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Food Insecurity and Age of Menarche: Using a Biocultural Approach and Life History Theory to Assess Risks of Food Insecurity among Girls in Tampa Bay, FL

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Food Insecurity and Age of Menarche

Using a Biocultural Approach and Life History Theory to Assess Risks of Food Insecurity among Girls in Tampa Bay, FL

by

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A thesis submitted in partial fulfillment
of the requirements for the degree
Master of Arts
with a concentration in Applied Biological Anthropology
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ABSTRACT

Using life-history theory within a biocultural perspective, this research explores whether household food insecurity correlates with early or delayed menarche among adolescent females in Tampa Bay, Florida. Early onset of puberty and menstruation is connected with numerous health consequences including growth stunting, obesity, type-2 diabetes, adult-onset asthma, reproductive cancers, increased risk for depression, behavioral problems, and early sexual activity which increases the risk for STIs and ovarian cancer. Early menarche also seems to disproportionally impact disadvantaged and minority groups. While there are many known factors that influence age at menarche (e.g.: genetics, diet), little is understood regarding the effect of food insecurity on menstrual timing. When considering food insecurity as an environmental adversity, long-term exposure may result in biological trade-offs within growth and development.

Using a mixed-methods approach, 40 girls and 36 parents or guardians from Pinellas, Hillsborough, and Manatee counties participated in household dyadic interviews that included the assessment of household food security, girls’ dietary analysis, and anthropometry. Using quantitative analyses, the associations of diet, food security, and body size/composition to menarche were evaluated. A Cox hazards model and regression further analyzed the association of food insecurity and the timing of menarche.

The research concludes that adolescents and their families are vulnerable to food insecurity for both biological and social reasons. Qualitative results examine the prevalence, experiences, and perpetrators of food insecurity, as well as strategies used by families to mitigate food insecurity. Food insecurity in this study refers to the inconsistent or limited access to adequate amounts of safe and nutritious foods to sustain health and wellbeing. Food insecurity does not necessarily result in hunger.
Once can have access to enough calories and not feel hungry but may still be food insecure if their access does not include enough high-quality, nutritious foods.

Quantitative analyses showed that iliac height, waist-hip ratio, snack consumption, and household food insecurity is associated with age at menarche among this sample. Spearman’s Rho confirms that height, leg length (p = 0.032, rs = 0.407), and snack consumption (p = 0.042, rs = 0.464) significantly positively correlate with age at menarche. Waist-hip ratio significantly negatively correlates with age at menarche (p = 0.032, rs = -0.518). Cox Hazard Regression analysis interprets that for every one unit increase in household food security survey score, the risk of experiencing menarche increases by 25% (p = 0.023, OR = 1.25). However, when adding leg length, waist-hip ratio, and snack consumption to the Cox Hazard Regression equation, no variables significantly predict menarche.

These findings provide a better understanding of the biocultural influences within the timing of menarche. The research provides new insights and further stresses the importance of improving food assistance programs for adolescents and families with older children.
CHAPTER 1: INTRODUCTION

“We cannot afford to systematically starve our children even by an indirect way, even in a mild degree”

– Horace Makechnie 1897, American Medical Association Annual Meeting.

Adolescence is defined as the transitional period between childhood and adulthood (Belachew et al. 2013; WHO 2016), and is one of the most important and fragile growth stages within the human lifespan (Cordeiro et al. 2012). Besides infancy, adolescence is the only life course period when one’s growth rate accelerates. Thus, it is essential to obtain adequate nutrients during this time to support healthy growth and development, as well as build immune responses to harmful infections and disease (CDPH 2012; Belachew et al. 2013). With the onset of menstruation, much of the body’s energy is shifted toward preparing for reproduction (Caudell and Quinlan 2012). When menarche, or the first appearance of menstruation, happens too early in the lifespan, numerous health consequences can occur. While debated, early puberty is generally defined as having breast development before the age of nine years in which menarche would typically follow two years after (10 years) (Berberoglu 2009). Thus, early menarche would include menarche at or before 10 years of age. For this study, menarcheal ages are compared to the national average. Early menarche will be determined as menarche that has occurred earlier than national average age for U.S. girls.

Early puberty has been linked to growth stunting, obesity, type-2 diabetes, adult-onset asthma, reproductive cancers, increased risk for depression, behavioral problems, and early sexual activity which increases the risk for STIs and ovarian cancer (Benson and Jattoi 2012; Mascali et al. 2011; Frontini et al. 2003; Remsberg et al. 2005; Allsworth et al. 2005; Kaltiala-Heino et al. 2003; Vaughan et al. 2015;
Villamor and Jansen 2016). In addition, early pregnancy when the body is not fully ready for reproduction is a risk that can lead to both physical and mental health maladies.

Food insecurity is defined as having limited or uncertain access to adequate amounts of safe and nutritious foods (USDA ERS 2017a). In the United States, approximately 6.8 million adolescents between the ages of 10 and 17 are food insecure (Popkin et al. 2016). The consequences of food insecurity during childhood are highly similar to the effects of early maturation. For example, there has been a consistent increase in childhood obesity in relation to food insecurity and hunger in the U.S over the past 25 years. There are many social determinants, including both macro and micro-level factors, that underpin food insecurity. Over the last twenty years, food prices have consistently increased while income has remained stable (Hadley and Crooks 2012; Stone et al. 2017). Growing income inequality paired with the high costs of food lead families to seek out lower-priced and lower-quality food items as a coping strategy to prevent hunger (Cook and Frank 2008; Hadley and Crooks 2012). Processed foods, in particular, have become much more affordable when compared to whole or organic foods. Thus, people turn to foods that are cheap, filling, and long-lasting to mitigate food insecurity (Hadley and Crooks 2012).

Geography also plays a role within food access. Living in a food desert, which is defined as an area that is at least one mile away from adequate amounts of healthy and whole foods, limits not only one’s access to nutritious foods but also the variety of foods available (American Nutrition Association 2015). Reduced dietary diversity is associated with poorer dietary quality and food insecurity (Armelagos 2014). Living in a food swamp additionally influences food security. Food swamps are made up of fast-food restaurants and convenience stores offering quick, effortless, and cheap meals that are low in nutritional value (Hager et al. 2017). The consumption of convenient foods is particularly related to factors such as time, effort, and cost. It is known that people in the U.S. turn to quick or ready-made meals to save time and energy (Dubowitz et al. 2007). Those who work long hours or have children are more likely to consume convenient foods (Dubowitz et al. 2007).
Other social determinates of food insecurity can include household size and whether children live in the home. Households with children have higher rates of food insecurity and that number increases among single-headed households (Coleman-Jensen et al. 2016). Adults in the home, as well as older children, may try to protect younger children from food insecurity by lowering their own food intake and dietary quality. In addition, coping strategies such as rationing, skipping meals, and overindulging all increase the risk of food insecurity within households with children (Connell et al. 2005). Psychological components are also important factors behind food insecurity. Stress and worry about food can lead to unhealthy eating patterns and reduced food intake (Connell et al. 2005). In addition, individuals may feel shame or embarrassment because of their financial circumstances (Connell et al. 2005). This stigma may limit participation in food assistance programs or keep someone from asking for help from neighbors, friends, or family.

The low cost and high availability of poor-quality foods paired with these social determinants have created a food insecurity and obesity paradox in developed countries. In the U.S., for example, food insecurity is mostly interrelated with overweight, obesity, and occasionally growth stunting (Hadley and Crooks 2012; Laraia 2013). In Brazil, a study by Schlüssel and colleagues found that food insecure female adolescents “are about two times more likely to have excess weight when compared to their food secure counterparts” (Himmelgreen 2013:230). In opposition, the connection between food insecurity and undernutrition is more present in the developing world where accounts of wasting and growth stunting remain a significant issue. Both overnutrition and undernutrition stemming from food insecurity are associated with poor health outcomes. These include increased risk for non-communicable chronic diseases and stress (Brenton 2014; Cook and Frank 2008). Therefore, it is necessary to understand how food insecurity during specific periods of a person’s life can impact their health throughout various stages of the life course.

Nutrition and food consumption have also been linked to the onset of puberty and menarche cross-culturally. When the body has enough calories (energy) to sustain one’s growth, development, and reproduction, menstruation can begin. When severe food insecurity leads to under-nutrition, menarche is
often delayed, as the body sustains and allocates energy for the survival of the individual rather than for reproduction. Energy may also be saved and used for vital physiological growth and development rather than for maturation. However, evolutionary research has also found that exposure to adversity in childhood and adolescence can accelerate menarche when the risk of immediate mortality is low (Belechew 2013). In the developed world, food insecurity among adolescents is associated with poor dietary habits, and consequentially, overnutrition (Widome 2009; Himmelgreen 2013). Overnutrition is defined by the Partnership for Maternal, Newborn, & Child Health (PMNCH) as abnormal or excessive fat accumulation that results in overweight or obesity and may impair health (PMNCH 2012). The SickKids Centre for Global Child Health defines overnutrition as excess calories or excess of a specific nutrient that can impair bodily functions and lead to overweight, obesity, and chronic disease (Rojas 2016). Thus, the results of overnutrition from food insecurity can alter body composition and increase the risks for various chronic illnesses. Applying energetics and life history theories, overnutrition and stress stemming from food insecurity have the ability to lead to earlier menarche as a biological trade-off where energy is allocated toward reproduction rather than toward immediate survival (Caudell and Quinlan 2012). This trade-off may induce health consequences as early onset of puberty and menarche are linked to diseases such as cancer, diabetes, obesity, and asthma, as well as mental and behavioral risks including depression and risky behaviors (Villamor and Jansen 2016; Benson and Jattoi 2012). Conclusively, these risks are why it is vital to understand the underpinnings of early menarche so that initiatives can be undertaken to prevent its occurrence. Ultimately, tackling the factors behind early puberty can be an effective preventive health method for girls and women in the U.S.

**Research Objectives**

The aim of this research is to understand whether household food insecurity associates with early or delayed menarche among adolescent females in the United States. Since diet and nutrition can play a significant role in the timing of menarche, this study will assess dietary quality and body mass index of participants to understand how food insecurity shapes diet, nutritional status, and ultimately development. These objectives provide a bio-cultural understanding of how the experience of food insecurity and its
interrelated effects are embodied by youth and adolescents. This research is a test to see whether food insecurity induces life-history tradeoffs by accelerating pubertal maturation and thus the reproductive process. I hypothesize that girls who are food insecure or experience food insecurity at time of menarche will have earlier ages of menarche when compared to the national average age of 12.5 years. Behind this main hypothesis, I will explore whether food insecure girls have poor quality diets consisting of energy-dense foods and how diet correlates with age at menarche. In addition, I will evaluate the hypothesis that food insecure girls will have higher body mass indexes and waist-hip ratios but shorter linear height when compared to U.S. for-age percentiles. Furthermore, I will analyze how body composition associates with food insecurity and age at menarche. Ultimately, the goal is to better understand human variation and health disparities and to apply the knowledge from this study to improve adolescent food security initiatives and preventive health tactics.

**Background**

Relative background information obtained from an extensive literature review is presented below. The reviewed articles, books, and chapters are taken from various disciplines.

**Trends in Age at Menarche**

Large shifts in the timing of menarche can be found throughout human history. Aligning with life history theory, prehistoric females are thought to have experienced menarche between the ages of seven and 13 years, where sexual maturation was most likely associated with psychosocial maturity (Gluckman and Hanson 2006). The age at menarche likely increased to between 12 and 15 years following the settlement of populations and the shift to agriculture, which induced an increase in mortality risks (Gluckman and Hanson 2006). During the 18th century, population size increased substantially as did the prevalence of disease and infection. This paired with the industrial revolution likely delayed the timing of menarche further—to approximately 15 years of age (Gluckman and Hanson 2006; Papadimitriou 2016). In contrast, the 20th century saw hygienic and socioeconomic improvements coupled with advances in
health care. Sequentially, the rate and measurements of growth and development increased and maturation became earlier. The secular trend in menarche over the past 160 years is presented in Figure 1.

Globally, there has been a negative secular trend in the age of menarche over the last century (Gluckman and Hanson 2006; Mpora et al. 2014; Villamor and Jansen 2016). Researchers estimate that menarcheal age in the U.S. has lowered approximately three months per decade since the beginning of the 20th century (Papadimitriou 2016; Johnson et al. 2013). However, some argue that the maturation rate has stabilized since as early as 1939 in the United States (Finer and Philbin 2014; Papadimitriou 2016). Gluckman and Hanson state “for the first time in our evolutionary history, biological puberty in females significantly precedes, rather than being matched to, the age of successful functioning as an adult” (Gluckman and Hanson 2006:10).

There is slight variation among sources as for the average age at menarche for U.S. girls today. The Center for Disease Control and Prevention (CDC) reports mean age of 12.5 years (CDC 2015) calculated from their 2011 – 2013 National Survey of Family Growth. An analysis of this survey by

![Figure 1: Secular trend in menarche age in Europe and the U.S. from 1840 to 2000. Reprinted from “Evolutionary Perspectives in Child Growth”, by Hochberg, 2011, Rambam Maimonides Medical Journal 2(3): e0057, Copyright 2011 by Ze’ev Hochberg. Used with permission.]
Finer and Philbin computed an average age of 12.3 years for women born in 1993 (Finer and Philbin 2014). Forman and colleagues estimate a mean age of 12.09 among non-Hispanic white and African American girls born between 1999 and 2002, based on the National Health and Nutritional Examination Survey (Forman et al. 2013). While variation exists, it can be concluded that mean age of menarche is approximately 12 to 12.5 years of age.

**Adolescent Growth Spurt**

“Adolescence is characterized by an increase in growth velocity, which marks the initiation of the spurt” (Malina et al. 1988:188). It is initiated by hormonal changes, specifically estradiol (Gluckman and Hanson 2006). Humans are the only primates who experience a pubertal growth spurt where the growth rate accelerates and reproductive abilities are obtained (Bogin 1999). One evolutionary theory behind the pubertal growth spurt involves delaying somatic growth during the juvenile period to account for adequate brain development (Gluckman and Hanson 2006). Other theories center on increasing pelvic growth to allow for offspring with larger brains and head size (Gluckman and Hanson 2006). Lastly, pubertal growth may be advantageous for sexual selection, in which taller males may be perceived as better providers and taller females may infer better reproductive success (Gluckman and Hanson 2006).

**Intra-household Food Insecurity**

Evidence shows that food insecurity may affect households disproportionately. For example, a recent analysis of Intra-household food insecurity among households in rural Costa Rica showed that food insecurity and its severity are positively associated with age. Those who experience moderate and severe levels of food insecurity are significantly older than those who experience mild food insecurity or are food secure (Himmelgreen et al. 2016; \( p = 0.028, r = 0.219 \)). Food insecurity was more prevalent among older males than older females and associated with high blood pressure among males (Himmelgreen et al. 2016). The study suggests that older males, who are likely the heads of the households, may be buffering for females and younger household members.

Other research has found buffering among mothers, too. In a study among Canadian mothers, Frank (2015) discovered maternal diets of “undesirable, cheap, and less nutritious foods—often obtained
from food banks”, while their children received better-quality items when available (Frank 2015:191). Other circumstances have led parents to skip meals or eat very little, sometimes whatever is left, as a means to ensure the children are eating and/or infants receive adequate amounts of formula (Frank 2015; Kirkland 2013; McIntyre et al. 2012; Quandt 2004; Cristina et al. 2012). For example, Ford and Beaumier (2011) discuss how parents drink tea or coffee to suppress their hunger when there is not enough food for them. This buffering by parents leads to food insecurity among adults while relieving severe food insecurity among children.

**Food Insecurity among Adolescents**

While research efforts have been successful in measuring and understanding food insecurity among children, households with children, and adults, little action has been taken to understand the intra-household variations within the food insecurity experience. While there has been some research in Africa, there exists a wide gap in the literature focusing on the prevalence and experiences of food insecurity among adolescents in the U.S. This has consequently led to a gap in communal and state resources as well as interventions for this age group.

In 2016, approximately 12.3% of U.S. households were food insecure (USDA 2017b). The prevalence is even higher in Florida, where approximately 15.1% of Florida residents live in food insecure homes (Coleman-Jensen et al. 2016). Among households with children, approximately 16.5% are food insecure in the U.S and an astonishing 22.7% are food insecure in Florida (Coleman-Jensen et al. 2016; USDA 2017b; Feeding America 2017). Moreover, the trend increases among single-parent households, where 31% of single-mother households and 22% of single-father households with children are food insecure in the United States (Rabbitt et al. 2017; Coleman-Jensen et al. 2016). Food insecurity also disproportionately affects children of minority groups: nationally and within subpopulations (Alaimo et al. 2001; Stuff et al. 2009; Coleman-Jensen et al. 2013). Furthermore, there is cause to believe that households with adolescents are more likely to be food insecure when compared to households with children under the age of nine years (Coleman-Jensen 2013 et al.; Gregory and Coleman-Jensen 2013).
This is likely because adolescents have increased nutritional demands and appetites as they are growing as well as unique social experiences that may limit food security (e.g.; stigma, peer pressure).

In 2015, 6.8 million teenagers were food insecure in the United States (Popkin et al. 2016). Recent research has suggested that teenagers and households with older children are particularly vulnerable to food insecurity. A report by the U.S. Department of Agriculture (USDA) concludes that the prevalence of food insecurity and very low food security is significantly higher among households with adolescents when compared to homes with children below the age of nine years (Coleman-Jensen 2013 et al.; Gregory and Coleman-Jensen 2013). In 2012, households with children up to eight years made up approximately 30% of food-insecure households with children, while households with children nine to 17 years consisted of 70% of the sample (Coleman-Jensen 2013). There are many factors that may underpin this trend, including the lack of food assistance and benefits for families with older children, household size, and the greater caloric needs of growing adolescents to name a few. Ultimately, teens and their families may face food insecurity for differential reasons.

**Factors behind Adolescent Food Insecurity.** Adolescents are at a life-course stage that is very different than that of childhood and adulthood. Due to their increasing growth rate, they have increasing energetic and nutritional demands necessary to sustain healthy growth and development. This demand places adolescents at a higher risk for food insecurity and relative long-term consequences (Hamersa and Kim 2016; Whitbeck et al. 2005). In addition, there are multiple social and cultural factors that make adolescents more vulnerable to food insecurity.

Low-income and living below the poverty line is a common factor behind food insecurity, especially among households with children. The USDA found that approximately 44% of food-insecure households with children fall below the U.S. poverty threshold (Coleman-Jensen et al. 2016). However, another concern is the high percentage of families who have incomes higher than the poverty cut-off but are still food insecure—possibly because they are not eligible to receive food assistance benefits.

“Between 31 and 45 percent of households with food insecurity among children may not have been
eligible for SNAP or for free school meals in 2010-11 because they had annual incomes higher than 130 percent of the poverty line—the income eligibility limit for these programs” (Coleman-Jensen 2013:16).

The ALICE (Asset Limited, Income Constrained, Employed) population refers to those who are employed but live paycheck-to-paycheck due to the high costs of living and challenges associated with childcare and transportation (United Way 2018). The ALICE project assesses household needs based on the household survival budget for each county within a state. The most recent ALICE report found that 44% of Florida households had incomes below the Household Survival Threshold (ALICE Threshold) (United Way 2018). In Tampa Bay counties, specifically, the percentage of ALICE households is as follows: Hillsborough county = 42%; Manatee county = 43%; Pinellas county = 41%. Thus, more than two-fifths of Tampa Bay residents are struggling to pay for living costs and food but do not qualify for government-funded assistance.

There are many factors behind why hard-working individuals struggle to make ends meet in Florida. To start, the basic cost of living has consistently increased in Florida since 2007. In addition, low-wage jobs, which pay $20 an hour or less, make up 67% of Florida jobs. Furthermore, 75% of low-wage jobs pay less than $15 an hour (United Way 2018).

There are also many misunderstandings surrounding food assistance. Children may not know where they can go to get help or food. Some believe they are not allowed to use local services, such as going alone to a food bank, if they are under the age of 18 years or they are not accompanied by an adult (Popkin et al. 2016). In fact, this is the case for the most prominent food pantry distributor in Tampa Bay. Feeding Tampa Bay, a network of Feeding America, requires an individual to be at least 18 years of age to receive food from their food bank or food pantries. However, they do not ask for ID. To receive food from a USDA pantry, households have to meet income requirements and a child or teen must be accompanied by an adult (USDA 2017c). All pantries only allow one box of food per household.

Another barrier is the targeting of food assistance programs to younger children. For example, the backpack program, which provides foods for children to take home to eat over the weekend, focuses on “child-friendly” snacks. Foods deemed and marketed as “child foods’ may not be desired by older
children, especially teens. Other child food assistance programs take place after school and therefore may be hard to access for adolescents who play sports or have part-time jobs.

Not eating meals provided by the National School Lunch Program or substituting these meals with poor-quality snack foods can significantly increase the risk of food insecurity among adolescents. Many studies have found that a large portion of children does not eat the lunch provided at school (Janavi et al. 2016; Contento et al. 2016; Hamersa and Kim 2016; Poppendieck 2010; Savige et al. 2007). The School Nutrition Dietary Assessment III (SNDA-III) found that about 60% of middle schoolers and 40% of high-school students eat a school lunch (Poppendieck 2010). Most often, the reasoning is a dislike for the taste or appearance of the foods served (Neumark-Sztainer et al. 1999; Janavi et al. 2016; Contento et al. 2016; Poppendieck 2010). Both parents and children have negative perspectives toward the quality of school lunch foods (Janavi et al. 2016). However, some researchers argue that stigma is another factor (Poppendieck 2010; Hamersa and Kim 2016; Popkin et al. 2016). Children above 14 years are less likely to participate in school lunch programs, possibly due to fear of being judged by their peers (Ralston et al. 2008).

Stigma is a consistent theme found throughout the literature. Popkin and colleagues state “teenagers fear stigma around hunger and actively hide it” (Popkin et al. 2016:5). Stigma may prevent adolescents from participating in child food assistance programs such as the backpack program or afterschool food pantries. Adolescents may fear that their peers will see and judge them for using these services. Hamersa and Kim (2016) believe that this fear of judgment and bullying is why adolescents have lower participation rates within school lunch programs, as adolescents do not want their peers to know they rely on school food for their food source (Hamersa and Kim 2016; Popkin et al. 2016).

Whether someone is food insecure or from a low-income family is apparent based on the availability of competitive food items within schools. These items are for-sale foods that are not a part of the National School Lunch Program (Poppendieck 2010). They have to be purchased separately or with a pre-made lunch card. Children on free or reduced-price lunch are not allowed to use their lunch cards for these competitive items. Thus, it is easy to tell who has lunch money and who does not within schools.
Approximately 70 to 90% of schools offer competitive foods via vending machines, a la carte menus, or snack bars (Templeton et al. 2005; Nutrition Week Report 2007). In Hillsborough County, all public middle and high school offer an a la carte menu (Hillsborough County Public Schools 2017). At least 75% of middle and high schools offer competitive foods in Pinellas County (PCS Summary Report 2016). Thus, having this alternative source of food is allowing students to purchase snack items in place of eating the school lunch. Snacking is associated with skipping meals among adolescents (Savige et al. 2007). For those who do not have lunch money, they are left without the option to snack in place of a meal. If students do not have time to eat their lunch due to long lines or they do not like what is provided due to preference or dietary restrictions, they are reduced to going hungry without extra money. The quote below, taken from Poppendieck’s book *Free for All: Fixing School Food in America*, speaks to the complex issue of children skipping school lunch:

“When I adjusted to the noise, however, I noticed a substantial number of students who were not eating anything at all. They did not have brown bags from home. They did not have trays or snack items. They were just sitting around, talking, with no food in sight. In fact, I later learned, only about 40 percent of the students in attendance actually took a reimbursable meal, very close to the national average for participation at the high school level; another several hundred bought a la carte items. I asked several students why they were not eating, and they replied that they were waiting for the lines to get shorter, but they did not get up and go to the serving area, even when the line virtually disappeared. One slim young man told me he was saving his lunch money. When I asked the cafeteria manager about this, she gave me a one-word answer: “stigma.” In Any Town, as elsewhere in America, it is not much of a problem at the elementary level, but it becomes a greater and greater concern as students grow older and more socially aware. As the director summarized the situation, ‘The older
you get, no matter what it is, unless you have universal free, they don’t want to take part in it because of that stigma” (Poppendieck, 2010:42).

Another finding in the literature relative to not eating school lunch is peer pressure within food preference. Janavi and colleagues found that children feared judgment by their peers for liking certain types of foods (Janavi et al., 2016). Gaspar and colleagues discovered that peers significantly influenced food choices among adolescents (Gaspar et al., 2016). With the overwhelming negativity surrounding school food, it may be uncool to like the food and therefore children may not eat it to simply fit in.

Teenagers have also noted a serious fear of getting their families in trouble with the child welfare system (Popkin et al. 2016). They are afraid that their parents will be viewed as poor guardians if community members or social services learn of the family’s food insecurity (Popkin et al. 2016; Connell et al. 2005). Furthermore, children may fear being taken away from their parents or guardians and placed in foster care (Connell et al. 2005).

In conclusion, stigma and fear lead to exacerbated risks for food insecurity and its relative implications because it can prevent teens from asking for help, accepting food assistance in public settings, and eating school-provided meals (Popkin et al. 2016; Shtasel-Gottlieb et al. 2014).

