigate cultural factors that may influence the association of women's autonomy and their increased likelihood for being overweight. Cultural factors should be taken into account when designing and implementing overweight prevention and control programs promoting married women's autonomy. For example, it has been suggested that overweight African women are reluctant to lose weight because in their culture fatness is associated with women's autonomy and wealth (Puoane et al, 2005; Venter et al., 2009). Finally, additional work should explore the association between women's autonomy and their nutritional status in different family structures such as polygamous or monogamous unions as well as single and multiple generational family households. 2006-2007 DHS reports have documented that the prevalence of married women are in a polygamous union (i.e., they have one or more co-wives) varied in these three countries (Namibia 6%, Swaziland 18%, Zambia 14%). Polygamy could influence household composition and women's autonomy.

Table 5.1
Socio-demographic characteristics by country.

	Namibia (n=2,633) n (%)	Swaziland (n=1,395) n (%)	Zambia (n=2,920) n (%)
Nutritional status[a]			
-Underweight	249 (9.5%)	12 (0.9%)	231 (7.9%)
-Normal Weight	1,221 (46.4%)	447 (32.0%)	2,040 (69.9%)
-Overweight	1,163 (44.2%)	936 (67.1%)	649 (22.2%)
OVC caregiving status			
-OVC caregiver	730 (27.7%)	340 (27.7%)	888 (30.4%)
-Non-OVC caregiver	1,446 (54.9%)	800 (65.3%)	1,844 (63.2%)
-Non-caregivers	457 (17.4%)	86 (7.0%)	188 (6.4%)
Women's Education			
-No Education	344 (13.1%)	155 (11.1%)	383 (13.1%)
-Primary Education	842 (32.0%)	451 (32.3%)	1,719 (58.9%)
-Secondary Education	1,216 (46.2%)	615 (44.1%)	682 (23.4%)
-Higher Education	231 (8.8%)	174 (12.5%)	136 (4.7%)
Women's Age			
Mean (standard deviation)	34.97 (7.85)	33.75 (7.83)	32.18 (8.04)
Women's work status[b]			
-Not working	1,009 (38.6%)	603 (43.3%)	1,089 (37.3%)
-Working in agriculture	285 (10.9%)	88 (6.3%)	925 (31.7%)
-Working other than agriculture	1,320 (50.5%)	702 (50.4%)	903 (31.0%)
Region of Residence			
-Urban	1,220 (46.3%)	434 (31.1%)	1,155 (39.6%)
-Rural	1,413 (53.7%)	961 (68.9%)	1,765 (60.4%)
Children ≤5 years old in Household			
-Yes	1,708 (64.9%)	930 (66.7%)	2,339 (80.1%)
Parity (number of children ever born)			
Mean (standard deviation)	3.38 (2.19)	3.68 (2.43)	4.33 (2.67)
Absolute Wealth Index			
Mean (standard deviation)	6.44 (4.01)	6.60 (3.23)	4.11 (3.17)

[a] Underweight (BMI < 18.5), normal weight (18.5 ≥ BMI < 25.0), and overweight (BMI ≥ 25.0).
[b] Non-agricultural jobs include the following: professional, technical, management, clerical, sales, household and domestic services, skilled or unskilled manual jobs. Agricultural jobs include self-employed as well as employed people.

