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Food Security Status And Life Events Among Households With Children In The Midlands Of South Carolina

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FOOD SECURITY STATUS AND LIFE EVENTS AMONG HOUSEHOLDS WITH CHILDREN IN THE
MIDLANDS OF SOUTH CAROLINA

by

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ABSTRACT

Purpose: Food insecurity is a major public health problem in the United States (US) with 14.5% of US households having experienced some level of food insecurity in 2012. Among households with children, 20% experienced low food security in 2012, and in half of these households, both the children and adults were affected. Food insecurity among children can have lifelong negative health and mental effects. Life events are defined as self-reported life changes, which create a strain on resources and an opportunity for food insecurity, Methods: The Midlands Family Study (MFS) was a cross-sectional study that surveyed households with children within an eight-county region in South Carolina between March 2012 and May 2013 and obtained information on food security and life events. Of 538 total participants, 511 remained for analysis: 28% were food secure (FS), 37.2% were low food secure (LFS), and 34.1% experienced very low food security among children (VLFS-C). Life events were analyzed by overall positive and negative count and summed impact, and four life event types were created with author consensus to analyze positive and negative life event counts and summed impact by event type. Results: VLFS-C and LFS participants reported experiencing more negative life events, and greater summed impact of negative life events compared to FS participants. Higher count and impact of negative life events are associated with risk for VLFS-C and LFS status. When testing for independent associations of specific event types with food security status, positive events involving family and relationships were

associated with decreased odds of food insecurity. Conclusion: Experiencing a higher number of negative life events, as well as perceiving those events as having a greater impact, is associated with higher odds of VLFS-C and LFS status among the MFS study population. Although most types of positive life events were not associated with food security status, events involving family and other relationships had a negative association with food insecurity. Thus, interventions against food insecurity should be targeted at establishing and strengthening positive familial, community and social relationships.

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LIST OF SYMBOLS

- α The probability of rejecting the null hypothesis when the null hypothesis is true.
- B A standardized regression coefficient.

LIST OF ABBREVIATIONS

CI	Confidence Interval
LES	Life Experiences Survey
MFS	Midlands Family Survey
OR.....	Odds Ratio
US	United States
USDA	United States Department of Agriculture

CHAPTER 1

INTRODUCTION

In 2012, the United States Department of Agriculture (USDA) estimated 14.5% of households in the United States did not have access at all times to enough food for an active, healthy life for all household members, or were food insecure.[1] These households included 5.7% who had very low food security where household members reduced their food intake and eating patterns were disrupted at times during the year because the household lacked money and resources for food.[1] Among households in the United States with children under the age of 18, 20% experienced some kind of low food security in 2012.[1] Among 10% of these households only adults were food insecure, and in the remaining 10% both children and adults experienced food insecurity (approximately 3.9 million households).[1,2] This is a serious public health concern for children, and the consequences of not having enough to eat range from problems with physical growth and development[3], impaired cognitive development[4], stunting of linguistic capabilities, motor skills, and emotional development for children under the age of three[5], and for children age three to eight problems with excessive weight gain (especially among girls), academic difficulties, and impaired social skills.[6] Among adults food insecurity is associated with increased risk for chronic disease,[7,8] obesity,[9] and maternal depression.[10,11]The consequences of not having enough food for an active, healthy lifestyle are devastating for families in the United States.

Why do some people remain food secure and do well in the face of risk and adversity while others do not? Food insecurity is intimately tied to a complex 'web' of factors that contribute to poverty and disparity which seems to be exacerbated by life events that place a disproportionate burden on a person or a family. When combined with stress from exposure to life events or severe adversity, households experiencing poverty would have the highest risk for low food security or very low food security among children.[12] The additional stress of persistent poverty disrupts the fragile balance between demands and capabilities within households for low food security.

Between 2010 and 2012, South Carolina had an average of 1,847,000 households which experienced some form of low food security status at least once within a twelve month period (15.4% of households).[1] Data from the Midlands Family Study Survey (MFS), a cross-sectional study conducted in 2012-2013 in an eight county region of South Carolina was used to examine the association of life events with food security status. This thesis had two main purposes:

Aim 1: To evaluate the overall association of life events, including their number and perceived positive and negative impacts, with food security status;

Aim 2: To evaluate the association of specific types of life events, including their number and perceived positive and negative impacts, with food security status.

To achieve these aims, the association of life events with food security status was evaluated as a continuous measurement, for overall counts and impacts of events, and by dividing the 42 life event counts and impacts into four event types. There were

four research questions for this thesis. (1) Is the summed number of life events experienced (positive and negative) associated with food security status, and if so, what is the direction and magnitude of this relationship? Our hypothesis was that an association exists, and that households with children that experienced a higher number of negative life events were more likely to be food insecure than those with a lower number of negative life events, and conversely that households with children that experienced a higher number of positive life events were less likely to be food insecure compared to those with a lower number of positive life events.

(2) Is the reported perceived impact of positive and negative life events associated with higher odds of food insecurity? The perceived impact of these life events was evaluated using a rating measurement between -3 and +3, where -3 was an event perceived with the most severe, negative impact, and +3 was an event experienced as extremely positive. The ratings of events scored as a negative life event (-3 to -1) were summed (absolute values) for each participant as a negative life event impact score. The ratings of events scored as a positive life event (+1 to +3) were also summed for each participant as a positive life event impact score. The hypothesis for this research question was that households with children that report a greater magnitude of perceived negative life event impact are more likely to experience some form of food insecurity than those reporting a lower impact of perceived negative life events. Also, we hypothesized that households with children that reported a greater magnitude of perceived positive life event impact are less likely to experience some

form of food insecurity compared to those reporting a lower positive perceived life event impact.

(3) Do the associations between the number of positive and negative life events experienced and food security status differ by the type of life event experienced? The four categories of life events are 1) events concerning spouse or partner relationships, 2) work or financial stability, 3) family and other relationship events, and 4) personal events and behavior changes. Because of the association between low income and food insecurity, our third hypothesis is that households with children which experience a higher number of negative life events related to work or financial stability were more likely to experience food insecurity, and households with children with a higher number of positive life events related to work or stability were less likely to experience food insecurity compared to those who experience positive or negative life events in other event types.

(4) Finally, we evaluated whether the perceived positive and negative impact scores of life events differed by the type of life event experienced. The final hypotheses were that households with children that reported a greater magnitude of perceived negative life event impact within the work or financial stability type of events were more likely to experience some form of food insecurity compared to those who experience negative life events in other categories. We also hypothesized that households with children that reported a greater magnitude of perceived positive life

event impact within the work or financial stability life event type were less likely to experience some form of food insecurity.

CHAPTER 2

LITERATURE REVIEW

2.1 Definition and Assessment of Food Security:

The USDA's defines food insecurity as the inability to afford enough food for an active, healthy lifestyle for all household members.[1] In the United States, most food insecurity instruments use this definition to focus on a lack of food due to limited money for its purchase. The Core Food Security Module (CFSM) was developed by the USDA to measure food security status with a focus on financial ability to provide food for a household.[13] This survey contains 18 questions for households with children, including three questions about food conditions in the household as a whole, seven about food conditions of adults, and eight questions that are child-specific.[1] Examples of questions include: "True or False: I worried whether our food would run out before we got money to buy more" (the least severe item), "Were you ever hungry but did not eat because you couldn't afford enough food?", and "Did a child in the household ever not eat for a full day because you couldn't afford enough food?" (most severe item). These questions reflect a focused, possibly limited conceptualization of food security because they only define food security status in the context of household finances.[14]

The USDA's 18 item Core Food Security Module is a common instrument to measure household food insecurity that can be used in various ways.[15,16]The scale

can be used to measure child hunger, or can measure food insecurity of adults by only using the first 10 items for households without children.[17] An example of a different use for the scale is a study by Gooding et al (2012), which used only the first item from the scale: "In the past 12 months, was there a time when (you/your household were/was) worried whether food would run out before you would get money to buy more?" Those who answered "yes" were coded as food insecure, and those who answered "no" were considered food secure.[18] Pan et al. (2012) modified this first item into a food "stress" measure as a surrogate for food insecurity ("How often in the past 12 months would you say you were worried or stressed about having enough money to buy nutritious meals?").[19] The Midlands Family Study survey used the USDA's Household Food Security Survey Module (HFSSM).[20,21,22] which similarly uses 18 items (8 child specific), but questions also ask about anxiety about food shortages and the reduced availability of quality food. Households are classified as Food Secure (FS) if they affirm less than two items on the HFSSM. Low food security (LFS) is determined when three or more items are affirmed, but not five or more child questions. Very low food security among children (VLFS-C) is assessed when five or more of the eight child specific questions are affirmed.

Every year, approximately one million US households with children experience hunger, which is a physiological state defined by the USDA as a result of the following conditions: diminished quality and size of meals, limited food variety, skipped meals, not eating for a full day, going hungry because of no money to buy food, and experiencing one or more of these for more than three months.[23] Food insecurity goes beyond the

physical pangs of hunger; it is the inability to afford enough food to satisfy hunger and achieve an active, healthy lifestyle for all household members.[1] In 2012, approximately 14.7% of all US households experienced some form of food insecurity (low food security, very low food security, or very low food security with hunger among children).[1] According to the USDA food security scale, approximately two thirds of these households with children that experienced food insecurity experienced it as a recurring episode, and approximately one fifth of food insecure households experienced it as a chronic or persistent condition.[21] Households in South Carolina had a prevalence of food insecurity that was not statistically different from the national prevalence ($\alpha=0.10$) at 15.4% experiencing some form of food insecurity in 2012.[1]

Previous research suggests that food insecurity and child hunger is most prevalent among households headed by single mothers, heads of households who are either African American or Hispanic, young, live in urban areas, live in the southern US, have older children, and among households with incomes less than 185% of the federal poverty line.[21,24] For example, 24.6% of Black non-Hispanic households surveyed, 23.3% of Hispanic households surveyed and 13.0% of other ethnicity households surveyed in the United States in 2012 experienced some form of food insecurity within the previous year, compared to only 11.2% of White non-Hispanic households surveyed.[1] Among all households with a female head-of-household (no spouse), 35.4% experienced food insecurity, compared to 23.6% of male head-of-households surveyed (no spouse).[1] One in five households with at least one child under the age of 18 surveyed also experienced some form of food insecurity in 2012.[1] In an effort to

contribute to eliminating child hunger in the US, the objective of the MFS was to identify household-level and community conditions that distinguish households experiencing low food security from other food insecure and secure households.

2.2 Introducing an Analytic Literature Review Framework:

The analytic literature review framework used here forms a bridge between social science and epidemiologic theory, which proposes a non-linear pattern of food insecurity occurrence resembling a 'web of causality' with multiple exposures developed over time.[25] In 1994, Nancy Krieger synthesized the origins, features, and problems associated with the theory of a 'web of causation'. [26] The 'web' epidemiologic theory began as a reaction to the idea of a 'chain' of disease causation where direct links from exposure to outcome were established without considering the complex origins of each variable or 'link' in the chain. The complexity of multiple variables that could be confounders or effect modifiers, and the fact that origins for a particular outcome might overlap, creating indirect and direct causes for a disease, was not considered.

Understanding an outcome from a perspective that does consider the complex relationship between multiple variables is, in a very simplistic definition, the 'web of causality'. Hidden in the 'web of causality' theory is a dependence on the framework of biomedical individualism, and if there is a 'web', the 'spider' can be thought of as the modern awareness of the processes of biologic evolution and the social production of disease that weaves a complex, multi-factorial idea about disease origins.

While the 'web' does allow epidemiologists to look at multiple causes for an outcome of interest, examine possible interactions and effect modifiers, and to identify multiple routes between cause and effects of disease, the 'web' is limited in that it cannot fully explain causal links. There is no understanding of why components of the 'web' are selected, and so researchers tend to focus on risk factors 'closest' to the outcome, which often are direct biologic causes. Differences between individuals and populations are lost in the 'web' of causation theory and Krieger proposed that epidemiologists adopt an alternative eco-social framework that accounts for the social and political determinants of health and disease. Krieger maintained that it is very important to still consider individual biologic growth and development of disease, but it is also vital that epidemiologic theory embrace a broader population-level way thinking to completely understand the etiology of conditions such as food insecurity that cause harm to the public's health.[26]

In an effort to understand the broader, population-level thinking needed to fully articulate an eco-social framework and address the multi-factorial nature of disease causation, Krieger proposed adopting an alternative theory known in social sciences as the political economy of health, or the social production of disease.[26] In this framework, people and groups either receive benefit or harm from the social and political status quo.[27,28] These groups are usually complementary pairs: men and women, whites and other races, hetero and homo-sexuals. Dichotomized groups are further divided between developed or undeveloped groups, privileged or disadvantaged, equal or unequal, etc.[29] Food insecurity is thus a consequence of the

political, economic, and social relationships that create and perpetuate inequality and sickness,[30] and food security status may reflect a person's position within the larger political economy: those with higher social status usually experience better food security status, and vice versa.[31]

Belonging to a disadvantaged group is not simply the sum of individual choices and physical traits. Instead, individuals do have the capacity to act and have agency while belonging to a larger socio-economic 'groups'. However, it should never be assumed that individual level data are completely sufficient to explain group level phenomena.[26] The ability of an individual to make decisions and have agency in their life is not the same as the idea of 'moral' agency, or the ability a person has to choose between a (socially accepted) 'right' or 'wrong' response (which leads to further questions about responsibility and meritocracy). For example, if a person has the ability to make a moral decision, they would also be responsible for the outcome: 'right' decisions lead to wealth, happiness, and health. Conversely, socially 'wrong' decisions would lead to poverty, depression, and sickness, and the responsibility is shifted onto the physical body of an individual, and away from larger policies or inequalities that make a 'moral' choice impossible. [32] To experience food insecurity in this type of meritocracy, people who are hungry would be socially perceived to be at fault because they must have made decisions not to follow 'right' social instructions to go to school, get a steady job, etc. and so they are responsible for their own situation. This ignores how falling into the disadvantaged groups described in the political economy of health framework (i.e. not being white, being young, and being female) makes moral agency

impossible. Food insecurity therefore needs to take a shift towards becoming an issue of social responsibility instead of accusations and not helping those who need it most.[33] If food insecurity is a system of power playing out onto individual lives in the form of hunger, depression, obesity, and chronic disease[34], then it is important to understand the points in a person's life, the life events that either alleviate or perpetuate these symptoms.

Literature for food security fits well with Krieger's ideas of the 'web' of causality and the larger framework of a political economy of health. For example, major risk factors for food insecurity usually include being African American or Hispanic, being young, and being female, which are related to larger political and economic issues of race and gender.[24] These risk factors also form social and political groups that experience large-scale social forces of inequality.[35] In a broad, population-level thinking like the political economy of health framework, food security becomes an extremely complex issue weighted with social responsibility and controlled by larger social forces. Life events are important to understand in relation to food security status because they can be a manifestation of larger, societal influences on individual lives.

Thinking about the association between life events and food security status should not be thought of as a simplistic 'chain', where the relationship would be depicted as follows:

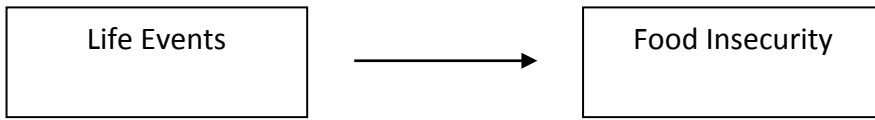


Figure 2.1: Crude Association between Life Events and Food Insecurity

Instead, based on the ‘web of causation’ framework, it would be better to think about the relationship between life events and food insecurity in a more complex, multivariate analysis:

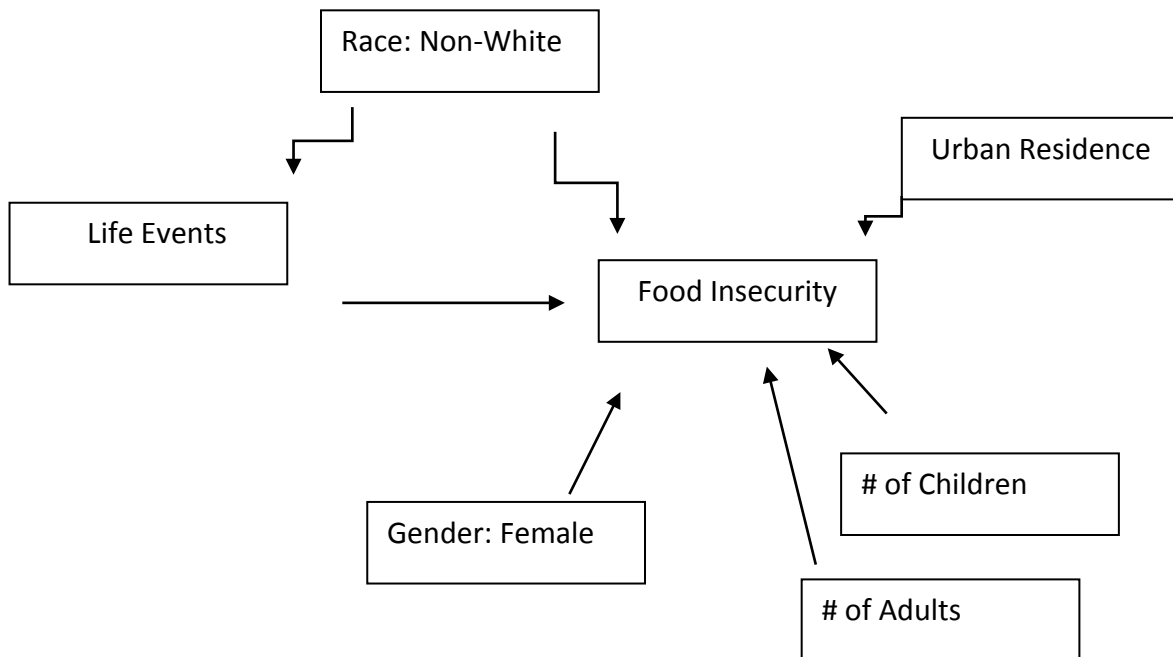


Figure 2.2: Relationship between Life Events and Food Insecurity, Without Income

The proposed research question about the association between life events and food security status fits well with the framework of a political economy of health since contributing variables such as race and gender are impacted by larger political and economic issues. While it is important to understand the risk factors associated with food security status for households with children in a way that can be generalized to the broader US population, the issue of food insecurity is also a much broader issue that is related to the risk factors among social groups. These social groups are impacted by poverty and inequality which complicates the relationship between life events and food security status. Adding an adjustment for low income becomes an especially important issue to consider for the relationship between food security status and life events.

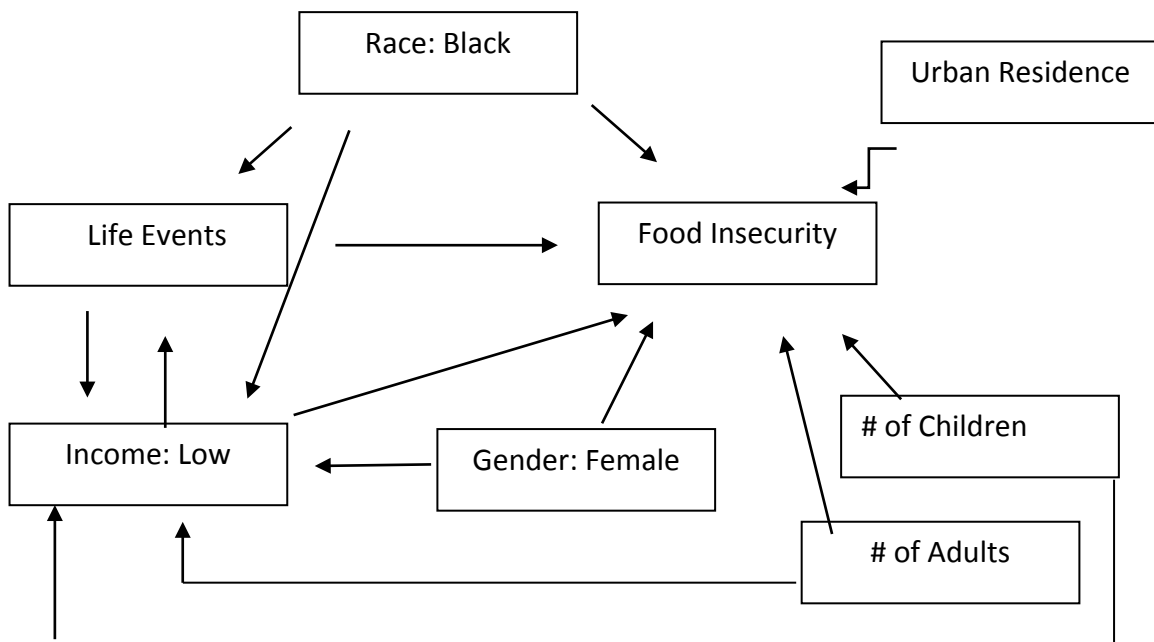


Figure 2.3: Life Events, Food Insecurity, and All Covariates

The above model illustrates both the complexity of food security status and the involvedness of income in this relationship. Low income and disparity are issues that households headed by women and those of non-white race are more likely to experience. According to the model above, low income impacts most other aspects of the life events and food insecurity relationship, and will be explored in detail for this review.