There are certain periods where children are more vulnerable as well. For adolescents who do rely on school breakfast and/or lunch programs as a large part of their food supply, weekends and summer breaks can significantly hinder teen food security (Waxman et al. 2016; Shtasel-Gotlieb et al. 2014). While some summer food programs exist, such as the Summer Food Service Program (SFSP), research shows that only 3.8 million children participated in the program in 2015 (Waxman et al. 2016). This is significantly lower than the 22 million who participate in free or reduced-price lunch programs (Waxman et al. 2016). Misperceptions of summer food programs may be the cause of low participation rates, as teens were unaware that programs were available or believed them to only be available to younger children (Waxman et al. 2016).

Other social factors that may lead to teen food insecurity and increase its severity include homelessness and running away. Whitbeck and colleagues discovered that approximately one-third of
adolescents who were homeless or had runaway experienced food insecurity in the past 30 days (Whitbeck et al. 2005). Furthermore, 25 percent had gone a whole day without food at least a few times and 34 percent had to cut the size of their meals at least a few times within the last 30 days (Whitbeck et al. 2005). The main hindrance to getting food was lack of money, but the researchers found other influences that made it more likely for homeless teens to experience food insecurity. These included a history of neglect or abuse, time spent on the street, substance abuse, and social isolation (Whitbeck et al. 2005).

**Strategies Used by Adolescents to Tackle Food Insecurity.** Older adolescents are in a position where they understand and acknowledge their families’ food security environment, and many find the ability to take on strategic roles to help with their needs and the needs of their family. Sometimes children may be pressured to help their families or they may take the initiative on their own as they feel they are responsible to help (Popkin et al. 2016). The literature discusses various tactics teens employ to help mitigate food insecurity for themselves or their families in the U.S.

Saving food, including taking food home from school to eat over the weekend (Popkin et al. 2016), is one strategy. Another is rationing food within the household, where adolescents and teens take on the responsibility of balancing food and regulating food/eating rules. For example, a teen may tell their younger siblings not to eat snack foods so they can have them for the next day’s lunch; or remind younger children when the family is running low on items (Fram et al. 2011). Thirdly, adolescents may skip meals like breakfast or lunch allowing them to eat those foods later in the day and prevent going to sleep hungry (Popkin et al. 2016; Fram et al. 2011). When old enough, adolescents may get part-time jobs to help their families pay for food or bills, or to be able to buy their own food or supplies (Popkin et al. 2016). Sometimes teens may participate in risky behaviors such as stealing food or money, selling items to get money, or entering into relationships with older individuals who will provide for them (Popkin et al. 2016).

**Strategies Used by Parents or Guardians to Mitigate Food Insecurity.** As mentioned in the intra-household variation section, parents often buffer their children from food insecurity by reducing
their own food intake or quality, skipping meals, or eating what is left over. It is also common to find parents who change their purchasing and/or food acquisition techniques, such as buying cheaper but low-quality foods, going to food pantries, and asking for food or money from relatives or neighbors (Popkin et al. 2016; Shtasel-Gottlieb et al. 2014; Hamersa and Kim 2016; Fram et al. 2011; Stevens 2009).

**Food Insecurity and Menarche**

Evolutionary life history theory, which will be discussed in more depth in the next section, suggests that exposure to adverse experiences (e.g. family conflict, disease, abuse, food insecurity) during childhood can “accelerate the timing of menarche as an alternative reproductive strategy to maximize the chance of leaving descendants” (Belachew et al. 2011:2). In other words, adverse childhood environments correlate with earlier menarche and increased fertility (Belachew et al. 2011; Chisholm et al. 2005; Walker et al. 2006; Jorm et al. 2004; Deardorff et al. 2014; Amir et al. 2016; Ellis et al. 2007). Thus, Jansen and colleague argue that measuring the age at menarche can be a reliable way to understand the conditions of one’s environment and socioeconomic status during childhood (Jansen et al. 2015).

There are competing hypotheses as to how food insecurity influences pubertal maturation. One is based on evolutionary life history theory and the belief that food insecurity will ultimately accelerate the reproductive life course stages. The other is underpinned by energetics theory and argues that chronic malnutrition and severe food insecurity will delay pubertal development and lead to smaller adult size (Belachew et al. 2011; Belechew 2011). Studies specifically looking at food insecurity and menarche have found conflicting results and show large variation between population groups. These contradictions propose the importance of incorporating a more narrow focus and understanding how differential environmental and socio-demographic factors shape maturation and adaptation.

Within the review, only two peer-reviewed articles were discovered that explicitly analyze the association between food insecurity and menarche. The first study to document the relationship between food insecurity and the age of menarche in Ethiopia, conducted by Belachew and colleagues, discovered a one year delay in menarche among food insecure girls when compared to their food secure counterparts (Belachew et al. 2011). In addition, they uncovered a negative relationship between stunting and age of
menarche (one year delay). Food insecure girls had higher workloads, were more likely to live in rural areas, and had low-quality diets (Belachew et al. 2011). Jansen and colleagues found similar results in their study among Colombian girls, where food insecurity and rural living was positively associated with age of menarche (Jansen et al. 2015). Both studies take place in lower-income areas of economic transition. Thus, research within developed middle and high-income countries is needed.

**Body Mass, Menarche, and Food Insecurity**

Body Mass Index (BMI) inversely correlates with pubertal maturation and age at first menstruation. Child BMI and maternal BMI have been found to negatively relate to the age of menarche in girls in Colombia, Nigeria, and Uganda, and many small-scale tropical societies (Jansen et al. 2016; Mpora et al. 2014; Nwankwo et al. 2016; Walker et al. 2006). A review by Villamor and Jansen cite multiple studies supporting the influence on childhood obesity and higher adiposity on the timing of menarche cross-culturally (Villamor and Jansen 2016). In the United States specifically, researchers have shown that increasing BMIs lead to earlier ages at menarche among all ethnicities (Forman et al. 2013; Deardorff et al. 2014; Ellis et al. 2007; Johnson et al. 2013). Body fat percentage has also been associated with earlier age at menarche in various studies (Gernelli et al. 2016). However, recently there have been conflicting findings relative to total body fat, and some researchers are concluding that fat distribution is more important within the onset of menarche. Bhadra and colleagues found that fat in the upper trunk and lower limbs, rather than the lower trunk and upper limbs was associated with earlier menarche in Bengali girls (Bhadra et al. 2013). In contrast, Lassek and Gualin confirmed that hip circumference was more closely related to menarche (Ziomkiewicz and Koziel 2015), and Malina et al. support this theory that girls gain more fat in the lower trunk upon adolescence (Malina et al. 1988). A longitudinal study by Ziomkiewicz and Koziel discovered that hip circumference and pelvis breadth was the most significant association to age at menarche, indicating that both fat distribution and skeletal size are important (Ziomkiewicz and Koziel 2015). Height may also play a role in the onset of pubertal maturation, although it is not known whether puberty influences height or height influences puberty or both (Jansen et al. 2016; Belachew et al. 2011; Papadimitriou 2016; Walker et al. 2006).
As mentioned in the introduction, food insecurity has been associated with overweight and obesity in both developed and developing areas throughout the globe. Due to our ever-increasingly globalized world, a large majority of populations today can easily access imported and industrialized foods, many of which are highly processed and have low dietary quality. Access to local and healthier food products seems to be consistently decreasing due to many underlying factors including reduced local agricultural productivity, tourism and/or urban development, and political-economic aspects. Foods that are processed and easily manufactured have become cheaper than nutrient-rich whole foods. The widespread elitism of eating healthy and whole-foods has only exacerbated this issue. Today, people of privilege are willing to pay high prices for produce, organic foods, “clean foods” that don’t have additives such as hormones or preservatives or made with genetically modified organisms (GMOs), and exotic items (e.g., acai fruit and product).

The high cost and low accessibility to healthy foods limit the ability to obtain adequate amounts of safe and nutritious foods in socially acceptable ways. As a result, food insecurity is associated with poor dietary quality (Cook and Frank 2008; Himmelgreen 2013). Food insecure individuals may not experience “hunger,” defined as feeling the physiological symptoms due to lack of food intake and access. Moreover, food insecurity can exist within a diet of sufficient or even overly-sufficient caloric intake. Consuming calories or specific nutrients is a form of malnutrition. Being malnourished and overweight can cause chronic health issues, low energy, and poor physical feelings as well as poor mental health (Himmelgreen et al. 2012). Feeling bad and not having the energy to cook or prepare meals can lead to an increase in poor dietary behaviors (Gucciardi et al. 2014) Also, medical costs associated with health issues will lower the economic means available for food (Gucciardi et al. 2014). Thus, the consequences of food insecurity often manifest biologically, and in turn, the biomedical ramifications keep creating limitations for food security.

**The Role of Diet within Menarche**

Diet is intertwined with body size and composition. Food provides the energy humans need to sustain somatic and reproductive fitness and therefore plays a large role within development and the
timing of life history traits. Researchers have noted the importance of diet and nutrition on menarche (Ellis et al. 2007; Jansen et al. 2016; Villamor and Jansen 2016; Walker et al. 2006; Nwankwo et al. 2016; Forman et al. 2013). For example, animal protein consumption from both dairy and meat intake may cause earlier maturation (Villamor and Jansen 2016; Jansen et al. 2016). Higher intakes of monounsaturated and polyunsaturated fats, carbohydrates through sugary drinks, aspartame, and caffeine may also induce earlier ages of menarche (Villamor and Jansen 2016). Some micronutrients may have a negative effect, such as calcium, magnesium, phosphorus, iron, and zinc (Villamor and Jansen 2016). Vitamin D, however, may have a positive influence on menarcheal age and work to delay the reproductive process (Villamor and Jansen 2016). Lastly, the impact of breastfeeding has provided varied results, but some studies show a relationship between longer breastfeeding and later timing of puberty (Villamor and Jansen 2016).

As mentioned previously, increasing BMI, overweight, and obesity is often found among food insecure individuals. One study on Brazilian females found that girls who were food insecure were two times more likely to be overweight when compared to food secure girls (Schlussel et al. 2013). Adult females in the study who were food insecure were almost 50 percent more likely to be obese than food secure women (Schlussel et al. 2013). The fact that energy-dense foods full of processed sugars and fat are inexpensive in industrialized countries, as well as the notion that food subsidies and assistance programs often favor these types of items, is critical in the contradictory co-existence of food insecurity and over-nutrition (Cook and Jansen 2008).

Stress from worrying about food or poor dietary habits (feeling bad because you are eating bad) can also lead to increased weight (Ellis et al. 2007). Humans are biologically adapted to crave energy-dense nutrients and are predisposed to deposit fat (Armelagos 2014; Ponzter et al. 2016). Today, the abundance and easy access to these items paired with high rates of sedentariness lead to a mismatch between biology and environment. Thus, researchers need to look beyond body mass and composition in lieu of pubertal maturation and ask: what are the factors behind high BMI and body fat percentage that are causing the early onset of puberty.
Other Influential Factors within Menarche

Genetics. Age of menarche can be shaped by genetic factors by as much as 50% to 76%, although the power of this influence is debated (Gluckman and Hanson 2006; Nwankwo et al. 2016; Ellis et al. 2007; Belachew et al. 2011; Johnson et al. 2013). It is generally agreed that genetic factors can explain approximately half of the variation seen across populations (Papadimitriou 2016; Gluckman and Hanson 2006). Genetic causal relation can be assessed and controlled for by incorporating mother’s menarcheal age within the research and analysis (Deardorff et al. 2014). A recent discovery found the same genes that code for early menarche may also predispose girls to obesity (Johnson et al. 2013). Perhaps life history theory could explain these findings through the perspective of epigenetics.

Pre-pubertal Stress. Early life stress consisting of abuse, familial conflict, stressful home-life, paternal absence, exposure to war and conflict, and disease have been shown to accelerate the maturation process (Forman et al. 2013; Papadimitriou 2016; Mpora et al. 2014; Chisholm et al; Jorm et al. 2003; Ellis et al. 2007; Amir et al. 2016; Belachew et al. 2011). Subjective perception of one’s safety and neighborhood crime may also be a significant indicator (Amir et al. 2016). Food insecurity could also be considered an early life stressor, as it can have both physiological and mental impact. Thus, the experience of food insecurity should be incorporated as a stressor within life history theory and research evaluating the timing of menarche.

Urban Living and Socioeconomics. The literature proposes that urban vs. rural living is significantly associated with age of menarche, where urban populations have earlier onsets when compared to their rural counterparts (Nwanko et al. 2016, Amir et al. 2016; Mpora et al. 2014; Jansen et al. 2015; Belachew et al. 2011). This may be relative to socioeconomic status and poverty, which are astoundingly related to maturation but show conflicting effects between population groups. For populations in developed countries like the U.S., lower socioeconomic status and poverty are related to earlier menarche (Deardorff et al. 2014; Amir et al. 2016). However, in undeveloped areas like Uganda and Ethiopia, for example, higher socioeconomic status is related to earlier menarche. This variation is
usually found between urban and rural areas (Mpora et al. 2014; Jansen et al. 2015; Nwankwo et al. 2016).

In the United States, food insecurity prevalence may also vary between urban and rural geographies, depending on the location of food deserts and the variation in socioeconomic factors. In addition, food insecurity is a socioeconomic phenomenon, involving both macro and microeconomic components. Therefore, when researching variation in socioeconomics and demographics in relation to age of menarche, food insecurity should also be incorporated as an interrelated effect.

**Conclusion of Review**

From this review, it is apparent that the social and biological needs of adolescents make them vulnerable to food insecurity. I hypothesize that food insecurity during this life stage can impact the timing of menarche in two ways: 1. through the impact of food insecurity and socioeconomic status on diet quality, nutrition, and energy. 2. through the experience of stress and worry surrounding food availability, access, and stigma. In this study, I will be testing both these hypotheses to understand how food insecurity is embodied during adolescence and compare which affect (energy availability vs. stress) is more influential on the timing of menarche.

It is evident from this review that the literature connecting food insecurity and life history traits such as menarche is substantially lacking. Most preceding research has focused on every other factoring influence from genetics, diet, body mass/composition, socio-demographics, ethnicity, stress and adversity, exposure to disease, and perceived stress. However, the linking of food insecurity within these dynamics is virtually missing. In addition, most of the articles cited in this background section come from disciplines other than anthropology, suggesting a vital opportunity for researchers to contribute an anthropological perspective to the issue of environmental and sociocultural influences on life history biology. Particularly for applied anthropologists, this area of research is in need of not only a holistic biocultural lens but also proposed interventions that can be applied by broadening our understanding and making these essential connections.
CHAPTER 2: THEORY

This research utilizes life history theory paired with a life course biocultural perspective. Life history theory provides the mean to understand biological tradeoffs and the timing of life history traits, while the life course perspective cannot be ignored as it provides a lens to understand critical periods and their associated needs and experiences within the life course. Lastly, a biocultural approach is necessary for studying the social and ecological determinants that influence individual experiences and behaviors which are manifested within one’s biology and health.

Life History Theory

In biological anthropology, life history theory focuses on the strategies used by humans to allocate energy throughout the lifecycle. Barry Bogin and colleagues state that this procedure involves “when to be born, when to be weaned, how many and what type of pre-reproductive stages of development to pass through, when to reproduce, and when to die” (Bogin et al. 2007:632). In other words, life-history theory addresses how and when organisms distribute their energetic resources for somatic, reproductive, mating, and parenting efforts (Chisolm 1993; Caudell and Quinlan 2012; Amir et al. 2016; Belachew et al. 2011). Historically, it has incorporated the idea that mammals are primarily concerned with two types of successes— that of simple, immediate survival (somatic success) when the risk of mortality is high, and that of reproductive success when the risk of death is low (Chisholm 1993; Caudell and Quinlan 2012). However, newer life-history approaches today propose that when the risk of adult mortality is high and risk of juvenile mortality is low, earlier maturation may occur in attempt to counteract threats to reproductive success (Chisholm 1993; Walker et al. 2006; Caudell and Quinlan 2012).
Adaptive compensations within life history theory usually involve some sort of cost-benefit circumstance, which is referred to as a “trade-off”. A trade-off is a response mechanism to sociocultural and biological stressors. Biologically, we can look to life history theory, which explains how trade-offs occur in which “growth, development, and immunity are compromised in expense for reproduction and reproductive fitness” (Himmelgreen 2013:233).

Conventionally, bioanthropological research has found that adverse environments result in slower growth and development and delayed menarche, especially in poorer geographical regions, as energy is saved for survival (somatic success). However, other studies are discovering the opposite effect, where puberty may occur earlier among persons exposed to stressful environments so that reproduction has a chance before morbidity or mortality (Belechew 2011). Both experiences are examples of life history trade-offs. It has been proposed that the trade-off is influenced by body size, as it is a proxy for energy and nutrient availability. For example, a review by Walker and colleagues found that “larger adult body size is associated with faster and earlier development, indexed by child-juvenile growth (weight and height), menarche, and age at first reproduction for females” (Walker et al. 2006:304). In addition, researchers have found that childhood experiences such as stress, health, anxiety, and neglect, are related to faster growth rates and earlier ages of menarche and first reproduction (Belechew 2011; Walker et al. 2006). These findings and theory are relevant to this study, as they posit that when future survival is less certain, such as when individuals live in a constant situation of food insecurity and have heightened risks for health consequences associated with this condition, then earlier development will allow for the biological investment in immediate reproduction rather than later when health and survival are less guaranteed.

Life history theory is biocultural by design and, thus, it fits the biocultural framework for this research. The biocultural approach within anthropology looks at the interrelationships of ecological, biological, and sociocultural factors. The ecological model of food and nutrition is the most common theoretical concept model used within biocultural nutritional anthropology (Pelto et al. 2012). The model provides a holistic framework for evaluating how the physical and social environment, social
organization, technology, culture, and global forces influence the foods that people eat and ultimately their nutritional status (Pelto et al. 2012). Thus, this study uses a biocultural approach to evaluate and understand how the environmental circumstance of food insecurity influences behaviors and perceived (both biological and mental) risks. Furthermore, this research evaluates how female adolescents biologically compensate for those risks through developmental trade-offs relative to maturation. Therefore, this study uses the biocultural approach combined with life history theory. Because of its focus on biological experiences and risks associated with a specific life course stage, the life course perspective is another valuable approach to this research.

Life Course Perspective

Environmental conditions during various life stages, including fetal, infant, childhood, juvenile, and adolescent periods (Bogin 1998), can impact immediate health and nutritional status, but also shape risks for chronic illnesses such as hypertension, diabetes, obesity, and cardiovascular disease later in life (Walker et al. 2006; Bogin et al. 2007; Gluckman et al. 2007). The life course perspective helps us understand the relationship between life-course stages and the risks and impacts of adverse experiences on health and wellbeing. The approach proposes that there are critical periods during one’s life where hardships can have a greater negative impact when compared to other life stages. Furthermore, it explains that nutritional status throughout various stages of the lifespan is shaped by different social, behavioral, physical, and biological factors, as humans have different lived experiences throughout their lives (Himmelgreen 2014; Himmelgreen 2013). For example, early life, particularly in-utero to three years of age, is highly important in determining energetic allocations, the timing of life history traits, and adult health (Worthman 2003; Gluckman et al. 2007). Studies have found that disadvantaged experiences in early life (<3 years) can have a significant influence on the age at menarche even when girls are adopted into improved environments (Worthman 2003). Infant and child health, nutrition, maternal health, and psychological experiences all act as environmental factors within the timing of menarche (Worthman 2003). Other research shows that hardships in utero are connected with disease and poor health in adulthood as well as with developmental timing (Worthman 2003; Gluckman et al. 2007) The theory falls
under the umbrella of life history evolutionary theory and is known as the Developmental Origins of Health and Disease (DOHaD) (Gluckman et al. 2007). DOHaD explains how predictions in early life influence biological energetic investments and trade-offs (Gluckman et al. 2007). For example, when a fetus or infant predicts a deprived living environment and uncertain life course based on exposure to stress, adjustments such as reduced growth of organs and body size, preterm birth, increased insulin resistance, predisposition to fat storage, and early puberty may occur as a trade-off between immediate survival and growth/development or immunity (Gluckman et al. 2007). When there is a mismatch between the predicted post-natal environment and the true post-natal environment, the risks for metabolic disease is severely magnified as one’s biology does not fit its environment (Gluckman et al. 2007). Thus, this is one example where experiences in one life-course stage can influence development and health throughout the life course.

Food insecurity is one hardship that has been shown to have different effects depending on the life course stage (Himmelgreen 2013; Laraia 2013). This is because energy requirements alter throughout the life course (Herman et al. 2014). As mentioned, food insecurity in utero or infancy can lead to reduced growth and development. On the other hand, food insecurity during older age is also significant within health. Older adults are both more prone to food insecurity for social and physical reasons and are at greater risk for the consequences of food insecurity. Elderly have increased risk for health issues, limited mobility, and social isolation, which can make getting food, preparing meals, and eating difficult (Host et al. 2016). Furthermore, poor diet is associated with lowered immunity, longer healing times, and predisposition to chronic diseases (Locher et al. 2005). So, like early life, late life is an important life-course stage in terms of nutritional energy and health.

There is another critical period within the life course that is often left out of human variation and health research—adolescence. Due to the accelerated growth rate, adolescence is a specific time when nutrition is extremely important to ensure healthy growth and development. Adolescence includes rapid physical growth to adult height as well as brain development, which calls for additional energy (Worthman 2003). Once adult height is reached, “energy previously used for growth becomes available
for reproduction” (Worthman 2003:296). Thus, nutritional demands are increased during this life course stage. When there is adequate energy available for growth or reproduction, growth and maturation may occur earlier and lead to earlier puberty (Worhtman 2003). However, adolescents who are food insecure may either not have enough energy for both processes (particularly in low-income and un-developed areas) or have substantially poor quality diets. In addition, adolescents may have some resistance to fat accumulation during the maturation process, meaning they do not hold onto energy as sufficiently when compared to adults or younger children due to energy-intensive changes connected with growth and development (Himmelgreen 2013). As a result, not having access to enough food as well as nutritious food (food insecurity) can have detrimental effects on adolescents during their growing years as well as later in life. Limited energy or consistent low-quality nutrition may result in life history trade-offs (Belechew et al. 2011). Growth may be stunted, immunity decreased, or brain development slowed to allocate energy for either survival or reproductive success (Himmelgreen 2013; Belechew 2011). This is where the life course perspective and life history theory meet. Since low-quality nutrition in areas of middle to high income does not typically propose risk for immediate death, girls who have consistent poor nutrition but not undernutrition or wasting will be more likely to experience an energetic tradeoff in favor of reproduction rather than one that delays maturation in favor of immediate survival or growth. The tradeoff toward reproduction takes away energy for growth and development and immunity and therefore increases the risks for metabolic disorders later in life. The trade-off could also result in an increased disposition to hold onto fat as an energy source for reproduction and lead to obesity. Himmelgreen (2013) explains how this life history energetic trade-off could be why researchers are finding a paradox between food insecurity and obesity among female adolescents in middle to high-income countries (Himmelgreen 2013).

Using the Life Course and Biocultural Perspectives within Life History Theory

Life history theory incorporating the life course perspective suggests the significant importance of environmental circumstances during specific stages of life in regards to human variation and health. Thus, one cannot understand this phenomenon without a biocultural lens. In researching the biological impact of
food insecurity, this study analyzes the embodiment of social, environmental, and economic experiences (Himmelgreen 2014). Humans are complex beings that employ various biological and cultural coping mechanisms to deal with outside stressors. In response to food insecurity, people often alter their food purchasing habits toward cheaper, more processed and energy-dense foods (Cook and Frank 2008). The biocultural framework and life course approach provide necessary understanding of why adolescents are food insecure, how they cope with food insecurity, and how food insecurity and coping behaviors impact nutrition and energy during this life stage, as well as risks for health maladies later in life. Life history theory provides a base for assessing if and how food insecurity during adolescence invokes energetic tradeoffs and what those tradeoffs may be. When all three come together, this approach can uncover variations in environmental, social, and biological aspects between and within populations, and ultimately compare biological responses between different nutritional environments.

Little is known in regards to how overnutrition, the excess of calories or specific nutrients like fat, and low-quality diets as a result of food insecurity may influence energy allocation and developmental trade-offs. Therefore, this research adds innovative insight for studying life history theory within food insecurity research in the U.S. adolescent population as well as other middle and high-income countries.
CHAPTER 3: METHODS

Ethics

The research, PRO #00028412, was approved by the University of South Florida Institutional Review Board (IRB). The results may be used by the Hunger Action Alliance to improve local food security initiatives and programming. The findings will be shared with the organizations within the Hunger Action Alliance and the Childhood Hunger Initiative. Appropriate measures were taken to protect the identities of participants and maintain anonymity. Only first names and phone numbers were received from sign up forms and shredded after interviews. No identifiable information was included in the dataset, recordings, transcriptions, or write-up. Participants were instead given numerical IDs.

IRB approved informed consent and child assent was received from all participants. Participants were informed prior to participation of the objectives and methodologies of the study and assured that their participation was voluntary. Furthermore, all participants were aware that they did not have to answer any question that made them comfortable and that they could stop participation at any time with no consequences.

The recruitment sites were partner agencies under Feeding Tampa Bay and gave written permission before recruitment took place. Feeding Tampa Bay provided a letter of support for the research and site locations, which was given to the USF IRB.

Research Design

The Hunger Action Alliance was founded in 2015 by the USF Department of Anthropology, Feeding Tampa Bay, Florida Hospital, Johns Hopkins All Children’s Hospital, and other key stakeholders in Tampa Bay. The mission is to address hunger and food insecurity through research, education, and transformation. The Hunger Action Alliance seeks to improve our understanding of the hunger-health
connection and food insecurity locally. Tampa Bay includes the counties of Hillsborough, Manatee, and Pinellas.