Figure 5.1. Household decision-making autonomy by country and OVC primary caregiving status
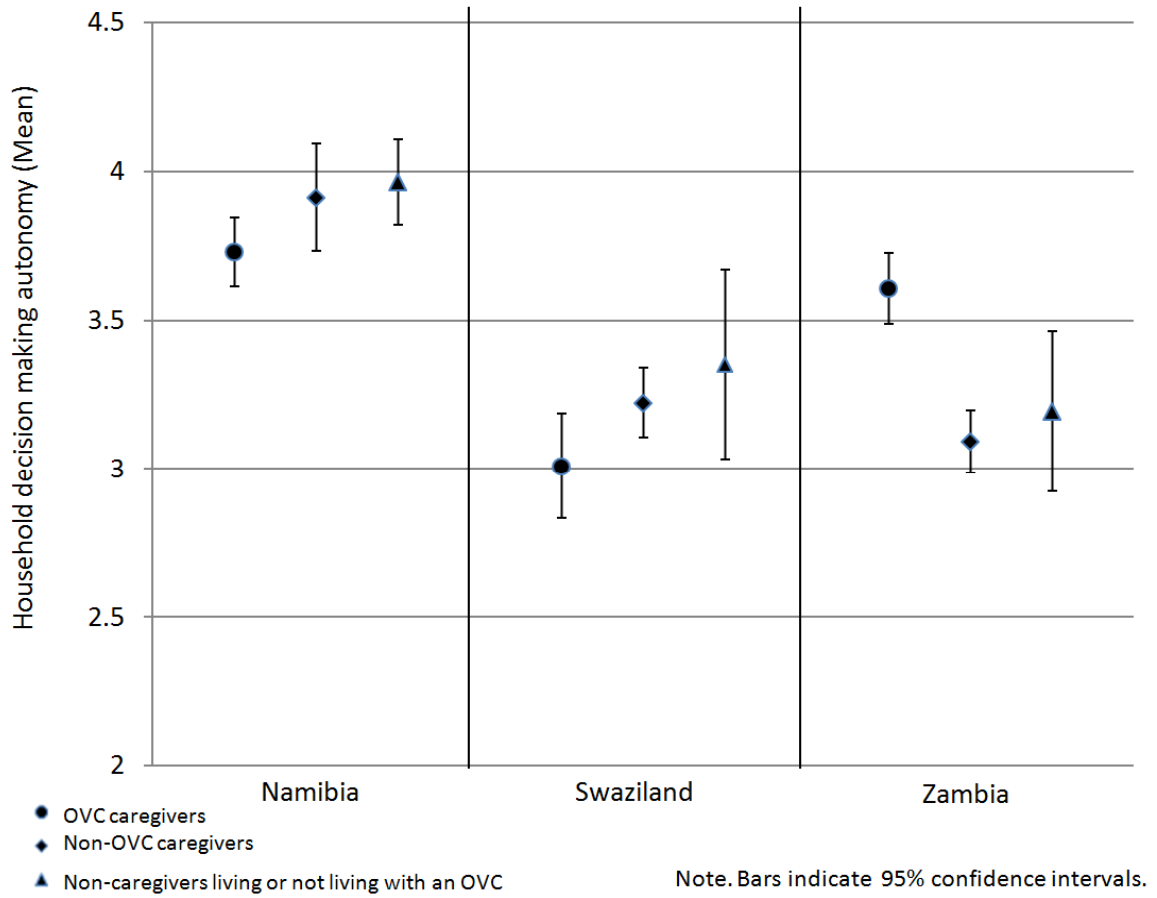
Figure 5.2. Household decision-making autonomy factors for OVC primary caregivers by country

%
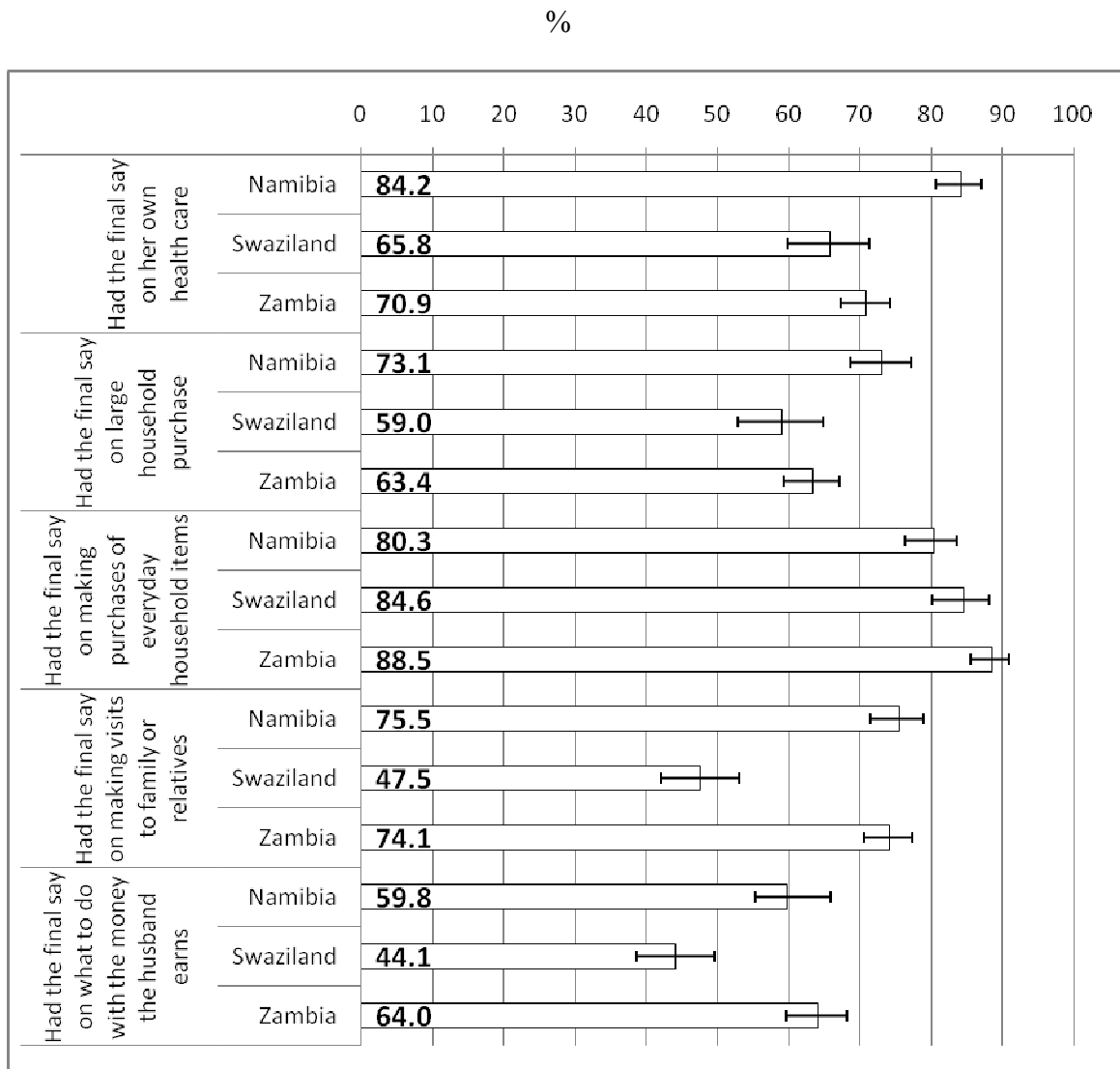
Table 5.2. Association between women's autonomy and women's underweight and overweight status.╪