2.3 Food Security Status and Poverty:

Poverty is defined in the United States using an absolute measure for income below a pre-specified amount, while considers the number of adults and children in a household.[36] In 2012 for a household with two adults and two children, the federal poverty line was specified as a total earned income of \$23,283.[1] This measurement of poverty was first developed in the 1960s by estimating the amount of money to afford a low cost diet in 1955, then multiplying by three since (at that time) families spent close to a third of household income on food.[36] Today the measurement of income-based poverty is a more challenging issue due to questions about what to count as income, the increased costs of living, and changing proportions of income spent on food. Income-based poverty measures do not take into account price differences in housing, food, health care, or the special needs of some households such as those headed by single parents or containing members with disabilities.[37] There are now alternative poverty measures that take into account assets, consumption patterns, and a broader range of well-being (i.e. material hardship and social inclusion).[36] However, the income-based

poverty measurement and definition is still very dependent on the cost of housing, food availability, and the number of financially contributing adults in a household, which are part of the 'web of causality' for food insecurity.

Even if the income-based poverty measurement described above is dependent on other financial variables, using low income as a measurement for poverty is an effective variable for predicting low food security. In 2012, the USDA found a strong association between food security status and household income, where 40.9% of households with incomes below the poverty lineⁱ were food insecure, compared to 6.8% of those with incomes above 185% of the poverty line in 2012.[1] The Federal poverty line was \$23,283 for a family of four (two adults, two children) in 2012. Tarasuk, et al. found a similar inverse relationship between food security and income in Ontario, Canada in 2009.[38] In Tarasuk's study, type of income was used to predict food insecurity, where 55% of households were most reliant on employment wages as the primary source of income, 23% relied on social assistance and welfare income, and 13% relied most on their pensions and senior benefits. Tarasuk, et al. found that households which relied most on social assistance and welfare incomes have 3.69 odds (95% CI: 2.33, 5.84) of experiencing low food security compared to households relying on employment wages, pointing to the need for adequate social assistance benefits and support for low wage workers in Ontario.[38] Another study by Kirkpatrick, et al. found an inverse relationship between income, income source, and food insecurity in 12 high poverty neighborhoods in Toronto, Canada.[39] Kirkpatrick et al. added geographic access to food to the analysis and found that household-level characteristics proved to

be more important than geographic location for accessing food, emphasizing that it is not the ability to access food, but rather the ability to afford enough food for all household members.[39] The importance of these household characteristics was also upheld by Carter, et al. who found that low income again was the strongest predictor of food insecurity (OR 4.9, 95% CI: 4.0-5.9 for lowest household income group versus highest income group).[40] Similar results were achieved when considering variables such as single parenthood, marital status, younger age groups, Maori and Pacific ethnicity (minorities), unemployment, and lower socioeconomic status (SES), which points to the complexity of considering only income when attempting to measure poverty.[40]

Despite the strong association between food insecurity and low income, a perfect correlation simply does not exist and it is important to give further consideration to some of the challenges of using low income as a measurement for poverty.[37] The first challenge to using low income as a measurement of poverty is the lack of sensitivity since households that are not considered to be in poverty (income >185% of the poverty line) can still experience food insecurity. For example, in 2012 in the US, 6.8% of households with incomes above 185% of the income-to-poverty ratio experienced some form of food insecurity at least one time in the previous 12 months.[1] In a study by Foley, et al. in South Australia, food insecurity was again linked to economic disadvantage, measured along with income, sex, age, education, work status, capacity to save money, housing tenure, and number of children in the household.[41] While odds ratios for food insecurity were highest among those with younger age,

unemployed, lower incomes, not able to save, and more than three children in the household, odds among the middle income groups were still significant. For those with incomes between \$AU 40,001-60,000 there was still a 2.89 higher odds ($p < 0.01$) of experiencing food insecurity, and for incomes between \$AU 60,001-80,000 there were 1.59 higher odds ($p = 0.03$), compared to those with incomes above \$AU 100,000.[41] While the odds of food insecurity were higher for lower income groups, it is important to note again that food insecurity is still possible among middle income groups.

The second challenge with using income as a measurement for poverty and food insecurity is that income is static, where poverty and food insecurity can fluctuate. In other words, income is a set amount that is earned through employment or received through assistance that does not fluctuate from day to day, depending on circumstances. While it may change because of a difference in job, pay increases, or receipt of more or less benefits, income doesn't usually adjust immediately or because of a change in daily events. Considering why income fluctuates is important when life events are brought into the picture. For example, Rose et al. found that low food secure status households are more likely than food secure households to have experienced events that stress household budgets such as losing a job, gaining a household member, or losing food stamps.[37] The fluctuation of income and household needs is an important component when explaining the lack of sensitivity in using low income as a measurement of poverty since all households, regardless of income or other circumstances[4], may experience life events that disrupt food security status.

If poverty or low income are such important predictors of food insecurity, why or how does poverty occur? As discussed above, people do not always have agency over their own 'poor' situations and the consequences of poverty can compound to create far reaching effects such as poor emotional and physical health[42] and depression.[43] There are bigger, social, political, and economic forces at work that perpetuate disparity and demand the attention of researchers and activists to re-position our understanding of food insecurity. A human rights approach to food insecurity[44] is needed which acknowledges the forms of structural violence[31] acted out on the poor in our society. While poverty is still tied to the measurement of income[1], there is also a 'web of causality' that illustrates the complexity of the issue and the political economics of health which will be discussed in detail in subsequent sections.

2.4 Household Finances, Food Prices, and Income:

The USDA's definition of food security (i.e., the ability to afford enough food for an active, healthy lifestyle) reflects a focused, possibly limited conceptualization of food security in the context of household finances.[14] Accordingly, most food insecurity instruments focus on a lack of food due to limited money for its purchase. The Core Food Security Module (CFSM) is the instrument developed by the USDA to measure food security status with a focus on financial ability to provide food for a household.[13]

While there are structural, social, political, and economic forces at work that perpetuate disparity, some individuals have been able to retain some 'agency' in the midst of life struggles, either to meet the challenges of scarce resources and multiple

demands with creativity and resourcefulness, or not. Whatever a person's response to scarce resources and multiple demands, the idea that their resourcefulness (or lack thereof) either protects or perpetuates food insecurity may not be correct. This literature review has made a case that there are bigger structural forces at work that individuals have the ability to respond to (agency). A study by Gunderson and Garasky, made a case using cross-sectional data that at the most basic household level, financial management skills are the link between food insecurity and poverty.[45,46] Gunderson and Garasky reported households with greater financial management abilities (ability to identify sales, stretch groceries, and effective budgeting skills) are less likely to be food insecure, even when restricting to families with incomes <200% of the poverty line. [46] This may imply that food insecurity is linked to a person's lack of ability to manage multiple demands and scarce resources, which does not provide a complete perspective. The alternative is that people experiencing food insecurity may adapt and take control (agency), and may develop exceedingly good skills for shopping at the lowest possible prices. For example, Olson et al. found that low-income mothers who have greater food and financial skills are less likely to experience food insecurity compared to mothers with fewer of these skills.[47] Specifically, mothers with medium food life skills had 0.23 odds of experiencing food insecurity ($p \leq 0.05$), and mothers with high food life skills had 0.14 odds of experiencing food insecurity ($p \leq 0.01$) compared to mothers with the lowest levels of food life skills.[47] Low income mothers may also compromise their own diets to feed their children[118], exhibiting traits of self-sacrifice

and coping strategies [119] which are examples of taking control or agency to manage multiple demands and scarce resources.

Increasing food prices also impact food security status among lower income households with children. Using longitudinal data from the Early Childhood Longitudinal Study – Kindergarten Class of 1998-1999, Zhang, et al. linked data on lower income children in food insecure households to food prices obtained from the Cost of Living Data of the Council for Community and Economic Research.[48] Zhang’s study found that higher overall food prices are significantly associated with food insecurity (OR = 1.85; $p < 0.05$) Higher fast food and fruit and vegetable prices also contributed to a higher odds for food insecurity compared to those who were food secure (OR = 1.88, $p < 0.01$ for higher fast food cost; OR = 2.41, $p < 0.01$ for higher fruit and vegetable prices).[48] Becquey, et al. also noted an association between food insecurity and food expenses in Burkina Faso ($p < 0.0001$) and the price of meat and fish ($p = 0.026$), where households with more children were the most vulnerable ($p < 0.0001$).[49] Galal, et al. further suggested that food insecurity is brought on by an overdependence on purchased food, lack of sufficient income, rapid reductions in available agricultural land, and adverse impacts of climate change, suggesting that there is a bigger system of food availability and population characteristics which drive the connection between food insecurity and food prices.[50]

Other variables associated with food insecurity and expenditures include housing costs[51], homelessness [52,53], and seasonality (i.e. higher heating costs in the winter,

and school lunches not provided for children during the summer months).[54] For example, Kirkpatrick, et al. found as household expenditures increase (i.e. housing costs), the amount of money spent on food for a household subsequently decreases among households in the lowest income groups, even among households which received housing subsidies.[51] Weinreb, et al. found that after controlling for housing status, mother's distress, and life events, severe child hunger was associated with higher rates of mother-reported child anxiety. Homelessness was a significant predictor of severe child hunger.[55] Housing insecurity (measured by Cutts, et al. as crowding, or >2 people per bedroom or >1 family per residence) has also been found to be associated with food insecurity (OR=1.30, 95% CI= 1.18, 1.43), poorer health, and developmental risk for younger children.[56] Beyond the cost of rent are energy costs, which is also associated with food insecurity and poor child health. Cook, et al. measured energy security by looking at utility shutoffs (actual or threatened), using the stove as a household heater, or having days without heating or cooling in the past year and found that among 9,721 children in the cross-sectional study, 34% (n=3,336) experienced some form of energy insecurity during the study.[57] Finally, costs associated with chronic illness and medical expenses may also impact household food security status either as a chronic condition, or brought about as a sudden life event, since low-income patients may often choose to purchase food instead of medication.[58] Housing costs, food prices, income, illness, etc. come together to make household choices for providing food for family members a complex choice that compounds stress and possible negative consequences that contributes to food insecurity.

2.5 Women, Race/Ethnicity, and Household Food Security Status:

Gender is a well-documented main effect in the study of food insecurity and poverty where women experience more risk than men. For example, Carter, et al. found that the odds of food insecurity were significantly higher for females compared to males in New Zealand (OR 1.6, 95% CI: 1.5-1.8).[40] Gooding, et al. also found that food insecurity is more common among young adult women (age 24-32) than among men.[18,59] In a longitudinal study from southwest Ethiopia, chronic adolescent food insecurity was predicted in urban, semi-urban, and rural areas for female adolescents (OR=1.46; 95% CI=1.12, 1.92 compared to male adolescents).[60]

Another way to view the gendered division of food insecurity is to look at one of its major consequences: obesity. Gooding, et al. found food insecure women have a BMI average 0.9 kg/m² higher than food secure women after controlling for food stamp use and whether or not there were children in the household (there was no significant association between food insecurity and BMI among men).[18] In a study by Jones and Frongillo[61], among a nationally representative sample of women on a trajectory for weight gain (reported weight gain in the last 2 years before the study interview), food insecure women who gained a clinically significant amount of weight gained between 6.5-12.9kg, depending on their initial weight status, and for those not gaining weight, experiencing food insecurity was not associated with a weight change. Jones & Frongillo pointed to the need for more life course studies to better understand these changes in weight gain and food insecurity among women.[61] Dressler and Smith came to similar

conclusions using a qualitative study that focused on eating behavior, weight status, low income, and food insecurity.[62] Themes that emerged in their interview of 83 women included several aberrant eating behaviors including emotional eating, hoarding, and overeating or binging, which are examples of food insecurity coping strategies. Obesity is not just a matter of calorie consumption versus energy expenditure; it is linked to poverty and eating behaviors brought on by not having enough money to buy food or by giving food to children before adults.[63] For women obesity is also complicated by the struggles surrounding food insecurity and gestational weight gain[64] and the stress of having more children in the household to feed.[11] It should be noted that the above studies sampled predominantly White women (not African American or other races who have higher odds both for obesity and food insecurity), and thus the effect sizes are relatively small.

Many times it is mothers or other female caregivers who shoulder most of the burden of food insecurity in households with children.[65,66] Carter, et al. again noted the gendered difference in prevalence of food insecurity among women, where women had 1.6 higher odds of experiencing food insecurity compared to men (95% CI: 1.5-1.8) and adjusting for single parenthood and unmarried status.[40] Hackett, et al. and Che, et al. found direct associations between food insecurity and female heads of households in Colombia[67] and Canada[68], respectively. In the United States, Kaiser, et al. also found an association between unmarried women and food insecurity.[43] It is important to remember that these cross-sectional studies present a 'snap-shot' view of the relationship between food insecurity and single motherhood or unmarried status.

Events such as motherhood, marriage, and/or divorce occur over time and not always in a particular order, which can add layers of stress (good or bad) to a household, and adds to the likelihood for changes in food security status.

Poverty is clearly an important determinant of food insecurity among female caregivers. In a study by Bhattacharya, et al., predicting poor nutrition using poverty and food insecurity measurements had different associations for preschoolers, school aged children, caregivers, and the elderly.[69] Poverty predicted poor nutrition for preschoolers, but neither food insecurity nor poverty predicted poor nutrition status for school aged children. It is possible that caregivers are allocating household resources in a way that protects younger children, and that older children are able to supplement their food intake outside the home (i.e. school lunches).[69] Shielding younger children from the effects of poverty is especially demonstrated by adult women and elderly caretakers,[37] and aberrant eating behaviors and maternal feeding practices can also lead to other health problems such as stress and obesity, which is known to be linked to chronic disease.[70,71,8] A study by Laraia, et al. of 606 pregnant women found that psychosocial indicators of perceived stress, anxiety, and depressive symptoms associated with low income, black race, and age when predicting food insecurity status.[11] In these analyses, women as a group experience bigger social problems which require reflection about personal and social responsibility.

Among households experiencing food insecurity in 2011-2012 in the United States, 29.1% were African American, 27.2% were non-Hispanic white, and 15.6%

identified as 'other' races (remaining food insecure population identified as Hispanic).[1]

Ethnicity has been found to predict hunger and illness among emergency room patients,[58] as well as being associated with increased food insecurity among Hispanic and non-Hispanic Black women in California[43] and in a nationally representative sample using NHANES III data among people with Mexican ethnicity.[72] In New Zealand, Carter, et al. found a positive association between having Maori or Pacific ethnicity (a disadvantaged minority group) and food insecurity.[40] In the United States, Chavez, et al. conducted a study among low income families with Hispanic origin in Chicago and found that 30% of his sample experienced food insecurity, 30% received food stamps, and 90% of the children in families involved in the study received free lunches from the school system.[73] The above examples of disproportionate prevalence of food insecurity among households of non-White racial/ethnic identity is an example of a group suffering from the effects of disparity due to bigger political, economic, and social problems.

While the effects of food insecurity among minority or underprivileged ethnic groups have been well documented, the cause of this disparity is an extremely complex issue that fits well with Krieger's 'web of causality' and political economic theory of health disparity. For example, African Americans and non-White Hispanics suffering from food insecurity are at a greater risk for homelessness [52], obesity [74], and chronic disease[8]. Willows, et al. compared food insufficiency among the Aboriginal population in Canada compared to all other ethnic groups and found that not only were 33% of Aboriginal households food insecure, compared to 9% of non-Aboriginal

households (OR 5.2; 95% CI 4.2, 6.3), but Aboriginals were more likely to have three or more children, be single parent households, not have home ownership, have lower education, and were in the lowest income categories.[75] While Whites do also experience homelessness, obesity and chronic disease, the risks of these occurring are somewhat mitigated by being part of a more privileged social group.[76]

Food insecurity is a consequence of the political, economic, and social relationships that create and perpetuate inequality and sickness,[30] and food security status may reflect a person's position within the larger political economy: those with higher social status usually experience better food security status, and vice versa.[31] While individuals do have the capacity to act and have agency while belonging to socio-economic 'groups', it should never be assumed that individual level data are completely sufficient to explain group level phenomena.[26] While there are individual household representatives that are women or non-Whites, examining associations between these variables and food security status is not sufficient to explain the bigger social, political, and economic phenomena which perpetuate disparities in food security status among these groups.

2.6 The FAAR Model, Stress Proliferation and Resilience

The Family Adjustment and Adaptation Response (FAAR) Model[77] emphasizes the processes that households engage in to balance family demands with family capabilities as these interact with family meanings to come to a level of adjustment or adaptation. Households face a variety of stressors, strains, and daily hassles that are constantly

balanced with their resources (financial and psychosocial) and ability to cope. Each household has a particular socio-economic situation, identity, and world view that help with the balance between demands and capabilities. When stress in the form of life events occurs, households are forced to re-balance: they must use their financial and psychosocial resources to meet the demands of life events, strains, and daily hassles.[77] Resilience here is the capacity and process of dealing with the balance between demands and resources[78], and stress proliferation is the tendency for stressors to create stressors, leading to a pile up of demands that could tip the balance between a family's ability/inability to avoid food insecurity.[79]

Why do some people remain food secure and do well in the face of risk and adversity while others do not? The capacity and process of dealing with balance is resilience, and here 'risk' refers to continuous exposure to adverse social conditions such as poverty. Every household does not have the same exposure to poverty and life events and neither do they have the same ability to be resilient by balancing demands and capabilities that come from the stress associated with poverty and life events. Resilience is a process, not a trait,[78] which does not mean that households without the ability to be resilient are inept or even at fault for one of the many outcomes of a deficient political economy: food insecurity.

As new life events compound with varying demands and meanings attached to each event (whether positive or negative), the ability to be resilient could diminish. When a household that is usually successful in dealing with stressors becomes food

insecure (i.e. has a decline in their resilience), it is very likely that they have encountered circumstances or life events that disrupted the balance between the capacity and process to deal with these events.[78] Patterson defined 'risk' as a continuous exposure to stress (examples would include poverty or disparity), which makes a family more likely to experience increased stress.[12] Stressors beget stressors within this environment of risk[79] so that even positive stress could add to the burden of demands for a household. Stress proliferation is then defined as the process of the effects of chronic poverty and disparity compounding as a 'clustered' set of events or stressors happen simultaneously.[80] These are not simply isolated or discrete events, but can become increasingly heavy demands that a household may or may not be capable of balancing to avoid food insecurity.

Stressors beget stressors and compromise a household's capacity and process to deal with the continuous exposure to 'risk'. When combined with stress from exposure to life events or severe adversity, households experiencing poverty would have the highest risk for low food security or very low food security among children.[12] A persistent state of poverty and disparity certainly makes certain disadvantaged groups more susceptible to the additional stress that disrupts the fragile balance between household demands and capabilities, which could lead to an increased risk for low household food security. In addition to low income or other constraints that may be associated with poverty, there are other stressors that, when combined may have other impacts on food security when combined with exposure to life events. For example Wehler, et al. conducted a study where eight questionnaires, in addition to a LES survey

instrument for life events, were administered, and while bivariate analyses with life events were significant for food security status, life events were not significant for the final, most parsimonious model. This suggests that the effects of life events in relation to food security status may have been overshadowed by other risk factors measured for the final model, such as health status, substance use, depression, coping strategies, service utilization, support, and other distal factors.[66] Certainly this compilation of stress on stress, or stress proliferation, is important to consider for our analysis of the MFS study population.