Through my advisor, Dr. David Himmelgreen—a co-founder of the HAA, I was able to partner with Feeding Tampa Bay to design a research project that fit the mission of HAA. Feeding Tampa Bay funded this research and assisted in connecting me with community members and organizations. They understand the need for evidence-based research to uncover limitations and necessary improvements within food security initiatives as well as support the need for private and public funding to maintain food assistance programming.

When searching for research topics that integrate food security, diet and nutrition, and long-term implications, I discovered large gaps in the literature. In particular, adolescents and teens were almost completely missing from food security research. I also noticed (surprisingly) that the connection between U.S. food insecurity and life history traits, such as the timing of menarche, was also missing. I was astonished that no one had asked the question of how food insecurity directly or indirectly may play a role within maturation in the U.S. Most preceding research has focused on other factoring influences from genetics, diet, body mass/composition, socio-demographics, ethnicity, stress and adversity, exposure to disease, and perceived stress. The only research that has evaluated food insecurity and menarche together has been conducted in Africa (Belechew et al. 2013; Belechew et al. 2011). Particularly for applied anthropologists, this area of research is in need of not only a holistic biocultural lens but also proposed interventions that can be applied by broadening our understanding and making these essential connections. Thus, through my own personal and academic experiences, the opportunities within the Hunger Action Alliance, and many hours of reviewing the literature, I created both a relevant and applicable research question.

This research is, therefore, deductive and applied by design. I started with the research question of how, if at all, does food insecurity influence the age that girls start menstruating. Through a preliminary review of the literature and using the basis of life history theory, I constructed the hypothesis below.


**Hypothesis**

Food insecure female adolescents will be more likely to begin menarche at earlier ages in comparison to the national average of 12.5 years.

Predictions:

1. There will be a significant negative correlation between food insecurity and age at menarche (e.g., as food insecurity becomes more severe, age at menarche decreases).
2. Food insecurity will increase the likelihood that girls will begin menarche early (using Cox Hazard Model)
3. Food insecure girls will have poor quality diets consisting of energy-dense (high-calorie) foods and therefore have high rates of overnutrition.
4. High-calorie diets will negatively correlate with age at menarche.
5. Food insecure girls will have higher BMI, lower heights, and higher waist and hip circumferences when compared to U.S. reference standards. I predict a significant positive correlation will exist between body composition and food insecurity.
6. A significant negative correlation will exist between body composition and age at menarche, where higher BMIs and hip circumferences will correlate with earlier ages of menarche.
7. Girls who have experienced consistent food insecurity and low-quality diets will have shorter leg lengths when compared to U.S. reference standards. This will suggest nutritionally insecure bodies.
8. Linear measurements including iliac height, height, and sitting height ratio will positively correlate with age at menarche, in that increasing linear heights will correlate with increasing age at menarche.

**Mixed Methods**

All predications were tested in this research except for those involving actual caloric data. I was not able to measure caloric intake among this sample. Thus, proxy measures of nutrition, including dietary variety and adequacy, are used. The philosophy of this study is to ultimately understand how a
complex sociocultural factor (food insecurity) is influencing the biological process of maturation. In other words, how food insecurity is embodied. Therefore, both qualitative and quantitative methodologies are used. Qualitative approaches provide an emic lens into the perceptions and sociocultural aspects of people’s lives, while quantitative measurements and analyses evaluate the more concrete biological and statistical components. An etic approach is also incorporated, as my own observations, hypotheses, and theoretical perspectives frame the findings and conclusions.

**Research Setting**

![Map of Florida counties](image)

Figure 2: Map of Florida counties. Reprinted from worldatlas.com, Copyright 2018 worldatlas.com by Valnet Inc. Reprinted with permission.

Figure 2 highlights the study area. Tampa Bay consists of three counties: Hillsborough, Manatee, and Pinellas. Almost 3 million residents live in Tampa Bay, and the area has one of the highest population growth rates in the U.S (U.S. Census Bureau 2016). In 2017, 58,000 people moved to Tampa Bay (U.S. Census Bureau 2016). With 375,888 residents, Manatee County has a significantly smaller population when compared to Hillsborough and Pinellas counties (U.S. Census Bureau 2016). Manatee County cities
and towns are smaller and it does not include a large metropolitan area. It sits on the Gulf of Mexico and
neighbors Sarasota County to the south and Hillsborough County to the north. Manatee County is home to
a large number of retirement communities, Anna Maria Island, and includes both urban areas (west and
central) and rural areas to the east.

Pinellas County has approximately 960,730 residents and is home the large cities of St.
Petersburg and Clearwater. It is largely urban or suburban. The Gulf of Mexico sits to the west and the
Tampa Bay is to the east. Pinellas County attracts more than 600,000 tourists each year with its white
sandy beaches, museums, and Tampa Bay Rays professional baseball team (Boatwright 2014).

Hillsborough County hosts more than 1.3 million people (U.S. Census Bureau 2016). It surrounds
the east and northeast part of Tampa Bay and includes both urban and rural areas. There are only three
cities in Hillsborough County: Tampa, Temple Terrace, and Plant City. However, there are many
unincorporated towns between Tampa and Manatee County. These areas are made up of suburbs and rural
environments. The county becomes more rural the further south and east you travel. Hillsborough is not
without its attractions. It is home to the Tampa Lighting hockey team, the New York Yankees spring
training facilities, as well as the Tampa Bay Buccaneers national football team.

Tampa Bay is home to a diverse population. The Hispanic/Latino population makes up the largest
minority group and approximately 18% of the Tampa Bay population (combining Manatee, Pinellas, and
Hillsborough counties) (U.S. Census Bureau). The second largest minority group is African Americans
who make up about 13% of the population (U.S. Census Bureau).

It is estimated that 14% of Tampa Bay residents live in poverty. The median annual household
incomes are as follows: $51,483 in Manatee County, $51,681 in Hillsborough County, and $47,090 in
Pinellas County (U.S. Census Bureau 2016). Approximately 58.7% of residents in all three counties are
part of the civilian workforce. Florida, particularly along the coasts, has a high rate of retired residents
and foreign-born persons that may not be documented within the workforce data.

Food insecurity affects 15% of Tampa Bay residents (Feeding America 2015). This is higher than
the national rate of 12.3% but lower than Florida’s statewide rate of 17% (Feeding Florida 2015; USDA
For Tampa Bay households with children, 22.5% are food insecure (Feeding America 2015). This makes this area highly vulnerable to childhood and adolescent food insecurity and its implications. Approximately 27% of Florida residents have incomes above the SNAP and other nutrition program threshold of 200% poverty. Thus, many food insecure households in Tampa Bay fall within the ALICE population mentioned previously.

Tampa Bay provides an important research setting when studying food insecurity and its influence on growth and development. The high prevalence of food insecurity among households with children allows the opportunity to study food insecure adolescents. Food insecurity research has failed to evaluate intra-household variation and the adolescent population in this region. Childhood food insecurity data generally groups all persons under 18 years of age. Furthermore, it is likely that childhood food insecurity research is missing adolescents within the data samples due to the difficulties in reaching this age group.

Tampa Bay is also an important area for study because of the growing population of people who do not qualify for income or food assistance but still struggle to afford living costs and food (e.g. ALICE population) in Tampa Bay. Research is essential for understanding the barriers faced by this group and how to innovate and modernize food assistance programs to fit their needs. Lastly, food insecurity affects Black and Hispanic households more than other demographics (USDA 2017b). Tampa Bay has a large percentage of Hispanic and African American residents allowing for data that captures these populations and the realities of food insecurity in the U.S. (U.S. Census Bureau 2015).

**Sample Criteria and Recruitment**

A total of 40 girls and 36 caretakers participated in the study. To be eligible, participant households had to have at least one female adolescent living in the house who had their first occurrence of menstruation. Due to the difficulty in recruitment, many girls that participated had started their cycles more than two years before. These participants were asked to answer the food security and dietary questions retrospectively based on the age that the girl had first started menstruation. I did not recruit girls over the age of 16 to prevent too much time passing between age at menarche and the present. While the
goal was to have a sample of low-income participants, there were no preliminary criteria questions within recruitment. Instead, I chose to recruit in known low-income areas and at mobile pantries where the likelihood of food insecure persons was high. Participants were never ineligible based on income or socioeconomic status. Participants had to be mentally stable to ensure their full understanding and consent of the research. In addition, girls were only eligible to participate after I obtained written parental consent.

Recruitment

Teenagers, puberty, menstruation, food insecurity…nothing about these terms say “easy”. In fact, everything about this research may seem utterly invasive to some. And for that reason, as well as the notion that adolescents are a hard-to-reach population and when one does “reach” them, they are even harder to invoke and maintain their interest, this research was one of the hardest projects I have ever been a part of. Particularly older girls (>14y) may much prefer to spend time with their friends or participate in their hobbies than sit down with a stranger and discuss sensitive pieces of their lives. Parents, too, are substantially busy, especially those who have adolescent children; and parents, too, may find it uncomfortable and/or embarrassing to discuss their family’s access to food, dietary habits, and when they and their daughters first had their periods. Community organizations, as well, perhaps felt the topic was too sensitive to market to their populous. All of these limitations played a significant role in the difficulty of recruiting participants for this project. I was told the research was “too messy,” after spending the summer volunteering at a local camp to build relationships with girls. Countless times I awaited email and phone call responses to ultimately never receive them. Many mobile pantry goers would tell me yes, sign up, and then essentially change their minds or ‘ghost’ my calls. It was these difficulties at fault for the unforeseen time it took to finish this research project and the smaller-than-hoped-for sample size.

Recruitment Process

My sample was recruited in various ways. Some from posted flyers at bus stops, libraries, and community centers. The flyers were approved by the University of South Florida Institutional Review Board (IRB), and can be found in Appendix B on pages 138 and 139. They advertised the research objectives, participation criteria, incentives, and my contact information. When I received a call or email,
I went over the sample criteria again to make sure the adolescent was eligible. I asked when the girl or
girls had their first periods and how old they were at the time of contact. Once participation was
established, I further explained the goals of the research, the methods that I would be using, and the time
it takes to complete the interview. If the parent or guardian was still interested, we then decided on a date,
time, and location for the interview.

Feeding Tampa Bay, a local network of Feeding American, also allowed me to attend their
mobile food pantries and recruit clients while they waited in line for their food. This is where I recruited
the majority of participants. There, I spoke with potential participants about the age of girls in their homes
determining eligibility. After explaining the research objectives and methods, I mentioned the incentives
and confirmed interest. If interested, I retrieved contact information of the parent or guardian in which I
kept in a private folder to hide identifiable information. Sometimes participants at the mobile pantries
would schedule a day and time to do the interview with me at the pantry. Most of the time, though, I
called the interested clients later that day or the following day after they had a chance to ask their girls if
they were interested in participating. The phone calls for these participants were similar to those recruited
from the flyers. We discussed the research objectives, methods, and time constraints. We then chose a
time, date, and location for the interview.

Feeding Tampa Bay also connected me with the Tampa Centre for Girls, which allowed me to
talk to their summer camp participants about nutrition and health, recruit at their location, and use their
site for interviews. The Childhood Hunger Initiative was also a helpful place to build connections and
partnerships. At the Childhood Hunger Meetings hosted at the Juvenile Welfare Board of Pinellas
County, I met an employee from the Clearwater Neighborhood Family Center. She allowed me to come
speak to their summer camp students, recruit, and also use one of their conference rooms for interviews.

At both the Tampa Center for Girls and the Clearwater Neighborhood Family Center, I talked to
the girls in their summer program about the importance of adequate nutrition during adolescence and
what a healthy diet looks like. I then briefly discussed my research in which I explained the goals,
methods, and incentives. After, I allowed the girls who were interested in participating to provide their
name and parent’s contact information so that I could talk to their parents about the study and schedule the interviews.

Feeding Tampa Bay also advised me to reach out to Tampa Bay YWCA where I recruited two girls at their WWE Girls Rock event. I set up a table at the event with flyers and a sign-up form for girls who may be interested. Just as I did at the community centers, I talked to the girls briefly about the research, methods, and incentives and then took their name and parent’s phone number to reach out to them later.

**Semi-Structured Dyadic Interviews**

Qualitative interviews were conducted with mothers, daughters, grandmothers, granddaughters, and one aunt and niece. The aunt and grandmothers were the primary guardians and caretakers of the girls. Thirty-one interviews took place at participant households in Hillsborough, Pinellas, and Manatee counties. Three interviews were hosted at the Clearwater Neighborhood Family Center and five at the Tampa Centre for Girls; in a private conference room at both locations. One interview was conducted in a private study room at the Temple Terrace Library. In these locations, I brought all the instruments with me and set them up in the conference/study rooms. I shut the door to ensure privacy. With permission from participants, interviews were recorded using an audio recording device or my cell phone.

The semi-structured interviews collected socio-demographic information for both the parent/guardian and the child, as well as household demographics. The interviews also acquired menarcheal age and date, as well as data regarding household food behaviors and strategies and the dietary behaviors of the girls (e.g.: how often they eat outside of the home; whether they eat school breakfast and lunch, etc.). I also used informal interviews to ask girls about their favorite foods to evaluate what foods and beverages adolescents prefer to eat and drink.

**Logistics for Household Interviews**

After scheduling the interview with participants, I obtained their addresses either over the phone or via text message. I called them the day before to remind them of the interview and then approximately an hour before the scheduled meeting to make sure the time still worked for them. If it did, I drove myself
to the homes using my phone’s GPS. I typically called or texted the participants when I arrived to let them know I was there. This was also a safety precaution for myself, as most often the adults or children would open the door or come outside after knowing I had arrived.

Once in the home, we found a place to sit either at a table or on couches and chairs. The first thing I would do is introduce myself again and explain why I was conducting the research. If other household members were present, I asked the participants whether they were comfortable doing the interview with the other people present. Then, I would talk about the methods and go through the informed consent and assent documents. Once the parent/guardian and girl(s) agreed to participate and signed the informed consent documents, I began the interview using the interview guide, which can be found in Appendix B on page 140 along with all interview instruments. I recorded the answers on a hard copy of the questionnaire as well as with audio recording device for reference. Once completed, I conducted the USDA six-question food security survey module with the parent or guardian and girl(s). I recorded the responses on a paper copy of the questionnaire.

After the interview and food security questionnaires had been completed, I set out some food models and utensils to show the girl(s) what various measurements of food look like. I also showed them what a recommended serving size looks like for pizza, cereal, and macaroni and cheese. I chose these foods because I guessed it would be items adolescents like to eat. The models were meant to help the girls answer the self-administered youth adolescent food frequency questionnaire (FFQ), which I gave them next.

While the girls filled out the FFQ, I set up the portable stadiometer, weight scale, and took out my measuring tape. Once the girls had completed the FFQ, I measured their weight, height, hip circumference, waist circumference, sitting height, and iliac height. All body measurements were written on the form I had created and printed out (see Appendix B, page 148). I will discuss each methodology in more detail in the subsequent sections.
Socioeconomic Status (SES)

Information obtained to measure socioeconomic status included current annual household income, annual household income at the time of menarche, and the parent/guardian’s level of education. Occupation was not obtained as I did not feel it was important for the research questions. Thus, no composite measure of SES could be attained. Poverty was indicated by the 2016 Census poverty thresholds and coded 0 for being above the federal poverty threshold and 1 for being at or below the threshold.

Measuring Food Insecurity

To measure household food insecurity, the Six Question USDA Household Food Security Survey Module was used (See Appendix B, page 143). The USDA Household Food Security Survey Module, as well as the six-item subset of the model, have both been validated as reliable tools for measuring food security and have been used in numerous studies (Keenan et al. 2001). I read the six questions aloud to parents/guardians and the girls (except for one interview where the parent gave her daughter permission to answer the questions on her own), and recorded their answers on the hard-copy of the questionnaire as well as with the audio recorder. Most of the time, the parent/guardian took the lead and answered the questions. However, a few times the responses were joint, where both the girls and their parent/guardian would answer either simultaneously or after confirming with each other. With some families, I observed a ‘teamwork’ effort in deciding their responses, which gave me the impression that the girls were viewed as equals and possibly had agency within the household, as well as the notion that the girls were fully aware of their household’s food and economic situation.

When girls had started menstruation within the last 12 months, then the food security questions were asked in regard to the last 12 months. For example, “in the last 12 months, did you or any other adults in the household have to cut the size of your meals or skip meals because there wasn’t enough money for food.” When girls had experienced menarche longer than 12 months prior, families were asked to think about their food and economic situations when the girl was the age that she first started and answer accordingly to that time period. So, the question would be read “when (name) was 11, did you or
any of the adults in the household have to cut the size of your meals or skip meals because there wasn’t enough money for food? ”

**Dietary Assessment**

Dietary assessment provides an important tool for understanding how food insecurity and income influence the diet and nutrition of girls. Food frequency questionnaires are used to understand the frequency of consumption of distinct food items or groups over a specified time period and can include quantity estimates that allow for semi-quantitative analyses (Burris 2017; Gibson 2005; Himmelgreen 2016d). They are effective in allowing researchers to analyze risks for diet-related illnesses and assess dietary quality at the individual level, including macro and micronutrient estimates, dietary diversity, balance, and adequacy (Gibson 2005; Coates et al. 2012). For this project, the Youth-Adolescent Food Frequency Questionnaire designed by Harvard University was chosen because it incorporates quantity estimates within the questionnaire, is constructed for children within the U.S., and can be self-administered.

The Youth-Adolescent Food Frequency Questionnaire was given to each girl after the dyadic interview questions were completed. For many of the younger girls, their mothers or guardians helped them with the questionnaire. However, the majority of the girls filled out the questions on their own, which I preferred to prevent inaccurate reporting by parents based on associated stigmas and/or beliefs surrounding children’s food intake. In addition, parents may not be fully aware of what their children eat when they are not at home.

Qualitative questions related to family food habits were also included in the interview. I asked questions about whether the household diet has changed over time or recently and in what ways, where the family gets their food, how often the family eats outside of the home, and what techniques or strategies the family does to make sure food lasts long enough for the family or children. I also asked whether the girls had ever been diagnosed with an eating disorder. These questions helped me understand household dietary behaviors and qualitatively estimate dietary quality.
Dietary Preference

Food insecurity research seems to be lacking in the incorporation of food preferences within determinates of food insecurity in the U.S. and developed countries. One study shows that individual food choices can create a barrier to nutrition and consequently food security. Mukoya and colleagues found that choice food pantry clients continue to choose foods high in sodium and fat and low in vitamins, calcium, and zinc when given the opportunity to choose their own foods (Mukoya et al. 2017). Other research has explored how food preferences and desires influence food security in transitioning societies. For example, a systematic review of food insecurity research in South Africa found that the preference for now readily available western and globalized foods, which are high in energy but typically low in nutritional value, is leading to a different face of food insecurity (Misselhorn and Hendriks 2017). This new realm of food insecurity involves overnutrition paired with growth stunting, as we see within developed and other developing areas. Furthermore, the desire to have western and processed foods is altering the types of foods available in South Africa, where healthy foods are becoming more expensive and harder to obtain (Misselhorn and Hendricks 2017).

Since U.S. research has left out food preference within food insecurity studies, I felt it was highly important to include it in this study. Children have been viewed to be particularly “picky” when it comes to food choices. Pickiness can include liking few foods to not liking few foods, not eating enough as viewed by the parents, not liking the textures of certain foods, and resistance to trying new foods (Trofholz et al. 2017). Research has found that children and teens may rather not eat at all than consume foods they do not like (Janavi et al. 2016; Contento et al. 2016). Thus, in order to fully tackle food insecurity among adolescents, we must first understand what they like to eat so we can ensure that culturally-relevant and age-specific foods are provided for those in need. For this study, girls were asked to tell me about their favorite foods, starting from breakfast and moving to lunch, snacks, dinner, desserts, and beverages. I simply flipped the interview guide over to the blank back page and made rows for each meal and two columns: one for favorite foods and one for foods most often consumed.
Anthropometry

Anthropometry allowed me to assess connections between food insecurity, diet, and body size/composition (Gibson 2005; Wiley 2017). Anthropometry is a powerful tool for understanding past and current nutritional status and health risks of individuals through the assessment of body size and composition (Gibson 2005; Wiley 2017). It also allows researchers to understand variations, as well as determinants, within nutrition, growth, and developmental patterns among and within populations (Gibson 2005). Total height, iliac height, sitting height, weight, waist circumference, and hip circumference were measured for this study. Body mass index (BMI), waist-hip ratios, and sitting height ratios were calculated based on these measurements. Linear measurements provide insight into past nutrition, growth, and development, while BMI and waist-hip ratios allow for body composition assessment to determine current nutritional status and health risks (Gibson 2005). All anthropometric measurements followed the steps provided by Gibson in *Principles of Nutritional Assessment* (2005) or the National Health and Nutrition Examination Survey III (NHANES) *Body Measurements (Anthropometry)* Manual (1988).

Linear Measurements

Research shows that linear measurements provide the best physical indicator for early life adversity, specifically food insecurity and malnutrition, which can lead to reductions in linear growth as an adaptive life history response (Bogin and Silva 2012; Himmelgreen et al. 1991; Gibson 2005; Gluckman and Hanson 2006). Thus, short stature as noted by short legs can propose adverse environments during early childhood and even in utero (Gluckman and Hanson 2006; Bogin and Silva 2012; Wiley 2017). In addition, shorter leg length and stature have been associated with an increased risk of morbidity and mortality (Bogin and Silva 2012). These measurements, therefore, allow me to understand whether life history tradeoffs have, or are, occurring among the adolescent girls in this sample (e.g. poor nutrition early in life has sped up the reproductive process to increase fitness). I will now explain how each linear measurement was conducted.
**Height.** Height was measured using a portable stadiometer. I set up the stadiometer in the households or conference/study rooms where the interview took place. I made sure the tool sat on a flat surface. Girls took off their shoes and any headwear they may have been wearing. The portable stadiometer had a marking for feet placement, making it easy for the girls to understand where to place their feet. The girls stood with their feet together facing forward and flat, knees straight, and their heels and the shoulder blades lightly contacting the measuring surface. They placed their arms relaxed down by their sides with palms facing their legs and looked straight ahead so that their heads were in a Frankfurt plane (Gibson 2005). They were advised to stand tall but relaxed. Once the girls were in the correct position, the moveable headboard was lowered down to lay flat on the crown of their head. Height was then recorded to the closest millimeter on the anthropometry measurement sheet (Appendix B, page 148). The same measurement method was then repeated two more times. The average of the three height measurements was used for analysis.

**Iliac Height.** Iliac height is “the distance between the summit of the iliac crest and the floor” (Bogin and Silva 2010:1049). I used a measuring tape for this measurement. I had girls stand exactly how they stood for the height measurement: shoes off, feet flat and facing forward, knees straight, arms relaxed with palms facing thighs, head aligned and looking straight forward, and standing tall but relaxed. I told them I needed to find their hip bone and most of the time they would point to it for me. Once I established the hip and found the top of the iliac crest, I ran the measuring tape from the floor to the top of the iliac crest (Bogin and Silva 2010). I then marked the tape where it met the top of the iliac crest and recording the marking to the nearest millimeter on the anthropometry sheet. The measurement was taken two more times in the same way, and the average of the three measurements used for data analysis.

**Sitting Height.** Sitting height is measured to understand the length of the torso and can provide the total length (stature - sitting height). It is also necessary for sitting height ratios, which compare body proportions among individuals of different heights (Bogin and Silva 2010). For sitting height, I positioned a chair, which was usually a dining room or kitchen table chair, so that the back of the chair was up against the stadiometer. The girls had previously removed any headwear that may hinder the
measurement before the height test. I then had the girls sit all the way back in the chair with their knees directly ahead and together. They placed their head straight in the Frankfort Horizontal Plane with their arms relaxed and palms at the sides of their legs (NHANES 1988). They were advised to sit up tall but relaxed. The horizontal measuring bar of the stadiometer was lowered down until lying flat on the crown. The measurement was recorded to the nearest millimeter on the anthropometric sheet. The measurement was taken three times and the average used for analysis.

**Sitting Height Ratio.** Sitting height ratios compare leg length to torso height. They show whether stunting has occurred. Sitting height ratios are also useful to compare individuals of various statures. Sitting height ratios were calculated by dividing sitting height by height and multiplying by 100 ((sitting height / height) x 100) (Bogin and Silva 2010).

**Total Leg Length.** Total leg length was calculated to reference Frisancho’s reference standards. It was attained for each individual by subtracting sitting height from height (sitting height – height) (Bogin and Silva 2010).

**Body Size, Fat, and Composition**

Weight, BMI, waist circumference, hip circumference, and waist-hip ratios provide inferences for present nutritional status (Gibson 2005; Wiley 2017). BMI is commonly used to determine whether someone is under- or overweight for their height and estimate risks for chronic disease like cardiovascular disease and hypertension (Gibson 2005; Himmelgreen et al. 1998; Wilson et al. 2011). It can confer body fat percentage but does not account for body composition (Lieberman 2017; Wiley 2017). Someone with low weight-for-height may be experiencing undernutrition and wasting, while someone with height weight-for-height may be over-nourished and overweight (Lieberman 2017; Gibson 2005). However, BMI cannot differentiate fat mass from muscle mass and there is a lot of variation between population groups (Gibson 2005). Thus, waist and hip circumferences are used to further understand body composition and body fat distribution among the girls. Waist circumferences may be used to measure abdominal (central) body fat (Lieberman 2017; Gibson 2005). Waist-hip ratios show whether more body fat lies in the hips or the waist, and it is used to measure the risks for cardiovascular disease (Gibson
Thus, for this study, analyzing body composition and fat distribution will indicate whether overnutrition (central adiposity) is playing a role within growth and development and can be used as a control factor when looking at the association between development and stressed/insecure bodies. Furthermore, waist and hip circumferences are assessed in relation to age at menarche to understand which measurement is a better indicator, since this is debated in the literature (Villamor and Jansen 2016; Gernelli et al. 2016; Bhadra et al. 2013; Ziomkieqicz and Koziel 2015). In addition, overnutrition from diet and food insecurity may explain larger waist circumferences and abdominal adiposity. Whereas, larger hip circumferences may point to skeletal maturation or lower body fat distribution, both of which may be significant to the onset of menarche (Ziomkieqicz and Koziel 2015).