	Namibia¥			Swaziland▲		Zambia↓		
Underweight vs. Normal Weight								
Bivariate Models								
Household decision-making autonomy								
Have final say on own health care	0.88	(0.62, 1.25)				0.92	(0.69, 1.22)	
Have final say on making large household purchases	0.71	(0.53, 0.95)	*			0.99	(0.75. 1.30)	
Have final say on making household purchases for daily needs	0.68	(0.50, 0.93)	*			0.96	(0.68, 1.35)	
Have final say on visits to family or relatives	0.80	(0.59, 1.09)				1.09	(0.81, 1.46)	
Have final say on deciding what to do with money husband earns	0.89	(0.68, 1.18)				0.73	(0.56, 0.96)	*
Educational attainment								
-No education	1.00					1.00		
-Primary education	0.69	(0.49, 0.99)	*			0.92	(0.63, 1.33)	
-Secondary education	0.37	(0.25, 0.54)	***			0.62	(0.39, 0.99)	
-Higher education	0.07	(0.02, 0.30)	***			0.99	(0.42, 2.32)	
Adjusted Models								
Household decision-making autonomy								
Have final say on own health care	1.31	(0.84, 2.04)				0.97	(0.70, 1.33)	
Have final say on making large household purchases[b]								
Have final say on making household purchases for daily needs	0.77	(0.50,1.19)				1.03	(0.70, 1.52)	
Have final say on visits to family or relatives	1.09	(0.73,1.62)				1.20	(0.86,1.68)	
Have final say on deciding what to do with money husband earns	1.14	(0.82,1.58)				0.73	(0.54,0.97)	*
Educational attainment								
-No education	1.00					1.00		
-Primary education	0.79	(0.54,1.13)				0.94	(0.65,1.36)	
-Secondary education	0.52	(0.34,0.79)	**			0.66	(0.41,1.06)	
-Higher education	0.13	(0.03,0.57)	**			1.07	(0.45,2.55)	