2.7 Mental Health and Food Insecurity

Compromised mental health places a person at a disadvantage in terms of stress adaptation and resilience. There are several studies which show an association between poor mental health and food insecurity. McLaughlin, et al. used a national sample to show that as food insecurity becomes more severe (every one standard deviation increase), the odds of having a mental disorder episode in the past year increased by 14%, even after controlling for extreme poverty, which also introduces a question about the cyclical relationship between mental health and food insecurity: Which comes first?.[81] Bhargava, et al. also found that among children in the US, poor emotional and physical health significantly increased food insecurity.[42]

Women with low incomes are especially at risk for food insecurity and mental illness. In a sample of women from California (controlling for income) Kaiser, et al. found that sadness or depression, feeling overwhelmed, and poor physical and mental health

are associated with increased food insecurity.[43] Laraia, et al. surveyed 606 pregnant women and, after controlling for income, black race, and age, found a positive dose-response relationship between increased food insecurity and psychosocial factors of perceived stress, anxiety, and depressive symptoms.[11] In a national cross-sectional study of rural families with incomes at least 200% below the Federal poverty line, Olson, et al. maternal symptoms of depression and difficulty paying for medical expenses were associated with increased odds of food insecurity.[47]

The strength of these cross-sectional studies is the ability to provide a snap-shot view of the prevalence and associations between exposure and outcome. However, all of these studies beg the question: which comes first? Do psychosocial factors of perceived stress, anxiety and depressive symptoms precede or follow food insecurity among pregnant women? Do maternal symptoms of depression cause food insecurity or does food insecurity and difficulty paying for medical expenses cause symptoms of maternal depression? As discussed in previous sections, life events also play a role in how families cope with stress and demands. A longitudinal study by Kessler, et al. shows that the relationship between depression and life events may actually be cyclical: depression causes life events and life events can equally cause depression.[82] Depression could also be considered a condition in the causal pathway between life events and food insecurity. Another longitudinal study by Hernandez, et al. suggested that depression may actually be in the causal pathway between food insecurity and intimate partner violence.[83] While depression and anxiety data are unavailable for the Midlands Family Study Survey used with this project, it is important to remember that

depression and poor mental health do play a role in the way participants experience food insecurity and life events.

2.8 Sarason's LES – Measuring Life Events:

One of the most commonly used instruments to measure life events is the Schedule of Recent Experiences (SRE) developed by Holmes and Rahe in 1967.[84] The SRE is a self-administered survey with forty-three events where participants are asked to mark only whether or not they had experienced the event in the last six months to one year. The difficulty was that by only requiring a 'yes/no' response, it ignored the possibility of events differing in desirability, depending on circumstances and perceptions.

To better understand the relationship between life stress, life changes and physical illness, Sarason, et al. created the Life Experiences Survey (LES) in an effort to enhance life event measurement.[85] Sarason's survey recognized the need for some measurement of how the respondent would rate the desirability or impact of the event experienced, and so he individualized the survey. The impact of events experienced is an important distinction between the number of events experienced in that it gives the survey a way to measure the pile up of events, and the household's ability to be resilient to a certain amount of stress. When used to calculate the association between life events and food security status, the impact gives a measurement of resilience and stress proliferation. Sarason's LES became a fifty-seven item instrument: forty seven events for adults, ten additional for students, and three blank spaces for other events.

The LES is unique in that it allows respondents to indicate events and rate based on a positive or negative scale ranging from -3 to +3, which allows for a negative or a positive change score using simple sums, or a total score. While it is recognized that negative events may have more of an impact on personal health than do positive life events, it is not possible within the survey to divide between these since people have different perceptions of what is a positive and negative event. For example, pregnancy could be a sought after event for one couple, but could cause negative stress if it was unintentional or there are other circumstances in play. By allowing people to rate an individualized experience of perceived stress, the LES makes an important step toward understanding the effects of life events. The LES is a better measure because of the clear distinction between each participant's perception of desirable and undesirable events.[86]

The Midlands Family Study Survey used a modified version of Sarason's 1978 Life Experiences Survey (LES) to measure the impact of life events on food security status among households with children in the Midlands region of South Carolina. The aims of this thesis are to assess the association between life events and their perceived impact with food security status as overall counts and impacts of events, and counts and impacts between different types or categories of events. The four categories of life events created by author consensus are events concerning spouse or partner relationships, work or financial stability, family and other relationship events, and personal events and behavior changes. Examples of events concerning spouse or partner relationships include marriage, divorce, death of a spouse, and increased

arguments with spouse. Examples of work or financial stability include getting a new job, foreclosure, and taking a large or small loan. Family and other relationship events include events such as death of a family member or close friend, trouble with in-laws, and a major change in living conditions. Finally, examples of personal events and behavior changes include an increase or decrease in sleep, change in church attendance, incarceration, or a major personal achievement.

2.9 Other Measurements of Life Events:

If not using an LES instrument to measure life events, most studies relied on assessing whether or not specific life events of interest occurred. An example of assessing specific life events is seen in a study among HIV-infected pregnant women in the US by Villar-Loubet, et al., where retrospective data was collected on childhood sexual or physical abuse, abuse in adulthood by a sexual partner, and abuse during pregnancy, with depression and anxiety being the outcomes of interest.[87] Similar assessments have been conducted for children born with severe health conditions[88], death of a child[89], divorce[90], and life transitions (i.e. marriage, parenthood).[91]

Other instruments exist for assessing family-related life events among children and adolescents. One example of such an instrument is the Adolescent Life Change Event Scale[92] which includes family related life events such as a parent's death, another family member's death, a family member's injury or illness, a family member's alcohol or drug problems, loss of a pet, recent change of residence, addition of a new baby or child to the household, parental separation, and parental divorce. These events

closely resemble events listed in Sarason's Life Experiences Survey, except are intended to be administered among children or adolescents, and like Sarason's LES, the Adolescent Life Change Event Scale can also be administered in a full or partial version. An example is the modified 23-Item Pediatric Quality of Life Inventory used by Coker, et al. to examine the association between family-related life events and health quality of life among fifth graders.[93]

2.10 Available Literature on Life Events:

Life events are loosely defined as self-reported life changes [94] which result in a strain on resources and creates an opportunity for food insecurity. After searching for literature on life events, articles related to traumatic natural disasters, veterans, PTSD, HIV, abuse (sexual, physical, and emotional), and all topics associated with aging (i.e. transitions, assisted living, and palliative care) were excluded since these were not events included in the Life Experiences Survey. Articles concerning immigration and abortion were also excluded because these events were not listed in the modified LES used for the Midlands Family Survey. Life events in childhood and adolescence were excluded because the survey asked adults about life events experienced within the last three years, and did not ask about events experienced during their youth.

Most of the relevant literature selected concerned specific life events, not life events in general. There were very few articles dealing with life events and food security status as an exposure or outcome variable, but life events did have similar relationships with variables noted in the literature on food security status, such as mental health, and

gender/racial disparity. For example, in a psychiatric epidemiology study conducted by Slopen, et al., women were most at risk for major depression, while men were most at risk for alcohol dependence, pointing to a differential in vulnerability and in reactions toward life stressors.[95] The most common life events reported in Slopen's study were death of family members or close friends, having a new family member, change in residence, difficulty finding a job, being fired or laid off from work[96], divorce, and motherhood. The literature on life events will be reviewed by four types of life event: first, events concerned with the relationship between spouses or partners, events related to work and finances, events concerning family and friends, and personal events and behavior changes (i.e. changes in eating or sleeping habits).

Literature on events concerned with spouse or partner relationships formed the majority of selected relevant literature, and especially included events of divorce and pregnancy stress and complications. Divorce had a more severe impact on the partner who did not initiate the event [97] and was also differential for women, which is similar to what was shown in the literature for food security status.[90] Pregnancy life events were measured pre-conception among healthy [98] and HIV positive women[87]. An association was found between an increase in life events experienced and several adverse birth outcomes, including low birth weight [98], severe child illness[88], and child death[89]. Like the study sample used in the Midlands Family Study survey, women, and especially African Americans, were at the highest risk for adverse health effects. Understanding the differential between gender and risk for negative health

outcomes is important to achieve a complete understanding of the ways food insecurity and life events occur and are perpetuated.

A gender differential also exists for events that concern work or financial stability and events concerning family and other relationships. While there does seem to be an association between experiencing financial types of events with outcomes such as depression or anxiety[82,99], social support networks may actually provide a protective factor for experiencing adverse outcomes among women.[100] Social support can occur within a religious community [101], or even within a family relationship between a husband and wife. An example of the protective nature of spousal social support was found in a study by Osborne, et al. that looked at mothers of small children, and found that women who transitioned to living with the biological father of their children have a decline in material hardship and depressive symptoms.[102]

Behavior change was a final type of life events that played an important part in the reviewed literature. Drug adherence is one example of a personal behavior change (contracting a major illness that requires drug adherence is also a personal life event). There were two studies that dealt with women who contracted HIV and changes in anti-retroviral drug (ARV) adherence. [87,103]As the number of life events experienced increased, HIV symptoms were exacerbated and ARV adherence and quality of life decreased. Changes in diet and/or behavior are another example where the impact of life events was felt among study participants. Findings from a focus group study (n=43) of midlife aged women by Brown, et al. found that women who experienced early life

events concerning household structure, health status, phases of motherhood, and shifts in financial and employment status all had the potential to experience an upheaval in their dietary behaviors.[104]

Given that most studies concerning life events have focused on the impact of individual life events or a specific type of life events, it is important within this study to also consider the possible association of multiple life events from multiple life event types (i.e. the independent effects), if any, on our outcome of interest: food security status. In 2012, Feizi, et al. published results for an analysis of the association between perceived stress with life events, lifestyle and socio-demographic factors among 4,583 adults living in Isfahan, Iran.[105] Feizi, et al.'s study used a self-administered life events questionnaire with 46 life events which were divided into 11 event types: home life, financial problems, social relations, personal conflicts, job conflicts, educational concerns, job security, loss and separation, sexual life, daily life, and health concerns. Only 4 of the above event types were selected for use in Feizi, et al.'s final analysis: financial problems, job security, social relations, and family conflicts with the argument that these 4 event types were most generally experienced by the study population. The outcome of interest was perceived stress, and other covariates considered were nutrition practice, physical activity, age, gender, marital status, education, type of job, income, place of residence, and smoking. Each regression model controlled for the association of all the above covariates, much like the modeling strategy laid out in Chapter 3: Methods below. However, it is unclear whether each of these models with all covariates also controlled for one life event type at a time like our modeling strategy for

Aim 2 Model 3, or if all life event types were combined like our modeling strategy for Aim 2 Model 4. Attempts to contact the author to clarify adjustment for other life event types were not successful. All authors are in Iran, and no responses have been received from email attempts to contact. After careful reading of the paper the tables seem to only lay out individual associations between life event types and perceived stress, and our best guess is that they did not test for independent effects but did other adjustments to compare the impact of different event types. Comparing the covariate coefficients of life event types for Feizi, et al's analysis shows that family conflict life events consistently were more associated with perceived stress, followed by social problems, job insecurity, and financial problems (in order of significance).

Another example of a study using life event types as the main exposure of interest was published in 2013 by Lumeng, et al. to test the association of life events experienced in childhood with the risk of being overweight in adolescence.[106] Mothers responded to a 71-item Life Experiences Survey at ages 4, 9, and 11 years for their children. Follow-up occurred at age 15 for the child to test the association of mean negative life events (rated -3 to -1) experienced in childhood with being overweight at age 15 years, controlling for child race/ethnicity, child gender, maternal education, and maternal weight status. Experiencing 'many' negative life events versus 'not' experiencing many events were the main predictor variables used for each fully adjusted model. Independent effects of 'many' and 'not' negative life events were also tested for each of 4 event types created with author consensus: family health, family finances, family relationships, and family structure, routine, and caregiving. The total

number of life events experienced (positive, negative, or no impact/not experienced) was not associated with a higher risk of overweight among adolescents (OR: 1.36, 95% CI: 0.95, 1.94). Likewise, the total number of negative life events was not associated with a risk of overweight in adolescence (OR: 1.00, 95% CI: 0.99, 1.02). Finally, when independent effects of the different life event types were included simultaneously in the model, only family health was a significant predictor of overweight in adolescence (OR: 1.81, 95% CI: 1.21, 2.72). Lumeng, et al. also tested for interactions of 'many' life events with child gender and education, with no significant results.

2.11 Research on Adolescents and the Role of Other Psychosocial Variables:

Though literature on life events among adolescents was not included in this review, the younger participants (age 18-20) in the MFS sample may be reporting events technically experienced in adolescence since the questionnaire asked about events experienced in the last 3 years. There is some evidence to suggest that experiencing life events as an adolescent is associated with experiencing more life events as an adult.[79] An example of this phenomenon among youth was shown in a study by Young-Wolf, et al. where children who experienced abuse as a child (physical or emotional) were more likely to report heavier drinking habits as adults, especially among women.[107] Also among adolescents, life events experienced had a positive association with disordered eating behaviors such as binge eating and extreme dieting, again demonstrating the importance of considering the impact of life events.[108]

Psychosocial variables such as personality, perceived anxiety and stress, coping mechanisms, and phenomenology (the meaning and value a person assigns to any experience) are possible mediators in the pathway between life events and food insecurity.[82,109] Perceived stress, anxiety, and depressive symptoms have also been shown to have a significant association with food insecurity.[11] Examples of phenomenological experiences used in the life events literature included asking women to recount the experience of a myocardial infarction[110] or the perception of a parent's divorce.[111] Each participant relates to a life event differently, and may perceive a positive or negative impact based on intricate psychosocial factors. It is therefore important to address the impact that life events have on individuals in the survey while remaining aware of the limitations that are inherent to the data used in the analysis, since it could never perfectly reflect the complexity of the struggles faced by individuals experiencing food insecurity.

2.12 Available Literature on Food Security Status & Life Events:

There are very few articles that discuss food security status among households with children and life events together, and most come from outside the United States.[11,86,112, 113] For many developing countries, food insecurity is rising because of declining food production, which is a different situation from that experienced in the US.[31,112] Interactions between economic development and rapid population growth are also strong contributing factors to international food insecurity.[31] When life events were studied in an international context, responses did have some similarities in

the response to household food insecurity with those from the United States.[112] Survey results from Tanzania noted a reduced intake of food, consuming less preferred foods, selling household assets, and seeking additional work as ways to respond to life events in these environments.[113] Food insecurity was associated with anxiety and depression in a study of women in rural Tanzania where Hadley & Patil also found that seasonal changes in food insecurity were associated with changes in symptoms of anxiety and depression.[113] In Ethiopia, a study demonstrated a high prevalence of food insecurity, life events and mental disorders, and both food insecurity and life events predicted symptoms of depression and anxiety.[112] There is a reciprocal relationship between food insecurity and depression[113], socio-economic status, and life events and gender differences were again significant. In South Africa, men experienced more life events than did women,[86] which is the opposite of the findings from literature from the United States, where women not only experience more life events, but they bear the most burden in the forms of depression, obesity, and poverty from food insecurity.[105] Only one study was found which directly addressed the association of stress with food insecurity.[11] In a study of very low income pregnant women, perceived stress (and anxiety and depressive symptoms) were associated with food insecurity.[11]

Repeated in the literature is a lack of understanding about the temporal sequence or causality of life events and food security status since virtually all studies reviewed for this thesis were cross-sectional by design. Even so, other research presented in this chapter confirms that factors such as socio-economic status, gender,

and income all contribute to the problem of food insecurity and may be better understood under the framework of a 'web' of causality and a political economy of health, where everything is socially/politically connected and so impacts food security status outcomes for households with children. Complementary analyses not within the scope of this thesis, but definitely important to consider for a comprehensive perspective about the issue of food insecurity may also consider geographic location, food deserts, and nutrient intake (or lack thereof) to think about a bigger picture of food availability that is not exclusively tied to its affordability. Instead, this thesis will begin to address an important literature 'gap' by analyzing the connection between food security status and life events using data from the MFS survey, which covers an eight county area of the Midlands region of South Carolina.

CHAPTER 3

METHODS

3.1 Aims and Research Questions:

This study examined the association between life events as an exposure, and food insecurity among households with children as the outcome, using a modified Life Experiences Survey[85] within the Midlands Family Study survey (MFS), a cross sectional study conducted in 2011-2012 in an eight county region of South Carolina. The aims of this study were as follows:

Aim 1: To evaluate the overall association of life events, including their number and perceived positive and negative impacts, with food security status;

Aim 2: To evaluate the association of specific types of life events, including their number and perceived positive and negative impacts, with food security status.

To achieve these aims, the association of life events with food security status was evaluated as a continuous measurement, for overall counts and impacts of events, and by dividing the 42 life event counts and impacts into four event types. There were four research questions for this thesis. (1) Is the summed number of life events experienced (positive and negative) associated with food security status, and if so, what is the direction and magnitude of this relationship? Our hypothesis was that an

association exists, and that households with children that experienced a higher number of negative life events were more likely to be food insecure than those with a lower number of negative life events, and conversely that households with children that experienced a higher number of positive life events were less likely to be food insecure compared to those with a lower number of positive life events.

(2) Is the reported perceived impact of positive and negative life events associated with higher odds of food insecurity? The perceived impact of these life events was evaluated using a rating measurement between -3 and +3, where -3 was an event perceived with the most severe, negative impact, and +3 was an event experienced as extremely positive. The ratings of events scored as a negative life event (-3 to -1) were summed (absolute values) for each participant as a negative life event impact score. The ratings of events scored as a positive life event (+1 to +3) were also summed for each participant as a positive life event impact score. The hypothesis for this research question was that households with children that report a greater magnitude of perceived negative life event impact are more likely to experience some form of food insecurity than those reporting a lower impact of perceived negative life events. Also, we hypothesized that households with children that reported a greater magnitude of perceived positive life event impact are less likely to experience some form of food insecurity compared to those reporting a lower positive perceived life event impact.

(3) Do the associations between the number of positive and negative life events experienced and food security status differ by the type of life event experienced? The four categories of life events are 1) events concerning spouse or partner relationships, 2) work or financial stability, 3) family and other relationship events, and 4) personal events and behavior changes. Because of the association between low income and food insecurity, our third hypothesis is that households with children which experience a higher number of negative life events related to work or financial stability were more likely to experience food insecurity, and households with children with a higher number of positive life events related to work or stability were less likely to experience food insecurity compared to those who experience positive or negative life events in other event types.

(4) Finally, we evaluated whether the perceived positive and negative impact scores of life events differed by the type of life event experienced. The final hypotheses were that households with children that reported a greater magnitude of perceived negative life event impact within the work or financial stability type of events were more likely to experience some form of food insecurity compared to those who experience negative life events in other categories. We also hypothesized that households with children that reported a greater magnitude of perceived positive life event impact within the work or financial stability life event type were less likely to experience some form of food insecurity.

3.2 Study Design and Data Collection:

The objective of the MFS was to identify household- level and community conditions that distinguish households experiencing very low food security from other food insecure and secure households. Surveys were collected from March 2012 to May 2013, and survey information is available for 179 Very Low Food Secure among Children households (VLFS-C, child experienced hunger in the past year), 202 Low Food Secure households (LFS), and 157 food secure households (FS). The Household Food Security Survey Module (HFSSM) [20,21,22] was used to classify household food security status. The HFSSM is an eighteen item module that asked caregivers about experiences with quality and quantity of food available, and anxiety about food shortages. Eight of these items were child-specific. Food secure (FS) households were classified as affirming two or fewer items on the HFSSM, low food secure (LFS) affirmed three or more items, but not five or more child-specific questions. Households which affirmed five or more out of the eight child-specific questions were classified as experiencing very low food security among children (VLFS-C).

Participants were recruited from an eight-county region of the Midlands region of South Carolina, which included Richland County, a metropolitan county containing the capital city, Columbia and seven other surrounding counties. To recruit caregivers into the survey, 1,646 potential recruiting sites were found through online searches or by contacting appropriate agencies. Examples of recruitment sites included grocery stores, farmers markets, daycare providers, food pantries, and feeding sites from the

South Carolina Department of Education and the Department of Social Services. Recruitment sites were then stratified by urban (n=776) and non-urban (n=870) locations. Forty urban and forty non-urban sites were then randomly selected for recruitment. Sites were then replaced as necessary if a site was unreachable or refused to participate.