**Weight.** Weight was measured using a portable digital scale. The scale was solar powered so I did not have to worry about running out of batteries or using electricity. The scale was placed on a flat surface, specifically on hard floors when available. It was first turned on by me and checked to make sure the balance was zero before measuring the girl’s weight. The girls then stood on the scale with both feet facing forward and head looking straight ahead. I did not ask the girls to remove their clothes but they did remove shoes. The weight was recorded to the nearest 0.1 kg on the anthropometric sheet. Weight was then taken two more times and the average of the three measurements was used for analysis.

**Body Mass Index.** BMI provides a weight to height ratio for individuals and is used in the U.S. for referencing healthy or unhealthy weight among adults and children (Gibson 2005). BMI was calculated by dividing weight (kg) by height (m) squared (Gibson 2005).

**Waist Circumference.** Waist circumference was measured using a measuring tape. Girls were asked to stand up straight with their feet together and to lift up their shirt if they felt comfortable doing so. If not, they left their shirts down and I measured around the shirt. I explained I would be measuring at their belly button. If the shirt was still down, I asked the participant to show me where the belly button was. I measured from the middle of the belly button around the abdomen making sure the tape was parallel to the ground and pulling snuggly. I pulled tight to lessen any error from the clothing. I marked
the measuring tape where it crossed. I recorded the measurement to the nearest millimeter on the anthropometry sheet. I took the measurement two more times and used the average for analysis.

**Hip Circumference.** Hip circumferences were measured with a measuring tape. Girls were asked to stand up straight with their feet together and head looking straight ahead. I did not ask them to remove any clothing for this measurement. I explained to them that I would be measuring around their “booty” before I began to lighten up the invasive measurement. I started on one side of the hip/thigh area and wrapped the measuring tape snugly around the most extended part of the buttocks. I then adjusted the tape on the sides so that it was even and parallel to the ground all the way around. I marked the tape at the crossing and recorded the measurement on the anthropometric sheet. I repeated this measurement two more times to get an average measurement for data analysis.

**Waist-hip Ratio.** Waist-hip ratios show where fat is distributed on one’s body. They were calculated by dividing an individual’s waist circumference by their hip circumference (waist circumference / hip circumference) (Lieberman 2017). A higher ratio indicates higher abdominal fat and higher risks for overweight and noncommunicable disease.

**Behavioral Observation and Field Notes**

Field notes were written as soon as I got home or to my office following an interview. They were typed into a word document and described the setting, the interview responses, noted behavioral observations particularly relative to food and eating, and the answers to the qualitative questions. Field notes also include my observations while volunteering at a local summer camp program as well as observations from visiting community centers. No names or identifiable information were included in the field notes.
CHAPTER 4: ANALYSIS

A total of 40 girls and 36 parents or guardians participated in the research. All data, including both qualitative and quantitative, were entered into a Microsoft Excel spreadsheet. When possible and fitting, responses were coded in excel to be quantified and used in statistical analyses. All audio recordings of interviews were transcribed into Microsoft Word. No names or identifiable information were transcribed. The analysis was broken up into two parts—qualitative and quantitative. I will discuss these separately.

Qualitative Content Analysis

Transcriptions and field notes were uploaded into Dedoose, an online qualitative analysis software. Using my research objectives as well as common themes noted from reading the field notes and transcriptions, codes were created in Dedoose and used to categorize the qualitative content. The primary codes included: Favorite Foods, Amenorrhea, Body Image, Buffering, Child Food Behaviors, Children & Adults Eating Same Foods, Children & Adults Eating Different Foods, Concerns, Debate Between Parent and Child, Dietary Change, Factors Behind Food Choices, Family Food Behaviors, Food Observation, Food Insecurity, Food Venues, Health of Adolescent, Higher Income and Healthier Foods, Immigrated Family, Importance of Balanced Diet, Importance of Healthy Diet, Maternal Health, Menarcheal Stories, Most Often Foods, Possible Non-Truths, Signs of Puberty, Skipping Breakfast, Skipping School Lunch, SNAP, Specific Food Purchasing Habits, Techniques/Strategies to Mitigate Food Insecurity, Treating Kids. Many of these codes also had secondary and tertiary codes under them. For an example, see table 2 on page 46 that shows the codes for Techniques/Strategies to Mitigate Food Insecurity. From coding, I was able to develop concrete themes, ranks responses, and quantify percentages.
Table 1. Secondary Codes for Techniques/Strategies to Mitigate Food Insecurity

<table>
<thead>
<tr>
<th>Primary Code: Techniques/strategies to Mitigate Food Insecurity</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeting</td>
<td>2</td>
</tr>
<tr>
<td>Buying Bulk</td>
<td>4</td>
</tr>
<tr>
<td>Buying Cheaper/Low Quality Foods</td>
<td>3</td>
</tr>
<tr>
<td>Cooking in Bulk/Leftovers</td>
<td>14</td>
</tr>
<tr>
<td>Cooking only what is Needed</td>
<td>2</td>
</tr>
<tr>
<td>Food Pantries</td>
<td>5</td>
</tr>
<tr>
<td>Freezing Foods</td>
<td>9</td>
</tr>
<tr>
<td>Portioning / Rationing</td>
<td>11</td>
</tr>
<tr>
<td>Shop Sales</td>
<td>14</td>
</tr>
<tr>
<td>Storage</td>
<td>2</td>
</tr>
</tbody>
</table>

Food Security

Household food security was scored and categorized based on the USDA Six-Question Food Security Survey Module. The module provides food security scores for each individual based on the accessibility to adequate amounts of food within the previous 12 months (USDA 2012; USDA 2017d). Raw scores are determined by the number of affirmative answers. If a person has 0 or 1 affirmative answer(s), they are categorized as having high or marginal food security. A raw score of 2 to 4 is categorized into the low food security group. Lastly, a raw score of 5 or 6 is considered to indicate very low food security. The tertiary groups were simplified to create binary categories of food insecure (low food security and very low food security) and food secure (high or marginal food security) (USDA 2012). The binary variables are used to compare food insecure and food secure groups. Household food security raw scores convert into a scale score (HFSS score). These scale scores were used within quantitative analyses including mean comparisons, correlations, and Cox Hazard survival analyses. The frequency distribution was observed to ensure the food security scores have a normal distribution and no outliers. The distribution is normal as shown in Figure 4 in the results section.
Anthropometry

Anthropometric body size and composition measurements were compared and referenced to the CDC 2011 and 2014 references in order to compare the study sample to the most recent data for girls in the U.S. Since the “norm” within body size and shape is consistently changing, (e.g., average weight and BMI has been consistently increasing in the U.S. for decades), it is important to understand how one’s sample compares with the average of the larger population. Thus, I referenced weight-for-age, height-for-age, BMI-for-age, and waist circumference-for-age to the most recent CDC reference data (2011-2014) obtained from the National Health and Nutrition Examination Survey (NHANES). Secondly, the anthropometric data were compared to reference standards. Weight-for-age, height-for-age, and BMI-for-age were referenced against the CDC 2000 child growth standards. Since the WHO does not go above 10 years of age for weight-for-age, U.S. CDC charts were used for this reference.

BMI-for-age percentiles are categorized by referencing both the current data and the 2000 reference charts. The categories include underweight when BMI-for-age is below the 5th percentile, normal weight when BMI is above the 5th and below the 85th percentiles, overweight when BMI is at the 85th percentile and below the 95th percentile, and obese when BMI-for-age is at the 95th percentile or higher.

Waist circumference percentiles were referenced to the most recent CDC data (2011-2014) to compare my sample to the national average. The CDC does not have waist circumference or hip circumference standards, so Frisancho’s standards are used to reference this sample. Hip circumference, waist-hip ratio, total leg length, sitting height, and sitting height ratio were referenced against Frisancho’s Anthropometric reference standards to find percentiles. Frisancho’s references were the only place I could find this data. However, they are older (published in 2008) and generalizations should be made with caution.

While cut-offs for waist circumference and waist-to-hip ratios have been determined in other research, I chose not to use cut-offs for this analysis due to the ethnic differences in body composition among children (Gibson 2005). Research posits that African American children generally have lower
intra-abdominal fat mass than Caucasian children (Gibson 2005). Thus, cut offs are not used for this sample, as my sample is demographically diverse.

**Quantitative Analysis**

All quantitative analyses were conducted using IBM SPSS Statistics 24.0. Descriptive statistics were used to understand central tendencies and frequencies for food security scores, body metrics, and sociodemographic variables. Exploratory data analysis also showed central tendencies and variance, as well as assessed trends, correlations, and comparisons among the sample. Due to the small sample size, non-parametric statistical tests were used. Mann-Whitney U and Kruskal-Wallis H tests evaluated differences in means and medians among sub-samples, except when conducting a one-sample t-test to compare mean menarcheal age between parents/guardians and the girls. Spearman’s Rho correlation coefficients and partial correlations assessed correlations between menarche and body size/composition, menarche and food security, menarche and diet, and food security and body size/composition. Specifically, correlations test the prediction that food insecurity, body composition, and energy-dense diets negatively correlate with age at menarche; food insecurity will positively correlate with body size and composition; and linear measurements will positively correlate with age at menarche. Cox regression hazard censured for missing menarcheal ages to provide a predicted mean and median. Furthermore, Cox regression explored the association between menarche and food insecurity and tested the prediction that food insecurity will increase the likelihood of menarche at an earlier age.

**Dietary Analysis**

Girls chose how often they consumed specific food items from provided frequency options on the youth adolescent food frequency questionnaire. Their answers were then coded to achieve a mean and median for each food item for the total sample in Microsoft Excel. This allowed me to understand which foods are consumed most and least frequently among the sample. The preferred foods were also tallied to find which foods girls preferred most. The distribution frequencies for each food item were checked for normality.
Dietary quality was also assessed, as it provides better insight into food security. Dietary quality goes beyond food frequencies to incorporate dietary diversity and adequacy. It is important for understanding risks for diet-related diseases, as research shows that monotonous diets and diets missing essential food groups are connected with malnutrition and relative diseases.

Dietary diversity is assessed as part of dietary quality. It has been shown to increase dietary quality (Armelagos 2014). Dietary diversity is indexed using the Dietary Quality Index-International (DQI-I) scale and calculated for each individual girl, and then averaged to infer dietary variety for the sample as a whole. The DQI-I is a validated diet quality indicator for individuals and accounts for cross-cultural dietary comparisons (International Dietary Data Expansion Project 2015). The DQI-I codes the number 3 for each food group that is consumed daily. The food groups for variety include meat/poultry/fish/egg, dairy/beans, grains, fruit, and vegetables. When a girl did not have one of the food groups on a daily basis, I coded zero. Dietary variety is then scored by adding up the codes, with the highest possible score equaling 15.

Dietary adequacy was calculated to understand whether individuals are consuming the recommended daily amounts of food groups based on the USDA dietary guidelines (2015). Similar to that of DQI-I, simple food groups are coded. I did not collect data on micronutrient content or oil consumption (only butter, nuts, seeds, and fried foods), and thus had to leave those out of the dietary adequacy evaluation. Instead, I referenced daily consumption of fruit, vegetables, grains, dairy, and protein to the USDA Dietary Guidelines (2015-2010) based on the recommended calorie intake for female adolescents. Each individual that met the recommended daily consumption for each food group was coded with 5. If the individual did not meet the daily recommendation, the food group was coded with a zero. The highest possible score for individual dietary adequacy is 25. After each individual’s scores for dietary variety and adequacy were calculated, I calculated the average score for the total sample.
CHAPTER 5: RESULTS

Critical Reflection

I can remember each and every interview uniquely in mind, as no two interviews were the same. I can distinctly recall the atmosphere, the energy, the conversation, and more for each visit. However, there are some household interviews that stand out more than others. If I ponder on the reasons why they have tattooed my brain, I can uncover some common, as well as opposing, characteristics—most centered on poverty or lack thereof.

I will never forget my first interview. Not because there was anything special about the household or the interview itself. Frankly, it was one of my least interesting and least informative interviews. No. This one remains concrete because of the intense feelings and recognitions discovered about myself, which left me critically appalled (at myself). This one is special because it uncovered my own biases and fears that I had not expected nor confronted prior to this study. As I am sure it is common, I was terribly nervous for my first interview. While I had practiced on my husband and imaginary persons (my dogs graciously lent their attention and turned heads while listening to me ramble on in my home), it is never the same as entering into an unfamiliar neighborhood, walking up to a stranger’s home, and asking them to tell you—a stranger—about their lives, while literally putting your own life in their world and what seems like their hands. Thus, my nerves were, and I’m going to use a cliché here, through the roof of my navy blue Jeep Patriot. As I drove into the neighborhood off Nebraska Avenue in the midst of Tampa, Florida, I came to two realizations. The first was that I had failed, up until this point, to think about how my own demographics may become a significant barrier to this research project. Being a white young female quickly set me apart from everyone else I saw in the neighborhood. Immediately I was an outsider. And I felt it. I felt like eyes were staring at me (which could have been a fabrication in my mind) as I got
out of my newer vehicle with my SECA box of anthropometric measuring instruments and my Human Biology Association bag I had received earlier that year from the annual meetings. This first interview allowed me to quickly acknowledge that my skin color, background, and even the way I spoke may limit the depth of information I receive from people. I am not only referring to my socioeconomic background because, actually, I grew up in a low-income household for the first half of my life. But I am also referring to the fact that I grew up in a small rural town in the Midwest. Thus, I could not even use the state of Florida, the south, or city life to relate to my participants.

While I have had experience in qualitative research and felt well-prepared, I have no doubt that in some cases my personal background may have been a limitation of this research. This is something that I can imagine many anthropologists experience, and we can only do our best to make participants feel comfortable. The more interviews I conducted, the easier it was to find ways to connect with participants and use the right probes to further open conversations, many of which included simply talking about myself, my own life experiences, and food. Food and eating indeed are social and cultural phenomenon, and I quickly realized that food is one of the best conversation boosters a researcher can ask for.

The second realization I discovered from my first interview was my own unfortunate biases. As I said, I was nervous before the interview, as I am sure most researchers are. However, there was more. I was scared. I was shamefully afraid. Again, a feeling I did not expect. Normally, I am one of those people who believe it is human nature to be “good,” whatever your definition for that abstract word may be. Typically, I have a naïve trust in people. Yet, as I drove through this neighborhood that I had never been in, and I looked at the people sitting out on their porches, the bars on the windows, the children playing basketball on a cracked and overgrown driveway, and the laundry hanging on clotheslines, I felt a sense of sadness but also a fear. I texted my husband and told him that I was in a “very bad neighborhood” and that I would call him within an hour. I don’t know why I felt afraid and I don’t know why I assumed this neighborhood was “bad”—well, actually I do. It was because of the bias social stereotypes that are ingrained in our minds as well as the fact that I grew up in a small rural town where the largest of dangers stem from the annual car wreck on the four-lane highway— but looking back, I regret that I felt that way.
Even as I drove away after completing the interview, unharmed, I wondered if the reason my tires felt bumpier was because someone had slashed them. ME. An anthropologist! Someone who is trained not to pre-judge, to be objective, and to understand others — particularly marginalized populations. Yet, still, I had the bias that inner-city poverty equaled danger and crime. A bias that soon diminished, thankfully, by my own critical examination of myself and a harsh reminder of anthropological theories and institutional ideologies. However, a bias that I shamefully had to fight back against more than once during this project.

**Research Setting Example 1- Tampa**

I entered an apartment complex on the Northside of town. Only ten minutes from the USF campus which was convenient. The complex was two rows of duplexes. The mother was outside waiting for me. She had seen my flyer at the bus stop and called. On the phone she told me that her girls were excited about the gift cards because they need new school clothes. As I entered, the first thing I noticed was the size of the space. It seemed so small. The ceilings were low and it was dark inside with only one dim ceiling light in the kitchen area—a vast difference from the blazing brightness outside. The curtain over the one front window in the living room/bedroom was black, blocking any sunlight from coming in. The front room had a pullout bed, where the teen girl was sitting, watching TV on an older box-style television. The walls were covered with religious decor, including crucifixes, photos of Jesus, and framed bible quotes. The window air conditioning unit was on full blast and loud, but the cold air felt great and easily cooled the small space. We sat down at a round bistro-style table that connected the small kitchen with the living area. A single row of kitchen counter, along with the sink, was covered in used dishes and boxes of food. A burnt-orange cockroach caught my eye as it scurried across the yellowy countertop. I learned a few months later that these are called “palmetto bugs” and not considered cockroaches in Florida. The refrigerator made up the other side of the kitchen, along with boxes of soda, water, and one box of Yoo-hoo stacked on floor. I thought to myself how I had not seen or had a Yoo-hoo in years. We sat down at the bistro table and they offered me a Coke. I do not normally drink soda, but I accepted to be polite. My grandma always said to never turn down food or beverage that is offered to you. Mom sat to my left and her daughter stayed on the couch-bed. It was close enough that we could all easily chat as a
group, although the AC unit made it difficult for me to speak at my normal tone. The dad shifted from standing in the kitchen to sitting on the couch-bed, back and forth, as if he could not make up his mind. During the interview I noticed more Palmetto bugs making their way across the ceramic kitchen tile that I think may have once been white. The tan carpet in the living room was stained in various areas, black and brown. The yellow and pink-flowered kitchen wallpaper had peeled off near the back door, and one area was completely bare. It was obvious that these were not great living conditions and I could not help but wonder why their landlord did not fix these things. The participants were kind and eager to let me into their lives. After I left, I cried. I felt helpless. How was I, or anyone, ever going to tackle all the complex structural issues that keep people living in these conditions?

**Research Setting Example 2- St. Petersburg**

This part of town did not seem too horrible. I pulled into a driveway off a busy street and parked on the side of a two-story white house. I was not sure if it was a single family home or apartments. The mom was outside waiting for me and she walked me in. Entering in the front door, there were wooden stairs immediately in front, and we turned to the right and walked into a living area. The square room had wooden floors and wood-paneled walls. There was an old fireplace with a white mantle on the right wall between two windows that were covered with blankets. The first thing I noticed was the absence of furniture. There was not one piece of furniture in the room. We turned left and walked into a dining room. We sat at a rectangular dining room table that had four chairs and a highchair. The kitchen was off to the right and it was abnormally empty. There was not a single thing on the counters; not one dish, not a microwave, not a coffee maker, and no food. The house was unbearably hot. It was apparent there was no air conditioning, or it was not on. It was the middle of summer. Behind me was a sliding glass door that let in the only light. There were five children present. Two of the girls participated in the study. They had a younger sister and two little brothers, one of whom was a toddler. All of the children sat or stood around the table with us, and the younger ones who were not participating were jealous. I just could not help
wonder why they did not have air conditioning or use it, and why they did not have furniture. Did they even really live here? Maybe they just moved?

Sample Demographics

A total of 40 adolescent girls from ages 9 to 16 years, eight grandmothers, 27 mothers, and one aunt who had legal custody participated in this study (40 girls and 36 parents/guardians). Eleven of the households are multigenerational, where eight consisted of the grandparents taking care of the grandchildren and three consisted of the grandparents, parents, and children all living in the household. One family consisted of an adopted daughter of the mother. The daughter was adopted when she was three weeks old.

The sample is diverse but not representative of the Tampa Bay population as minority groups make up most of the sample (see page 31 for demographic data). Approximately 65% of the girls self-identify as African American, 17.5% self-identify as Latina or Hispanic, 12.5% self-identify as Biracial, and 5% self-identify as Caucasian. As seen in table 2, the mean age of the girls is 13.20 years with a standard deviation of 2.21 years. The average grade level is 8th grade with a standard deviation of 2.2 grades.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Variance</th>
</tr>
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<tbody>
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<td>16</td>
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<tr>
<th>Ethnicity</th>
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</tr>
<tr>
<td>Latina/Hispanic</td>
<td>7</td>
<td>17.50%</td>
</tr>
<tr>
<td>Biracial</td>
<td>5</td>
<td>12.50%</td>
</tr>
<tr>
<td>Caucasian</td>
<td>2</td>
<td>5%</td>
</tr>
</tbody>
</table>

Table 2. Adolescent Demographics
The mean age of parents/guardians is 45.14 years with a standard deviation of 12.3 years. Self-identified ethnicities again were not representative of Tampa Bay, as the majority of caretakers were African American (63.9%). You can view the parent/guardian demographics in Table 3.

The most noted educational levels of parents/guardians include: 30.3% graduated high school, 24.2% some college, 18.2% bachelor’s degree, 12.1% associate’s degree. Educational data is missing for three participants, thus, percentages are based on 33 participants.

### Table 3. Parent/Guardian Demographics

<table>
<thead>
<tr>
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<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years</td>
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<td>42</td>
<td>29</td>
<td>12.309</td>
<td>151.479</td>
</tr>
<tr>
<td>Income</td>
<td>$33,420.69</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$16,040.34</td>
<td>257292413</td>
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</table>

<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>African American</td>
<td>23</td>
<td>63.9%</td>
</tr>
<tr>
<td>Caucasian</td>
<td>4</td>
<td>11.1%</td>
</tr>
<tr>
<td>Latina/Hispanic</td>
<td>4</td>
<td>11.1%</td>
</tr>
<tr>
<td>Trinidadian</td>
<td>3</td>
<td>8.3%</td>
</tr>
<tr>
<td>Biracial</td>
<td>1</td>
<td>2.8%</td>
</tr>
<tr>
<td>Native America</td>
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<td>2.8%</td>
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<table>
<thead>
<tr>
<th>Education</th>
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<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>High School Diploma</td>
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<td>30.3%</td>
</tr>
<tr>
<td>Some College</td>
<td>8</td>
<td>24.2%</td>
</tr>
<tr>
<td>Bachelor's Degree</td>
<td>6</td>
<td>18.2%</td>
</tr>
<tr>
<td>Associate's Degree</td>
<td>4</td>
<td>12.1%</td>
</tr>
<tr>
<td>In College</td>
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<tr>
<td>GED</td>
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<td>6.1%</td>
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<tr>
<td>Technical Degree</td>
<td>1</td>
<td>3.0%</td>
</tr>
<tr>
<td>10th Grade</td>
<td>1</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

The mean age of parents/guardians is 45.14 years with a standard deviation of 12.3 years. Self-identified ethnicities again were not representative of Tampa Bay, as the majority of caretakers were African American (63.9%). You can view the parent/guardian demographics in Table 3.

The most noted educational levels of parents/guardians include: 30.3% graduated high school, 24.2% some college, 18.2% bachelor’s degree, 12.1% associate’s degree. Educational data is missing for three participants, thus, percentages are based on 33 participants.
There was one extreme outlier in household annual income ($375,000). Thus, this outlier was removed when looking at means, but remained when using nonparametric tests which assess the medians or distribution of the data rather than means. The mean household annual income with the outlier is $45,306.67; the median is $30,500.00; and the standard deviation is $65,263.65. After removing the outlier, the mean annual income is $33,937.93; the median is $30,000; and the standard deviation is approximately $16,000. Incomes range from $9,600 to $75,000 (without the outlier). The distribution is slightly skewed to the right. Referencing the U.S. census poverty threshold, 11 families are considered to be in poverty.

**Menarche**

In the study sample, 30 girls have experienced menarche. The 10 girls who have not started their periods had other pubertal signs such as breast development, facial changes, and body odor. Table 4 shows the summary statistics for menarche. The mean age of menarche for girls is 11.2 years (134.4 months) with a standard deviation of 1.36 years. The mean age at menarche is more than one year lower than the current national average of 12.3-12.5 years. Thus, this sample is experiencing early-onset puberty when compared to the national average. Menarcheal age ranges from eight to 13 years of age. The distribution for menarcheal age is shown in Figure 3. The distribution is slightly skewed to the left, but there are no outliers. A survival analysis censoring for the 10 non-menarcheal girls predicted an estimated

<table>
<thead>
<tr>
<th>Adolescents</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Variance</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in Years</td>
<td>11.2</td>
<td>11</td>
<td>12</td>
<td>1.356</td>
<td>1.837</td>
<td>5</td>
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<tr>
<td>Age in Months</td>
<td>134.4</td>
<td>132</td>
<td>144</td>
<td>16.266</td>
<td>264.591</td>
<td>60</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Parents/Guardians</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
<th>Std. Deviation</th>
<th>Variance</th>
<th>Range</th>
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</thead>
<tbody>
<tr>
<td>Age in Years</td>
<td>12.19</td>
<td>12</td>
<td>11</td>
<td>2.039</td>
<td>4.157</td>
<td>7</td>
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</table>
mean age at menarche of 11.44 years (137.32 months) and an estimated median age of 12 years (144 months) for the total sample.

There are significant differences in mean age of girls who have experienced menarche and those who have not (p < 0.001). Girls who have started menstruating are on average 14.17 years of age. Girls who have not started have a mean age of 10.30 years.