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	Overweight vs. Normal Weight							
Bivariate Models								
Household decision-making autonomy								
Have final say on own health care	1.36	(1.08, 1.70)	**	1.11	(0.87, 1.42)	1.29	(1.06, 1.56)	*
Have final say on making large household purchases	1.46	(1.20,1.77)	***	1.21	(0.96,1.53)	1.74	(1.44,2.09)	***
Have final say on making household purchases for daily needs	1.4	(1.20,1.84)	***	0.96	(0.71,1.30)	1.97	(1.51,2.59)	***
Have final say on visits to family or relatives	1.61	(1.32,1.97)	***	1.24	(0.99,1.56)	1.62	(1.32,1.98)	***
Have final say on deciding what to do with money husband earns	1.34	(1.13,1.59)	**	1.01	(0.81,1.27)	1.83	(1.51,2.21)	***
Educational attainment								
-No education	1.00			1.00		1.00		
-Primary education	1.31	(0.98,1.742)		1.12	(0.76,1.64)	2.25	(1.57,3.23)	***
-Secondary education	2.14	(1.63,2.81)	***	1.36	(0.94,1.98)	3.74	(2.56,5.46)	***
-Higher education	3.76	(2.60,5.44)	***	2.15	(1.32,3.49)	**	11.49	(7.05,18.72)	***
Adjusted Models								
Household decision-making autonomy								
Have final say on own health care	0.86	(0.64, 1.16)		1.01	(0.76,1.34)	0.85	(0.68,1.06)	
Have final say on making large household purchases ь				1.02	(0.76,1.36)	1.27	(1.02,1.59)	*
Have final say on making household purchases for daily needs	1.05	(0.78,1.42)		0.76	(0.54,1.07)	1.32	(0.97,1.79)	
Have final say on visits to family or relatives	1.15	(0.87,1.51)		1.13	(0.87,1.47)	1.19	(0.94,1.51)	
Have final say on deciding what to do with money husband earns	1.03	(0.84,1.26)		1.12	(0.88,1.43)	1.34	(1.08,1.66)	**
Educational attainment								
-No education	1.00			1.00		1.00		
-Primary education	1.03	(0.76,1.39)		1.29	(0.86, 1.93)	2.11	(1.46,3.03)	***
-Secondary education	1.10	(0.80,1.50)		1.87	(1.25,2.78)	**	3.24	(2.20,4.76)	***
-Higher education	1.36	(0.90,2.01)		2.44	(1.46,4.08)	**	9.10	(5.54,14.96)	***

*p value <0.05, ** p value <0.01, *** p value < 0.001

ь This variable was not included in the logistic regression model due to high collinearity with the variable "Have final say on making household purchases for daily needs."

‡ BMI was defined as weight in kilograms divided by height squared in meters (kg/m^2). BMI was categorized in three groups: underweight (BMI < 18.5), normal weight $(18.5 \geq BMI < 25.0)$, and overweight $(BMI \geq 25.0)$.

¥ Logistic regression model for underweight vs. normal weight is adjusted for religion, work and AWI. Logistic regression model for overweight vs. normal weight is adjusted for parity, work, AWI and the interaction between OVC primary caregiving and educational attainment.

▲ Logistic regression model for underweight vs. normal weight was not performed due to the small number of underweight cases (n=12, 0.9%). Logistic regression model for overweight vs. normal weight is adjusted for women's age.

Ѱ Logistic regression model for underweight vs. normal weight is adjusted for region and women's age