Participants were invited to complete a brief screening questionnaire and were given \$5 compensation for their time. To be invited to complete the screening questionnaire participants had to meet four criteria for inclusion in the household assessment. First, the participant must have at least one child in the household under their legal custody that resides in the household at least 50% of the time. The participant had to be an adult at least 18 years or older and must reside in the eight county area of the study (used postal zip codes). Finally, household income could not exceed \$100,000 per year (approximately 300% of federal poverty threshold). The HFSSM was also used to classify food security status. A total of 1,122 people were screened. Of those, 1,039 met the eligibility criteria. A final total of 544 people were then asked to participate in the MFS survey after 236 were not invited to participate because a food category had been filled and 259 declined to participate. Six unreliable surveys were excluded, leaving the final sample of 538 caregivers, which included 157 who were Food Secure (FS), 202 with Low Food Security (LFS), and 179 with Very Low Food Secure among Children (VLFS-C) (see Table One). Of those who completed the MFS survey, twenty-seven (27) participants' responses were not considered for the analytic sample due to missing income data (10 FS, 12 LFS, and 5 VLFS-C, See Table 2). A final

analytic sample of 511 participants (147 FS, 190 LFS, and 174 VLFS-C) had complete data for all covariates considered for this analysis, including gender, race, urban status, income, number of children and adults in the household, and information for whether or not the participant was referred to the study. Participants from eligible households were then asked to complete the MFS assessment within two weeks of screening and were offered a small compensation for their time. Surveys were conducted by trained interviewers in the homes of caregivers or in another location of their choice. Interviewers used web-based survey software on a laptop computer and usually lasted between 45 and 90 minutes. Participants were then given \$40 compensation and were offered referral services based on needs identified during the survey.

The MFS included five main survey topics: program participation, household coping strategies, family adjustment and adaptation, household perceptions of community resources, and demographics (race, gender, household size and composition, child's school, and residential address). Life events were measured under the topic of family adjustment and adaptation using a modified Life Experiences Survey.[85] Participants were asked to affirm whether or not 42 life events had occurred in the last three years, and to value how positive or negative each event impacted their life using a 7-point scale (-3 to +3). Additional demographic data were collected for self-reported race, gender, income and use of assistance programs, urban or non-urban residence, and the number of adults and children in the household.

3.3 Defining Outcome Variable: Food Security Status

The outcome of interest, food security status, had three levels: Food Secure (FS), Low Food Secure (LFS), and Very Low Food Secure Among Children (VLFS-C). Food security status was determined at the initial screening based on the number of items affirmed in the Household Food Security Survey Module (HFSSM)[22]. The HFSSM is an 18 item screener that asked caregivers about experiences with quality and quantity of food available, and anxiety about food shortages. Eight of these items were child-specific. Food secure households were classified as affirming two or fewer items on the HFSSM, food insecure affirmed three or more items, but not five or more child-specific questions. Households which affirmed five or more out of the eight child-specific questions were classified as very low food secure and experiencing child hunger. Again, survey information from the Midlands Family Study was available for 179 VLFS-C households, 202 LFS households, and 157 FS households.

3.4 Defining Exposure Variable: Life Events

For the Midlands Family Study (MFS), life events were measured under the module topic of family adjustment and adaptation using a modified Life Experiences Survey (LES).[85] Where the original questionnaire accounted for 46 life events, the final MFS survey modified the instrument to include only 42 life events, excluding (a) abortion, (b) which close family member died, (c) which close family member had a serious illness, and (d) asking if the participant had sexual difficulties. Events (excluding pregnancy) were not worded differently for women/men, but instead asked “for spouse”, and the recreation

question was modified to be “change in type of recreation” instead of “change in type and/or amount”. Participants were asked to affirm whether or not these 42 life events had occurred in the last three years, and to value the perceived negative or positive impact using a 7-point scale (-3 to +3, 0=no event).

Sarason recommended that the life events in the LES not be separated into positive or negative life event types because a participant may interpret the life event differently than the study conductor.[85] However, as seen in articles published by Feizi, et al. and Lumeng, et al. discussed above, it is possible to divide the events into broader types or categories.[105,106] For this study, positive and negative life events as the main exposures were first assessed by summing the number of event counts marked for life events rated between -3 and -1 as a perceived negative life event, and events rated between +1 and +3 as a perceived positive life event. In the second part of the analysis, positive and negative impact scores for life events were created as the main exposure variables by summing the impact scores for events perceived as a negative life event (-3 to -1) and summing the impact scores for events perceived as a positive life event (+1 to +3). For both analyses, any event marked ‘0’ (i.e. not experienced) was not considered.

The positive and negative life event exposures were then categorized to create four type-specific measures. Each of the 42 events were initially placed into one of the following five types by the study committee: 1) Events concerning spouse or partner relationship (12 events), 2) Work or financial stability (10 events), 3) Family and other relationship events (10 events), 4) Personal events and behavior changes (11 events),

and 5) Incarceration (1 event). Incarceration was later merged into life event type 4, as explained below. These events are listed by category in Table 1 in the order in which they appear in the modified Life Experiences Survey used for the Midlands Family Survey.

The modeling strategy of testing a fully adjusted model with a single life event type, followed by including all life event types to test independent effects was also used for this thesis to test the association of life events, positive and negative by overall count and impact scores, with food security status among households with children in the Midlands region of South Carolina. Like Feizi, et al. and Lumeng, et al., this study will use life events as overall positive and negative count measures, will also use life events divided into four life event types created by author consensus, will test fully adjusted models, will test for interactions, and will test for independent effects by including all life event type variables simultaneously. Unlike Feizi, et al. and Lumeng, et al. which use only negative life event types to predict an outcome of interest, this study will consider positive and negative life events, and will not only count the number of events, but will examine the reported impact, positive and negative, of events experienced by study participants. The same analysis will also be repeated for four life event types created with author consensus to better understand the association between life events and food security status.

3.5 Covariates

Covariates considered included gender, race/ethnicity, urban/rural status, income, number of children adults living in the household, and whether or not a participant was referred to the study. Based on the literature examined in Chapter 2, gender and race were potential effect modifiers of the relationship between life events and food security status. However, the study population for the Midlands Family Study consisted of mostly women and mostly African Americans, hence evaluation of interaction between gender and race was not possible. Only 7 of the caregivers identified as a race other than African American, Hispanic, or White; race was categorized as “Black” or “Not-Black”. Since the results of this analysis largely reflected the experiences of women, a sensitivity analysis was also conducted. Men (total of n= 38, 7.4% of analytic sample) were removed from this sensitivity analysis sample and the main, most adjusted final models (Models 3 for Aim 1; Models 3 for Aim 2) were repeated to ensure that the small number of men in this sample did not unduly impact the final results. The sensitivity analysis revealed very little difference between the full analytic sample and the females only sample (n= 473) with respect to Model 3 results. (See Appendix A) Models from the females-only sample had odds ratios that were virtually identical to the full analytic sample, with point estimates just slightly closer towards the null value than the models for the analytic sample, but the magnitude of those differences was negligible. The full analytic sample therefore was used for all analyses.

To assess economic demands on households with children, income included all wages and assistance programs, including SNAP participation, Social Security Disability Insurance, Temporary Assistance for Needy Families (TANF), retirement, child support, workers compensation, unemployment insurance, veteran's benefits, and other income using the Consumer Expenditure Survey instrument.[114] Income was measured and reported for each month. To obtain a total income variable, the variable for monthly wages and the variable for monthly assistance were summed, Winsorized and centered to create an income variable for analysis. Income was a possible effect modifier, and was tested with the negative life event variables for a potential interaction. Because income could also have been a possible mediator, its effect was carefully evaluated by also showing models with and without adjustment for income (no interaction).

The variable 'urbanicity', though likely not a confounder, was included to remain true to the original study design. Urban was coded "1" if the caregiver lived in Columbia, SC (in Richland County), and was coded as "0" for caregivers living in any of the other study counties or rural areas of Richland County. Dummy variables were created for all categorical variables. Two additional continuous variables were also assessed: number of children living in the household, and number of adults living in the household. Table 2 lists the variables used and their characteristics for analysis.

3.6 Plans for Statistical Analysis:

The ultimate goal of the MFS project was to understand how households and communities with food insecurity differ from households and communities that are food

secure. This thesis will contribute to this goal by examining the odds of experiencing low or very low food security compared to being food secure among households with children as they experience a variety of life events. All data were analyzed using SAS 9.3 Statistical Software (Cary, NC).[115]

The first step was to describe the study population. For each level of food security status outcome the number and percentage of study participants are given for each covariate level, including total number of positive and negative life events, total positive and negative life events experienced within each event type, gender, race, and income. Table 3 describes the full MFS survey study population, Table 4 describes the creation of the final analytic sample for this project, Table 5 describes the final analytic study participant demographic variables, and finally, Table 6 describes income for the final analytic sample (n=511).[85] Table 7 shows the mean and standard deviation of the positive and negative life event overall count and impact variables, and each of the positive and negative life event count and impact variables for each of the four life event types created by author consensus for this project.

Because there are three food security status outcome levels (food secure, low food secure, and very low food secure among children), multinomial logistic regression was used for all of the final analyses. The multinomial logistic model has a binomial distribution and therefore assumes an equal probability for each of the three outcomes considered here. The following sections describe the modeling strategy.

Modeling strategy for Aim 1, Research Question 1: The first aim evaluated the overall association of life event counts, including their number and perceived positive and negative impacts, with food security status. The first research question was: are the total number of life events experienced (total positive and total negative) associated with food security status, and if so, what is the direction and magnitude of this relationship? Our hypothesis was that there is an association, and that households with children that experienced a higher number of negative life events were more likely to be food insecure than those with a lower number of negative life events, and conversely that households with children that experienced a higher number of positive life events were less likely to be food insecure compared to those with a lower number of positive life events. To evaluate this research question, the number of positive and negative life events as the primary exposures were assessed as continuous variables for each completed Life Experiences Survey (LES). Any event not coded as “0” (no impact, not experienced) was counted as one event. Events coded as a perceived negative event (irrespective of weighting/impact score) were summed for a total negative LES event count, and events coded as a perceived positive event (also irrespective of weighting/impact score) were summed for a total positive LES count. Using the multinomial logistic model, odds for low food security (LFS) or very low food security status among children (VLFS-C) outcomes compared to food secure (FS) status were then assessed for every one event increase in positive and negative life events experienced.

Aim 1, Research Question 1, Model 1 measured the crude association between food security status and positive and negative LES counts for life events, expressed as:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES count}) + \beta(\text{Negative LES count}) + \text{Referred to study (Y/N)}$$

Statistical significance was assessed at $\alpha \leq 0.05$. Aim 1, Research Question 1, Model 2 included positive and negative life events as the primary exposures and added the literature-based potential confounders (excluding income). To understand the relationship of income to food security status, income was excluded from this model to ensure that it was not a mediating variable with food security status:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES count}) + \beta(\text{Negative LES count}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# children in household}) + \beta(\text{\# adults in household}) + \text{Referred to study (Y/N)}$$

Aim 1, Research Question 1, Model 3 included income as a continuous covariate:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES count}) + \beta(\text{Negative LES count}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# children in household}) + \beta(\text{\# adults in household}) + \beta(\text{Income}) + \text{Referred to study (Y/N)}$$

Odds Ratios and 95% Confidence Intervals for each of the main exposure variables (Positive LES count and Negative LES count) for Aim 1, Research Question 1, Models 1-3 are listed in Table 8. Model fit was assessed by comparing -2 Log Likelihood statistics between the nested models. To assess if income is a significant confounder, which it

was, the -2 Log Likelihood for Model 3 was compared to the -2 Log Likelihood for Model 2 and a significance level of $\alpha=0.05$. The difference in -2 Log Likelihood was equal to 43.21 (1012.47-969.26) with a difference of 1 degree of freedom. Because 43.21 is greater than the chi-square test statistic of 3.84 (0.05 significance), Model 3, which accounts for income, has a better model fit than Model 2, which does not include income.

Though not listed in Table 8, we also tested for effect modification between income and negative LES count because it is believed these have more impact on a household's food security status, expressed as:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES count}) + \beta(\text{Negative LES count}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# adults in household}) + \beta(\text{\# children in household}) + \beta(\text{Income}) + \beta(\text{Income*Negative LES count}) + \text{Referred to study (Y/N)}$$

To assess if the inclusion of an interaction between negative LES and income improved not only model fit but also added a significant term to the model, the interaction model was compared to Model 3 by comparing differences in -2 Log Likelihood statistics.

Inclusion of an interaction between negative LES and income did not significantly improve model fit (-2 Log Likelihood = 968.01). Model 3 is therefore the best model fit for this analysis of LES count, positive and negative, and the association with food security status among households with children.

The above procedure was followed for assessing model fit for each of the Aims and Research Questions for this project.

Modeling strategy for Aim 1, Research Question 2: The second research question was whether or not the perceived positive and negative impact of life events reported by households with children was associated with food security status. The perceived impact of life events was evaluated using a rating measurement between -3 and +3, where -3 is an event with the most severe negative impact and -1 is a negative event with the least severe impact. Positive impacts ranged from +1 to +3, where +3 is an event perceived as extremely positive. For each participant of the Life Experiences Survey (LES), negative perceived impacts were summed (absolute values) for a “Negative LES Impact Score”, and positive perceived impacts were summed for a “Positive LES Impact Score”. The hypothesis for this research question was that households with children that report a greater magnitude of perceived negative life event impact are more likely to experience some form of food insecurity than those reporting a lower impact of perceived negative life events. Also, we hypothesized that households with children that reported a greater magnitude of perceived positive life event impact are less likely to experience food insecurity compared to those reporting a lower positive perceived life event impact score.

Using the multinomial logistic regression model, odds for low food security (LFS) or very low food security among children (VLFS-C) outcomes compared to food secure status were then assessed for every one increment increase in perceived positive and negative impact of life events experienced. Aim 1, Research Question 2, Model 1 measured the crude association between food security status and positive and negative life event impact scores, expressed as:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES Impact}) + \beta(\text{Negative LES Impact Score}) + \text{Referred to study (Y/N)}$$

Statistical significance will be assessed at $\alpha \leq 0.05$. Aim 1, Research Question 2, Model 2 included positive and negative life event perceived impacts as the primary exposure and the literature based confounders. To understand the relationship of income and food security status, income was excluded from this model to ensure that it was not a mediating variable with food security status:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES Impact}) + \beta(\text{Negative LES Impact}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# children in household}) + \beta(\text{\# adults in household}) + \text{Referred to study (Y/N)}$$

Aim 1, Research Question 2, Model 3 included income as a continuous covariate:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES Impact}) + \beta(\text{Negative LES Impact}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# children in household}) + \beta(\text{\# adults in household}) + \beta(\text{Income}) + \text{Referred to study (Y/N)}$$

Odds Ratios and 95% Confidence Intervals for each of the main exposure variables (Positive LES impact and Negative LES impact) for Aim 1, Research Question 2, Models 1-3 are listed in Table 9.

Though not listed in Table 9, we also tested for effect modification between income and negative LES impact because it is believed these have more impact on a household's food security status, expressed as:

Log(Odds of LFS or VLFS-C) = Intercept + β (Positive LES Impact) + β (Negative LES Impact) + β (Gender) + β (Race) + β (Urban/Rural) + β (# adults in household) + β (# children in household) + β (Income) + β (Income*Negative LES Impact) + Referred to study (Y/N)

Model fit was assessed by comparing -2 Log Likelihood statistics between the nested models as noted above for Aim 1, Research Question 1 using differences in -2 Log Likelihood statistics. Model 3, which accounts for all covariates and income, had a better model fit than Model 2, which does not include income. Additionally, inclusion of an interaction between negative LES impact and income did not significantly improve model fit. Model 3 was therefore the best model fit for this analysis of LES impact, positive and negative, and the association with food security status among households with children.

Modeling Strategy for Aim 2, Research Question 1 The second aim for this project was to evaluate the association between life events by event type, including the number of events and perceived positive and negative impact of such events, with a participant's food security status. The first research question for this aim was whether the association between positive and negative life events and food security status differed by the type of life event experienced. The four types of life events created by thesis committee consensus were events concerning spouse or partner relationships, work or financial stability, family and other relationship events, and personal events and behavior changes. Because of the association between low income and food insecurity,

the hypothesis for aim 2, research question 1 was that households with children that experienced a higher number of negative life events related to work or financial stability were more likely to experience food insecurity, and households with children with a higher number of positive life events related to work or financial stability were less likely to experience food insecurity compared to those who experience positive or negative life events in other event types.

Frequencies for each positive and negative event in each event type were totaled and listed in Table 10. Overall positive event counts by life event type and food security status are listed in Table 11, and the overall negative event counts by life event type and food security status are listed in Table 12. Any event *not* coded as “0” (no impact, not experienced) was be counted as one event. Events coded as a perceived negative event (irrespective of weighting/impact score) were summed for a total negative LES event count, and events coded as a perceived positive event (also irrespective of weighting/impact score) were summed for a total positive LES count.

Using the multinomial logistic model, odds for low food security (LFS) or very low food security among children (VLFS-C) outcomes compared to food secure status (FS) were then assessed for a one event increase in positive and negative life events experienced within a specific event type. Using the multinomial logistic model, odd ratios for low food security (LFS) or very low food security status among children (VLFS-C) outcomes compared to food secure (FS) status were then assessed for every one event increase in positive and negative life events experienced by life event type. Aim 2,

Research Question 1, Model 1 measured the crude association between food security status and positive and negative life events within each event type, expressed as:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES Count: type "X"}) + \beta(\text{Negative LES Count: type "X"}) + \text{Referred to study (Y/N)}$$

Statistical significance was assessed at $\alpha \leq 0.05$. Aim 2, Research Question 1, Model 2 included positive and negative counts of life event types as the primary exposures and the literature based confounders. To understand the relationship of income to food security status, income was excluded from this model to ensure that it was not a mediating variable with food security status:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES Count: type "X"}) + \beta(\text{Negative LES Count: type "X"}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# children in household}) + \beta(\text{\# adults in household}) + \text{Referred to study (Y/N)}$$

Aim 2, Research Question 1, Model 3 included income as a continuous variable:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES Count: type "X"}) + \beta(\text{Negative LES Count: type "X"}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# children in household}) + \beta(\text{\# adults in household}) + \beta(\text{Income}) + \text{Referred to study (Y/N)}$$

Aim 2, Research Question 1, Model 4 was intended to be a sensitivity analysis to measure the independent effects of each life event type. All covariates and positive and negative life event variables for each event type were included in this model as follows:

Log(Odds of LFS or VLFS-C) = Intercept + β (Positive LES Count: type 1) + β (Negative LES Count: type 1) + β (Positive LES Count: type 2) + β (Negative LES Count: type 2) + β (Positive LES Count: type 3) + β (Negative LES Count: type 3) + β (Positive LES Count: type 4) + β (Negative LES Count: type 4) + β (Gender) + β (Race) + β (Urban/Rural) + β (# children in household) + β (# adults in household) + β (Income) + Referred to study (Y/N)

Odds Ratios and 95% Confidence Intervals for each positive and negative LES Count variable (event types 1-4) for Aim 2, Research Question 2, Models 1-4 are listed in Table 13. Though not listed in Table 13, we also tested for effect modification between income and negative LES counts within each event type since it is believed that these have more impact on a household's food security status, expressed as:

Log(Odds of LFS or VLFS-C) = Intercept + β (Positive LES Count: type "X") + β (Negative LES Count: type "X") + β (Gender) + β (Race) + β (Urban/Rural) + β (# adults in household) + β (# children in household) + β (Income) + β (Income*Negative LES Count: type "X") + Referred to study (Y/N)

Model fit was assessed by comparing differences in -2 Log Likelihood statistics between the nested models. The differences in -2 Log Likelihood between Model 3 (all covariates), and Model 4 (testing for independent effects) show Model 4 to have the best model fit for this aim and research question (difference in degrees of freedom=6, $\alpha=0.05$, chi-square test statistic=12.59).

Modeling of Aim 2, Research Question 2: The second research question for the analysis of the impact of positive and negative life events by type (Aim 2) was whether

or not the reported perceived positive and negative impact within four life event types was associated with the odds of food insecurity. The final hypotheses were that households with children that reported a greater magnitude of perceived negative life event impact within the work or financial stability type of life events were more likely to experience some form of food insecurity compared to those who experience negative life events in other categories. We also hypothesized that households with children that reported a greater magnitude of perceived positive life event impact within the work or financial stability life event type were less likely to experience food insecurity. Using the multinomial logistic model for three possible levels of food security outcome, odds for low food security (LFS) or very low food security among children (VLFS-C) outcome compared to food secure status was assessed for a one event increase in the perceived positive and negative impact scores of life events experienced in a specific event type. Events that were coded as having experienced a negative impact (-3 to -1) were summed (absolute values) into an LES negative impact score, and any events coded as having a positive impact (+1 to +3) were summed into an LES positive impact score.