Maternal mean age at menarche is 12.19 years with a standard deviation of 2.04 years. The average maternal age at menarche is still considered lower than the national average but is significantly higher than the mean age for the girls (Student’s One-Sample t test: p < 0.00). There is also more range in maternal menarcheal ages when compared to the girls. Maternal menarcheal ages ranged from 9 to 16 years of age, with no outliers. In opposition to the literature, maternal menarcheal age does not correlate with adolescent menarcheal age in this sample. I ran two Spearman’s Rho correlations. The first without

Figure 3: Histogram showing frequency distribution for adolescent menarcheal age; Interval width of 10 months
the aunt and adoptive mother, since they were not biological mothers ($p = 0.072, r_s = 0.374, n = 24$). The second correlation included the aunt and adoptive mother ($p = 0.07, r_s = 0.368, n = 25$). Both tests were not significantly correlated with adolescent menarcheal age.

**Food Insecurity**

More than half of the households in the sample are food insecure (55.6%, n = 20 households). This means that 55% of girls in the study live in food insecure homes. While this proportion is high and not representative of the local or national distribution, it is expected from the recruitment methods and warranted by the objectives of the research. In addition, it is known that food insecurity disproportionately influences minority groups which make up most of the sample. For example, food insecurity affects 22.5% of African American households in the U.S. and 18.5% of Hispanic households compared to a 16.5% prevalence among all U.S. households as a whole (USDA 2017b). Among this study sample, 56% of African American girls are food insecure, 71.4% of Hispanic girls are food insecure, 33% (1 out of 3) biracial girls are food insecure, and 50% (1 out of 2) Caucasian girls are food insecure. A Chi-Square test shows there are significant associations between food security status and ethnicity ($p < 0.001; df = 64; \text{Chi-Square value} = 286.931$).

<table>
<thead>
<tr>
<th>Table 5. Food Security Categories</th>
</tr>
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<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>High/Marginal Food Security</td>
</tr>
<tr>
<td>Low Food Security</td>
</tr>
<tr>
<td>Very Low Food Security</td>
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<tr>
<td>Binary</td>
</tr>
<tr>
<td>Food Secure</td>
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<tr>
<td>Food Insecure</td>
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</table>
The USDA Household Food Security Survey Module categorizes scores into three groups: high/marginal food security, low food security, and very low food security. Percentages are based on 36 households. Table 5 shows that 16 (44.4%) households have high/marginal food security, 16 (44.4%) have low food security, and 4 (11.1%) have very low food security in this sample. It is common in food security research to group the latter two categories (low food security and very low food security) into one food insecure group. This is the binary group used when I discuss differences or similarities between food insecure and food secure groups.

The summary statistics for Household Food Security Scale scores (HFSS scores) are presented in Table 6. The mean food insecurity score is 3.65 and the standard deviation is 2.359. The mean score falls between the categories of high/marginal food security and low food security. The median and mode HFSS scores are both 4.19, which is considered low food security (food insecure). The distribution of scores is slightly skewed to the left, but there are no significant outliers (Figure 4).

<table>
<thead>
<tr>
<th>HFSS Score</th>
<th>Mean</th>
<th>Median</th>
<th>Mode</th>
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<tbody>
<tr>
<td></td>
<td>3.65</td>
<td>4.19</td>
<td>4.19</td>
<td>2.359</td>
<td>5.565</td>
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</table>

The summary statistics for Household Food Security Scale scores (HFSS scores) are presented in Table 6. The mean food insecurity score is 3.65 and the standard deviation is 2.359. The mean score falls between the categories of high/marginal food security and low food security. The median and mode HFSS scores are both 4.19, which is considered low food security (food insecure). The distribution of scores is slightly skewed to the left, but there are no significant outliers (Figure 4).

Figure 4: Histogram showing frequency distribution for Household Food Security Survey Scores; interval width of 2.
Supplemental Nutrition Assistance Program (SNAP). Among the sample, 20 (55.6%) households participate in SNAP. While this amount is equal to the number and percentage of food insecure families, being food insecure and SNAP participation do not go hand-in-hand. Among food insecure families, 12 are SNAP recipients (60%) and 8 are not (40%). Thus, 40% of food insecure families are not receiving SNAP assistance. When comparing the mean incomes of food insecure SNAP families and food insecure non-SNAP families, there are significant differences in mean annual incomes (Student’s t test: $p = 0.048$, df = 6.703, $t = 2.419$; equal variances not assumed). Food insecure households who are not on SNAP have an average income of $39,857.14$ (with income outlier removed) and food insecure families who are on SNAP have a mean annual income of $21,775$. Thus, it is likely that the food insecure households who are not SNAP recipients do not qualify for assistance. To qualify for SNAP participation in the Florida, households must have a monthly income at or less than 200% of the federal poverty level (DCF 2017). The income limits vary based on household size. For example, a family of two people must have a monthly household income less than $2,709 to receive SNAP benefits (DCF 2017). Individuals must also have U.S. citizenship or qualified noncitizen criteria including social security application status (DCF 2017).

Table 7 shows the cross tabulation statistics for SNAP users. Among SNAP recipients, 60% (12) are still food insecure. Thus, SNAP is only preventing food insecurity for 40% of recipients in this sample. In addition, 30% of SNAP participants said they relied on food pantries as a main food source.

Food Pantries. Even though a large proportion of the sample was recruited at mobile food pantries, only 10 families said they go to food pantries when asked where they get food and what they do to make sure their families have enough food (27.7%).

| Table 7. Cross Tabulation of SNAP Participation, Food Security, and Food Pantry Use |
|---------------------------------|-----------------|-----------------|-----------------|
| SNAP               | Food Insecure | Food Secure | Food Pantry Use |
| No (n = 16)        | 8              | 8            | 4               |
| Yes (n = 20)       | 12             | 8            | 6               |
| Total             | 20             | 16           | 10              |
Health

No girls in this sample have been diagnosed with an eating disorder. Girls were asked about current and past health conditions. A total of 17 girls listed current health conditions. The three most common current health conditions include asthma (n = 6), allergies (n = 5), and ADHD (n = 3). Common past health issues include premature birth (n = 5), and asthma (n = 3). I found it interesting that five parents/guardians listed premature birth as a past health issue.

The top three most common current health conditions for parents/guardians include diabetes (n = 11), high blood pressure (n = 8), and mental health conditions (n = 3). The only past health issue mentioned by more than one person is allergies (n = 2).

Body Size and Composition

The mean birth weight for the girls in this sample is 2.96 kg (n = 34) with a standard deviation of 0.66 kg. This is lower than the overall national average for full term pregnancies which was 3.39 kg in 2005 (Donahue et al. 2011). It is also lower than the full term national mean for Hispanic mothers (3.37 kg) and African American mothers (3.24 kg) (Donahue et al. 2011). Out of those who knew their birth weights, 24 (70.6%) had birth weights under the national average. However, the mean sample birth weight is not considered low birth weight by CDC references (less than 2500 grams) (Martin et al. 2017). In addition, five mothers mentioned their daughters were premature. The early term births could be skewing the mean.

Descriptive statistics for girls’ body size and composition can be found in Table 8 on page 62. The mean current weight of girls is 57.63 kg and the standard deviation is 17.73 kg. The frequency distribution for weight is skewed to the right with one outlier at 107.6 kg. The mean weight-for-age percentile based on the CDC 2000 references is 69.45. The mean height of the girls is 155.8 cm with a standard deviation of 12.64 cm. Height is distributed normally. The average height-for-age percentile is 55.34. The girls have a mean body max index (BMI) of 23.6, and a BMI standard deviation of 6.67. The BMI distribution is skewed to the right due to one outlier at 42.19. The mean BMI-for-age percentile is 65.57.
Referencing the CDC BMI class cut offs (2000), 16 of the girls are considered to have a normal weight (42.1%), two girls are underweight (5.3%), eight girls are overweight (21.1%), and 12 girls are obese (31.6%). It is interesting to see that when comparing the girls’ weight to the CDC 2000 BMI-for-age reference standards, over half of them are overweight or obese. However, when compared to girls today (2011-2014 CDC reference data) only eight are outside the “normal” percentile range for their age group.

Average iliac height is 93.8 cm and the standard deviation is 7.53 cm. Individual total leg length was also calculated to compare to Frisancho’s references (stature-sitting height). The total leg length mean was 81.02 cm with a standard deviation of 10.85 cm. The average total leg length is much less than the iliac height mean. In addition, when comparing my sample’s total height to Frisancho’s reference percentiles, the average percentile is 64.38, but many of the girls have total heights above the 95th percentile (n = 11). Thus, there may be measurement error in the data, or girls today have significantly longer legs than the 2008 reference sample.

The mean sitting height is 76.74 cm with a standard deviation of 8.1 cm. The average percentile is 29.2 for the total sample sitting height. In opposition to leg length, sitting heights seem to be significantly shorter than the references. Again, this is likely due to measurement errors, but could
represent differences in sitting heights today. Sitting height ratio has a mean of 48.9 and a standard deviation of 4.69. The sitting height ratio falls within the 29.7 percentile on average. Thus, this sample seems to have longer legs and shorter torsos compared to the national average.

Waist and hip circumferences as well as waist-to-hip ratio allow evaluation of body composition. The girls have a mean waist circumference of 78.35 cm and standard deviation of 12.58 cm. When compared to population data from the CDC 2011-2014 report, the girls fall into the 42.88th percentile for waist circumference. Mean hip circumference is 93.51 with a standard deviation of 10.92. The average percentile for hip circumference is 61.97. Mean waist-hip ratio for the sample is 0.836 with a standard deviation of 0.073. For the total sample, the average waist-hip ratio falls into the 50th percentile.

Quantitative Findings

Dietary Analysis

Frequency distributions for dietary consumption were checked for normality. Many were skewed to the right, as increasing codes stand for increasing consumption such as daily or multiple times a day. Many were normally distributed and none were skewed to the left. There were no outliers. The top 5 most frequently consumed “main dish” foods for the sample as whole include in descending order: chicken or turkey as a main dish, eggs, chicken nuggets, peanut butter and jelly / pasta (tie), and pizza. The top ten other foods most commonly consumed based on mean consumption in descending order include: white milk, cheese, cold cereal, sugary drinks (not including soda), fruit juice (not including orange juice), potato chips, banana, grapes, white bread, and butter. Since frequency distributions were sometimes skewed, medians were taken into consideration. Here are the foods with the highest medians (3 and 2) for consumption: foods with median 3: white milk (the other milk option was chocolate or flavored milk), cheese, and cold cereal; foods with median 2: sugary drinks, butter, eggs, white bread, wheat bread, white rice, bananas, oranges, strawberries, fruit juice, beans, potato chips, and corn chips.

Sugary drink consumption including diet and regular soda, other sugary drinks such as Kool-Aid, lemonade, sweet tea, Capri Sun, and High C, sports drinks, energy drinks, and smoothies was analyzed as well. For this sample, 15 girls consume some kind of sugary drink on a daily basis (37.5%). Eighteen
girls consume a sugary drink on a weekly basis (45%). Thus, 17.5% of girls consume sugary beverages less than once a week.

Fried foods are consumed on average 1-3 times per week. Snack foods are only consumed individually on average between 1-3 times per month and once a week (average consumption score is 1.4 out of 4). Snack food options can be found in the Youth-Adolescent FFQ on the Harvard T.H. Chan School of Public Health Nutrition Department's file download website. They include everything from potato chips to candy and desserts.

**Dietary Variety.** Dietary variety for the total sample is average. The variety score based on the DQI-I is 7.1 and the standard deviation is 3.92. The highest score possible is 15. Thus, the variety for the sample as a whole is almost exactly between 0 and 15. Thus, dietary variety is moderate. Each food group is scored based on whether at least one item from the food group is consumed daily, and the daily consumption scores are added up and averaged for the whole sample to further understand what food groups may be missing in the diet.

The food group consumed the most, based on the percentage of girls who have it at least once a day, is fruit (n = 25, 62.5%). Daily protein consumption is a close second, with about 60% of girls consuming some source of protein each day (n = 24; sources: meat, poultry, fish, and egg). Grains are consumed once a day among 57.5% of the sample (n = 23). The lowest scoring food groups include milk and beans (n = 18, 45%) and vegetables (n = 17, 42.5%). So, less than half the girls in this sample are consuming vegetables, beans, and milk each day.

**Dietary Adequacy.** The average dietary adequacy score for the total sample is 12.3, and the standard deviation is 6.77. The mean dietary adequacy for the sample is almost exactly between 0 and 25, with 25 being the highest possible score. Thus, dietary adequacy for the sample is moderate, but it ranges from low to high.

Again, vegetables and dairy have the lowest adequacy among the sample. Only 10 girls, or ¼, are consuming the recommended daily amount (RDA) of vegetables, which is two cups per day according to the USDA guidelines. This is not surprising, as it is common for this sample to only receive one vegetable
serving per day—at dinner—if at all. In addition, many of the girls do not like vegetables or only prefer one type (e.g. green beans). Potatoes were not included as a vegetable, which may have reduced the count. However, beans were included.

For dairy, 11 girls (27.5%) are getting the recommended daily amount (three cups; USDA 2015). Dairy includes all dairy products in the FFQ, including ice cream and frozen yogurt. The main source of dairy is coming from milk, typically in cereal. Milk as a drink is not a popular choice among the girls. I asked them what they prefer to drink with their favorite meals, as well as what they typically drink with each meal. “Milk” was answered three times in the favorite foods category separate from cereal and three times in the most-often category and only at breakfast.

In contrast, protein and grain adequacy is high for this sample. Approximately 70% of girls consume the adequate amount of protein each day, which is 5 oz. according to the USDA guidelines. And 62.5% are getting the recommended daily amount of grains, which is also 5 oz.

The USDA RDA for fruit is 1 and ½ cups. A little over half (55%) of the girls are consuming the adequate amount of fruit each day, including fruit juices. So, while fruits have the highest daily consumption rate, girls are not necessarily meeting the recommended daily amounts.

**Diet and Food Insecurity.** Mann-Whitney U found no significant dietary differences between food secure and food insecure groups. Variables assessed included mean dietary variety score, mean dietary adequacy score, and means for food group consumption including protein, sugary drinks, grains/starches, fruits, vegetables, snack foods, and dairy.

There are significant correlations between the USDA Household Food Security Survey Module scores and diet. There is a positive correlation between HFSS scores and grains/starch intake, where increasing scores (decreasing food security) correlate with increasing grains and starchy vegetable intake ($r_s = 0.443, p = 0.028$; Figure 5). I chose to combine grains and starch together to assess the
“carbohydrate” of the plate based on qualitative data that shows the sample often groups these together as “carbs” when discussing balanced meals (e.g. rice or potatoes). There is also a significant strong positive correlation between the frequency of snack consumption and HFSS scores, where decreasing food security correlates with more snack consumption ($r_s = 0.834, p < 0.001, \text{Figure 6}$). Lastly, total dietary adequacy scores significant positive correlation with HFSS scores (0 – 25). As food security decreases on the HFSS scale, the dietary adequacy score increases ($r_s = 0.403, p = 0.018, \text{Figure 5}$). Thus, the girls who are food insecure may be consuming adequate amounts of certain food groups when compared to food secure girls and more snack foods. A cross tabulation shows this association in Table 9. While not significant, the table shows that more food insecure girls have an adequate score of 5 for all food groups.

<table>
<thead>
<tr>
<th>Food Security Group</th>
<th>Dairy Adequacy</th>
<th>Protein Adequacy</th>
<th>Grains Adequacy</th>
<th>Fruit Adequacy</th>
<th>Vegetable Adequacy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Food Insecure</td>
<td>12</td>
<td>7</td>
<td>4</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Food Secure</td>
<td>13</td>
<td>3</td>
<td>7</td>
<td>9</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>10</td>
<td>11</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>
except vegetables when compared to food secure girls. Therefore, more food insecure girls are eating at least the recommended daily amounts for most food groups, although the association is not significant.

**Diet and Age at Menarche.** There are no significant differences in mean dietary variables when comparing the diets of girls who have had menarche and those who have not. The only significant correlation between age at menarche and diet is found within snack consumption, where there is a positive correlation between age at menarche and the average frequency of snack consumption ($r_s = 0.464, p = 0.042$). Thus, girls who eat snacks more frequently seem to have menarche later. This is interesting since snack foods are normally energy-dense and one would expect them to correlate with earlier menarche based on energetics. Since snack consumption may associate with menarche, it is used as a control variable when analyzing the associations between age and menarche and other variables.

**Food Insecurity**

The associations and correlations between food insecurity and body size, demographic variables, and menarche are assessed using quantitative analyses and discussed below.

**Food Insecurity and Parental Age.** Parental age is associated with food insecurity in this sample. A Student’s t test shows a significant difference in mean parental age between the groups ($p = 0.019$, df = 29.82, $t = 2.48$; equal variances not assumed), where mean parental age of food insecure households is higher at 49.68y when compared to the mean age of food secure households (40.47y). This
suggests that households with older adults may face additional barriers when it comes to food security, such as health limitations and associated costs or lower income levels if retired or unable to work. It could also suggest that households with various generations such as ones with grandparents, parents, and children, are more vulnerable to food insecurity as they have more people to provide for.

**Food Insecurity and Income.** Table 10 highlights the variations in income levels between food secure and food insecure groups. The median income for food insecure households is $24,500 and the median income for food secure households is $37,500. For girls who have experienced menarche, the mean income at the date of menarche for food insecure girls was $30,971.43 with a standard deviation of $29,600.00

<table>
<thead>
<tr>
<th>Total Sample</th>
<th>Current Income</th>
<th>Mann-Whitney U</th>
<th>Menarche Income</th>
<th>Mann-Whitney U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Secure</td>
<td>$39,276.92</td>
<td>( p = 0.036 )</td>
<td>$36,88.89</td>
<td></td>
</tr>
<tr>
<td>Food Insecure</td>
<td>$29,600.00</td>
<td></td>
<td>$30,971.43</td>
<td>( p &gt; 0.05 )</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spearman's Rho Correlation</th>
<th>P</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFSS Score</td>
<td>-0.511</td>
<td>0.005</td>
</tr>
</tbody>
</table>

Table 10. Food Insecurity and Income Association

Figure 7: Scatterplot showing negative correlation between food security score and income.
$19,976.11; and the mean income at the date of menarche for food secure girls is $36,888.89 with a standard deviation of $16,557.97 (the income outlier is not included in this mean comparison because the girl from that household has not had menarche). A Student’s t-test shows no significant differences in both mean current household income ($p = 0.110, df = 25.823, t = -1.652; equal variances not assumed) and mean menarcheal household income (df = 11.817, t = -0.845; equal variances not assumed) for food insecure and food secure. However, since the sample size is small, a Mann-Whitney U test was performed to check these assumptions. The Mann-Whitney U test results for current annual income are significant, where there is significant variation in the medians and distributions of current annual income between food insecure and food secure groups ($p = 0.036).

Spearman’s rho correlation coefficient finds a significant negative correlation with HFSS scores and income ($r_s = -0.552, p = 0.002$). Figure 7 presents a Scatterplot showing the negative correlation. Thus, referencing the non-parametric tests, it can be inferred that food insecurity is negatively associated with income.

**Food Insecurity and Body Size.** There are no significant differences in mean body metrics between food secure and food insecure girls (Mann-Whitney U: $p > 0.05$). In addition, there is not a significant association between BMI category (underweight, normal, overweight, obese) and food insecurity. All BMI categories are evenly distributed between food secure and food insecure, except for the obese category. For the obese sub-sample, two-thirds ($n = 8$) are food insecure, where only one-third ($n = 4$) are food secure. However, a chi-square test does not portray this as a significant association. In addition, there are no significant correlations between body size/composition and HFSS scores (Spearman’s rho: $p > 0.05$).
Table 11. Menarche and Income Association

<table>
<thead>
<tr>
<th></th>
<th>Menarche Y</th>
<th>Menarche N</th>
<th>Mann-Whitney U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Income</td>
<td>$31,369.23</td>
<td>$36,444.44</td>
<td>p = 0.0533</td>
</tr>
<tr>
<td>Menarcheal Income</td>
<td>$32,184.00</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

Spearman's Rho
Correlation

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Menarcheal Income</td>
<td>0.418</td>
<td>0.037</td>
</tr>
<tr>
<td>Menarcheal Age</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Menarche

Menarche, Income, and Poverty. Table 11 shows girls who have experienced menarche live in a household with an average current annual income of $31,747.83 and standard deviation of $16,194.08; and girls who have not started their periods have a mean current annual household income of $34,666.67 and a standard deviation of $17,580.29 (without the income outlier). With the income outlier, girls who have had menarche have a median current annual household income $30,000 (SD = $16.194.08) and girls who have not started have a median annual household income of $35,000 (SD = $129,631.162). The distributions of income are not significantly different from one another when comparing the groups with

Figure 8: Correlation between age at menarche and menarcheal income.
the nonparametric Mann-Whitney U test ($p = 0.598$). There is no association or correlation between age at menarche and current income (Spearman’s rho without outlier $p = 0.218$).

Table 11 also displays the mean income at the age of menarche which is $32,184.00 and is interestingly slightly more than the current mean annual income of girls who have had menarche. There is a significant positive correlation between mean household income at the time of menarche (menarcheal income) and the age of menarche ($r_s = 0.418, p = 0.037$, Table 11). Figure 8 provides visual support for this correlation with a scatterplot. Thus, an increase in household income at the time of first menstruation is correlated with an increase in the age at menarche.

Table 12 on shows that girls currently living in poverty according to the U.S. census threshold (United States Census Bureau 2017) have a significant lower mean age at menarche than those who are not living in poverty ($p = 0.012$). Girls living in poverty started menstruation at 10.38 years of age (SD = 1.41 years), while girls who are not in poverty had menarche at 11.86 years of age (SD = 1.23 years).

**Menarche and Body Size**

Table 13 on page 72 shows that menarche is associated with body size and composition for this sample. There are differences in median body metrics between girls who have and have not experienced menarche, as well as significant correlations between age of menarche and body metrics.

<table>
<thead>
<tr>
<th>Poverty Y</th>
<th>10.18 y</th>
<th>$p = 0.012$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poverty N</td>
<td>11.6 y</td>
<td></td>
</tr>
</tbody>
</table>

**Table 12. Poverty and Menarcheal Age**
Table 13 presents that girls who have experienced menarche weigh significantly more \( (p = 0.031) \), are significantly taller \( (p = 0.011) \), have longer legs \( (p = 0.013) \) and have significantly higher mean hip circumferences \( (p = 0.015) \) when compared to girls who have not started menstruation. These findings are to be expected, as menarche is related to maturation of the body and changes in fat distribution, as well as growth. However, it is hard to understand whether weight and hip circumference lead to the onset of menarche or vice versa. These results may also be related to age, as girls who have started menarche are older than girls who have not. Kruskal-Wallis non-parametric analysis proves significant differences among age groups and median height \( (p = 0.022) \), but the differences in weight and hip circumference are not significant.

A correlation analysis helps to understand how body metrics are associated with the age of menarche. Table 14 shows that iliac height (leg length) is significantly positively correlated with age at menarche \( (r_s = 0.407, p = 0.032) \). Thus, there is a correlation between linear growth and age at menarche.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Menarche Y</th>
<th>Menarche N</th>
<th>Mann-Whitney U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>61.1 kg</td>
<td>46.45 kg</td>
<td>( p = 0.013^* )</td>
</tr>
<tr>
<td>Height</td>
<td>158.42 cm</td>
<td>148.89 cm</td>
<td>( p = 0.011^* )</td>
</tr>
<tr>
<td>BMI</td>
<td>24.38</td>
<td>21.14</td>
<td>( p = 0.311 )</td>
</tr>
<tr>
<td>Iliac Height</td>
<td>95.02 cm</td>
<td>90.16 cm</td>
<td>( p = 0.062 )</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>77.15 cm</td>
<td>75.63 cm</td>
<td>( p = 0.558 )</td>
</tr>
<tr>
<td>Sitting Height Ratio</td>
<td>48.16</td>
<td>50.82</td>
<td>( p = 0.196 )</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>79.89 cm</td>
<td>74.23 cm</td>
<td>( p = 0.0312 )</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>96.59 cm</td>
<td>85.3 cm</td>
<td>( p = 0.004^* )</td>
</tr>
<tr>
<td>Waist-Hip Ratio</td>
<td>0.82</td>
<td>0.87</td>
<td>( p = 0.157 )</td>
</tr>
</tbody>
</table>

Table 14. Significant Spearman's Rho Correlation Coefficients for Menarcheal Age and Body Metrics
where shorter legs correlate with earlier menarche. Since linear measurements, typically leg length, can highlight insecure bodies and adversity, this finding may indicate that shorter leg length due to food insecurity and/or environmental adversity is connected to earlier menarche. Figure 9 displays a scatterplot showing the positive correlation between age at menarche and iliac height.

There is a significant negative correlation between waist-hip ratio and menarcheal age ($r_s = -0.518$, $p = 0.008$). Figure 10 on page presents the correlation in a Scatterplot. This finding implies that the placement of fat on the body may be related to the onset of puberty, as waist and hip circumferences become closer to equal (1), the age at menarche is earlier. A higher waist-hip ratio is associated with stomach adiposity and risk for chronic diseases. Thus, girls who have more central adipose tissue (at the
waist) may be more likely to start puberty earlier. This is understandable, as fat above the hips is associated with energy-dense diets and malnutrition—both factors within maturation and life-history traits. In addition, abdominal fat is connected with food insecurity and poor quality diets. This connection and what it means will be discussed further in the discussion section.

**Food Insecurity and Menarche**

Among girls who have experienced menarche, 20 are food insecure (67%) and ten are food secure (33%). There are significant differences in the distribution of Household Food Security Survey scores between girls who have experienced menarche and those who have not, where menarcheal girls have a mean food security score of 4.18 (SD = 2.17; low food security = food insecure) and pre-menarcheal girls have a mean score of 2.37 (SD = 3.02; high/marginal food security = food secure) \((p = 0.037);\) Table 15).