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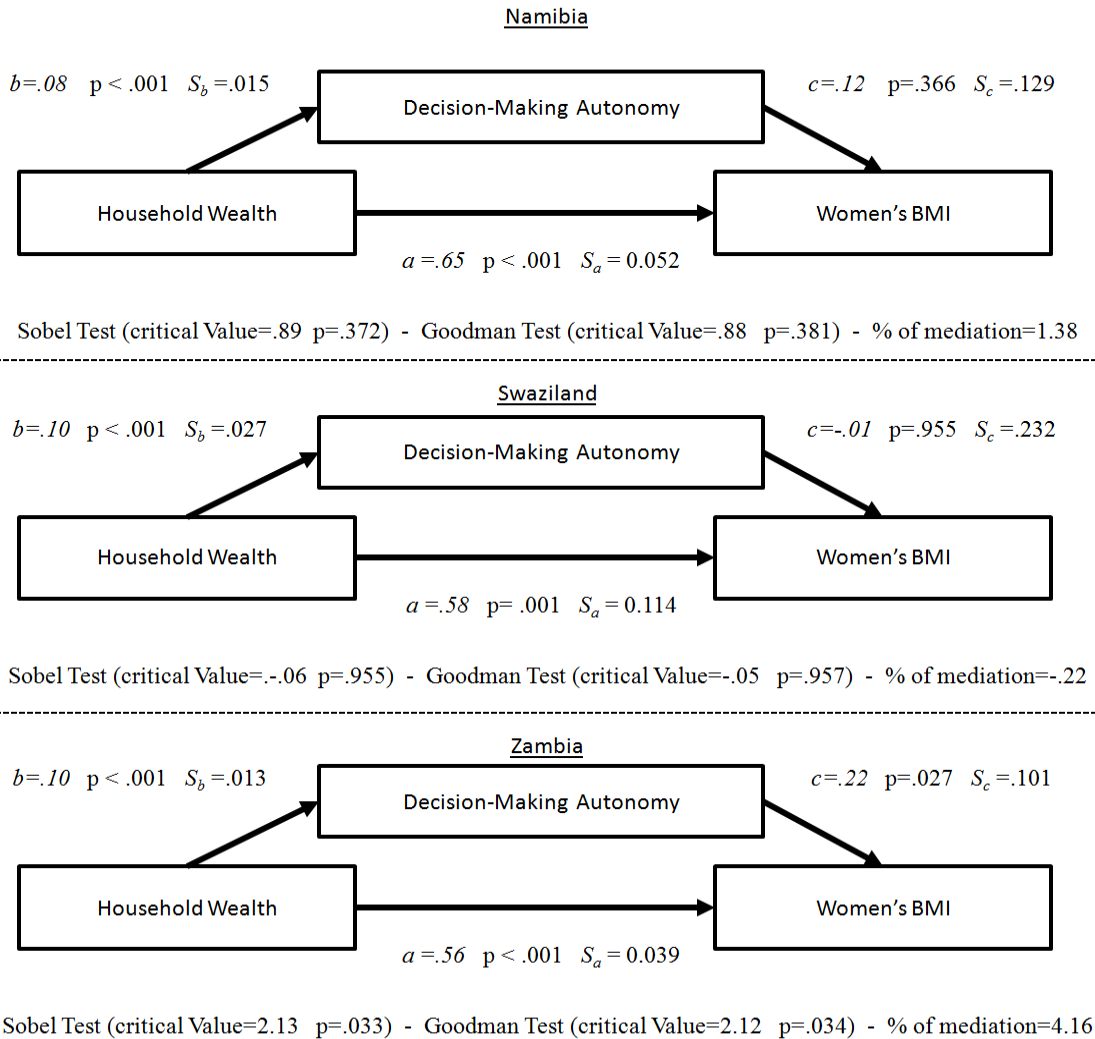Table 5.3. Association between women's autonomy and women's overweight status stratified by OVC caregiving status, Zambia.‡

	OVC caregivers			Non-OVC caregivers			Non-caregivers	
	OR	95% CI		OR	95% CI		OR	95% CI
OVERWEIGHT VS. NORMAL WEIGHT								
Household decision-making autonomy								
Have final say on own health care	0.77	(0.52, 1.12)		0.91	(0.68, 1.22)		0.66	(0.25, 1.76)
Have final say on making large household purchases	1.45	(0.99, 2.13)		1.19	(0.89, 1.58)		1.07	(0.39, 2.97)
Have final say on making household purchases for daily needs	2.02	(1.03, 3.95)	*	1.28	(0.88, 1.85)		0.45	(0.14, 1.45)
Have final say on visits to family or relatives	1.41	(0.93, 2.14)		1.05	(0.78, 1.42)		2.37	(0.76, 7.44)
Have final say on deciding what to do with money husband earns	1.41	(0.96, 2.06)		1.26	(0.96, 1.66)		1.76	(0.64, 4.81)
Educational attainment								
-No education	1.00			1.00			1.00	
-Primary education	3.10	(1.37, 7.02)	**	1.88	(1.22, 2.89)	*	1.36	(0.35, 5.29)
-Secondary education	5.02	(2.17, 11.59)	***	2.82	(1.77, 4.50)	***	1.73	(0.41, 7.38)
-Higher education	10.48	(4.15, 26.47)	***	13.69	(6.61, 28.37)	***	1.44	(0.19, 10.76)

*p value <0.05, ** p value <0.01, *** p value < 0.001

‡ BMI was defined as weight in kilograms divided by height squared in meters (kg/m^2). BMI was categorized in three groups: underweight (BMI < 18.5), normal weight ($18.5 \geq$ BMI < 25.0), and overweight (BMI $\geq$ 25.0). Logistic regression model adjusted for parity, work and AWI.

Figure 5.3. Mediation analyses of OVC primary caregivers' decision-making autonomy on the association between their Absolute Wealth and their Body Mass Index.