Aim 2, Research Question 2, Model 1 measured the crude association between food security status and life event perceived positive and negative impacts within each type, expressed as:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive Impact Score: type "X"}) + \beta(\text{Negative Impact Score: type "X"}) + \text{Referred to study (Y/N)}$$

Statistical significance was assessed at $\alpha \leq 0.05$. Aim 2, Research Question 2, Model 2 included perceived positive and negative impact scores for life event types as the primary exposures and the literature based confounders. To better understand the relationship of income to food security status, income was excluded from this model to ensure that it is not a mediating variable with food security status:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive Impact Score: type "X"}) + \beta(\text{Negative Impact Score: type "X"}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# children in household}) + \beta(\text{\# adults in household}) + \text{Referred to study (Y/N)}$$

Aim 2, Research Question 2, Model 3 included income as a continuous covariate:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive Impact Score: type "X"}) + \beta(\text{Negative Impact Score: type "X"}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# children in household}) + \beta(\text{\# adults in household}) + \beta(\text{Income}) + \text{Referred to study (Y/N)}$$

Aim 2, Research Question 2, Model 4 was selected to measure the independent effects of the impact of each life event type. All covariates and positive and negative life event impact variables for each event type will be included in this model as follows:

$$\text{Log(Odds of LFS or VLFS-C)} = \text{Intercept} + \beta(\text{Positive LES Impact: type 1}) + \beta(\text{Negative LES Impact: type 1}) + \beta(\text{Positive LES Impact: type 2}) + \beta(\text{Negative LES Impact: type 2}) + \beta(\text{Positive LES Impact: type 3}) + \beta(\text{Negative LES Impact: type 3}) + \beta(\text{Positive LES Impact: type 4}) + \beta(\text{Negative LES Impact: type 4}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\text{\# children in household}) + \beta(\text{\# adults in household}) + \text{Referred to study (Y/N)}$$

Odds Ratios and 95% Confidence Intervals for each of the main exposure variables (Positive LES Impact and Negative LES Impact) for Aim 2, Research Question 2, Models 1-4 are listed in Table 14. In addition to the above Models 1-4 for Aim 2, Research Question 2, we also tested for effect modification between income and a negative perceived impact score for each event type (not shown in tables) because it is believed that these have more impact on a household's food security status as follows:

$$\begin{aligned} \text{Log(Odds of LFS or VLFS-C)} = & \text{Intercept} + \beta(\text{Positive Impact Score: type "X"}) + \\ & \beta(\text{Negative Impact Score: type "X"}) + \beta(\text{Gender}) + \beta(\text{Race}) + \beta(\text{Urban/Rural}) + \beta(\# \\ & \text{adults in household}) + \beta(\# \text{ children in household}) + \beta(\text{Income}) + \beta(\text{Income*Negative} \\ & \text{Impact Score: type "X"}) + \text{Referred to study (Y/N)} \end{aligned}$$

Model fit was assessed by comparing differences in -2 Log Likelihood statistics between the nested models. The differences in -2 Log Likelihood between Model 3 (all covariates), and Model 4 (testing for independent effects) show Model 4 to have the best model fit (overall) for this aim and research question (difference in degrees of freedom=6, $\alpha=0.05$, chi-square test statistic=12.59).

CHAPTER 4

RESULTS

4.1 Descriptive Statistics:

The total sample for the Midlands Family Study included five-hundred forty-four (544) participants. After excluding six (6) unreliable surveys and participants with missing responses for gender, race, urban status, number of children and number of adults in the household, and income, five-hundred eleven (511) remained for the analytic sample for this project. Table 3 describes the categorical covariates considered for this analysis by food security status (n(%)) for the full study population (n=538). The full study population was mostly female (92.6%) and identified as African American (79.0%). Urbanicity and the number of children and adults in the participant's household were fairly evenly distributed. Table 4 then describes the exclusion criteria for creating an analytic sample of n=511 by food security status and each specific variable. Of the initial 538 participants in the full study population, 27 had missing information related to income, and so were excluded from our final analytic sample. Of the 27 excluded, 10 were Food Secure (FS), 12 had Low Food Security (LFS), and 5 had Very Low Food Security among Children (VLFS-C). After excluding 27 with missing income information, we were left with a final analytic sample of n=511. The final analytic sample has n=147 FS participants, n=190 LFS participants, and n=174 VLFS-C participants. Table 5 describes

the categorical covariates by food security status (n(%)) for the analytic sample (n=511), and Table 6 describes the continuous variable for monthly household wages for the analytic sample. For the final analytic sample, the majority of MFS participants were female (92.6%; no change in proportion from full sample) and identified as African American (78.5%; decrease of 0.5% overall from full study population). Again, urbanicity and number of children and adults in the household remained fairly evenly distributed. Monthly household wages for the final analytic population were Winsorized, divided by 100, then centered, and is described by food security status in Table 6.

4.2 Aim 1: Association of Food Security Status with Overall Event Count and Impact:

Table 7 describes Life Experiences Survey event counts and impact scores by food security status for the analytic sample (mean, standard deviation) overall, and for each event type, positive and negative. All life event counts and impact scores were calculated using absolute values, so that positive and negative life event variables compare magnitude and direction of associations. The average number of positive life events experienced was approximately 4 (total 1,910 positive events among 511 participants; mean=3.72; std. deviation=2.87), with an average impact of approximately 9 (mean=8.71; std. deviation=7.16). Participants who were Food Secure had the greatest number of positive life events (mean=4.07; std. deviation = 2.87), and also the highest positive impact score overall (mean=9.77; std. deviation = 7.46), while participants experiencing Very Low Food Security among Children (VLFS-C) had the lowest number of positive life events (mean=3.51; std. deviation = 2.82), and the lowest perceived positive

impact (mean=8.09; std. deviation = 7.08). Negative life event statistics also followed a pattern meeting our expectations. Overall, participants experienced approximately 7 life events which were perceived as negative (total 3,407 negative events among 511 participants; mean=6.67; std. deviation=4.20), and reported a negative impact score of approximately -12 (reported as absolute value mean=12.23; std. deviation=9.71). VLFS-C participants reported the greatest negative impact scores (mean=16.05; std. deviation = 10.36) and had the greatest count of negative life events experienced (mean=8.36; std. deviation = 4.29). Food Secure participants reported the fewest number of negative life events (mean=4.68; std. deviation = 3.40) and had the least perceived negative impact (mean=7.61; std. deviation = 6.95).

The crude data analysis (Table 8, Model 1) revealed that negative life event counts were positively associated with odds of experiencing LFS and odds of VLFS-C among households with children, whereas positive life event counts were not associated with food security status. Adjusting for gender, race, urbanicity, number of adults in household, number of children in household, and referral status (Table 8, Model 2) did not appreciably alter any of the measures of association but drastically improved model fit (34.14 difference in -2 Log Likelihood compared to chi squared value of 12.59 for a difference of 6 degrees of freedom at $\alpha=0.05$). After additional adjustment for income (Table 8, Model 3), these findings suggest that a one-unit increase/higher number of negative life events (i.e. each additional count of negative LES), we expect a 16% (95% CI 1.09-1.24) higher odds of LFS and a 28% (95% CI 1.20-1.37) higher odds of being VLFS-C, but that counts of positive LES are not associated with LFS (OR: 0.96; 95% CI: 0.88-1.04)

or VLFS-C (OR: 0.95; 95% CI: 0.87-1.04) when adjusting for other variables in the model. Adjustment for income did improve model fit, comparing Model 3 to Model 2 (43.21 difference in -2 Log Likelihood is greater than 3.84 chi square value for difference in one degree of freedom at $\alpha=0.05$).

For the association between food security status and overall perceived impact of life events, the crude data analysis (Table 9, Model 1) revealed that perceived negative impact scores were positively associated with odds of experiencing LFS and odds of VLFS-C among households with children, and positive perceived impact scores were not associated with food security status. Adjusting for gender, race, urbanicity, number of adults in household, number of children in household, and referral status (Table 9, Model 2) did not appreciably alter any of the measures of association but did improve model fit (33.82 difference in -2 Log Likelihood is greater than chi squared value of 12.59 for a difference of 6 degrees of freedom at $\alpha=0.05$). When income was added to the model (Table 9, Model 3), these findings suggest that for a one-unit increase/higher (of -1) in perceived negative impact score, we expect a 8% (95% CI 1.04-1.11) higher odds of LFS and a 12% (95% CI 1.08-1.15) higher odds of VLFS-C. The perceived impact scores of positive events were not associated with LFS (OR: 0.98; 95% CI: 0.95-1.01) or VLFS-C (OR: 0.98; 95% CI: 0.95-1.01) when adjusting for other variables in the model. Adjustment for income did improve model fit when comparing Model 3 to Model 2 (39.82 difference in -2 Log Likelihood is greater than 3.84 chi square value for difference in one degree of freedom at $\alpha=0.05$).

4.3 Aim 2, Description of Life Event Count and Impact by Type:

To understand the distribution of the types of events experienced as positive or negative among Midlands Family Study participants, Table 10 a-d shows the frequency and percentage of each life event experienced within each event type, by positive and negative frequency. Four life event types were created by author consensus: 1) events concerning spouse/partner relationships, 2) work or financial stability, 3) family and other relationship events, and 4) personal events and behavior changes.

Tables 11 and 12 give a broad overview of life event counts by type and food security status. To re-cap, if a participant indicated a perceived impact between -3 and -1 for a life event, that event was counted as one (1) negative life event, and if a participant indicated a perceived impact between +1 and +3 for a life event, that event was counted as one (1) positive life event. The overall counts and summed impact scores of positive and negative life events were the focus of Aim 1, and Aim 2 broke these overall count and impact score measurements into four event types created by author consensus. Among 511 participants included in this study, there were 5,317 total events. Of these, 1,910 (35.9%) were counted as positive life events, and 3,407 (64.1%) were counted as negative events. For positive events, personal events and behavior change events (type 4) contained the most positive event counts (30.6%), followed by event type 3, family and other relationship events (29.3%), and event type 2, work and financial stability (22.1%). Negative life event counts again show personal events and behavior changes (type 4) with the highest number of event counts (36.7%), followed by

type 3 family and other relationship events (30.8%) and then negative events for type 2, work or financial stability (25.2%). Life event type 1, events concerning spouse/partner relationships, contains the lowest overall counts for both positive (20.0%) and negative (7.8%) scored events.

Each description of the distribution of positive and negative events among event types (Tables 11 & 12, respectively) that follows should also be viewed with Table 7, which shows the average number of events for each participant (n=511) within each event type, by food security status. For example, to interpret the mean and standard deviation found in Table 7 for positive spouse/partner relationship events (event type 1), the average number of positive life events experienced by each of the 511 study participants was 0.67 (std. deviation= 0.91), where 343 total positive spouse/partner relationship events were recorded (See Table 11). Keep in mind that some participants may have had 0 events within event type 1, and some had multiple events within event type 1, but overall we can say that each participant experienced 0.67 events, plus or minus 0.91 events within event type 1.

For spouse/partner relationship events (Tables 11 & 12, Type 1), a total of 343 positive events were experienced by the study population (97 positive events among FS, 121 among LFS, and 125 among VLFS-C), and 248 negative events were experienced by the study population (57 among FS, 93 among LFS, and 98 among VLFS-C). The events within event type 1 with the highest number of positive and negative counts were major

change in number of arguments with spouse/partner (17.7%), female pregnancy (17.9%), and breaking up with a boyfriend or girlfriend (15.8%), as shown in Table 10 (a).

Events concerning work and financial stability (Type 2) yielded a total of 422 positive events experienced by the study population (See Table 11; 156 positive events among FS, 155 among LFS, and 111 among VLFS-C), and 859 negative events experienced by the study population (See Table 12; 152 among FS, 337 among LFS, and 370 among VLFS-C). The events within event type 2 with the highest number of positive and negative counts (See Table 10-b) were major change in financial status (30.3%), a changed work situation (19.8%), and a new job (11.2%).

For events concerning family and other relationships (Type 3), a total of 560 positive events were experienced by the study population (See Table 11; 183 positive events among FS, 205 among LFS, and 172 among VLFS-C), and 1,050 negative events were experienced by the study population (See Table 12; 228 among FS, 379 among LFS, and 443 among VLFS-C). The events within event type 3 with the highest number of positive and negative counts (Table 10-c) were major change in closeness of family (20.0%), gaining a new family member through birth, adoption, moving in, etc. (19.9%), and a serious injury or illness of a close family member (14.7%).

Initially, incarceration was included as its own life event type, since we considered that incarceration could have an effect in all four other event types and thus wanted to explore its impact separately, in a fifth event type category. However, after calculating the total impact scores for event types by food security status (See Tables 11

&12), the original proposed life event type 5, incarceration, had cell counts that were too small for the multinomial models. There were 8 counts of incarceration as a positive event among the analytic sample, and 48 counts of incarceration as a negative event. After considering these calculations and conversation with committee members, it was decided that the incarceration event should no longer be its own event type, but should be incorporated into life event type 4: Personal Events and Behavior Changes. All events in other categories are meant to reflect events that happened to the individual study participant, and did not necessarily measure the effect of such events on other relationships (spouse/partner, family and other) or financial stability.

Finally, for personal events and behavior changes (Type 4), a total of 343 positive events were experienced by the study population (See Table 11; 97 positive events among FS, 121 among LFS, and 125 among VLFS-C), and 248 negative events were experienced by the study population (See Table 12; 57 among FS, 93 among LFS, and 98 among VLFS-C). The events within event type 4 with the highest number of positive and negative counts (Table 10-d) were major change in sleeping habits (15.2%), major changes in eating habits (13.8%), and a major change in social activities such as parties, movies, visiting, etc. (10.9%).

4.4 Aim 2, Research Question 1: Association of Food Security Status with Life Event

Counts by Event Type:

After a crude analysis (Table 13, Model 1) of the association between food security status and life event counts by event type, Model 2 adjusted for gender, race,

urbanicity, number of adults in household, number of children in household, and referral status for each event type (Table 13, Model 2). Model fit was drastically improved between Model 1 and Model 2 for each event type, and model fit consistently improved for event type models that adjusted for income in Model 3, which was expected based on our hypotheses around the importance of low income related to food insecurity.

When comparing VLFS-C to FS status without adjusting for income (Model 2), all negative event counts for each of the four life event types had a significant association with higher odds of VLFS-C, and positive event counts for work or financial stability (type 2) and positive events for family and other personal relationships (type 3) had a significant association with lower odds of VLFS-C, which suggested that event types 2 and 3 may be protective against VLFS-C. With additional adjustment for income (Model 3), we found that the number of positive events concerning spouse/partner relationships (event type 1) was no longer associated with VLFS-C, but with each additional count/increase of negative events of type 1, we expect 45% higher odds of being VLFS-C (OR 1.45, 95% CI 1.04-2.01). For work or financial stability events (type 2), positive events were no longer significant after adjusting for income, but for a one unit increase/higher negative event in type 2, we expect a 84% higher odds of VLFS-C (95% CI 1.51-2.23). Type 3 events, events related to family and other personal relationships, showed significant associations for both positive and negative life event counts after adjusting for income. Positive life event counts in event type 3 have an association with lower odds of VLFS-C (OR 0.78, 95% CI 0.63-0.98), whereas negative event counts of

type 3 had an association with higher odds of VLFS-C (OR 1.47, 95% CI 1.25-1.72). Personal events and behavior changes (type 4) had no association with VLFS-C for positive event counts when adjusted for all covariates and income. With each count of negative events from event type 4, we expect 57% higher odds of VLFS-C (95%CI 1.35-1.83).

The association between LFS (compared to FS) and life event type counts was also calculated for each of the four life event types, adjusting for income. Whereas the contrast between FS and VLFS-C found a negative association with positive event counts from the family and other personal relationship event type, when we compared FS and LFS there were no significant associations between any of the positive counts of life events in each of the four event types for LFS. Negative event counts within life event type 1 (events concerning spouse/partner relationships) while significant when contrasting FS and VLFS-C, was not significant when contrasting FS and LFS.

Negative event counts within event types 2, 3, and 4 were positively associated with LFS. For each additional count of negative life event in event type 2 (work or financial stability), we expect 54% higher odds of LFS (95% CI 1.28-1.85), which, while still significant, is not as strong of an association as seen above for VLFS-C and negative event counts in event type 2 (OR: 1.84; 95% CI: 1.51-2.23). For event type 3 (family and other personal events), for each one unit increase/higher count of negative life event, we expect 22% higher odds of LFS (95% CI: 1.05-1.42). Again, the association between FS and LFS was not as strong as the association between FS and VLFS-C for negative event

counts in event type 3 (OR: 1.47; 95% CI: 1.25-1.72). Finally, for a one unit increase/higher negative count of negative life event for personal events and behavior changes (event type 4), we expect 29% higher odds of LFS (95% CI: 1.12-1.49), which was again not as strong of an association between FS and VLFS-C (OR: 1.57; 95% CI: 1.07-1.53).

4.5 Research Question 2: Association of Food Security Status with Life Event Impact

Scores by Event Type:

After a crude data analysis (Table 14, Model 1) of the association between food security status and life event impact scores by event type, Model 2 adjusted for gender, race, urbanicity, number of adults in household, number of children in household, and referral status for each event type (Table 14, Model 2). Model fit was drastically improved between Model 1 and Model 2 for each event type, and model fit consistently improved for event type models that adjusted for income in Model 3.

When comparing VLFS-C to FS status without adjusting for income (Table 14, Model 2), all negative impact scores for each of the four life event types had a significant positive association, however no positive event impacts had a significant association. With additional adjustment for income (Model 3), the positive association of negative impact scores within each of the four life event types remained significant. For a one unit increase/higher negative impact score within event type 1, we expect 20% higher odds of being VLFS-C (95% CI: 1.04-1.40). For a one unit increase/higher

negative impact score in type 2, we expect 29% higher odds of VLFS-C (95% CI 1.20-1.40).

Type 3 event impacts, events related to family and other personal relationships, showed significant associations with VLFS-C for both positive and negative life events after adjusting for income (respectively: OR 0.91, 95% CI 0.83-0.99; OR 1.20, 95% CI 1.11-1.30). Negative event impact scores in event type 3, model 3, had a positive association with LFS (OR 1.12, 95% CI 1.03-1.21), and positive event impact scores for event type 3 were insignificant. Personal events and behavior changes (type 4) had no association with VLFS-C for positive event impact scores when adjusted for income, but VLFS-C was significant for event type 4 negative impact scores when adjusted for income. For a one unit increase/higher negative event impact score from event type 4, we expect 20% higher odds of being VLFS-C (95%CI 1.11-1.29).

The association between LFS (compared to FS) and life event type impact score was also calculated for each of the four life event types, adjusting for income. When we contrasted FS and LFS there were no significant associations between any of the positive impact scores of life events in each of the four event types for LFS. Negative event impact scores within life event type 1 (events concerning spouse/partner relationships) while significant when contrasting FS and VLFS-C, was not significant when contrasting FS and LFS.

Like negative event counts, negative event impact scores within event types 2, 3, and 4 were positively associated with LFS. No positive event impact scores for any of the

four event types had a significant association with LFS compared to FS. For a one unit increase/higher negative life event impact score in event type 2 (work or financial stability), we expect 20% higher odds of LFS (95% CI: 1.12-1.30), which, while still significant, is not as strong of an association as seen above for VLFS-C and negative event impact scores in event type 2 (OR: 1.29; 95% CI: 1.20-1.40). For event type 3 (family and other personal events), a one unit increase/higher negative event impact score yielded 12% higher odds of LFS (95% CI: 1.03-1.21). Again, the association between FS and LFS was not as strong as the association between FS and VLFS-C for negative event impact scores in event type 3 (OR: 1.20; 95% CI: 1.11-1.30). Also, while positive impacts in event type 3 had a significant negative association with VLFS-C, there was no association between positive impact scores in event type 3 and LFS compared to FS. Finally, for a one unit increase/higher negative life event impact score for personal events and behavior changes (event type 4), we expect 11% higher odds of being LFS (95% CI: 1.03-1.20), which was again not as strong of an association as the same contrast between FS and VLFS-C (OR: 1.20; 95% CI: 1.11-1.29).