Thus, girls who have started menstruation are significantly less food secure than girls who have not started.

However, an ANOVA and Kruskal Wallis analysis show no significant differences in the mean age at menarche between food security groups (ANOVA: \(p = 0.289,\) df = 2, \(F = 1.301;\) Kruskal Wallis: \(p = 0.892\)). This may be due to the small sample size for very low food secure girls who have experienced menarche \((n = 3),\) and high/marginal food secure menarcheal girls \((n = 9).\) The mean menarcheal ages include: 120 months or 10 years for very low food security girls; 136.24 months or 11.35 years for low food security girls; and 133.33 months or 11.11 years for high/marginal food security girls.

Comparing median age at menarche for the binary groups (food insecure vs. food secure) using Mann-Whitney U, no significant differences in median ages or distributions are found \((p = 0.899)\). The

<table>
<thead>
<tr>
<th>Table 15. Comparing Food Security and Age at Menarche</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Menarche Y</strong></td>
</tr>
<tr>
<td>Mean HFSS Score</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Food Insecure</th>
<th>Food Secure</th>
<th>National Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Menarcheal Age (y)</td>
<td>11.16</td>
<td>11.27</td>
</tr>
</tbody>
</table>
mean age at menarche for food insecure and food secure girls are shown in Table 15. Food insecure girls have a mean menarcheal age of 133.89 months or 11.16 years (SD = 1.44 years), and the mean age at menarche for food secure girls is 133.20 months or 11.27 years (SD = 1.35). Both means are significantly lower than the national average of 12.5 years (CDC 2015).

The correlation between menarcheal age and HFSS scores using a Spearman’s Rho bivariate correlation coefficient is nonsignificant ($p = 0.133, r_s = -0.286, n = 30$). A parametric Pearson’s correlation coefficient is also nonsignificant, although the probability is closer to the alpha at 0.071. When controlling for variables associated with food insecurity and age at menarche (iliac height, waist-hip ratio, income, snack consumption, grains/starch consumption, dietary adequacy, and parental age) the correlation between household food security score and menarche age remains nonsignificant.

Survival Analysis. As mentioned in the analysis section, a Cox Hazard survival analysis is used to incorporate the whole sample by censoring the 10 girls who have not had menarche. This allows for a larger sample size ($n = 40$) within the analyses to further evaluate an association between menarche and food insecurity. In addition, Cox Hazard is a non-parametric analysis. The survival analysis provides an estimated/predicted mean and median age at menarche, as well as the odds of experiencing menarche by a
certain age. The predicted mean is 137.32 months (11.44 years; Std. error = 2.639), and the predicted median is 144 months (12 years; Std. error = 3.079).

The survival analysis (Figure 11) incorporating household food security scores as the influential variable plots the stepwise graph showing the probability of survival without experiencing menarche in months. After 95 months, the probability drops below 100%. At 110 months, there is a 90% probability of not experiencing menarche, and at 120 months the probability lowers to 75%. The predicted mean age at menarche, 137.32 months, is plotted with a 50% probability of surviving without experiencing menarche. By the age of 140 months, only approximately 25% of the sample will not have experienced menarche. Lastly, by 155 months, there is a zero percent chance of surviving without menarche.

*Cox Hazard Regression with HFSS as the Predictor Variable.* Table 16 presents the results of the Cox Hazard Regression analysis. Household Food Security Survey score significantly predicts the age at menarche ($p = 0.023$, df $= 1$, Wald $= 4.907$, B $= 0.225$). The hazard ratio for HFSS and age at menarche is $\text{Exp}(B) = 1.25$, with confidence intervals between 1.026 and 1.529. Since the hazard ratio and confidence intervals are both above 1.0 and Beta is positive at 0.225, the association between food insecurity and the likelihood of menarche is positive. Thus, food insecurity increases the risk of menarche. Since HFSS variable is a continuous variable, the hazard ratio is interpreted as the following: for every one unit increase on the HFSS scale, the risk of experiencing menarche increases by 25%. Since time in months is the factor associated with menarche, it can be concluded that risk of earlier menarche increases with the severity of food insecurity. Figure 12 on page 77 shows the increasing hazard with age.

<table>
<thead>
<tr>
<th>B</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
<th>95% Confidence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>HFSS Score</td>
<td>0.225</td>
<td>1</td>
<td>0.027</td>
<td>1.253</td>
</tr>
</tbody>
</table>

Table 16. Cox Hazard Regression: HFSS Score Predicting Time to Menarche
When plotting the hazard (risk) of experiencing menarche without any influential covariates, it is obvious that food insecure girls (0-blue line) have a higher (risk) of experiencing menarche at all ages compared to food secure girls (Figure 13, page 77).

When adding in the additional variables associated with age at menarche (iliac height, waist-hip ratio, and snack consumption) no variables significantly predict the hazard.

Figure 12: Cox Hazard Regression step-wise graph showing the risk of menarche increasing as predicted by food insecurity scores.

Figure 13: Hazard step-wise plot showing risk of earlier menarche between food secure and food insecure girls.
Qualitative Findings

Many themes emerged from the qualitative data relative to food insecurity, including the perpetrators of food insecurity for both adolescents and their families, strategies used to mitigate food insecurity, limitations within food assistance programs as well as gratitude for them, factors influencing food choices for girls and households, and dietary behaviors and preferences. I will discuss each of these themes separately. Some of the qualitative themes are supported by quantitative analyses which I have included with the qualitative results to keep the supportive evidence with the findings. I feel this provides a stronger platform for discussion and inferences.

Participant Observation

My time volunteering at a local summer camp from May to August allowed me to observe the food items served to adolescents and the food behaviors of adolescents and the older teen volunteers. Every day that I volunteered, students got almost the exact same cold lunch, which included a peanut butter and jelly sandwich, cheese stick, apple slices or banana, and either fruit juice or milk. The milk options were 2% percent white milk or chocolate milk. Snacks varied from Scooby Doo Cinnamon Baked Graham Cracker Sticks and Cheeze-It® Baked Snack Crackers. On Fridays, girls had Pearl Girls where they spent time away from the boys and crafted. During Pearl Girls, the girls would get candy bars. They could choose between Reese’s Peanut Butter Cups, Hershey’s Milk Chocolate Bar with Almonds, or Kit Kat.

There were definite differences in lunch consumption among ethnic groups, depending on how long they had lived in the U.S. About half of the students were of Asian descent. The non-Asian students almost always ate the provided lunch, aside from a couple of the older girls who would bring snack foods such as potato chips and hot fries for lunch. The Asian students that recently immigrated or who were not born in the U.S. would always bring their lunch. Their lunch items were Asian-inspired, typically including egg rolls, rice, and noodles. The children that were from Asian backgrounds but may have one American-born parent or who were born in the U.S. brought more Western-style foods such as sandwiches, ramen noodles, and chips.
The children who attended this camp were middle schoolers. I did not see much skipping of meals among the camp-attendees themselves. However, I did notice meal skipping among the older teen volunteers who were in high school. The female teen volunteer never brought her lunch and never accepted the provided lunch. She sometimes ate leftover snacks or cheese from the middle-schoolers that did not want them. The male teen volunteers would either not eat, eat cereal, or one would go grab fast food for them all to share. I only noticed the males not eating twice and it was two different males.

**The Diverse and Complex Face of Food Insecurity**

There is a reason why food security researchers and advocates keep repeating the fact highlighted in this section’s title. Not only because it is true, but also because there continues to be a mismatch between food insecurity knowledge and practice. Although it has been widely understood since the Great Recession of 2007-08 that food insecurity no longer only affects those in poverty, food assistance programs have hardly changed their program design or objectives to reach these new, diverse populations. Thus, it is not surprising that my research, too, found themes relative to this mismatch. The first finding provides support for the fact that food insecurity affects populations of various socioeconomic backgrounds. Secondly, my findings highlight gaps in current food assistance programs.

As mentioned earlier, many of my food insecure families are not on SNAP, which seems to be related to income as those who are not SNAP recipients have higher mean incomes when compared to those who are. However, a Student’s t-test shows no significant difference in mean incomes between food secure and food insecure families in the study sample ($p = 0.101$) when removing the income outlier. When including the outlier and using the non-parametric Mann-Whitney U test to compare medians between the groups, the differences in median incomes is significant ($p = 0.019$). The median income for food insecure families is $24,500.00 and the median income for food secure families is $37,500.00. Thus, income may be playing a role within food insecurity for this sample but it is likely paired with many other challenges faced by the U.S. ALICE population. Household size, living expenses, childcare, transportation barriers, and health issues are just some of the other factors that underpin food insecurity.
The high cost of living, especially for single parents and older adults who are on fixed incomes, was a particular concern among participants.

“You know, I’m a single mom, I struggle, big time. I pay for her private school. It’s hard... and our bills are very high. My bills are high just because of when I do my own business and living here and stuff, but, you know, when it came down to it today, was I on the struggle bus for paying for my groceries? Absolutely.”

The quote above came from a single mother who owns her own hair salon booth and sends her daughter to a charter school. She went on to explain that the week she was interviewed, her refrigerator was emptier than normal because it was the beginning of the month when all her bills are due. This is just one example where the cost of living, education, and surviving on one income can become barriers to food security in our community. Other parents talked about expenses like insurance and medications. Multidimensional homes often discussed being on social security and/or retired, and the importance of budgeting.

Food prices, especially the high cost of healthy food came up multiple times in my interviews (see page 54 for more on this topic). Participants discussed how this was a barrier to eating healthy for their family, particularly when it came to produce. In addition, many “life happens” situations were mentioned when discussing food security and the difficulties involved with paying for groceries for the family. Injuries and health issues were among these, and participants explained how both can make it difficult to buy groceries and cook as well as lead to time off work and medical expenses that further burden the financial and food security of the home. This is shown in the quote below.

“Hmm... I’ve been off a work so that’s what’s been allowing me to go to Feeding America, so...um... But I’m sayin’ before even I was makin’ more money, cause I was part time not full time, but it was not evenin’ out. It was like so bad. Insurance and all that stuff. And medications...So, in a twelve month period, probably the second one...”
The quote came from a mother who had to have surgery on her shoulder and was currently on medical leave from work. Her response was during the USDA Six-Question Household Food Security Survey Module after she said yes to the question *in the last twelve months did you ever have to cut the size of your meals or skip meals because there wasn’t enough money for food,* and I asked her how many months this occurred providing the options *one to two months, some months but not every month,* or *almost every month.* After pondering it with me and discussing her situation, she decided this had happened *some months but not every month.*

Other circumstances such as early retirement, taking in the grandchildren or other family members, losing food due to Hurricane Irma, and home repairs were factors that made it difficult for families to obtain or maintain food security.

**Food Assistance**

Among SNAP recipients, a common thread was the issue of SNAP not providing enough assistance to supplement the family’s needs (n = 7). Parents and guardians would sometimes sarcastically answer my question of whether they participate in the Supplement Nutrition Program, such as when one mom said “Chyea, a whopping $16 a month.” Others would comment “yeah, but we don’t get much” similarly. SNAP allocations vary depending on your household size and monthly income. One grandma who is raising her granddaughter explained:

“...I didn’t recertify cause we only got $16. So, I said no good. The questions that they ask, you know, they go deep. I’m like ‘all of this for $16’...no way.”

While the dialogue related to SNAP benefits was generally negative, participants held an opposite view of local food pantries. Food pantries were almost always discussed in a positive manner, usually where the parent or guardian would explain their gratitude for the pantries and how much it helps feed their families (n = 13). This theme came up mostly during the USDA HFSS where families would not respond with an affirmative answer “thanks to Feeding America,” but also when asked about strategies to make sure they do not run out of food.
“I’m so happy when I get my food from the program. It’s like a sent heaven.”

While not a common theme in this research, it is important to mention concerns participants have regarding food pantries. One concern is related to operation hours, where few parents mentioned how it is hard for them to utilize food pantries because they work and their local pantries are only open during normal business hours (n = 3). The only other concern involved the food provided at the pantries (n = 3). Two parents explained how they would like to get more fruits and vegetables from the pantries. One talked about how she usually only receives bell peppers and eggplant. Another mother and her mother (multigenerational home) wished for milk at the pantries and discussed how expensive milk has become.

Adolescents and Their Families are at Higher Risk for Food Insecurity

There are factors specific to adolescents and households with older children that place them at an increased risk for food insecurity. Two qualitative themes help to uncover these factors and speak to the unique experiences and needs of adolescents and their families. These include adolescent’s large appetites and feelings of hunger commonly noted across the sample, and its connection with running out food; as well as a concerning finding that the adolescents are often not eating school- or program-provided meals.

Large Appetites. Parents, guardians, sometimes siblings, and sometimes the girls themselves consistently commented on the large appetites of the girls, using phrases such as “she eat up all the food,” “she’ll eat anything you put in front of her,” “they come home starving,” “loves to eat,” and various related remarks (n = 17). While an increased appetite is to be expected among adolescents to match their increasing nutritional demands, it becomes a concern when households with older children are running out of food and do not have the ability to buy more, as seen in the quote below.

“Everything. She eat everything. If you get up and walk away it's ate. She come in here in the mornin’ time. And if I have cereal, I find the cereal bowl in the sink. If I got oatmeal, I find she done get her some oatmeal for breakfast. Um...Then from school, 'grandma can I have a snack'. She got to have a peanut butter jelly sandwich. Sometimes she'll make her lunch and take it to school. I can tell when she
done came in here and get up on me like she be...I go lookin' for me some boiled ham or some turkey and it's all gone."

The quote is just one example when the food ran out before for the parent or grandparent could have some. Commonly, participants explained that “food doesn’t last,” “it goes so quick,” or “the kids eat more when it’s something they like” particularly when discussing the first USDA HFSS question that asks respondents to answer whether it is often true, sometimes true, or never true that food doesn’t last and they didn’t have money to get more. For example, this mom who had two adolescent daughters responded:

“If sometimes. They eat so much it goes so quick. And I just let them eat whatever because I don’t want to deprive them…”

Thus, it is not solely adolescents who need more food and it is not only adolescents who are at greater risk for food insecurity. It is their households, too. Particularly, it is the maternal caregivers who are buffering for their children.

Skipping Meals. In addition to the nutritional needs and appetites of adolescents, families may be running out of food quicker due to the fact that many of the girls are not eating at school or camp. Hence, they arrive home hungry and eat the foods designated for the home. Skipping school lunch or the lunches provided at summer programs was mentioned 29 times during the interviews. The reasons were almost always pinned on taste or preference. The girls said the food is “gross,” “nasty,” or “there’s not much variety.”

“I hate school food. I hate it. Yesterday, my hot dog was green. It’s not supposed to be green.”

When discussing summer program provided lunches, the girls explained that they are given pre-made sandwiches that are “not good” or “taste old.”

Only one girl mentioned embarrassment for being on the free lunch program and having to get the school lunch tray. Beginning in middle school, Hillsborough, Pinellas, and Manatee Counties public
schools, as well as most public schools in the country (approximately 70% – 90%), incorporate competitive foods separate from the regulated National School Lunch Program. The a la carte program allows students to purchase alternative options including snacks, ice cream, and popular foods like fries. You can see a list of a la carte selections for Pinellas County middle schools on the right side of Figure 14. A full list of a la carte items served in Hillsborough County schools is on page 159 in Appendix C.

The school makes a large profit from the a la carte line, as there are no pricing or nutritional regulations. While schools benefit excessively, the children do not. Not only does the a la carte system provide poor quality food options for children to have in place of an adequate meal, it creates division between the students who have lunch money and those who do not. If a student is on the free or reduced-price lunch program, they are only allowed to choose from the school lunch entree options. If they want to get something a la carte, such as a snack, they must bring extra money. In contrast, the kids who have prepaid their lunches or bring money each day get to choose whatever they like. The girls explained this...
system to me during the research process, and I confirmed it by contacting the student nutrition services of Hillsborough County and speaking with community members who have worked with and in local schools.

“And you can bring your own money and then they give you some like some chicken fries. They give away like, if you want to buy something, you can get chicken fries or like snack bar.”

As mentioned in the quote, the girls would tell me that when they had money they would buy and eat low-quality foods such as “junk food,” “goldfish,” or “fries” rather than the school lunch. Some said they just drink the milk or juice provided. I did not ask them if they had lunch money or were on free or reduced lunch. Four girls mentioned they would eat the fruit provided in the school or program lunch.

Parents were not surprised to hear that their children were skipping lunch and/or eating snack foods instead. Most parents were in agreement with the girls’ views on the quality and taste of the food, commenting that it’s “so bad” and “nobody eats it, it's just a waste.” When I asked the girls what they normally have for lunch, parents and guardians numerous answered for them with an answer similar to “junk.”

While views surrounding school lunch were almost completely negative, one school food is popular among the girls—salads. Many said they eat the school salads and described them as “good.” Unfortunately, salads are not served every day, as can be seen in Figure 14 on page 84.

The conclusion of this finding is this: many children are not eating at school or are supplementing school meals with low-quality foods that may prevent hunger but are not preventing food insecurity. Skipping meals among growing adolescents is significantly hindering their food security, as well as their nutritional security and health. In addition, coming home from school hungry or “starving,” as the girls would say, is resulting in the consumption of “home foods” and may be accelerating food loss within the home. Thus, again both adolescents and their families are at risk for food insecurity and altering the school food system may be a way to help lower this risk.
Factors behind Food Choices

It is apparent that taste plays a critical role within the food choices of girls, as the girls in this sample would rather not eat at all than consume foods that do not look or taste good. While taste is the most common answer among the girls when asked about factors that influence their food choices, other factors are more important for their parents. The most influential aspect when choosing foods to buy and eat for their family is healthiness \((n = 28)\). There is a large prevalence of health consciousness among both the parents and the girls. Families understand what it means to eat healthily and emphasized the importance of eating balanced meals and/or having a well-balanced diet. A balanced meal for the study sample generally includes a meat, a carbohydrate such as potatoes or rice, and a vegetable. I found it interesting that the word “meat” was used in place of “protein”. Some mentioned more specific characteristics that make foods and diets healthy, including ingredients, non-GMO, hormone-free, organic, whole foods, and behaviors like looking at the dates on foods and reading labels.

“I started reading my labels and stuff. You know how much sugar is in something. It’s just the hidden sugar you know?”

Rarely girls themselves mentioned healthfulness as being the most important factor \((n = 4)\), and interestingly it was often connected to moderation and balance such as the quote below highlights.

“When it’s healthy. Not like fatty. Cause I eat a lot of junk food. Like I just ate a bunch of Twinkies, but, like I have to eat healthy cause being skinny’s hard. So...”

Participants were asked whether their diet has changed over time or recently, to get an idea of dietary behaviors when the girl started her period versus currently. Participants, including both parents and girls, said their diets have become healthier \((n = 15)\) for various reasons. Many said they know more about food and eating healthy now, and are more health conscious. Some discussed health reasons such as having high cholesterol, diabetes or pre-diabetes (of the child), and food allergies such as gluten. Two girls have changed to vegetarianism, with one being vegan. Families and girls discussed how their diets had become healthier as well. Common themes include eating more vegetables, less fried foods, baking or
air frying instead of cooking in oil, consuming less soda and junk food, eating less meat, and having more salads.

Cost is the second most common factor behind food choices (n = 25), and often mentioned directly following healthiness. Cost, among many, was discussed as a barrier to healthy food purchases and choices.

“[fruits] They’re expensive and that’s what my doctor keeps saying, I need more fruits and vegetables but you know... we doin’ the best we can.”

Families commonly mentioned the high cost of food, especially fruit, and how food prices have gone up. They would also explain how groceries are expensive with children, such as the comment: “you know, and they eat so much.” Cost was a common reason why families’ diets have become less healthy (n = 15), explaining that they used to be able to buy organic foods, be vegetarian, and purchase from the farmer’s market. Two girls and parents are no longer vegetarian.

Taste is tied with cost as the second most common influence on food choices (n = 25). Families often discussed taste in relation to the children and children’s preferences. They buy foods they know their children will eat. This is most likely why 29 families answered yes when asked if the adults and the children eat the same foods in the household. Adults even discussed buying more foods their children like and less of what they prefer for themselves. For example, this mom said:

“I would say cost but I basically cook what, they, you know, I buy what they eat. What I know they gonna eat.”

Only 16 times children and/or adults discussed eating different foods, and this usually occurs when the child does not like a specific dish or ingredient such as broccoli or casserole. When the girls eat something different, it is often poorer-quality items, with cereal and sandwiches being the most common substitutes. Pickiness of children was mentioned 16 times and often associated with a food group (e.g.: vegetables) or a specific food item.
The third most influential factor behind food choices is *time and effort* (*n* = 20). Parents generally spoke of time and effort in regards to not having enough time due to busy schedules, which often included discussion of children’s activities, having to pick them up and take them places, and being tired after work. Time and effort were a large factor behind why diets have become less healthy, as families explained that being busy leads to eating out more often. It was also connected with health and injury, where parents and guardians mentioned how health issues and injuries make it difficult to cook so they turn to fast foods or easy-to-prepare foods. The quote below speaks to this.

“I know sometimes they cook a little different because my dad’s on blood thinners and, oh, my mom had surgery on her neck so I know she like tries to cater to things that are easier sometimes.”

Interestingly, *time and effort* is the second most common answer among the girls aftertaste. The girls were honest and aware of their desire for quick-fix meals or ready-made snacks.

“I just, like, will eat anything that I can eat right at that moment.”

This trend may be connected with skipping school meals and hunger that results in the girls wanting something quick and easy to fill their empty stomachs after school.

Lastly, *family preference* is the fourth most influential factor (*n* = 17). Like *taste*, this was usually noted in reference to the children, but sometimes in relation to health or food restrictions as well. It, too, came up as a reason for decreased dietary quality. Three women discussed how getting remarried worsened their diets, as they had to incorporate foods that their husbands prefer. Two others discussed how moving to the United States has made their diets worse because their children want to eat all the “bad American foods”. For example, when I asked a mom and her daughter whether their diets have changed recently or over time, the mom answered:

“Oh, yes. After moving to the U.S. our diets are totally worse.”
Food Preferences

In working with Feeding Tampa Bay, I wanted to understand what older children like to eat so that this information can be passed on to the food bank to improve its programs. Since this is a time of transitioning, I assumed that the diets of adolescents are also changing from “kid foods” to trying and eating more “adult foods.” I was also curious to see how picky adolescents are, and perhaps whether their tastes have or are changing. I asked the girls about their favorite foods and then asked them what they typically eat for each meal. After realizing how many children are not eating school-provided meals, I am even happier that I included this question and method within my research. Understanding food preferences may help provide recommendations to improve school food programs and assistance targeting adolescents.

Breakfast. The top five favorite breakfast foods that girls prefer to eat in descending order include: eggs (n = 11), cereal (n = 9), sausage (n = 7), pancakes (n = 6), bacon (n = 5). Only two girls said they do not like to eat breakfast. The most breakfast food actually consumed based on the qualitative data is cereal (n = 9), followed by eggs (n = 8). Thus, preference and consumption match up well for breakfast. This may relate to eating breakfast at home versus school, which almost all the girls said they did.

Lunch. The top five most preferred lunch food items in descending order include: pizza (n = 10), sandwich/wrap (n = 8), no preference/nothing (n = 5), salad (n = 3), peanut butter and jelly sandwich (2). It is interesting to see pizza so close in the running to sandwiches and wraps, as one is generally considered healthy while the other not. Pizza is often served at school lunches at least once a week. It is even placed under the “lean and green” option of the Hillsborough County school lunch menus. Thus, I am wondering why so many girls are not eating lunch at school even though pizza is the favorite lunch for food for eight of the girls. Perhaps they do not like the type of pizza served. When asked about most often consumed foods for lunch, only one girl said pizza. This needs to be looked at further to understand if students do not like school pizza or they are not eating for other reasons.

As mentioned earlier, schools do not always have salads available as a meal, and often they are served as a side in small portions. Typical sandwiches and wraps with deli meat are almost missing from
the lunch menus for Hillsborough County. It would seem that the perfect place to put a cold sandwich, wrap, or salad would be under the “lean and green” daily option. While there is the option on the menu to “build your own munchable,” the only sandwich option is a PB&J. This is the same across schools for both middle and high schools. Adolescents seem to not want to eat PB&Js for lunch. Thus, by comparing food preferences to food served at schools, we can find limitations and propose alterations that may stop students from skipping meals.

The most commonly consumed lunch foods include in descending order: sandwich (n = 7), which is almost always consumed at home either after school or on the weekends, snack food (n = 5), PB&J (n = 2), and Ramen noodles (n = 2). Since so many girls did not eat lunch, I did not have a lot of data or commonalities here.

Dinner. Favorite dinner meals were highly diverse. The top foods or dishes in descending order include: pasta (n = 8; including spaghetti, Alfredo, and shrimp pasta), seafood (n = 5; including lobster, fish, crab, and shrimp), chicken (n = 4; including teriyaki, BBQ, and fried), macaroni and cheese (n = 3), and shepherd’s pie (n = 3). The most commonly consumed dinner foods include in descending order: chicken (n = 10), pizza (n = 4), rice (n = 4), pasta (n = 4), and tacos (n = 3). From the responses, there are some similarities in preferred foods and consumed foods, specifically for chicken and pasta. However, seafood, specifically fish, was only noted once.

There is also a connection with appetite, food preference, and food insecurity among the girls in this sample. Girls who answered with phrases such as “I don’t have a preference,” “anything,” or “I don’t know” when asked about their favorite foods were all from food insecure households. This may suggest that girls who experience very low food security are less choosy when it comes to foods. Perhaps they understand the value in food choice. It could also suggest these girls are not as willing to discuss food and food choices as girls from food-secure homes.