Namibia

$b=.08$ p < .001 $S_b =.015$

Decision-Making Autonomy

$c=.12$ p=.366 $S_c =.129$

Household Wealth

Women's BMI

$a =.65$ p < .001 $S_a = 0.052$

Sobel Test (critical Value=.89 p=.372) - Goodman Test (critical Value=.88 p=.381) - % of mediation=1.38

Swaziland

$b=.10$ p < .001 $S_b =.027$

Decision-Making Autonomy

$c=-.01$ p=.955 $S_c =.232$

Household Wealth

Women's BMI

$a =.58$ p= .001 $S_a = 0.114$

Sobel Test (critical Value=.-.06 p=.955) - Goodman Test (critical Value=-.05 p=.957) - % of mediation=-.22

Zambia

$b=.10$ p < .001 $S_b =.013$

Decision-Making Autonomy

$c=.22$ p=.027 $S_c =.101$

Household Wealth

Women's BMI

$a =.56$ p < .001 $S_a = 0.039$

Sobel Test (critical Value=2.13 p=.033) - Goodman Test (critical Value=2.12 p=.034) - % of mediation=4.16

a represents the unstandarized regression coefficient for the relationship between BMI and AWI. S_a represents the standard error of said regression coefficient. *b* represents the unstandarized regression coefficient for the relationship between OVC primary caregivers' decision-making autonomy and AWI. S_b represents the standard error of said regression coefficient. *c* represents the unstandarized regression coefficient for the relationship between BMI and OVC primary caregivers' decision-making autonomy controlling for AWI. S_a represents the standard error of said regression coefficient. Both the Sobel and the Goodman test yield critical z-scores as the test statistics.

Appendix 5.1. Association between women's autonomy and women's underweight and overweight status (continuous measurement)

Table 4. Association between women's autonomy and women's underweight and overweight status.╪

	Namibia¥			Swaziland ▲			Zambia Ѱ		
Underweight vs. Normal Weight									
Bivariate Models									
Household decision-making autonomy (continuous)	0.92	(0.85, 1.00)					0.97	(0.89, 1.05)	
Adjusted Models									
Household decision-making autonomy(continuous)	1.01	(0.93, 1.10					0.98	(0.90, 1.07)	
Overweight vs. Normal Weight									
Bivariate Models									
Household decision-making autonomy (continuous)	1.14	(1.08, 1.20)	***	1.06	(0.98, 1.14)		1.25	(1.17, 1.33)	***
Adjusted Models									
Household decision-making autonomy(continuous)	1.05	(1.00, 1.11)		0.99	(0.91, 1.08)		1.10	(1.03, 1.18)	**

*p value <0.05, ** p value <0.01, *** p value < 0.001

╪ BMI was defined as weight in kilograms divided by height squared in meters (kg/m^2). BMI was categorized in three groups: underweight (BMI < 18.5), normal weight (18.5 ≥ BMI < 25.0), and overweight (BMI ≥ 25.0).

¥ Logistic regression model for underweight vs. normal weight is adjusted for women's education attainment, religion and AWI. Logistic regression model for overweight vs. normal weight is adjusted for women's education attainment, region and women's age.

▲ Logistic regression model for underweight vs. normal weight was not performed due to the small number of underweight cases (n=12, 0.9%). Logistic regression model for overweight vs. normal weight is adjusted for women's education attainment, parity, women's age and AWI.

Ѱ Logistic regression model for overweight vs. normal weight is adjusted for women's education attainment, parity, region and women's age.

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Chapter VI. Public health significance

The primary goal of this dissertation was to investigate factors associated with OVC primary caregivers' body mass index (BMI). The following are the four main findings:

First, nutritional status of OVC primary caregivers differs by country with the mean BMI in Swaziland being in the overweight range (BMI ≥ 25.0) while Namibia and Zambia were in the normal weight range (18.5 ≥ BMI < 25.0). This underscores the enormous variation that exists amidst the "nutrition transition" underway on the continent. In this context, we found that among OVC primary caregivers, the prevalence of overweight (Namibia: 33.2%, Swaziland: 61.3% and Zambia: 26.9%) was higher than the prevalence of underweight (Namibia: 13.1%, Swaziland: 1.7% and Zambia: 7.2%). These findings suggest that African public health systems and OVC programs may face an overweight epidemic alongside existing ones (e.g., HIV/AIDS, tuberculosis, malaria).

Second, our results suggest that OVC primary caregiving is associated with women's overweight status but the effects vary by country. Namibian OVC primary caregivers were less likely to be overweight than non-OVC caregivers and non-caregivers not living with an OVC. Swazi and Zambian OVC caregivers were more likely to be overweight than non-caregivers.