4.6 Aim 2: Association of Food Security Status with Life Event Counts and Impact by Event Type ; Testing for Independent Effects, Model 4:

As outlined in Chapter 3, the purpose of Model 4 is to test for any independent effects of the association between positive and negative counts and perceived impact scores of life event types with food security status. So, for Aim 2, Research Question 1, testing for the independent effect of life event counts by type, at any level of the other covariates

held constant, meant including all covariates and every positive and negative overall count variable for each of four event types simultaneously into a single model. By adding all positive and negative life event type variables, the concept for Model 4 is that the model now adjusts one type of event for all other types of life events held constant, so that one event type (positive or negative) is now independently predictive of food security status. In other words, any significant associations should be considered as independent effects, independently predictive of food security status.

When testing for independent effects (Model 4) now for positive and negative life event counts for each life event type (Table 13), we found that event types that were previously significantly associated with food security status (when analyzed type-by-type), changed in significance when all other life event count variables were included in Model 4. For event type 1 (events concerning spouse/partner relationships), negative event counts were no longer significantly associated with VLFS-C and remained insignificant with LFS. No positive event counts for event type 1 were significant for VLFS-C or LFS when testing for independent effects. Event type 2, work or financial stability, within Model 4 yielded similar results as event type 2 counts in Model 3, where negative life event counts remained significant for LFS and VLFS-C, and positive event counts remained insignificant. Negative life event counts for event type 2, Model 4 had an association with higher odds of VLFS-C (OR: 1.59; 95% CI: 1.29-1.96) and with higher odds of LFS (OR: 1.43; 95% CI: 1.18-1.74).

For event type 3 (family and other personal relationship events), negative event counts were also no longer significant with VLFS-C or LFS when testing for independent effects in Model 4, where they were significant within Model 3. Positive event counts for event type 3 remained significant after adjusting for all other life events, where for a one unit increase in positive event counts in event type 3, we expect 75% lower odds of VLFS-C (95% CI: 0.58-0.97) holding all other variables constant; LFS and positive event counts for event type 3 remained insignificant. Event type 4 (personal events and behavior changes) remained significant for VLFS-C when adjusting for all other event count variables and all covariates, where for a one event increase in negative event counts for event type 4, we expect 28% higher odds of being VLFS-C (95% CI: 1.07-1.53), again holding all other variables constant. LFS and negative event counts within event type 4 were no longer significant when adjusting for independent effects of other life event count variables in Model 4. Changes from Model 3 to Model 4 suggest that some types of life-event related relationships may be confounded by other types of life events, and thus are no longer independently predictive (or protective) of food security status holding all other variables (covariates and life event counts by type) constant in Model 4. Intuitively, this makes sense; events are never only experienced within one event type, but instead are mixed over time.

A similar analysis is also applicable for Model 4 when considering positive and negative perceived impact scores for event types (Table 14). When positive and negative event impact scores were considered in separate models by type, adjusting for income (Model 3) for positive and negative impact scores, event type 1 negative impacts had an

association with higher odds of VLFS-C, event type 2 negative impacts had an association with lower odds of LFS and VLFS-C, event type 3 positive impacts had an association with higher odds of VLFS-C and negative impacts had an association with lower odds of LFS and VLFS-C, and event type 4 negative impacts had associations with higher odds of LFS and VLFS-C, these relationships almost disappear when testing for independent effects. Now holding all other covariates and life event impact variables constant, event type 1 impact scores, positive and negative were insignificant, as well as positive and negative type 3 impact scores, and type 4 impact scores for positive and negative. The only significant measures that remain in Model 4 after adjusting for all covariates and positive and negative impact score variables for each of the four event types are negative impact scores within event type 2: work or financial stability. For every one unit increase in negative impact for work or financial stability, adjusting for all other covariates and positive and negative impact scores for all event types, we expect a 23% higher odds of VLFS-C (95% CI: 1.13-1.34), and a 17% higher odds of LFS (95% CI: 1.08-1.27). For all life event types, model fit improved when adjusting for independent effects (difference in degrees of freedom=6, $\alpha=0.05$, chi-square test statistic=12.59).

4.7 Tables:

Table 4.1: Event Types and List of Life Events in Each Event Type

	Events:
Events Concerning Spouse/Partner Relationships	
	Marriage
	Death of a spouse
	Marital reconciliation with mate
	Major change in number of arguments with spouse
	Male: Wife/girlfriend's pregnancy
	Female: Pregnancy
	Marital separation from mate (due to conflict)
	Divorce
	Separation from spouse (due to work, travel, etc)
	Engagement
	Breaking up with boyfriend or girlfriend
	Reconciliation with boyfriend or girlfriend
Work or Financial Stability:	
	Foreclosure
	Borrowing for a moderate purchase (car, TV, school loan)
	Borrowing for a major purchase (home, business)
	Being fired from job
	Changed work situation (responsibilities, working conditions, working hours, etc)
	New job
	Trouble with employer (danger of losing job, being suspended, demoted, etc)
	Major change in financial status (better or worse)
	Retirement from work
	Change in spouse's work outside the home (lost job, new job, retirement)
Family and Other Relationship Events:	
	Death of a close family member
	Death of a close friend
	Serious injury or illness of a close family member
	Trouble with in-laws or parents
	Major change in closeness of family (increase or decrease)
	Gaining a new family member (birth, adoption, moving in, etc)
	Major change in living conditions for family (building a new home, remodeling, deterioration)
	Serious illness or injury of close friend

	Son or daughter leaving home (due to marriage, college, etc)
	Change in residence
Personal Events and Behavior Changes:	
	Detention in jail or comparable institution
	Major change in sleeping habits (more or less)
	Major change in eating habits
	Outstanding personal achievement
	Minor law violation (traffic ticket, disturbing the peace)
	Major change in usual type of recreation
	Major change in church activities (increased or decreased attendance)
	Major personal illness or injury
	Major change in social activities (parties, movies, visiting, etc)
	Ending of formal schooling
	Leaving home for the first time
Incarceration:	
	Detention in jail or comparable institution

*For Incarceration, please see later comment in the analysis section. This variable is included with life event type four (Personal events and behavior changes) for the final analysis because there were too few events in one of the food security categories to create stable modeled estimates.

Table 4.2: Variable Names, SAS Variable Name, Type, and Referent Levels:

Variable Name & Levels:	SAS Variable Name:	Type:	Referent Level (If Applicable):
Food Security Status	FSS_Status	Categorical	Food Secure ("0")
Life Events (Count)			
Overall Count	Pos_count; Neg_count	Continuous	N/A
Type One	LES_negcount_type1; LES_poscount_type1	Continuous	N/A
Type Two	LES_negcount_type2; LES_poscount_type2	Continuous	N/A

Type Three	LES_negcount_type3; LES_poscount_type3	Continuous	N/A
Type Four	LES_negcount_type4; LES_poscount_type4	Continuous	N/A
Life Events (Impact)			
Overall Impact	Pos_Impact; Neg_Impact		
Type One	Neg_impact_type1; Pos_impact_type1	Continuous	N/A
Type Two	Neg_impact_type2; Pos_impact_type2	Continuous	N/A
Type Three	Neg_impact_type3; Pos_impact_type3	Continuous	N/A
Type Four	Neg_impact_type4; Pos_impact_type4	Continuous	N/A
Gender	dem_q9_gender	Categorical	Male
Race	id_race = 1 = "Black"	Categorical	Other: id_race = 0 (Other)
Urban/Rural	FSS_Urban	Categorical	Non-urban
Income	Monthly_wages_HH_100_W_C	Continuous	N/A
Number of Children in Household	DEM_q10_childhouse	Continuous	N/A
Number of Adults in Household	DEM_q11_adulthouse	Continuous	N/A
Referred to Study	BELL_rcrt_refd	Y/N Categorical	N/A

Table 4.3: Description of Full Midlands Family Study Population, Categorical Variables by Food Security Status; N = 538

Variable	Total: N (%)	Food Secure: n (%)	Low Food Secure: n (%)	Very Low Food Secure among Children: n (%)
Food Security Status	538 (100.0%)	157 (29.2%)	202 (37.5%)	179 (33.3%)
Gender				
Female	498 (92.6%)	146 (93.0%)	188 (93.1%)	164 (91.6%)
Male	40 (7.4%)	11 (7.0%)	14 (6.9%)	15 (8.4%)
Race/Ethnicity				
Black	425 (79.0%)	110 (70.1%)	158 (78.2%)	157 (87.7%)
Not-Black	113 (21.0%)	47 (29.9%)	44 (21.8%)	22 (12.3%)
Urban/Non-Urban				
Urban	310 (57.6%)	87 (55.4%)	101 (50.0%)	122 (68.2%)
Non-Urban	228 (42.4%)	70 (44.6%)	101 (50.0%)	57 (31.8%)
Number of Children in Household				
1 child	194 (36.1%)	55 (35.0%)	78 (38.6%)	61 (34.1%)
2 children	192 (35.7%)	57 (36.3%)	74 (36.6%)	61 (34.1%)
3+ children	152 (28.3%)	45 (28.7%)	50 (24.8%)	57 (31.8%)
Number of Adults in Household				
1 adult	231 (42.9%)	58 (36.9%)	92 (45.5%)	81 (45.3%)
2 adults	220 (40.9%)	76 (48.4%)	72 (35.6%)	72 (40.2%)
3+ adults	87 (16.2%)	23 (14.6%)	38 (18.8%)	26 (14.5%)
Referred to Study				

Yes	130 (24.2%)	36 (22.9%)	48 (23.8%)	46 (25.7%)
No	408 (75.8%)	121 (77.1%)	154 (76.2%)	133 (74.3%)

Table 4.4: Creation of Final Analytic Sample: Table indicates number of participants excluded from full study sample for specific missing variables by Food Security Status, N=538.

Variable	FS N=157 (29.2%)	LFS N=202 (37.5%)	VLFS-C N=179 (33.3%)	Total N=538
FSS_Status	0	0	0	0
Gender	0	0	0	0
DEM_q10_childhouse	0	0	0	0
DEM_q11_adulthouse	0	0	0	0
FSS_Urban	0	0	0	0
Income (Windsorized and Centered)	10	12	5	27
Race	0	0	0	0
Referral	0	0	0	0
New Analytic Total:	147 (28.8%)	190 (37.2%)	174 (34.1%)	511 (100%)

Table 4.5: Description of Covariates by Food Security Status, Final Analytic Sample N=511:

Variable	Total: N (%)	Food Secure: n (%)	Low Food Secure: n (%)	Very Low Food Secure Among Children: n (%)
Food Security Status	511 (100%)	147 (28.8%)	190 (37.2%)	174 (34.1%)
Gender				
Female	473 (92.6%)	136 (92.5%)	178 (93.7%)	159 (91.4%)
Male	38 (7.4%)	11 (7.5%)	12 (6.3%)	15 (8.6%)
Race/Ethnicity				
Black	401 (78.5%)	101 (68.7%)	147 (77.4%)	153 (87.9%)
Not-Black	110 (21.5%)	46 (31.3%)	43 (22.6%)	21 (12.1%)

Urban/Non-Urban				
Urban	298 (58.3%)	85 (57.8%)	94 (49.5%)	119 (68.4%)
Non-Urban	213 (41.7%)	62 (42.2%)	96 (50.5%)	55 (31.6%)
Number of Children in Household				
1 child	183 (35.8%)	50 (34.0%)	73 (38.4%)	60 (34.5%)
2 children	183 (35.8%)	54 (36.7%)	71 (37.4%)	58 (33.3%)
3+ children	145 (28.4%)	43 (29.3%)	46 (24.2%)	56 (32.2%)
Number of Adults in Household				
1 adult	222 (43.4%)	54 (36.7%)	89 (46.8%)	79 (45.4%)
2 adults	211 (41.3%)	72 (49.0%)	67 (35.3%)	72 (41.4%)
3+ adults	78 (15.3%)	21 (14.3%)	34 (17.9%)	23 (13.2%)
Referred to Study				
Yes	124 (24.3%)	34 (23.1%)	44 (23.2%)	46 (26.4%)
No	387 (75.7%)	113 (76.9%)	146 (76.8%)	128 (73.6%)

Table 4.6: Description of Midlands Family Study Population, Monthly Household Wages * (N = 511).

Variable	Overall	Food Secure	Low Food Secure	Very Low Food Secure among Children
Food Security Status	N=511	N = 147	N = 190	N = 174
Income				
Mean	\$1,319	\$2,157	\$1,181	\$762
Std. Deviation	\$1,627	\$2,236	\$1,321	\$871

Minimum	0	0	0	0
Maximum	\$8,167	\$8,167	\$8,167	\$4,750

*The income variable (wages and assistance) used for this descriptive table was Winsorized and divided by 100. Results above are multiplied by 100 for 'actual' amounts. The income variable used in for regression models was Winsorized, divided by 100, and Centered.

Table 4.7: Mean and Standard Deviation of Life Experiences Survey **Counts** and Absolute Values of **Impact Scores**, Overall and by Event Types, by Food Security Status. (N=511)

Variable	Overall (N=511)	Food Secure (N=147)	Low Food Secure (N=190)	Very Low Food Secure Among Children (N=174)
Positive Life Events				
LES Count	3.72 (2.87)	4.07 (2.87)	3.63 (2.90)	3.51 (2.82)
LES Impact Score	8.71 (7.16)	9.77 (7.46)	8.46 (6.93)	8.09 (7.08)
Negative Life Events				
LES Count	6.67 (4.20)	4.68 (3.40)	6.66 (4.00)	8.36 (4.29)
LES Impact Score	12.23 (9.71)	7.61 (6.95)	12.32 (9.42)	16.05 (10.36)
Event Types:				
1. Spouse/Partner				
Positive LES Count	0.67 (0.91)	0.66 (0.87)	0.64 (0.91)	0.72 (0.93)
Negative LES Count	0.49 (0.80)	0.39 (0.65)	0.49 (0.83)	0.56 (0.88)
Pos. LES Impact Score	1.57 (2.27)	1.67 (2.34)	1.50 (2.28)	1.55 (2.20)
Neg. LES Impact Score	1.03 (1.96)	0.70 (1.32)	1.09 (2.19)	1.22 (2.11)
2. Work/Finances				

Positive LES Count	0.83 (1.09)	1.06 (1.21)	0.82 (1.14)	0.64 (0.86)
Negative LES Count	1.68 (1.49)	1.03 (1.20)	1.77 (1.44)	2.13 (1.58)
Pos. LES Impact Score	1.78 (2.57)	2.35 (2.93)	1.71 (2.60)	1.39 (2.10)
Neg. LES Impact Score	3.99 (3.89)	2.15 (2.84)	4.21 (3.80)	5.30 (4.19)
3. Other Relationships				
Positive LES Count	1.10 (1.09)	1.24 (1.18)	1.08 (1.07)	0.99 (1.03)
Negative LES Count	2.05 (1.68)	1.55 (1.42)	1.99 (1.66)	2.55 (1.77)
Pos. LES Impact Score	2.59 (2.71)	2.99 (2.96)	2.59 (2.64)	2.25 (2.53)
Neg. LES Impact Score	3.40 (3.64)	2.28 (2.81)	3.27 (3.56)	4.48 (4.04)
4. Personal Events				
Positive LES Count	1.13 (1.20)	1.13 (1.12)	1.10 (1.21)	1.16 (1.25)
Negative LES Count	2.35 (1.78)	1.64 (1.56)	2.32 (1.71)	2.99 (1.79)
Pos. LES Impact Score	2.70 (2.97)	2.76 (2.91)	2.59 (2.88)	2.76 (3.11)
Neg. LES Impact Score	3.59 (3.70)	2.32 (2.72)	3.53 (3.55)	4.71 (4.21)
5. Incarceration**				
Positive LES Count	0.02 (0.12)	0 (0.0)	0.02 (0.12)	0.03 (0.17)
Negative LES Count	0.09 (0.29)	0.07 (0.25)	0.08 (0.28)	0.13 (0.33)
Pos. LES Impact Score	0.03 (0.29)	0 (0.0)	0.03 (0.27)	0.06 (0.40)
Neg. LES Impact Score	0.24 (0.77)	0.16 (0.62)	0.21 (0.73)	0.34 (0.92)
***Revised Personal				

Event Type 4				
Positive LES Count	1.14 (1.21)	1.23 (1.12)	1.12 (1.22)	1.19 (1.28)
Negative LES Count	2.45 (1.83)	1.71 (1.60)	2.40 (1.77)	3.12 (1.84)
Pos. LES Impact Score	2.72 (3.02)	2.76 (2.91)	2.62 (2.89)	2.83 (3.24)
Neg. LES Impact Score	3.82 (3.87)	2.48 (2.89)	3.74 (3.73)	5.05 (4.34)

*Values are listed as Mean (Standard Deviation)

**Event Type 5, Incarceration, was folded into Event Type 5, Personal Events.

***Revised Personal Event Type 4 includes incarceration event.

Table 4.8: Association of Low Food Security (LFS) and Very Low Food Security among Children (VLFS-C) Compared to Food Secure (FS) Households, Positive and Negative **Life Event Counts**. N=511

Model:	Positive Count, OR (95% CI)	Negative Count, OR (95% CI)	Model Fit: -2 Log Likelihood
Model 1:			
LFS	0.94 (0.87-1.02)	1.16 (1.09-1.24)	1046.61
VLFS-C	0.93 (0.86-1.01)	1.28 (1.20-1.37)	--
Model 2:			
LFS	0.95 (0.88-1.02)	1.17 (1.10-1.24)	1012.47
VLFS-C:	0.93 (0.85-1.01)	1.29 (1.20-1.38)	--
Model 3:			
LFS	0.96 (0.88-1.04)	1.16 (1.09-1.24)	969.26
VLFS-C	0.95 (0.87-1.04)	1.28 (1.20-1.37)	--

*OR(95% CI) for every one unit increase in event experienced. (Aim 1, Research Question 1).

Model 1 is the crude association between food security status outcome and positive/negative LES counts as a continuous measure of exposure, controlling for referred to the study (Yes/No).

Model 2 includes all covariates from literature review, except income.

Model 3 includes all covariates from the literature review, including income.

Table 4.9: Association of Low Food Security (LFS) and Very Low Food Security among Children (VLFS-C) Compared to Food Secure (FS) Households, **Positive and Negative Life Event Impact Score**. N=511.

Model:	Positive Impact, OR (95% CI)	Negative Impact, OR (95% CI)	Model Fit: -2 Log Likelihood
Model 1:			
LFS	0.98 (0.95-1.01)	1.08 (1.05-1.11)	1044.47
VLFS-C	0.97 (0.94-1.01)	1.12 (1.09-1.16)	--
Model 2:			
LFS	0.98 (0.95-1.01)	1.08 (1.05-1.11)	1010.65
VLFS-C:	0.97 (0.94-1.01)	1.12 (1.09-1.16)	--
Model 3:			
LFS	0.98 (0.95-1.01)	1.08 (1.04-1.11)	970.83
VLFS-C	0.98 (0.95-1.01)	1.12 (1.08-1.15)	--

OR(95% CI) for every one unit increase in impact score from life events experienced. (Aim 1, Research Question 2).

Model 1 is the crude association between Food Security Status outcome and positive/negative life event impact scores as a continuous measure of exposure, controlling for referred to the study (Yes/No).

Model 2 includes all covariates from literature review, except income.

Model 3 includes all covariates from the literature review, including income.