Strategies to Mitigate Food Insecurity

Families were asked what strategies they used to make sure the family has enough food to eat or to make sure food lasts long enough for the household. There are definite patterns in the responses that
match well with previous research. I combined techniques that were similar to make themes clearer. The most common strategy was *shopping sales / buying cheaper foods* \((n = 17)\). Numerous parents discussed visiting different venues to get the best deals and would tell me what stores had the best prices on different items. Some mentioned reading the store ads to see what was on sale that week. The most popular places to get food include: Walmart \((n = 20)\), Publix \((n = 14)\), Save-a-lot \((n = 10)\), Winn Dixie \((n = 9)\), and food pantries \((n = 8)\).

Families also discussed purchasing foods that cost less and will last, as well as *not* purchasing certain types of foods deemed expensive (typically fruits) and perishable. Specific food items that were labeled low-cost and have a longer shelf life include rice, bread, grits, potatoes, beans, and eggs. These types of foods were also brought up during the food insecurity questionnaire. For example, when asking one family if they could afford to eat balanced meals, a grandmother answered: “we always try to, even if we just pull out a can of beans.” In this case, beans were the vegetable of the dish and allowing the family to have more diverse and balanced meal.

Meal items also came up during this question and the food insecurity questionnaire. Participants would say things like “we eat a lot of spaghetti,” or when asking if they ever feel hungry but do not eat a parent said: “no, there’s always peanut butter and jelly.”

Shopping around and finding sales saves money. However, it takes substantial time and transportation. Thus, not everyone has the ability to implement such a strategy. Purchasing cheaper food items that will last the family longer may be preventing hunger, but it is not preventing food insecurity. The items mentioned are poor-quality but energy-dense foods. Consistent consumption of these without pairing them with more nutritious items will only lead to malnutrition and health risks.

The second most noted strategy to mitigate food insecurity is *cooking in bulk / eating leftovers* \((n = 14)\). Families discussed cooking enough food at once so that it will last for a couple or a few days, and so the family “can eat off it.” Common types of bulk meals or foods prepared are one-pot dishes or casseroles, pasta, chicken (e.g., chicken and rice, for sandwiches or tortillas), and cold salads (e.g., tuna salad, pasta salad).
“I try to cook like a big pot on the stove and I try to cook so it at least lasts two to three days. I cook a big pot of rice like this chicken and yellow rice.”

Eating leftovers fell into this strategy, too, and was often connected with eliminated food waste and overeating. For example, sometimes parents or girls would explain that they do not eat all the food at once so there are leftovers for the next day. This overlaps with the third most common strategy: portioning / rationing (n = 11). Participants discussed cutting foods in half, specifically chicken and meats, so they last longer. Other techniques involved separating foods into quantities depending on the meal, cooking only the needed portion sizes for the family members who will be eating that day and freezing the rest, and not overeating. Portioning was sometimes discussed in relation to food waste. Rationing, too, is sometimes a system among this sample. Words like “stretch,” “balance,” “split,” and “cut,” are all used in connection with preventing food loss and hunger. Again, the theme of not eating all the food at once is present. Some parents mentioned tracking food consumption, such as in the quote below.

*Grandma:* “Well, we make sure that they don’t eat a lot of snacks because you know…”

*Girl:* “It’s sad”

*Grandma:* “It is sad isn’t it?”

Portioning and rationing can certainly ensure that food lasts longer for the family and is an effective strategy to prevent overeating. However, this technique is concerning for households with adolescents. Adolescents need enough food to support their maturation and growth. If they are not getting enough food throughout the day at school or summer camp, then portioning or cutting the size of their foods at home may be resulting in under-consumption.

The last strategy to mention is freezing foods (n = 10). This technique is often combined with others including portioning and leftovers. Participants freeze leftover foods so they last longer and do not go to waste. Families also discussed buying foods on sale, particularly meats, and freezing what they are not going to use right away.
Conclusion of Qualitative Findings

Adolescents and their families have unique and complex needs when it comes to food, making them more vulnerable to food insecurity. It is apparent that current food assistance programs need to account for the age of children. Older children are not the only ones who need more food, but families with older children do as well. In addition, school-provided food must consider making alterations to satisfy the preferences of students.

It is important to note that adolescents should never be blamed or feel they are wrong for being hungry and/or eating more than other children or the adults in the household. While the dialogue surrounding the girls’ large appetites and preferences was almost always in a joking and friendly manner, there is a possibility these comments may make girls of this age feel embarrassed or uncomfortable. They may also feel responsible and/or guilty after hearing their parents or guardians discuss how food does not last and how much the adolescents eat.

The sensitivity of this phenomenon only heightens the importance of improvising or creating better food assistance and school nutrition programs that account for the needs of adolescents and their households, while also considering taste, preference, and healthiness (as these are important factors behind food choices and consumption). Providing more food, benefits, and preferred foods to families with older children and adolescents, especially those who may not qualify for assistance, may prevent any negative feelings surrounding eating and appetite. These tactics will also help prevent families from running out of food.
CHAPTER 6: DISCUSSION

This research shows that food insecurity influences the timing of menarche in the U.S. and in Tampa Bay, Florida specifically. Among the girls in this study, 55.6% live in food insecure households and 75% have experienced menarche. The average age at menarche for this sample is 11.2 years, which is more than one year earlier than that of the national average of 12.3 – 12.5 years. Thus, the girls in this research are experiencing early onset puberty and high rates of food insecurity. Income, food insecurity, snack consumption, iliac height, and waist-hip ratio all significantly correlated with the timing of menarche for this sample. I will discuss each of my predictions in relation to the findings and follow with the implications these findings have for the literature, anthropological theory, and practice.

Prediction 1: There will be a significant negative correlation between food insecurity and age at menarche (e.g.: as food insecurity becomes more severe, age at menarche decreases). The correlation between household food security score and age at menarche was not significant for this sample. Therefore, this prediction is not supported by the analyses. It is likely that my sample size was too small to determine a significant correlation. In addition, the ages at menarche did not highly alter from one another due to the limitation of not having specific dates for the timing of menarche.

Prediction 2: Food insecurity will increase the likelihood that girls will begin menarche early (using Cox Hazard Model). This prediction is supported by the findings. A Cox Hazard regression analysis shows that food insecurity scores significantly predict age at menarche. Furthermore, the analysis states that for each one unit increase on the household food security survey score scale, the odds of menarche increase by 25%. Thus, as food insecurity becomes more severe, the likelihood of experience menarche earlier increases. In addition, girls who have begun menstruation are significantly less food secure when
compared to girls who have not, further supporting the role that food insecurity may play within maturation.

This finding is in contradiction to the literature. Previous research within food insecurity and menarcheal timing have found the opposite effect, where food insecurity delays menarche rather than accelerates it. Belachew and colleagues’ research in Ethiopia found a one year delay in the age of menarche among food insecure girls when compared to their food secure peers (Belachew et al. 2011). In addition, research among girls in Colombia discovered a positive association between age at menarche and food insecurity (Jansen et al. 2015). I propose my contrasting results are due to the vast differences in population demographics, environments, and diet. Thus, the results of this study add important insight into the variations between environmental circumstances and food insecurity experiences among different populations and regions. I will discuss the implications of these findings in more detail in subsequent paragraphs.

Prediction 3: Food insecure girls will have poor quality diets consisting of energy-dense (high-calorie) foods, and therefore have high rates of overnutrition. There were no significant differences in diets between food secure and food insecure girls. However, food insecurity did correlate with diets higher in grains and snack consumption and higher dietary adequacy. Since I did not measure actual calories, I cannot say whether food insecure girls consume more calories than food secure girls. Furthermore, the analysis found no significant associations between food insecurity and body weight or BMI. Nonetheless, it seems that as food insecurity becomes more severe, girls are eating more carbohydrates and snacks which could infer energy-dense diets. This finding aligns with previous food insecurity research that has found that food insecure persons in middle to high-income countries as well as developing areas consume diets high in carbohydrates because these types of foods are cheap, filling, and long-lasting (Hadley and Crooks 2012). For example, a recent study among adolescents in Korea found that food insecure middle-schoolers had higher intakes of carbohydrates than food secure students (Nakitto et al. 2017). Food insecurity among females in Canada also associated with higher carbohydrate consumption (Egeland et al.
The findings from this study indicate that consuming carbs, such as rice, potatoes, and bread, is a coping strategy among food insecure households.

The relationship between snack consumption and food insecurity may stem from various factors. It may be that food insecure girls snack more because they do not have access to full meals. This condition could be based on severe household food insecurity where the resources to make full meals are limited. Connell and colleagues found in their food insecurity research among children that families and children may eat “little small foods or like just 3 things to eat and drink” when facing household food insecurity (Connell et al. 2005:447). Thus, snacking could be a coping mechanism for dealing with food insecurity and satisfying hunger.

Living in a food desert where the nearest food sources are convenient stores can limit access to meal-type foods as well. Research shows that living in a food desert associates with increased consumption of snack foods and desserts among adolescent girls in the U.S. (Hager et al. 2017). Another factor could involve parental behaviors. Parents of low-income households may be more likely to buy their children snack foods and let their children consume more snack foods because it may be the only indulgence or ‘treat’ they can afford (Hoerr et al. 2009). Moreover, food insecure adolescents may be given or consuming snack foods to satisfy hunger (Blaine et al. 2015). Since so many girls in this sample are not eating meals at school, it is also likely that they are eating snacks either at school or after school to prevent feelings of hunger.

The consumption of grains/starches may be influencing dietary adequacy, but more food insecure girls consume the recommended daily amounts for all food groups except vegetables when compared to food secure girls, although the association is not significant. It may be that food insecure girls participate in programs where they receive more food when compared to food secure girls (e.g. summer camp, National School Lunch Program, after-school programs). It could also imply that food insecure adolescents are indulging more, meaning they are eating more when food is available (Connell et al. 2005).
As a whole, the girls in this sample have diets that are high in protein and grains but lacking in vegetables and dairy intake. Their dietary diversity is average. Fruit is consumed the most out of the food groups, followed by protein. High fruit consumption may be related to the importance families place on healthiness paired with the girls’ preference (as the girls like fruits). Thus, fruits provide a way for parents to provide healthy options to adolescents that they know the children will eat. It is also likely that girls are getting fruit from school or programs since caretakers expressed concern for the high costs of fruits.

The higher adequacy percentages for protein and grain intake among this sample are likely related to the importance families place on a well-balanced diet as well as social factors. Parents and guardians discussed the vitality of having a protein, carbohydrate, and vegetable on each plate. However, vegetables are consumed the least out of all food groups, with only ten girls (25%) eating the recommended daily amount of vegetables. Low vegetable consumption among children, particularly low income and food insecure children, is not surprising, though. This is commonly noted in the literature and influenced by food prices, parental feeding patterns, and individual preference (Hoerr et al. 2009; CDC 2017). The qualitative data documents that many girls in this sample dislike vegetables. Age of children may also influence fruit and vegetable consumption, as Minaker and Hammond found the odds of consuming adequate amounts of fruits and vegetables decreased for students in grades eight through 12 when compared to those in six and seventh grades (Minaker and Hammond 2016). In addition, time and effort may be an underlying factor within the high protein and carbohydrate intake paired with low vegetable consumption. Families discussed how their busy schedules, child activities, long working hours, and being tired after work and activities influenced their diet in negative ways. They expressed how these time and energy constricting factors provoked them to buy fast food or easy-to-prepare meals, many of which do not include vegetables.

Milk and beans are another food group that is consumed in low amounts. Only 11 girls are consuming the recommended daily amounts of dairy even though cheese and milk are one of the most consumed food items among the sample. It is possible that adolescents are transitioning away from milk as they get older. Only three girls answered ‘milk’ for their drink of preference to have with meals.
Another factor behind low dairy adequacy could relate to the daily recommended amounts. The USDA recommends adolescent girls consume 3 cups of dairy per day. This seems like a lot, particularly considering the cost of dairy. The high daily recommendations could be why dairy adequacy is low but consumption of milk and cheese is still higher than consumption of other food items.

A large barrier to adequate consumption of vegetables and dairy is the price. Vegetables, along with most produce items, are not cheap and have consistently risen in price since 2000 (USDA 2016b). Fresh vegetable costs rose 3.5 percent compared to December 2016 and are projected to rise by 0.5 percent this year (USDA 2018). Milk prices have also steadily increased over the last twenty years and are projected to increase by as much as 2.5 percent this year (USDA 2018). The USDA claims that food prices in total have increased by 1.6 percent since 2016 and are expected to rise between 1 and 2 percent in 2018 (USDA 2018).

Food prices were a large concern among my families when discussing barriers to food security and healthy eating. Caretakers noted how prices kept them from purchasing fruits and vegetables specifically. The increasing prices of foods paired with stable incomes make it continually harder for families who do not qualify for food assistance such as SNAP or EBT (ALICE population) to feed their families. Approximately 40% of food insecure families in this sample are not participating in SNAP because they likely are not eligible. The barriers to food insecurity are even stronger among ALICE households who have older children. The weekly costs to feed children consistently increases as the child ages (USDA 2014). The USDA has designed a food cost chart that describes the cost of food at home based on the age of individuals (see appendix page 151 to view the full chart). The chart shows, for example, that it costs $39.10 - $70.40 per week to feed a girl aged 12 to 13, and $38.40 - $71.10 to feed a girl between 14 and 18 years. The numbers are even higher for males. Compare these costs to the cost to feed a child 6 – 8 years of age: $32.10 - $44.70; and even a child 9 to 11 years: $36.20 - $72.10. It is apparent that households with adolescent and teen children need more resources to prevent food insecurity when compared to households with pre-adolescent children.
Even for families who do receive SNAP benefits, food insecurity may not be mitigated for households with adolescents. Sixty percent of SNAP users in this sample are still food insecure. It can be inferred that the mismatch between food assistance and the unique needs and costs associated with adolescents is playing a role in this high percentage. The SNAP and other food aid services do not consider the age of household members. Although there is government published data showing the association between aging children and increasing food costs/needs, families with adolescents do not receive more aid or money. This mismatch is likely why SNAP recipients expressed concern and negative responses regarding the monetary amount of benefits they receive.

Thus, the dietary assessment findings coupled with the qualitative data supports the fact that costs of food and the needs of adolescents may be preventing families and girls from eating vegetables and obtaining adequate diets. Furthermore, the risks for household food insecurity for families with adolescents may not be mitigated with the SNAP program.

*Prediction 4: High-calorie diets will negatively correlate with age at menarche.* I was unable to measure caloric intake in this study. However, using frequencies and adequacy measurements, no dietary factors correlated with menarche aside from snack consumption. Snack consumption significantly positively correlated with age at menarche among the sample. This finding contradicts my prediction as snack foods are high in calories. In addition, the positive correlation opposes the literature, which shows sugary snacks and fats induce earlier ages of menarche (Villamor and Jansen 2016). There is no association between animal protein and menarche among the girls in this study, further contradicting previous findings that show increasing animal protein associated with earlier ages at menarche (Villamor and Jansen 2016). This study does not provide the best insight into diet and menarche, though, because the girls likely answered the food frequency questionnaire based on their current diets. If they had not recently begun menstruation then their current diets may have been different than their diets at menarche. For example, 15 families said their diets have become healthier recently or over time. Thus this is a limitation of the research and the findings.
The association between snack consumption and food insecurity is interesting and should be considered further. Snack consumption is related to food insecurity in this sample. It is possible that the underlying relation between snacks and menarche is associated with food insecurity and poor nutrition. However, the correlation is opposite of that found between food insecurity and age at menarche. More research is needed to understand this association.

**Prediction 5:** Food insecure girls will have higher BMI, lower heights, and higher waist and hip circumferences when compared to U.S. reference standards. I predict a significant positive correlation will exist between body composition and food insecurity. While there are significant associations between food insecurity and dietary consumption, I found no significant associations between body size or composition and food insecurity. Likewise, no significant differences exist between food secure and food insecure girls relative to body metrics. These findings oppose the literature which has documented a correlation between food insecurity and increasing weight and higher body fat percentages (Popkin et al. 2016; Himmelgreen et al. 2016; Himmelgreen 2013; Laraia 2013; Hadley and Crooks 2012). The contradiction may be relative to the fact that girls during adolescence may be exempt from significant fat accumulation because of their rapid growth and increased metabolism (Schlussel et al. 2013). However, other researchers feel that adolescence, particularly puberty, is a time when the risks for increased body fat is high (Todd et al. 2015). While there were no differences in body size within the sample, food insecure girls have above national-average percentiles for weight-for-age and BMI. This finding aligns with previous studies that show food insecurity associates with overweight and obesity in developed countries (Popkin et al. 2016; Himmelgreen et al. 2016; Himmelgreen 2013; Laraia 2013; Hadley and Crooks 2012). Food insecure girls also had longer leg lengths and larger hip circumferences when compared to national reference standards.

Food insecure girls in this sample are in the 65th percentile for weight-for-age and BMI when referencing the CDC standards (2000). There are two-times more food insecure girls who are obese (n = 8) when compared to food secure girls (n = 4). However, the association is not significant. Food insecure girls have hip circumferences in the 64th percentile, as well as leg lengths in the 67th percentile. Thus, my
prediction for lower heights and higher waist circumferences among food insecure girls compared to the national reference standards was not supported. The higher weight and leg length percentiles may be related, as height increases weight and BMI. Accordingly, larger hips may be connected to skeletal maturation rather than fat deposition and align with longer legs as part of the pubertal growing process. Furthermore, it may be that energy-dense diets connected to food insecurity are playing a role within above-average leg lengths, weight, and BMIs.

The findings suggest that food insecurity among this sample is aligning with the overweight-food insecurity paradox documented in the literature (Himmelgreen 2013). This paradox is found among middle to high-income countries as well as developing countries where undernutrition is less prevalent due to the easy access of high-calorie foods (Himmelgreen 2013; Cook and Frank 2008; Hadley and Crooks 2012). However, these foods that are economically and ecological accessible to food insecure households are low in nutritional value and high in fat, sodium, and sugars (Cook and Frank 2008; Hadley and Crooks 2012). Therefore, an epidemic of overnutrition and obesity is occurring among low-income and working families. Food insecurity among adolescents in this sample does not seem to influence leg length and stature. Thus, it can be inferred that the food insecure girls have experienced energy-dense diets. Further research is needed to understand if larger-than-average hip circumferences among food insecure girls are due to poor-quality diets or to maturation.

Despite food security status, the sample as a whole has high rates of overweight and obesity when referencing the CDC BMI cut-offs. Around 50% of the girls were either overweight or obese. Weight, when compared to weight-for-age CDC references, is almost at the 70th percentile for the whole sample, meaning girls in this sample had higher weights on average when compared to the national average. Thus, the adolescents as a whole may have poor-quality diets.

Prediction 6: A significant negative correlation will exist between body composition and age at menarche, where higher BMIs and hip circumferences will correlate with earlier ages of menarche. Girls who have had menarche are taller, have longer legs, larger hip circumferences, and weight more compared to girls who have not experienced menarche. Furthermore, waist-hip ratio and iliac leg length
significantly correlated with age at menarche. However, body mass index and hip circumference did not correlate with menarche. Thus, my prediction was wrong. Multiple findings have documented the influence of obesity, body fat, and BMI on early menarche (Villamor and Jansen 2016; Forman et al. 2013; Deardorff et al. 2014; Ellis et al. 2007; Johnson et al. 2013; Gernelli et al. 2016). Furthermore, others have found that larger hips are related to menarcheal timing, but whether the relationship is based on lower trunk fat or skeletal pelvic breadth is unknown (Malina et al. 1988; Ziomkiewicz and Koziel 2015). I could also be the case that larger hip circumference is the result of maturation rather than the influencer. However, the data from this study does not support the association between hip size, weight, and BMI within menarche.

In contrast to my prediction, waist-hip ratio negatively correlates with menarche. This finding implies that central fat distribution may induce earlier menarche and is a better indicator of the timing of menarche than hip circumference and BMI for this sample. Other research that has found fat distribution influences menarche, particularly when there is more abdominal fat, and can lead to earlier menarche (Bhadra et al. 2013). The outcome deduces that abdominal fat, which indicates overnutrition and poor quality diet, is playing a role within earlier menarche. Central adiposity and high waist-hip ratios are indicators for disease risk such as cardiovascular disease (Gibson 2005; Wiley 2017). This is significant within food insecurity analysis as we know that food insecurity is associated with more abdominal fat because of the poor quality energy-dense diets of food insecure persons (Cook and Frank 2008; Hadley and Crooks 2012). Thus, in this sample, it may be that food insecurity is leading to energy-dense diets high in fat and stomach adiposity which is increasing the risk for obesity and chronic disease. These risks could be perceived as biological stressors.

Prediction 7: Girls who have experienced consistent food insecurity and low-quality diets will have shorter leg lengths when compared to U.S. reference standards. This will suggest insecure bodies. My results did not show significant associations between food insecurity and leg length among this sample. Food insecure girls, as well as the total sample, had total leg lengths above average when compared to Frisancho’s references (2008). There are no reference standards for iliac height so it could not be
compared. The non-association is contradictory to the literature which has found height and leg length to inversely correlate with food insecurity among adolescents (Belachew et al. 2011; Belachew 2012). However, previous research for this association primarily takes place outside of the U.S. in underdeveloped nations. Since food insecurity and overall living environments in the U.S. are highly differential when compared to low-income countries, the odds of severe linear growth impairments will too be different.

**Prediction 8** Linear measurements including iliac height, height, and sitting height ratio will positively correlate with age at menarche, in that increasing linear heights will correlate with increasing age at menarche. While sitting height ratio and height did not significantly correlate with menarche, iliac height positively correlates with the age at menarche. Thus, shorter legs are correlated with earlier menarche. This finding is significant in that it indicates that less nutritionally secure bodies are experiencing early-onset puberty. Leg length provides a valuable lens into past malnutrition as poor nutritional environments in childhood can reduce linear growth (Bogin and Silva 2012; Gluckman and Hanson 2006). Shorter legs can suggest prolonged food insecurity and increased risk of morbidity (Bogin and Silva 2012; Belachew et al. 2011). Thus, the correlation between increasing iliac height and age at menarche proposes that girls who are starting menarche earlier in this sample have shorter legs and therefore have likely experienced low-quality nutrition during childhood. This finding fits within life history theory as it suggests a biological trade-off is occurring. The trade-off involves allocating energy towards reproductive maturation and reducing energy designated for linear growth. Previous research has documented the effect early menarche can have on adult height (McIntyre 2011; Yousefi et al. 2013). However, little is known regarding whether shorter leg length is a result of menarche or a predictor (Jansen et al. 2016; Belachew et al. 2011; Papadimitriou 2016; Walker et al. 2006). Since food insecurity significantly predicts menarche in this sample, we can hypothesize that poor nutrition stemming from food insecurity and manifested in linear growth stunting is the invoker of menarche. While the waist-hip ratio correlation points to energetics, it could also be a consequence of food insecurity and poor nutrition. Thus, both waist-hip ratio and iliac height may highlight nutritionally insecure bodies and the effect of food
insecurity on the timing of puberty. The limitation to this proposal, however, is the non-significant correlation between these variables and food insecurity among this sample.

Since there are weight and hip size differences between girls who have had menarche and those who have not, but no significant correlations between these body measurements and age of menarche, it is likely that girls weigh more and have larger hips as a result of puberty and variations in fat distribution after menarche.

**Implications**

These findings suggest that food insecurity among girls in the U.S. influence diet, nutrition, and ultimately the timing of menarche. Furthermore, food insecurity is prompting early menarche. Life history theory can be used to understand the energetic and biological responses to food insecurity among girls in the U.S. My results contrast previous research findings and demonstrate the need for further research to compare and contrast variations between and within populations.

The determinants of food insecurity in the U.S. are not the same as those in developing areas, such as Ethiopia and Colombia where previous research on this topic has been implemented. While there is a significant correlation between food insecurity and income in this sample, the barriers to food security go beyond income and food availability in the U.S. and in Tampa Bay specifically. A large portion of the sample is considered to be ALICE households, meaning they are employed but live paycheck-to-paycheck and struggle to buy food due to ineligibility for food assistance and the high costs associated with living and with raising children. Thus, this sample is just one example of how food insecurity is affecting a modern group of people who are not among the stereotypical homeless and impoverished groups. The biological and health effects of food insecurity are also different in the U.S. when compared to areas that continue to experience high rates of undernutrition. Where someone who is food insecure in a low-income country may be underweight or even experience wasting, a food insecure person in Tampa is more likely to experience overnutrition through diets high in energy but low in micro-nutritional value. Thus, food insecurity will be embodied differently based on differences in food access in different environments. Furthermore, food insecurity and growth and development are multidimensional and
complex issues. Therefore, it is important to understand and account for all environmental and social determinants that influence biology when evaluating maturation and health. Thus, a biocultural approach is necessary when evaluating the embodied experiences and implications food insecurity can have on various groups, as well as within growth and development research.