The <u>third</u> key finding is that OVC primary caregivers may be facing household wealth disparities. OVC primary caregivers in Namibia and Swaziland had a lower mean AWI than other women in the same country. Zambian OVC primary caregivers had a lower mean AWI score than non-caregivers living with an OVC, but a higher mean AWI score than non-OVC primary caregivers. Similar to previous studies, we found positive associations between having more wealth and being overweight.[1,2]

<u>Fourth</u>, our findings suggest that women's autonomy was associated with underweight and overweight status. Depending on each country's contextual characteristics, having more education could either increase the odds for being an underweight woman or increase the odds for being an overweight woman. In Zambia, OVC primary caregiving modified the effect of the association between educational attainment and overweight status.

Main strengths and limitations of the dissertation

Strengths of this dissertation include the use of a diverse and representative sample of reproductive age women living in southern Africa. This dissertation included three countries that are experiencing different overweight and underweight prevalence. DHS surveys contain core questions that are identical across countries, and height and weight were measured rather than relying on self-reported information. This dissertation

included two different dimensions of women's autonomy: household decision-making and educational attainment.

This dissertation was able to present mean AWI differences by women's primary caregiving status within countries, and by country within primary caregiver status. AWI measures absolute poverty (or wealth), and produces gradients with respect to health indicators which are more stable and robust than wealth quintiles.[3] However, AWI means should be interpreted cautiously. Even though OVC primary caregivers' mean AWI scores fell in the medium wealth category in these three countries, only nine percent of Swazi OVC primary caregivers had adequate toilet facilities and less than twenty percent of Swazi OVC primary caregivers had an adequate source of drinking water. In Zambia, about one-third of OVC primary caregivers had access to adequate toilet facilities and/or drinking water. Our results also suggest that wealth characteristics varied by country. Overall, Namibian OVC primary caregivers had greater access and Swazi OVC primary caregivers had less access to AWI items.

This study had important limitations that should be acknowledged when interpreting the results. The cross-sectional nature of the study did not allow the ability to: 1) determine whether overweight preceded OVC's primary caregiving or vice versa; 2) assess whether the child might have moved to live in a wealthier household to receive care; 3) assess the length of time the person was providing primary caregiving; and, 4) determine whether

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underweight or overweight preceded household wealth indicators. Data related to women's health status, dietary food intake, and intensity of primary caregiving by the type or quantity of assistance provided were not available in the DHS dataset used. Only one nutritional measurement (BMI) was available. Due to contextual differences among African countries, results may not be generalized to other countries. Finally, the religion variable only included "Roman Catholic", "Protestant" and "other or no religion" category.

Implications for program and policy development

Our findings suggest that future studies, interventions and policies to curb overweight should consider OVC primary caregiving status and address country-level differences. Differences in the direction of the measures of association between OVC primary caregiving with women's overweight status in Namibia compared to Swaziland and Zambia highlight the need for designing and evaluating nutritional strategies that are tailored to each country's OVC primary caregivers' economic, health and social support characteristics. It has been suggested that the most effective delivery systems for OVC families include a family-centered approach using a referral system that provides healthcare, nutrition, formal education, livelihood training, protection, and psychological and socioeconomic support.[4]

Findings from this dissertation also demonstrate the important role that educational attainment has on the nutritional status of African married women especially among OVC primary caregivers. Nutritional strategies should be implemented in school settings where a large number of OVC and their families can be reached.[4] In order to appeal to women unreached by traditional educational means, educational strategies should be adapted to the reality of women (e.g., OVC primary caregivers) who have to work at home, look after other family members, or who are involved in rural and informal sector activities as recommended by UNESCO.[5]

Overall, this dissertation found that OVC primary caregivers are facing household wealth disparities compared to women from the other three caregiving groups. As such, there is a need for developing appropriate policy responses that could reduce this household wealth gap. Researchers should pre- and post-test strategies aimed at mitigating OVC household wealth disparities. Researchers should also share their results through the peer reviewed literature rather than only developing reports that may not be accessible to the scientific community (e.g. final reports for donors and stakeholders).

Since two-thirds of OVC primary caregivers in these three countries do not have houses with adequate floor, wall and roof materials, OVC primary caregivers' appropriate access to these AWI components is a major concern in these three countries. OVC primary caregivers' houses need to be tailored according to their reality including adequate materials that correspond to religious or cultural traditions and way of living.[6] In this

context, social action funds (or cash transfers) could be an alternative for improving OVC primary caregivers' houses as it has been suggested that this strategy can strengthen social capital at a community level.[7]

Implications for further research

This dissertation assesses associations using cross-sectional data from DHS. Future longitudinal studies can help us understand the temporal nature of these associations. These studies could determine whether OVC caregiving preceded nutritional changes among reproductive age women as well as assess whether the child might have moved to live in a wealthier household to receive care. An important contribution from a longitudinal study also involves the assessment of the effect of primary caregiving intensity and length of time providing primary caregiving on the nutritional status of the OVC primary caregiver.