Table 4.10: Frequency of Positive and Negative Events for Four Types of Life Events (Note: This table includes Incarceration in Event Type 4: Personal Events and Behavior Changes)

Table 4.10 (a): Type 1 – Events Concerning Spouse/Partner Relationship

Event:	Positive Frequency of Event:	Negative Frequency of Event:	Overall Frequency (%) of Event:
Marriage	36	14	50 (8.0%)
Death of a Spouse	1	11	12 (1.9%)
Marital reconciliation with mate	17	6	23 (3.7%)

Major change in number of arguments with spouse	47	70	117 (18.7%)
Male: Wife/girlfriend's pregnancy	6	1	7 (1.1%)
Female: Pregnancy	75	37	112 (17.9%)
Marital separation from mate (due to conflict)	29	45	74 (11.8%)
Divorce	11	8	19 (3.0%)
Separation from spouse (due to work, travel, etc.)	5	28	33 (5.3%)
Engagement	38	10	48 (7.7%)
Breaking up with boyfriend or girlfriend	52	47	99 (15.8%)
Reconciliation with boyfriend or girlfriend	23	10	33 (5.3%)
Total Events: 12	340 (54.2%)	287 (45.8%)	Total Frequency: 627 (100%)

Table 4.10 (b): Type 2 – Work or Financial Stability

Event:	Positive Frequency of Event:	Negative Frequency of Event:	Overall Frequency (%) of Event:
Foreclosure	2	17	19 (1.5%)
Borrowing for a moderate purchase (car, TV, school loan)	67	62	129 (10.1%)
Borrowing for a major purchase (home, business, etc.)	24	12	36 (2.8%)
Being fired from a job	12	77	89 (7.0%)

Changed work situation (responsibilities, working conditions, working hours, etc.)	79	173	252 (19.8%)
New job	121	21	142 (11.2%)
Trouble with employer (danger of losing job, being suspended, demoted, etc.)	10	93	103 (8.1%)
Major change in financial status (a lot better or a lot worse)	70	315	385 (30.3%)
Change in spouse's work outside the home (lost job, new job, retirement)	33	75	108 (8.5%)
Retirement from Work	2	6	8 (0.1%)
Total Events: 10	420 (33.0%)	851 (67.0%)	Total Frequency: 1,271 (100%)

Table 4.10 (c): Type 3 – Family and Other Relationship Events

Event:	Positive Frequency of Event:	Negative Frequency of Event:	Overall Frequency (%) of Event:
Death of a close family member	0	0	0 (0.0%)
Death of a close friend	13	113	126 (11.4%)
Serious injury or illness of a close family member	13	150	163 (14.7%)
Trouble with in-laws or parents	8	95	103 (9.3%)
Major change in closeness of family (increase or decrease)	73	148	221 (20.0%)

Gaining a new family member (birth, adoption, moving in, etc.)	198	22	220 (19.9%)
Major change in living conditions for family (building a new home, remodeling, deterioration, etc.)	63	78	141 (12.7%)
Serious illness or injury of close friend	11	62	73 (6.6%)
Son or daughter leaving home (due to marriage, college, etc.)	35	24	59 (5.3%)
Total Events: 9	414 (37.4%)	692 (62.6%)	Total Frequency: 1,106 (100%)

Table 4.10 (d): Type 4 – Personal Events and Behavior Changes

Event:	Positive Frequency of Event:	Negative Frequency of Event:	Overall Frequency (%) of Event:
Major change in sleeping habits (much more or much less)	54	255	309 (15.2%)
Major change in eating habits	82	199	281 (13.8%)
Outstanding personal achievement	202	13	215 (10.6%)
Minor law violation (traffic tickets, disturbing the peace)	13	87	100 (4.9%)
Major change in usual type of recreation	61	134	195 (9.6%)
Change in residence	140	82	222 (10.9%)
Major change in church activities (increased or	90	105	195 (9.6%)

decreased attendance)			
Major personal illness or injury	13	130	143 (7.0%)
Major change in social activities (parties, movies, visiting, etc.)	85	137	222 (10.9%)
Ending of formal schooling	41	35	76 (3.7%)
Leaving home for the first time	18	5	23 (1.1%)
Incarceration	8	48	56 (2.7%)
Total Events: 12	807 (39.6%)	1,230 (60.4%)	Total Frequency: 2,037 (100%)

Table 4.11: **Positive Life Event Counts** by Type and Food Security Status:

Event Type	Overall Total	Food Secure	Low Food Secure	Very Low Food Secure Among Children
1. Spouse/ Partner	343	97	121	125
2. Finances	422	156	155	111
3. Family/Friend	560	183	205	172
4. Personal/ Behavior*	577	166	209	202
5. Incarceration	8	0	3	5
4. Pers./Behav., Revised**	585	166	212	207
Totals (Type 1, 2, 3 and Revised Type 4):	1,910	602	693	615

*Includes Incarceration event.

**Revised, Final Type Four without Incarceration event.

Table 4.12: **Negative Life Event Counts** by Type and Food Security Status:

Event Type	Overall Total	Food Secure	Low Food Secure	Very Low Food Secure Among Children
1. Spouse/ Partner	248	57	93	98
2. Finances	859	152	337	370
3. Family/Friend	1,050	228	379	443
4. Personal/ Behavior*	1,202	241	440	521
5. Incarceration	48	10	16	22
4. Pers./Behav., Revised **	1,250	251	456	543
Total:	3,407	688	1,265	1,454

*Includes Incarceration event.

Revised, Final Type Four without Incarceration event. Table 4.13: Multinomial Logistic Regression Analysis of Positive and Negative Life **Event Counts for Each Life Event Type. N=511.

	Model 1		Model 2		Model 3		Model 4	
	LFS	VLFS-C	LFS	VLFS-C	LFS	VLFS-C	LFS	VLFS-C
Type 1: Events Concerning Spouse/Partner Relationships								
Type 1: (Positive)	0.97 (0.76-1.23)	1.07 (0.84-1.36)	0.99 (0.78-1.27)	1.08 (0.85-1.39)	1.03 (0.80-1.32)	1.17 (0.90-1.52)	1.08 (0.82-1.43)	1.29 (0.95-1.76)
Type 1: (Negative)	1.21 (0.90-1.62)	1.34 (1.00-1.79)	1.23 (0.91-1.66)	1.46 (1.08-1.98)	1.23 (0.89-1.68)	1.45 (1.04-2.01)	0.93 (0.66-1.30)	0.93 (0.65-1.34)
Model Fit:	1111.74		1076.01		1021.22		954.13	
Type 2: Work or Financial Stability								
Type 2: (Positive)	0.87 (0.72-1.06)	0.75 (0.60-0.93)	0.87 (0.71-1.06)	0.75 (0.60-0.94)	0.95 (0.77-1.17)	0.90 (0.71-1.15)	0.94 (0.75-1.18)	0.88 (0.67-1.15)
Type 2: (Negative)	1.51 (1.27-1.81)	1.74 (1.46-2.09)	1.56 (1.30-1.86)	1.80 (1.49-2.16)	1.54 (1.28-1.85)	1.84 (1.51-2.23)	1.43 (1.18-1.74)	1.59 (1.29-1.96)

Model Fit:	1060.94		1025.44		980.72		954.13	
Type 3: Family and Other Personal Relationships								
Type 3: (Positive)	0.87 (0.71- 1.05)	0.80 (0.65- 0.99)	0.881 (0.72- 1.08)	0.81 (0.65- 0.99)	0.86 (0.70- 1.06)	0.78 (0.63- 0.98)	0.85 (0.68- 1.08)	0.75 (0.58- 0.97)
Type 3: (Negative)	1.22 (1.05- 1.41)	1.47 (1.27- 1.71)	1.24 (1.07- 1.44)	1.50 (1.29- 1.75)	1.22 (1.05- 1.42)	1.47 (1.25- 1.72)	1.06 (0.88- 1.28)	1.17 (0.97- 1.42)
Model Fit:	1082.58		1048.75		998.92		954.13	
Type 4: Personal Events and Behavior Changes								
Type 4: (Positive)	0.99 (0.83- 1.19)	1.07 (0.88- 1.29)	0.98 (0.81- 1.18)	1.00 (0.83- 1.22)	0.99 (0.81- 1.19)	1.02 (0.83- 1.25)	1.04 (0.84- 1.30)	1.08 (0.85- 1.37)
Type 4: (Negative)	1.30 (1.13- 1.50)	1.62 (1.40- 1.87)	1.31 (1.14- 1.51)	1.60 (1.39- 1.86)	1.29 (1.12- 1.49)	1.57 (1.35- 1.83)	1.14 (0.96- 1.35)	1.28 (1.07- 1.53)
Model Fit:	1064.58		1036.50		990.31		954.13	

Odds Ratios, 95% Confidence Intervals, and -2 Log Likelihood (model fit) at $\alpha=0.05$; Aim 2, Research Question 1, Models 1-4.

Model 1 is the crude association between Positive and Negative Life Event Counts; Model 2 includes all covariates from the literature review, except income; Model 3 includes all covariates from the literature review; Model 4 includes all Life Event Types Positive and Negative Life Event Count variables.

Table 4.14: Multinomial Logistic Regression Analysis of Positive and Negative **Life Event Impact Scores** for Each Life Event Type. N=511.

	Model 1		Model 2		Model 3		Model 4	
	LFS	VLFS-C	LFS	VLFS-C	LFS	VLFS-C	LFS	VLFS-C
Type 1: Events Concerning Spouse/Partner Relationships								
Type 1: (Positive)	0.97 (0.88- 1.06)	0.98 (0.89- 1.08)	0.98 (0.89- 1.08)	0.99 (0.89- 1.09)	0.99 (0.90- 1.10)	1.02 (0.92- 1.14)	1.02 (0.92- 1.14)	1.08 (0.95- 1.23)
Type 1: (Negative)	1.15 (1.00- 1.32)	1.18 (1.03- 1.35)	1.16 (1.00- 1.33)	1.23 (1.06- 1.41)	1.15 (0.99- 1.33)	1.20 (1.04- 1.40)	1.02 (0.87- 1.18)	1.00 (0.85- 1.18)
Model Fit:	1109.06		1073.69		1021.22		957.39	

Type 2: Work or Financial Stability								
Type 2: (Positive)	0.94 (0.87- 1.02)	0.90 (0.82- 0.99)	0.94 (0.86- 1.02)	0.90 (0.82- 0.99)	0.96 (0.88- 1.05)	0.95 (0.86- 1.06)	0.97 (0.88- 1.06)	0.95 (0.85- 1.07)
Type 2: (Negative)	1.21 (1.12- 1.30)	1.29 (1.20- 1.39)	1.22 (1.13- 1.31)	1.30 (1.20- 1.41)	1.20 (1.12- 1.30)	1.29 (1.20- 1.40)	1.17 (1.08- 1.27)	1.23 (1.13- 1.34)
Model Fit:	1050.04		1015.98		974.75		957.39	
Type 3: Family and Other Personal Relationships								
Type 3: (Positive)	0.95 (0.88- 1.03)	0.91 (0.84- 0.99)	0.96 (0.89- 1.04)	0.92 (0.85- 1.00)	0.95 (0.87- 1.03)	0.91 (0.83- 0.99)	0.96 (0.87- 1.05)	0.90 (0.81- 1.00)
Type 3: (Negative)	1.11 (1.03- 1.19)	1.21 (1.12- 1.30)	1.12 (1.04- 1.21)	1.21 (1.13- 1.31)	1.12 (1.03- 1.21)	1.20 (1.11- 1.30)	1.04 (0.95- 1.14)	1.08 (0.98- 1.19)
Model Fit:	1080.64		1048.02		997.60		957.39	
Type 4: Personal Events and Behavior Changes								
Type 4: (Positive)	0.99 (0.92- 1.07)	1.03 (0.95- 1.11)	0.99 (0.92- 1.06)	1.00 (0.93- 1.08)	0.99 (0.91- 1.07)	1.00 (0.93- 1.09)	1.01 (0.92- 1.10)	1.03 (0.94- 1.13)
Type 4: (Negative)	1.13 (1.05- 1.21)	1.23 (1.14- 1.32)	1.13 (1.05- 1.21)	1.22 (1.14- 1.31)	1.11 (1.03- 1.20)	1.20 (1.11- 1.29)	1.04 (0.95- 1.13)	1.07 (0.98- 1.17)
Model Fit:	1076.97		1046.75		1002.29		957.39	

Odds Ratios, 95% Confidence Intervals, and -2 Log Likelihood (model fit) at $\alpha=0.05$; Aim 2, Research Question 2, Models 1-4.

CHAPTER 5

DISCUSSION

Initially we hypothesized that a higher number of negative life events and impact scores would be associated with higher odds of food insecurity, while a higher number of positive life event counts and corresponding higher positive impact scores would be inversely related to food insecurity. We found significant associations for food insecurity only between negative overall life event counts (OR for LFS: 1.16, CI 1.09-1.24; OR for VLFS-C: 1.28, CI 1.20-1.37) and perceived impacts (OR for LFS: 1.08, CI 1.04-1.11; OR for VLFS-C: 1.12, CI 1.08-1.15), and no significant results between food insecurity and positive overall life event counts, or between food insecurity and positive perceived impact scores.

The MFS study used Sarason's Life Experiences Survey (LES)[85] to better understand the influence of life events and food security status by allowing participants to indicate whether or not they experienced a broad spectrum of events (42 events included in this modified tool), and to indicate the perceived positive and negative impact of those events. Many of the life event studies reviewed for this thesis in Chapter 2 were centered around specific/individual life events (i.e. Sakraida [97], Hull [91], Villar-Loubet [87]), the impact of a category of life events measured with another life event tool (i.e. Han [96], Witt [98], Corless [103]), the use of general life event

counts irrespective of whether the event was positive or negative (i.e. Weinreb [55], and Wehler [66]), or around other measures that may be tangentially related to life events such as socio-economic status and the impact of psychosocial variables (i.e. Laraia [11], Bhargava [42]). There were very few articles that discussed food security status among households with children and life events.[11,112] Whenever possible, literature reviewed in this chapter will focus on comparisons with other life event studies conducted with a LES tool (or modified LES tool, like the MFS), and the differences in LES utilization to measure the influence of life events.

As discussed in Chapter 2, an underlying argument for this thesis is that there is a struggle between the structure of disparity, and an individual's agency or ability to act in the midst of stress and adversity.[118,119] There are risk factors that a participant may be born with (i.e. gender or race) and unable to control or change, that place him/her at risk for life struggles and adversity from historical, social, political and economic forces. These forces may work to act 'upon' a participant's life, where life events would happen to the participant, instead of the participant having the ability to make choices to change their situation. The alternative argument is that even in the midst of adversity, disparity, and life struggles, individuals are able to redefine expectations, respond and have agency, if not to reverse their situation or reduce everyday hardships, at least be able to adapt and survive, or to fail or quit.[120] The response to life events or stressors in the face of food insecurity may be increased/decreased financial management skills[45] (the self-professed ability to identify sales, discounts, using assistance

programs to supplement and weather financial shock, budgeting), and food life skills [47] (ability to stretch groceries, prepare meals, and couponing).

While we have reviewed literature in Chapter 2 related to financial management skills and food life skills [46,47,118], the perspective of 'agency' may not be accurately measured using the LES instrument. Life events used for the LES mostly ask about events that have acted 'upon' a participant's life or how 'structure' has wrought life changes for the individual participant. Events may overlap, happen more than once within the 3 year time period asked for reporting, and we cannot see the temporal sequence for how these events follow each other. Participants are asked to indicate the perceived impact of an event, positive or negative, but even this implies an event happening 'to' the participant instead of measuring an action generated (i.e. agency) by the participant. For example: Within the work and financial stability event type 2, the events 'New job', 'Changed work situation', 'Fired from a job', and 'Trouble with employer' may all be linked in any temporal order, but are counted separately. New jobs don't just 'happen'; neither does a 'Changed work situation' or any of the above events. Additionally, a participant's current work situation may impact how the perceived event impact is noted, instead of if the event occurred 2 years ago and the participant is asked to recall an impact. For future research, adjusting for current employment status or number of weeks employed during the last calendar year may be important when thinking about the association between work and financial stability events and food security status. For the purposes of this thesis, the argument of 'structure' versus

'agency' is an important conceptual framework or lens to apply to all uses of life event measurements discussed in this chapter, LES or otherwise.

A major advantage, and something that is unique about this study, is that by always analyzing positive and negative life events within the same model, by count, impact, and/or type, we at least have the possibility of gaining some insight into the impact of positive life events. After adjusting for income, all other covariates, and negative counts for event type 3, positive counts of family and other personal relationship events had a significant, negative relationship with VLFS-C (OR 0.78, 95% CI 0.63-0.98). Within the same model, holding all covariates and positive life event type 3 counts constant, a positive association of negative life event counts with food insecurity status within the same event type exists (OR 1.47, 95% CI 1.25-1.72). Positive impact scores for family and other relationship events, after adjusting for income were significantly associated with lower odds of VLFS-C compared to FS status (OR 0.91, 95% CI 0.83, 0.99). Within the same Model 3 analysis, holding all covariates and positive impact scores for event type 3 constant, higher negative life event impact scores for family and other relationship events were associated with higher odds of VLFS-C compared to FS status (OR 1.20, 95% CI 1.11, 1.30).

Examples of the use of positive and negative events were found in studies by Pretorius in a sample of South African students [86], and Semple, et al., to examine the association between life events and sexual risk among HIV negative heterosexual methamphetamine users.[116] Pretorius' study was primarily concerned with

correlating the use of Sarason's Life Experiences Survey with the use of scores on the Center for Epidemiological Studies Depression scale in a South African context. Pretorius found that positive events moderated the correlation of negative events with depression [86] consistent with findings found for this project using the MFS study sample, where positive life events remain significant while holding the effects of negative life event variables constant. Semple, et al. examined the relationship between positive and negative life events both as counts and as impacts (discussed later in this chapter), but did not use the LES tool to measure life events. Instead, participants were first asked to detail any positive or negative events in an open-ended format, and Semple, et al. later divided the responses into positive and negative event types based on responses. Regression analysis included positive and negative events, grams of methamphetamine use in the last 30 days, depressive symptoms, and an interaction term between negative events and grams of methamphetamine use. Negative life events were positively associated with the number of unprotected sex acts engaged in by the participant, and positive life events had no association. Gender was significant for predicting the number of unprotected sex acts (being male was associated with more unprotected sex), but no difference was found between negative events reported by men and women.[116] Like the regression analyses for this project, when positive events were included with negative events in the same model, negative life events remained significant for both LFS and VLFS-C while many of the positive event findings remained insignificant, or were no longer significant when adjusting for all covariates and all other positive and negative life event variables, for count or impact.

Direct comparison of life event counts versus overall impact was not possible for this study due to life event counts having a more compressed scale (smaller range) than impact scores; thus, the difference in a one unit change would not be comparable in our models for counts and perceived impact scores. Any differences between the association of negative overall count associations and negative overall perceived impact associations with food security status may be due to these differences in scale, or perhaps a function of random variation. Life events (as counts) may also be a more reliable construct than recall of the perceived impact of a life event, the latter potentially leading to misclassification and bias toward the null.

Similar to the MFS survey, Lumeng, et al. also used a modified Life Experiences Survey to measure event counts and perceived impact by event type, where responses were captured on a 7-point scale with an event rated -3 having an extremely negative perceived impact, and +3 having the most positive perceived life event impact (0=no event).[106] Like the analysis for this project, if an event was scored -3, -2, or -1, the event was counted as 1 negative life event and all negative life events for that participant were summed. In Lumeng's analysis, the impact of overall negative life events was not associated with risk of overweight, but neither was the overall count of life events (positive and negative) associated with overweight status in adolescence (no direct comparison between event counts and impacts). Our study shows that when positive and negative life event counts were separated into separate variables for analysis, family and other personal positive events were significant, having a negative association with both categories of food insecurity. The analysis for this project is

therefore stronger in that we do gain some insight into the potentially protective impact of positive life events.

Another example of a study that has studied both overall life event counts and perceived impact scores using Sarason's LES life event tool is a recent article by Fang, et al. (2015) about positive and negative life events and insulin resistance among Chinese immigrant women in the United States.[117] Fang and her colleagues sampled 423 women from Pennsylvania using Sarason's LES and positive and negative events as overall count variables, and the summed positive and negative impact scores in two separate models. Positive life event counts were not significantly associated with insulin resistance, but negative life events when included in the same model showed 17% (95% CI 1.02-1.34) higher odds for each one unit increase in negative event count of experiencing insulin resistance. Similarly, positive impact scores were not associated, but negative impact scores in the same model had 8% (95% CI 1.01-1.16) higher odds for each one unit increase in impact score for insulin resistance. Fang equates greater stress with greater risk, a finding consistent with our analysis of life events and food insecurity.

Analyzing life events by event type was the final layer of analysis that we applied to positive and negative life event counts and impact scores. Semple, et al. again did not use Sarason's LES as a life event measurement tool, but still used positive and negative life events by type as part of their final analysis. However, instead of allowing participants to self-rate their experience and assign a weighted positive or negative value to each event (-3 to +3), Semple and her colleagues identified 5 positive life event

types and 8 negative life event types from open ended survey responses related to life events experienced in the last 6 months to examine the association between life events and methamphetamine use with unprotected sexual acts among 100 HIV negative heterosexuals.[116] For negative life events, the top 3 categories of life events experienced were death of a significant other (29.1%), negative health event involving self or significant other (14.5%), and relationship problems (12.7%). The top 3 positive events experienced were birth or pregnancy involving self or significant other (34.0%), positive relationship events (21.3%), and positive life changes (21.3%). Males and females did not differ in the percentage reporting a positive or negative life event in any category (55% male sample, 45% female sample). Since Semple, et al.'s categories for positive and negative life event types were different, or didn't 'match' like event types created for this project (example: positive work and financial events 'match' negative work and financial events), it is difficult to make comparisons of the effect of similar positive and negative life event types in the way that our study seeks to do, or in the way that Lumeng, et al.'s study seeks to do.[106] Based on the top reported negative life events in Semple's study, negative events related to family and other relationship events (what we call event type 3) were the most commonly reported events.

When we began analyzing life events by event type, we hypothesized that positive and negative life event counts and impact scores related to work or financial stability would be most strongly associated with food security status. This hypothesis originated with the idea presented in Chapter 2 that poverty (here measured as low income) is closely tied to food insecurity, which may be most reflected in positive or

negative events related to work and financial stability. Our findings were partially consistent with our hypotheses, and we found that for each one unit increase/higher negative life event experienced within event type two, we expect 84% higher odds of being VLFS-C, and 54% higher odds of being LFS. For each one unit increase of perceived negative impact within life event type 2, we expect 20% higher odds of VLFS-C and 12% higher odds of LFS. Positive event counts or perceived impact scores within event type 2 were not significant. We also observed that participant income played an important role, similar to results found by Laraia, et al where low income was a significant predictor of food insecurity when added to the logistic models.[11]

To the best of our knowledge, Hadley, et al. conducted the only other study (besides Laraia, et al.) which used food security and life events, measuring the association with anxiety and depression in East Africa.[112] Hadley's study differed from the MFS examination of life events in almost every respect: the LES instrument was not used (used the Harvard Trauma Questionnaire), life events were assessed as having happened at any point in the participant's life (instead of MFS assessment of in the last 3 years), and most questions were not culturally comparable to events noted in the LES. For example, women were asked about 'marriage by abduction' as a possible life event, and the most commonly endorsed items for men and women were witnessing beatings to the head or body, confiscation or destruction of property, and lack of food and water. Only incarceration in the list of most commonly noted events was common with the LES instrument. High anxiety and high depression were the ultimate outcomes for Hadley et al.'s study, and both food security and life events were strongly associated with anxiety

and depression symptoms ($p < 0.01$ for each). Our study, using the MFS study sample, is a unique assessment of the association of food security status and life events in the US, and is consistent with Hadley's findings that even with cultural differences, there is a relationship between food insecurity and life events.

Among MFS study participants, the strongest associations between food insecurity and negative life event counts and perceived negative event impact scores were observed for work and financial stability life events (i.e. type 2 discussed above), followed by personal events and behavior changes (event type 4), then family and other personal events (event type 3). Events concerning spouse/partner relationships (event type 1) negative event counts and perceived impacts (separate models) were associated with VLFS-C only. When testing for independent effects, positive and negative event counts concerning spouse/partner relationships (event type 1) were not significant, and spouse/partner relationship events (type 1), family and other personal relationship events (type 3), and personal events and behavior change events (type 4), positive and negative, were insignificant. While the strongest odds of food insecurity were in models considering negative work and financial stability life event (type 2) counts and models considering perceived negative impacts of event type 2 (both models holding income constant), it is important to note again that food insecurity is still possible among middle income groups. [41] Participants who experienced negative life events within the work or financial stability event type (count or impact) still seem to have experienced more instability in their food security status.

To compare, Feizi, et al.'s study is another study that used negative life event types: family conflicts, financial problems, social problems, and job insecurity (LES instrument was not used).[105] Feizi et al. found that family conflicts had the strongest association with perceived stress, followed by social problems, and financial problems and job insecurity with the weakest associations. Major differences between this project and Feizi, et al.'s study were that in addition to different outcomes and measurement tools for life events, our event types were different, and the LES tool allowed MFS participants to indicate positive experiences with any of the 42 indicated life events in the module. For our models, even when testing for independent effects, positive family and other personal relationship event counts (type 3) had a negative association with food insecurity. Based on findings from our study with the MFS sample, had Feizi, et al. also included positive family events would they have still seen the strongest association with family conflicts and perceived stress?

Like the MFS study, Lumeng, et al.[106] used a modified Life Experiences Survey, and in addition to using event counts and impacts as discussed above, also divided the events into event types by author consensus. Only negative life events were included for the analysis by event type, and when testing for independent effects, only family health remained a significant predictor of overweight in adolescence.[106] Four negative event types were created: parent or family physical or mental health and well-being, parental work or financial stability, emotional aspects of relationships, and family structure and routine. Events noted within each of the four types created by Lumeng were very similar to events included in the four event types created for our analysis, but were directed at

the experiences of children. Lumeng, et al. tested for independent effects of the event types, as we did for our analysis. While the overall impact of negative life events and the overall event counts (positive, negative, and/or neutral) were not associated with risk of overweight, when different types of negative life events were included simultaneously in the model, only family health remained a significant predictor of overweight.[106] This event type most closely corresponds to our event type 3 (though the LES asks for life events experienced by adults), family and other personal relationships. When testing for independent effect, life event type 3 was insignificant for positive and negative impact by type, but positive event counts for event type 3 were significant (OR 0.75, 95% CI: 0.58-0.97). Our inclusion of positive event counts and impacts by event type (separate models) are important to consider, and again add an advantage in that more can be understood about the impact of positive life events when experienced alongside negative life events. To compare with Lumeng et al.'s paper, another study by Weinreb also focused on negative life events (did not use the LES tool) for the child's life, not the caretaker, and found similar associations between negative life events among children and child hunger.[55] After controlling for housing status, mother's distress, and life events, severe child hunger was associated with higher rates of mother-reported child anxiety (school-aged and preschool-aged).

A final method for using life events has been shown by Wehler, et al.[66] where negative life event counts are not considered the primary exposure, but are treated as one of many possible contributing factors to adult or child hunger. Wehler, et al. used a count of major life events using the LES measurement tool among 354 women who

were either homeless or at risk for homelessness. Eight other formal questionnaires, in addition to collecting general demographic data and the LES survey, were administered and included in Wehler's analysis to measure initial risk factors such as health status and behaviors, substance use, depression, post-traumatic stress, coping strategies, service utilization and perception of service needs, social network size and social support, and distal factors such as the respondent's parenting received as a child, adverse child events such as physical/sexual abuse, and parental substance abuse. When the initial analysis of bivariate associations with both adult and child hunger were performed, life events were significant ($p < 0.001$), but when tested in the final multivariate model of factors associated with hunger status, life events were not selected for the final, most parsimonious model. In the context of all other risk variables studied, the use of life events (not clear whether only negative life event counts were used, or a sum of all life events, positive and negative) did not have an independent association with child hunger or food security status.[66] While our study using the MFS sample has been careful to make a distinction between only negative life events and the possible effect of positive life events, based on Wehler, et al.'s findings there may certainly be other variables or stressors that 'absorb', or maybe even overshadow the effects of negative life events and the association with food security status.

The Midlands Family Study sample included a large proportion of minority households (79.0%) and female households (92.6%), which allowed analysis of populations found to be disproportionately affected by household food insecurity. The MFS sample also considered the effect of geographic location by sampling in urban,

suburban, and rural areas. A major strength of this study was that it assessed not only the overall association of the number of life events experienced with food security status but included consideration of the perceived impact of the life events. We were able to assess the differences between the positive and negative perceived impacts of life events with food security status, and the differences between positive and negative overall counts of life events with food security status. Analysis of the number of life events and the impact of life events was also applied to four life event types, which was another strength of this study. This extra layer of analysis allowed us to further understand the relationship of certain categories of events and their association(s) with food security status.

Sample size and composition for the MFS study population was a strength when evaluating the impact of life events for food security in the US. Lumeng, et al. was the other major life event study reviewed in this chapter, with a sample size of 848 study children (82% non-Hispanic White) for a study in the United States.[106] Other life event literature reviewed for this chapter had varying, but still comparable sample sizes to the MFS study. Feizi et al. had a sample size of 4,583 adults in Iran [105], Fang, et al. surveyed 423 women[117], and Semple, et al. surveyed 100 HIV negative participants.[116] The MFS study had 79.0% African American participants, and 21.0% identified as any other ethnicity. The MFS study was focused on food security status as the outcome of interest, and the literature reviewed in Chapter 2 shows a differential between African Americans and other races for experiencing some form of food insecurity. Racial differences exist for food insecurity and other physical health

outcomes such as increased risk for chronic disease,[7,8] obesity,[9] and maternal depression.[10,11] We also know that life events may have a significant impact on the onset of stress, financial changes, personal health, and even mental health issues, which may also be experienced differently by different ethnicities. The MFS study is therefore strong both as a comparable sample size to Lumeng, et al.'s study on the impact of life events, and also stronger with more emphasis on composition of the sample.

In addition to study size, the MFS study was composed or sampled by food security strata. Of the MFS study participants in the final analytic sample for this project, 29% of the sample were food secure, 37% were low food secure, and 34% had a status of very low food security among children. By sampling on these strata instead of having disproportionate sampling in a specific group, more can be said about the impact of exposures such as life events on each of the three food security categories. For example, in another study on food security and psychosocial variables by Laraia, et al. a positive association was found between food insecurity among pregnant females, and psychosocial variables such as perceived stress, trait anxiety, and depressive symptoms. Laraia, et al. sampled 606 pregnant women, 75% who were food secure, 15% were experiencing some form of food insecurity, and 10% were very low food secure.[11]The association noted by Laraia is for any form of food insecurity, where the Midlands Family Study sample allows for real comparisons between different combinations of food insecurity and food secure status, as was done for this project.

While the modeling strategy used in this thesis does allow us to begin to understand the effect of positive events, by count or impact, comparing counts and perceived impacts cannot be done as a direct comparison within this study since there is a difference in scales. Each model used to compare FS and LFS, or FS and VLFS-C calculates the odds of the given food security status associated with a one-unit increase in life event count or life event impact, but these are not comparable because life event count variables have a more compressed scale or smaller range (i.e. a -3 impact score is a 3 unit increase for a negative life event variable, but the same -3 impact score also indicates 1 unit of negative life event count). Z-Scores may be considered for future research to standardize count and impact variables for effective comparison. Additionally, to assess the true impact of positive events, future models may run negative life event variables only to assess the difference in effect. Finally, based on the discussion throughout this thesis about the effect of 'structure' versus 'agency' for life event measurements, future modeling strategies may also include adjustments for current employment status and/or the number of weeks employed during the previous calendar year.

Other limitations for this study are mostly related to the study population and study design. There may be sample selection bias among the MFS study population used for this study, as participants were drawn from families who were already seeking assistance. We did control for whether or not the participant was referred to the study in each of our models to adjust for this possible limitation. The cross-sectional survey and study design used here does allow for a simultaneous examination of exposure (life

events by count, impact and/or type) and outcome (food security status), but is limited in that causal inference cannot be made. In other words, while we can analyze the association between life events and food security status, we are limited in that we cannot assess whether life events led to or protected against a future state of food security or low food security. Given the nature of our findings, particularly the strong associations of work and financial stability life events with food insecurity we found, these findings might be an impetus to design longitudinal studies will allow for stronger causal inference and potentially lead to testable intervention designs focused on dealing with life events.

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APPENDIX A- SENSITIVITY ANALYSIS TABLES

Table A.1: Sensitivity Analysis for the Association of Low Food Security (LFS) and Very Low Food Security among Children (VLFS-C) Compared to Food Secure (FS) Households, **Positive and Negative Life Event Counts.**

Model:	Positive Count, OR (95% CI)	Negative Count, OR (95% CI)
Analytic Sample:		
LFS	0.96 (0.88-1.04)	1.16 (1.09-1.24)
VLFS-C	0.95 (0.87-1.04)	1.28 (1.20-1.37)
Females Only:		
LFS	0.96 (0.88-1.04)	1.14 (1.07-1.22)
VLFS-C	0.96 (0.87-1.05)	1.27 (1.18-1.36)

N=511 Analytic Sample; N=473 Females Only. OR (95% CI) for every one unit increase in event experienced. (Aim 1, Research Question 1, Model 3). Model 3 is the fully adjusted model which includes all covariates from the literature review, including income.

Table A.2: Sensitivity Analysis for the Association of Low Food Security (LFS) and Very Low Food Security among Children (VLFS-C) Compared to Food Secure (FS) Households, **Positive and Negative Life Event Impact Score.** N=511 Analytic Sample; N=473 Females Only.

Model:	Positive Impact, OR (95% CI)	Negative Impact, OR (95% CI)
Analytic Sample:		
LFS	0.98 (0.95-1.01)	1.08 (1.04-1.11)
VLFS-C	0.98 (0.95-1.01)	1.12 (1.08-1.15)
Females Only:		
LFS	0.98 (0.95-1.01)	1.07 (1.04-1.10)
VLFS-C	0.98 (0.94-1.01)	1.11 (1.08-1.15)

N=511 Analytic Sample; N=473 Females Only . OR (95% CI) for every one unit increase in impact score from life events experienced. (Aim 1, Research Question 2, Model 3).

Model 3 is the fully adjusted model which includes all covariates from the literature review, including income.

Table A.3: Sensitivity Analysis for the Association of Low Food Security (LFS) and Very Low Food Security among Children (VLFS-C) Compared to Food Secure (FS) Households, **Positive and Negative Life Event Counts By Event Type**. N=511 Analytic Sample; N=473 Females Only.

	Analytic Sample		Females Only	
	LFS	VLFS-C	LFS	VLFS-C
Type 1: Events Concerning Spouse/Partner Relationships				
Type 1: Positive	1.03 (0.80-1.32)	1.17 (0.90-1.52)	1.06 (0.80-1.40)	1.24 (0.93-1.66)
Type 1: Negative	1.23 (0.89-1.68)	1.45 (1.04-2.01)	1.23 (0.89-1.70)	1.40 (1.01-1.96)
Model Fit:	1021.22		952.22	
Type 2: Work or Financial Stability				
Type 2: Positive	0.95 (0.77-1.17)	0.90 (0.71-1.15)	0.90 (0.72-1.12)	0.88 (0.68-1.12)
Type 2: Negative	1.54 (1.28-1.85)	1.84 (1.51-2.23)	1.53 (1.27-1.85)	1.83 (1.50-2.23)
Model Fit:	980.72		913.28	
Type 3: Family and Other Personal Relationships				
Type 3: Positive	0.86 (0.70-1.06)	0.78 (0.63-0.98)	0.89 (0.72-1.10)	0.80 (0.64-1.01)
Type 3: Negative	1.22 (1.05-1.42)	1.47 (1.25-1.72)	1.18 (1.01-1.39)	1.43 (1.21-1.68)
Model Fit:	998.92		935.46	
Type 4: Personal Events and Behavior Changes				
Type 4: Positive	0.99 (0.81-1.19)	1.02 (0.83-1.25)	0.99 (0.81-1.21)	1.02 (0.83-1.26)
Type 4: Negative	1.29 (1.12-1.49)	1.57 (1.35-1.83)	1.23 (1.06-1.43)	1.54 (1.32-1.80)
Model Fit:	990.31		925.12	

N=511 Analytic Sample; N=473 Females Only . OR (95% CI) for every one unit increase in life event count. (Aim 2, Research Question 1, Model 3). Model 3 is the fully adjusted model which includes all covariates from the literature review, including income.

Table A4: Sensitivity Analysis for the Association of Low Food Security (LFS) and Very Low Food Security among Children (VLFS-C) Compared to Food Secure (FS) Households, **Positive and Negative Life Event Impact Scores By Event Type**. N=511 Analytic Sample; N=473 Females Only.

	Analytic Sample		Females Only	
	LFS	VLFS-C	LFS	VLFS-C
Type 1: Events Concerning Spouse/Partner Relationships				
Type 1: Positive	0.99 (0.90-1.10)	1.02 (0.92-1.14)	1.00 (0.90-1.11)	1.04 (0.92-1.16)
Type 1: Negative	1.15 (0.99-1.33)	1.20 (1.04-1.40)	1.15 (0.99-1.34)	1.20 (1.03-1.40)
Model Fit:	1021.22		952.02	

Type 2: Work or Financial Stability				
Type 2: Positive	0.96 (0.88-1.05)	0.95 (0.86-1.06)	0.95 (0.87-1.04)	0.94 (0.85-1.04)
Type 2: Negative	1.20 (1.12-1.30)	1.29 (1.20-1.40)	1.19 (1.10-1.29)	1.29 (1.19-1.40)
Model Fit:	974.75		908.14	
Type 3: Family and Other Personal Relationships				
Type 3: Positive	0.95 (0.87-1.03)	0.91 (0.83-0.99)	0.96 (0.88-1.04)	0.91 (0.83-1.00)
Type 3: Negative	1.12 (1.03-1.21)	1.20 (1.11-1.30)	1.11 (1.02-1.20)	1.20 (1.10-1.30)
Model Fit:	997.60		932.59	
Type 4: Personal Events and Behavior Changes				
Type 4: Positive	0.99 (0.91-1.07)	1.00 (0.93-1.09)	0.98 (0.91-1.07)	1.00 (0.92-1.09)
Type 4: Negative	1.11 (1.03-1.20)	1.20 (1.11-1.29)	1.09 (1.01-1.17)	1.19 (1.10-1.28)
Model Fit:	1002.29		935.27	

N=511 Analytic Sample; N=473 Females Only . OR (95% CI) for every one unit increase in perceived impact scores. (Aim 2, Research Question 2, Model 3). Model 3 is the fully adjusted model which includes all covariates from the literature review, including income.

APPENDIX B-

SUMMARY TABLES FOR AIM 2

Table B.1: Multinomial Logistic Regression Analysis of Positive and Negative Life **Event Counts** for Each Life Event Type. N=511.

	Model 1		Model 2		Model 3		Model 4	
	LFS	VLFS-C	LFS	VLFS-C	LFS	VLFS-C	LFS	VLFS-C
Type 1: Events Concerning Spouse/Partner Relationships								
Type 1: (Positive)								
Type 1: (Negative)				Pos (+)		Pos (+)		
Model Fit:	1111.74		1076.01		1021.22		954.13	
Type 2: Work or Financial Stability								
Type 2: (Positive)		Neg (-)		Neg (-)				
Type 2: (Negative)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)
Model Fit:	1060.94		1025.44		980.72		954.13	
Type 3: Family and Other Personal Relationships								
Type 3: (Positive)		Neg (-)		Neg (-)		Neg (-)		Neg (-)
Type 3: (Negative)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)		
Model Fit:	1082.58		1048.75		998.92		954.13	
Type 4: Personal Events and Behavior Changes								
Type 4: (Positive)								
Type 4: (Negative)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)		Pos (+)
Model Fit:	1064.58		1036.50		990.31		954.13	

Odds Ratios, 95% Confidence Intervals, and -2 Log Likelihood (model fit) at $\alpha=0.05$; Aim 2, Research Question 1, Models 1-4. Model 1 is the crude association between Positive and Negative Life Event Counts; Model 2 includes all covariates from the literature review, except income; Model 3 includes all covariates from the literature review; Model 5 includes all Life Event Types Positive and Negative Life Event Count variables.

Table B.2: Multinomial Logistic Regression Analysis of Positive and Negative **Life Event Impact Scores** for Each Life Event Type. N=511.

	Model 1		Model 2		Model 3		Model 4	
	LFS	VLFS-C	LFS	VLFS-C	LFS	VLFS-C	LFS	VLFS-C
Type 1: Events Concerning Spouse/Partner Relationships								
Type 1: (Positive)								
Type 1: (Negative)		Pos (+)		Pos (+)		Pos (+)		
Model Fit:	1109.06		1073.69		1021.22		957.39	
Type 2: Work or Financial Stability								
Type 2: (Positive)		Neg (-)						
Type 2: (Negative)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)
Model Fit:	1050.04		1015.98		974.75		957.39	
Type 3: Family and Other Personal Relationships								
Type 3: (Positive)		Neg (-)				Neg (-)		
Type 3: (Negative)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)		
Model Fit:	1080.64		1048.02		997.60		957.39	
Type 4: Personal Events and Behavior Changes								
Type 4: (Positive)								
Type 4: (Negative)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)	Pos (+)		
Model Fit:	1076.97		1046.75		1002.29		957.39	

Odds Ratios, 95% Confidence Intervals, and -2 Log Likelihood (model fit) at $\alpha=0.05$; Aim 2, Research Question 2, Models 1-4. Model 1 is the crude association between Positive and Negative Life Event Impact Scores; Model 2 includes all covariates from the literature review, except income; Model 3 includes all covariates from the literature

review; Model 4 includes all covariates and all Life Event Types Positive and Negative Impact Score variables.