Findings from this dissertation may be indicative that the association between OVC primary caregiving and the caregivers' BMI is influenced by different factors in each country. Given the inconsistency in the direction of the odds ratios found between OVC primary caregiving and the caregivers' overweight status by country, future longitudinal studies should explore different pathways between OVC primary caregiving and women's nutritional status in different settings. Results from these studies could be used by governments and international organizations for developing frameworks that articulate

the pathways by which an intervention/policy is expected to cause the desired nutritional outcomes. More specifically, these frameworks can be used for identifying components (e.g. AWI, primary caregivers' decision-making autonomy and educational attainment) that might influence OVC primary caregivers' nutritional status, to reinforce possible approaches/techniques that could be used to change OVC primary caregivers' health and nutritional behaviors, and to elucidate how such approaches/techniques might work. Baseline research can be used to determine which behavioral change techniques are feasible according to available resources, and which techniques are likely to be suitable for the specific setting and OVC primary caregiver population.

Additional results suggest that the specific nutritional conditions of OVC primary caregivers during this time of nutritional transition in Africa differ by country. In this context, greater efforts including data collection and analyses are needed for examining within country variation of OVC primary caregivers' nutritional status. Our findings also underscore the need for additional nutritional studies focusing on OVC primary caregivers in other African countries. In this context, there is a need for data that allow for the identification of OVC primary caregivers. In order to assess the validity of our findings, future research with additional nutritional measurements should be performed. Further studies should study the association between OVC primary caregiving and their nutritional status using different approaches for categorizing the vulnerability of the child.

Additional work should be performed to understand which specific country differences [e.g., discrepancies in: the prevalence of households that have a female headship, scores of the gender parity index (GPI), percentage of households with electricity and/or a refrigerator, percentage of men with two or more wives, women's mean age (years) at first marriage, and women's status in society as measured by the levels of tolerance for violence against women] could explain the reason why we found that OVC caregiving modified the effect of the association between household decision-making autonomy and educational attainment only in Zambia and that decision-making autonomy mediated the association between AWI and OVC primary caregivers' BMI only in Zambia.

Interestingly, we found that OVC primary caregiving modified the association between AWI and women's nutritional status only in Namibia. In order to have an objective interpretation of our main effect and effect modification analyses, we recommend further studies using other household wealth measurements and performing the analyses for each AWI item separately. These studies could also include additional approaches for creating a household wealth indicator using DHS data such as the multiple correspondence analysis, factor analysis, and/or principal components analysis to reduce the number of variables in a data set into a smaller number of domains/dimensions.[8,9] Our findings suggest that future studies and interventions in Swaziland and Zambia should consider using population based approaches to reach women from every household wealth level to curb overweight. Additional studies should examine specific household wealth characteristics that are associated with Namibian OVC primary caregivers' overweight status.

Because women's autonomy may have different meanings by country due to variation in cultural contexts, future studies should explore the validity of using DHS autonomy measures in each African country. [10] Additional work should examine at other dimensions of women's autonomy including freedom of movement, differences in age and education between marital partners, and the process of spouse selection.[10] Future research with OVC caregivers should replicate our study and target other factors associated with health and nutritional outcomes that could potentially be mediated by women's decision-making autonomy. In addition, the modeling of such mediation processes could be improved by using more complex techniques such as path analyses.

Further efforts should also investigate cultural factors that may influence the association of women's autonomy and their increased likelihood for being overweight. Cultural factors should be taken into account when designing and implementing overweight prevention and control programs promoting married women's autonomy. For example, it has been suggested that overweight African women are reluctant to lose weight because in their culture fatness is associated with women's autonomy and wealth.[11,12] Finally, additional work should assess the association between women's autonomy and their nutritional status in different family structures such as polygamous or monogamous unions as well as single and multiple generational family households. DHS reports (2006-2007) have documented that the prevalence of married women are in a polygamous union (i.e., they have one or more co-wives) varied in these three countries (Namibia 6%, Swaziland 18%, Zambia 14%). Polygamy could have influenced household composition and women's autonomy. Future studies and interventions to curb overweight and to

address underweight should consider OVC caregiving status and women's autonomy while addressing country-level differences and OVC primary caregiving household wealth disparities.

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