The sample included in this study experiences unique barriers when it comes to food security. Adolescents are at risk for food insecurity for both biological and social reasons. Biologically, adolescence is a critical life period involving accelerated growth and increased energetic needs. The life course perspective posits that poor nutrition and exposure to environmental adversities during critical life periods can have substantial negative consequences on one’s growth, development, and health in adulthood (Himmelgreen 2014; Himmelgreen 2013). This approach is useful for understanding studies that connect early onset of puberty with health issues. Puberty involves increasing hormones and energy for the reproductive process. Thus, adolescents not only need more food to sustain their rapid growth but also to ensure they have energy for pubertal maturation. This increased energetic demand is felt physiological through appetite. Adolescents likely feel hungrier than younger children and adults. In this study, both parents and adolescents discussed the large appetites of adolescents. While this is a normal part of growing, families connected the large appetites and consistent hunger of adolescent to the issue of food not lasting within the home. This problem is especially relevant for teens who do not eat at school, as they come home hungry and eat the home-foods after school. Thus, these findings show that households with older children are at greater risk for food insecurity as food may run out quicker. Therefore, the increased nutritional demands during the critical life period of adolescence do not only influence adolescents themselves, but also their families. The need for more food can become a burden on the household. This phenomenon is revealed within the statistics that show that households in Florida that have children have the highest prevalence of food insecurity (22.7%) and households with children over the age of nine make up approximately 70% of food-insecure households with children in the U.S. (Coleman-Jensen 2013 et al.; Gregory and Coleman-Jensen 2013). Food assistance programs should
consider the age of children within the household when allocating resources (more on this in recommendations).

Households with older parents and guardians have higher rates of food insecurity among this sample as well. Food insecurity positively correlates with parental age, proposing that older caretakers likely face more barriers to food security when compared to younger adults. Factors could include larger household size, as guardians who are older may have more children or may be a part of a multigenerational household. Eleven of the households in this study were multigenerational. Health and income may play a role as well. Older adults are at higher risk for health issues that could limit their ability to work, drive, shop for food, or prepare food (Host et al. 2016). Some may be on limited income if they are retired or disabled.

Apart from biology and parental age, there are numerous sociocultural dynamics that place adolescents at risk for food insecurity. To start, adolescents have been left out of food insecurity research as well as food assistance programming. In the U.S. our food assistance programs are highly two dimensional. They typically focus on younger children or adults. In Tampa Bay for example, we have the backpack program, Pack-a-sac, after-school meal programs, and after-school food pantries designed to mitigate childhood food insecurity. However, these programs do not consider the social and physical limitations for adolescents. After school meals offered to students leave out teens who play sports after school or have part-time jobs. The backpack, pack-a-sac, and school pantry initiatives are not discrete, allowing other students to know who participates. It does not take into account the social difficulties of adolescence such as judgment by peers and embarrassment. Research among adolescents has documented the embarrassment and shame they often feel in regards to food insecurity or being of low income (Connell et al. 2005; Popkin et al. 2016; Hamersa and Kim 2016; Poppendieck 2010). Teens, specifically, fear judgment from their peers and actively try to hide hunger and food insecurity. Furthermore, adolescents are unlikely to ask for help from people they are not close to (Popkin et al. 2016). They may fear that expressing their hunger will get their families in trouble with the welfare system, too (Popkin et al. 2016; Connell et al. 2005).
The free and reduced priced lunch program, as part of the national school lunch program, does provide assistance to all children despite age. However, it does not consider the above complexities of adolescence such as stigma as well as others such as competitive for-sale food options, peer pressure, and the social aspects of food preferences. This research, as well as many others, shows that students have an overarching negative view of school food. Adolescents view school food as “gross” with limited options. The high rates of students who do not eat school-provided lunch may indicate that taste and preference is highly important for adolescents in the sense that they would rather not eat than eat something distasteful (Janavi et al. 2016; Contento et al. 2016). However, other psychosocial dynamics may undermine skipping school meals. The negative views toward school lunch could be creating peer pressure for adolescents to dislike the school food and keep them from eating it for fear their friends or peers will judge them for liking it. For example, many of the girls said they would prefer pizza as their number one lunch choice, yet, many are not eating the pizza served at school. In schools that have competitive food options, such as an a la carte menu, it is obvious who has lunch money and who does not as you have to have extra money or not participate in free or reduced lunch to purchase the items not on the general school lunch menu. In Poppendieck’s book, she discusses the phenomenon that this division may invoke stigma and embarrassment for students that have to get the school tray and, thus, may be a reason why some adolescents do not eat school lunch (Poppendieck 2010). Furthermore, body image and peer pressure have been found to associate with meal skipping among adolescents and could be another reason why girls are not eating at school (Janavi et al. 2016; Contento et al. 2016). Further research is necessary to better understand school lunch preferences, ways to make options more equitable, and the complex social factors that may be keeping students from eating.

On the other end, food assistance programs are targeted to and for adults. For example, Feeding Tampa Bay requires that food pantry clients be 18 or over to retrieve food (one box per adult). While colleagues have discussed how they would not turn down a teen who came to a pantry, it is the notion that these regulations exist that may keep teens away. They may fear they will be turned away, get in trouble,
or get their families in trouble. It is these types of rules that continue to knock teens out of programming and the larger picture.

Lastly, it is important to note that this sample consists mostly of minority groups and has a high prevalence of food insecurity. Therefore, the findings further support the issue that food insecurity disproportionately affects minorities in the U.S. (Alaimo et al. 2001; Stuff et al. 2009; Coleman-Jensen et al. 2013).

**Consequences of Early Puberty and Food Insecurity**

Food insecurity leads to poor nutrition and has significant health consequences including risk for obesity and adult-onset chronic diseases such as diabetes, cardiovascular disease, and hypertension (Himmelgreen et al. 2012; Schlüssel et al. 2013; Laraia 2013; Hadley and Crooks 2012). Food insecurity is also associated with stress and poor mental health as worry about one’s food circumstances and stigma surrounding food insecurity can lead to anxiety and depression (Connell et al. 2005). This study found that food insecurity associated with diets high in carbohydrates and snack foods. Importantly, the findings show that food insecurity influences the onset of earlier menarche. When puberty occurs before an individual has reached adult height in combination with inadequate nutrition, energy may be taken away from skeletal growth, immunity, and metabolic functions to support and maintain reproduction (fitness) (Belachew et al. 2011; Himmelgreen 2013; Worthman 2003). This circumstance is an example of a life-history trade-off in which immediate fitness is chosen over growth and development (Walker et al. 2006; Caudell and Quinlan 2012). This research shows that earlier menarche does correlate with shorter legs and may be an example of this energetic tradeoff.

The downside to life history trade-offs is the health risks involved. Studies show that the early onset of puberty is connected to obesity, type-2 diabetes, metabolic syndrome, hypertension, adult-onset asthma, breast and endometrial cancers, cardiovascular disease, and growth faltering (Benson and Jattoi 2012; Mascalí et al. 2011; Frontini et al. 2003; Remsberg et al. 2005; Allsworth et al. 2005). Furthermore, growth faltering is associated with lowered immunity, perinatal and neonatal mortality, lower occupational and educational productivity, hypertension, and glucose disorders (Onis and Branca 2016).
The brain is also still developing during adolescence and the pubertal growth spurt is theorized to begin after adequate brain development (Gluckman and Hanson 2006). Thus, if puberty occurs early, then brain development may suffer and result in psychological, behavioral, and cognitive issues. Studies have documented that early menarche is connected to depression, anxiety, substance use, and bulimia nervosa among female adolescents (Kaltiala-Heino et al. 2003; Vaughan et al. 2015). Heighten prevalence of sexually transmitted infections, aggressive behaviors, and poor academic performance are also associated with early puberty (Villamor and Jansen 2016).

When food insecurity and early onset of puberty coexist, the health risks associated with both experiences are significantly exacerbated. Hence, it is vital to work toward both improving food security and lowering the prevalence of early pubertal onset in the U.S. Food insecurity plays a role in early menarche in this sample. Therefore, if we are to tackle early onset of puberty and improve developmental health and preventive medicine, we must start with food security and nutrition. While there are many other factors that influence the timing of menarche, such as perceived stress, genetics, body size, and diet, food security may underpin these factors. Food insecurity leads to poor diets and stress, which both influence pubertal timing and body size. For this reason, preventing food insecurity during childhood and adolescence can be the starting point to preventing adult-onset diseases by lowering the prevalence of early puberty.

**Recommendations for Social Interventions and Policy**

Adolescents and their families have unique and complex needs that can create additional barriers to food security. By not designing programs that account for the complexities of adolescents, including both physical and social dynamics, we are furthering the risks of food insecurity, early onset of puberty, and the associated adverse health effects for both adolescents and their caretakers. Parents and guardians of adolescents are at particular risk for food insecurity because they often buffer their children against food insecurity and hunger. Furthermore, food insecurity among households that do not qualify for income or food assistance is continuing to increase as food prices and living costs rise and wages stay the same.
There continues to be a mismatch between food insecurity knowledge and practice. The face of food insecurity is diverse and many additional factors beyond income underpin the risk. Thus, food assistance programs need to be innovated to meet the needs of adolescents and their households, as well as the needs of working families (ALICE). Families in this research discussed the difficulties of attending food pantries because they were only open during normal business hours. Thus, more pantries are needed in the evenings and weekends. In addition, mobile food pantries should extend past impoverished and low-income neighborhoods to reach areas where ALICE families may live. The ALICE report for Florida can be used to see which municipalities in Hillsborough, Pinellas, and Manatee Counties have high percentages of ALICE households. Furthermore, data on the median household incomes per zip code could be useful to compare the median income to ALICE’s household survival and stability budgets. For example, the Tampa Hillsborough Economic Development Corporation provides a map showing median income levels by zip codes and neighborhoods (Tampa Hillsborough EDC 2015). Lastly, having pantries at or near low-wage workplaces could improve food assistance reach to working food-insecure families.

**Food Assistance Programs**

There are two changes within current food assistance programs that may help mitigate the increased risk of food insecurity for families with older children. These alterations would lie within both local food pantry distribution centers and food banks and the USDA Supplemental Nutrition Assistance Program (SNAP).

When a person goes to a food pantry, they usually get one box or one bag of food. This is the same at choice pantries, as well, where participants choose items to fill up their bag or box. The same amount of food is, thus, distributed to all persons despite household size or age of household residents. There are a few complexities that make this system less successful for certain populations. First, families with more people, especially those with older children who have larger food needs when compared to younger children, are going to run out of food quicker. The one box or bag of food will be less likely to sustain a family’s food needs if they are part of a larger household or have adolescence in the home.
Secondly, it is known that while food pantries are supposed to be supplemental, they are very often used as a main food source among community members. Families who work and have adolescent children likely have less time to go to various food pantries on different days, or have the time or means to travel to other neighborhoods to get food.

A solution, based on the concerns of study participants and the findings from this research, is to change food distribution within food pantries. Food assistance programs should be created or revised to account for the age of children in the home. The amount of food given to an adult at a food pantry should be based on the makeup of the household and the age of children. This way, families with older children can be allotted more food to ensure adolescents have enough to eat for healthy growth and development and the supply for the household is sustainable. This method would benefit the household as a whole as well as the health and well-being of adolescents. Furthermore, household size should be considered within food distribution.

Obviously, this task will not be easy, and it is much simpler and more efficient to keep distributions equal. However, boxes could be premade in different sizes based on age and household size, or more boxes could be allocated to families with children over 10 years of age. Food pantries typically ask clients to write down their name, household size, and the number of children in the household before receiving their food. Simply adding a second question as to the age of the children in the household could provide useful information for determining the amount of food a family needs. Another idea is to have weekend farmer’s market style pantries that use vouchers. Feeding Tampa Bay, for example, could partner with a local farmer’s market or set up their mobile pantries in a farmer’s market style and provide various voucher amounts based on the makeup of the household. Families with older children will get more “money” than families with younger children. The pantry/market could use the USDA weekly food cost plans to determine how much “money” to give families. Then, families have the choice to take foods they prefer and they know their children will eat. They will also have the ability to get the right amount of food to sustain their household food security throughout the week. Lastly, this system ensures that ALICE families are not left out. Some farms and farmer’s markets in the area do accept SNAP and give discounts
for SNAP recipients. However, this method leaves out families who do not qualify for SNAP. Thus, partnering with a food pantry is a way to reach the entire face of food insecurity and allocate resources based on family size and age.

Similarly to the recommendations for food pantries, a change in monthly SNAP allocations could be effective in assisting families with older children. Families discuss the concern that SNAP does not provide enough assistance. While this program was developed to be supplemental, people in the U.S. rely on it more and more. I propose that SNAP go beyond household size and consider the age of household members as well, in which increasing monthly allotments will correlate with increasing child ages. When applying for SNAP benefits, applicants can simply state the age and birthdates of the members in their household, as well as social security numbers to confirm the ages.

Schools and Summer Programs

The a la carte menu within public middle and high schools provides significant financial support for the schools. It is understandable why schools implement such a strategy, particularly within a time of continual funding cuts. However, schools need to consider whether making profit outweighs stigma, division, and the biological and social consequences that students may face as a result of the current system. Competitive food systems within schools also debunk all the hard work that has been put into improving the school nutrition program for U.S. children (Templeton et al. 2015). Although schools may be abiding by newer guidelines and providing “healthier” options, students still have the option to choose highly unhealthy food items with the a la carte menu/line. Research shows that having vending machines, snack bars, and a la carte menus in schools leads to an increase in low-quality quality calorie intake and BMI among middle school children (Briefel et al. 2009; Templeton et al. 2005; Crooks 2007). Students can eat ice cream for lunch if they choose and if they have money to buy it. Or maybe they prefer curly fries—no problem. Since the a la carte items are not an actual part of the National School Lunch Program, there are no regulations attached.

Providing low-quality food options is not the only issue here. Children apparently do not like the foods served as part of the school lunch program. School lunch has a significant place within the diets of
adolescents. Yet, they dislike the taste or appearance of the foods so much that they prefer not to eat anything at all, eliminating this critical meal from their overall diet. Waiting to eat until they get home is not only leading to unhealthy dietary habits but is also increasing the rate at which home foods are used up. Thus, schools should attempt to conduct research on adolescent dietary preferences and views and update school entrée items to foods adolescents will enjoy, such as salads and sandwiches.

Appearance and quality of the food seem to be important, too. Freezing food items may have something to do with the negative opinions of the foods at school. If the labor could be worked out, schools could attempt to incorporate non-frozen foods that are simply kept in a refrigerator, and evaluate students’ response to these.

However, as long as there is division within the school system where children who have lunch money can get whatever they please from the a la carte menu and those who do not have lunch money have to get the “gross” school lunch, it is likely that changing the foods served on the school lunch menu will not have a large impact on consumption during lunch. While more research is needed, it is possible that stigma and embarrassment have something to do with why children choose not eat school lunch (Poppendieck 2010). The only solution that could equalize school lunch is to get rid of competitive foods in schools and update school menu items to preferable foods. This will not only benefit students who may be embarrassed that they have to get the school tray, but it may also lead to healthier dietary habits among all the children. Studies have proven that eliminating competitive food items from schools leads to decreased consumption of poor-quality and energy-dense foods among children (Briefel et al. 2009). If they do not have the option to eat potato chips or pizza every day, then students may be more likely to eat healthier options such as a school salad, sandwich, or entrée instead. However, if school food items are not improved to satisfy the tastes of students, then the opposite effect could occur where students simply do not eat anything at all. This calls to the vitality of conducting evidence-based research among students to understand their need and desires.

Ridding competitive foods in schools can take away funding for the school. However, schools would also stop buying these items, saving money on food purchasing. In addition, other fundraising
techniques could be employed. For example, growing a school garden could provide fresh produce for the schools, and studies show that students are more likely to eat fruits and vegetables that they have grown themselves (Evans et al. 2016; Ratcliffe et al. 2011). This could lead to healthier food consumption and cost savings for the school. Other fundraising opportunities requiring no upfront costs include selling cookie dough, movie cards, and candles. These types of fundraisers allow the students to do the selling and become an active part of helping the school.

Lastly, if schools refuse to take away competitive foods, then they should consider only making healthy competitive items available and making them available to all students. Healthy snack options could include fruits, vegetable and dip, nuts, seeds, smoothies without added sugar, and snacks made of whole foods/ingredients. These options should be available for every child, not just children that have money on their lunch cards or bring cash to school. This would involve changing the computer system and possibly policy, but if children can decide whether they want to go to the a la carte line or the regular lunch line with no consequences, then stigma will be reduced and children may begin eating more. The students with free or reduced-price lunches can have an amount on their cards, like all other students, at which they can use for any items. This system also provides an opportunity to teach middle schoolers and high schoolers about budgeting and financial responsibilities.

As for the summer program food items, adolescents also discuss that the sandwiches provided do not taste good. Since all students are given the option to take the provided lunch or bring their lunch, stigma may not be a significant factor within skipping lunch at summer programs. Rather, it is the taste of the food items and the preference of the adolescents. Adolescents do not want to eat peanut butter and jelly sandwiches every day, and this is what is mostly provided at summer camps. In addition, they speak of the food tasting old or being plain. Perhaps providing fresher foods may reduce the prevalence of skipping meals, food waste, and food insecurity among children.

For adolescents who play sports or participate in afterschool activities, food and snacks are important to sustain their energy and prevent injury, especially among those who are not eating lunch. For these students, schools could host various fundraisers throughout the year to obtain money or food
donations for snacks and sandwiches for these adolescents before practices and games. This way, adolescents who may be missed with other child food assistance programs can be reached. Furthermore, the snacks and foods will be available to all the kids who participate in the team or club. Thus, stigma is eliminated.

**School Pantries and Food Security**

A solution to help tackle the issue of food insecurity among families with older children is to work with Feeding Tampa Bay to increase the number of school food pantries and school “farmer’s market” pantries. Feeding Tampa Bay has implemented school pantries in Hillsborough County that allow students, with parental permission, to take home food items and to eat fruits and vegetables at the end of or after school. This is initiative is progressive in that is involves giving choice to the students and their families. However, it must be implemented in ways that lower stigma. Based on the qualitative data from this study, it is recommended that school pantries remain stocked at all times and open every day of the week so that children who may have skipped lunch can grab a healthy snack item to eat whether at certain times of the day or at the end of the school day. For the farmer’s market school pantry, it is recommended to have these set up during school at the end of the week when food may be running out at home or at the beginning of the week as employees often get paid at the end of the week. Having pantries during school hours will ensure that adolescents who participate in after-school activates or jobs will have the opportunity to take food. It is apparent from this data that adolescents love fruit. Thus, having healthy snacks like fruits at school available to all children will equalize the snack options and possibly lead to children eating *something* while at school rather than nothing.

**Reassurance**

It is important that adolescents do not feel shame for their hunger and growing appetites. When talking to teens and designing food assistance interventions, researchers and advocates should ensure adolescents know that their appetites are normal and a part of their accelerated growth. Adolescents should be reassured not to feel embarrassed and not to restrict themselves when they feel hungry.
CHAPTER 7: LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The Absence of Extensive Participant Observation and Possible Errors in Dietary Reports

While I was able to observe small pieces of family’s foodways by conducting interviews within the households of my participants as well as dietary habits at summer programs, I was rarely able to observe food consumption or household food items. More participant observation, meaning spending more time with families and/or girls—possibly following them throughout a day, going grocery shopping with them, or spending time with the girls at school, would have allowed better inferences on the diets of the families and/or the girls in this study. It would have also helped uncover fallacies in the questionnaires or interviews.

It is known that a large limitation to doing food and nutritional research is the falseness that may occur. Participants may not be honest about what they eat for fear of judgment by the researcher or even their children or parents. I interviewed girls and mothers together and observed numerous debates between the two on what and how much the girls and the family eat. The debates went both ways. For example, some parents would stress their healthy food habits and the girl(s) would debunk that by telling me that they often eat out fast food or they just had fried chicken last night. In opposition, many times a mom or grandma would discuss how much the girl(s) eat snack foods or junk foods or add sugar to cereals/drinks, but the girls would argue against the frequency. Furthermore, caregivers would often answer for the girls rather than let them answer for themselves. This is a limitation in conducting research among children, as it is hard to understand the child’s perspectives and experiences if their parents and guardians are answering the questions for them. Thus, the presence of the family member may have skewed the participant’s answer and the data. In addition, my presence may have led to alterations, even though I explained there was no judgment and consistently talked about the foods I love to eat (often
unhealthy). Utilizing more participant observation would have allowed me to find non-truths in my data and possibly gain more valid data on diet. For example, while doing a household interview I observed a girl eating a Popsicle. However, in her food frequency questionnaire, she answered that she never ate popsicles. Thus, this is one example where my observation was extremely helpful in obtaining truthful dietary data. If I had been able to spend more time with her, such as a week or month, I could have documented on average how many times she ate popsicles or asked her to re-think her answer the next time I saw her. However, since I was only with her for one day (at a small period of time), I did not feel comfortable changing her documented response and the data.

While I did work as a volunteer at a summer camp and used my observations from that experience in this research, I, unfortunately, did not get to interview the girls from the summer camp who I had built rapport with. This was due to organization deciding they did not want to go through with helping me with my research at the end of the summer, which they claimed was due to the “messiness” of having to keep autonomy and sign consent and assent forms. Thus, where this experience led me to observe what middle schoolers eat for lunch and snacks every day at a summer camp, and differences in food behaviors between cultures and ethnicities, I was not able to use this experience to validate my dietary analysis methods. Thus, it is not included in this report.

I recommend that others who are interested in learning about diet, food security, and growth and development among adolescents should definitely incorporate more participant observation into their research methodologies. I feel that better data and understanding of the complex biocultural arena of food and eating can be obtained by spending time with prospective participants before asking them to take part of the study or implementing the interview and questionnaires. Although this may result in smaller sample sizes, I think it is important. If one wants to understand the various factors that influence menarche and development, one will have to have a rapport with individuals to ensure they will want and allow the researcher to poke into every aspect of their lives. Maybe this is the difficulty of conducting research in the United States. It is not as simple as going and living in a different world and immersing yourself in a new community. Even if one lives within the community they are studying, in the United
States that community is most likely going to be vast and diverse. I believe for answering this type of research question, one needs to work closely with a subpopulation/culture within a community, such as a school, a summer camp, an after-school program, etc. I wish I would have secured this type of opportunity before starting my research. I feel I would have had much more success in participation rates and completion of all the methodologies I hoped to use – including photovoice and perceived stress.

**Dyadic Interviews**

Conducting interviews with both the maternal guardian and the adolescent posed limitations. Girls may not have felt comfortable talking to me about some things in front of their parents, even though the questions were not intrusive. Caretakers often responded for the girls rather than let them answer for themselves. Thus, the data could be biased toward the parent’s perspective and have missed important information from girls who did not want to say things in front of their parents/guardians.

**The Absence of Photovoice and Perceived Stress Questionnaire**

After numerous attempts at getting girls to participate in photovoice, I decided to remove this method from the research for this study. Photovoice is a participatory research methodology that asks participants to take photographs relative to the research questions with a provided camera (or their phone). The photographs are then developed and discussed in an interview or focus group. It is a powerful method because it gives the participants agency in the research and provides strong visual data that can be used for presentations and displays for community members, stakeholders, and policy-makers. I would like to do photovoice in the future when there is more opportunity to work within a specific organization or school or have relationships with the girls. Having more control over the research site and more contact would have likely prevented the many missing cameras and lack of communication after the initial interviews. I began the photovoice process by giving the first few girls disposable cameras and the probes. The girls and their families were not giving the cameras back to me, and many ignored phone calls and emails to follow up with them. Since the perceived stress questionnaire was supposed to take place during the second interview along with a discussion of the photographs, this tool was left out as well. This is a definite limitation of the research and the findings, as perceived stress and abuse are known to influence
maturation. Thus, future research should incorporate a perceived stress questionnaire. Photovoice would also have been beneficial in obtaining a better idea of what girls are eating throughout the day, especially at school, or if they are eating at school.

**Maternal Anthropometry**

Future research should include maternal anthropometry to understand the parental influence on body size/composition of the adolescent. This can be useful in controlling for the influence of diet and food insecurity on biology. I recommend that future research with more time and resources should have two researchers per interview so that one can also obtain the parent’s measurements. Since maternal BMI can play a role in menarche, this should be measured and its absence is a limitation to this research.

**Food Insecurity – Household vs. Adolescent**

Measuring household food insecurity may not be effective as adolescents may have different experiences with food security. Often times parents and guardians will buffer for adolescents and hence be more food insecure than the children. Or, children may be more food insecurity than their households believe if they are eating poor quality foods and skipping meals. Future research should measure adolescent food insecurity and solely ask the adolescent the questions regarding food security. These questions could simply be added to the self-administered FFQ so they are more private.

**Food Insecurity and Preference**

While it seems obvious, there is very little data and literature looking at the influence of taste and preference on food security. Future research should aim to better understand this role, particularly among children and in regard to school-provided foods. In addition, studies should analyze how food preferences are connected with social class and social ideals among adolescents. Stronger research on this topic can provide a stance for arguing for changes in the school nutrition system, as well as uncover ways to improve provided meals so that children will eat them.

**Leg length and Stature**

Bogin and Silva (year) explain that African Americans have been shown to have longer extremities and shorter trunks than whites, particularly among children 12 to 17 years old. This may play
a role in my data and may influence the high reference percentiles for leg lengths and low reference percentiles for sitting heights.

**Relying on Recalled Age at Menarche**

While many girls and women concretely remember when they started menstruation, anytime participants are asked to recall a past circumstance or date can lead to error. In addition, most of the girls and their parents/guardians could not remember the exact date of menarche. Thus, the data is based on ages. Future research should attempt to track girls start dates through longitudinal research or by utilizing doctor’s records (if useful).

**The Absence of Body Image Assessment**

When studying diets of teens, it may be important to look at body image perspectives. While this was not part of my research questions, it came to my realization that the older girls (15 and 16 years of age) were more likely to bring up their body size than younger participants. However, this only happened three instances, but the lack of discussion on body image may have been because it was not included in my research questions. Since so many girls are not eating at school or summer programs, it is important to incorporate other factors besides food preferences/taste in future research.

I recommend for future researchers to utilize a body image methodology if one is attempting to understand the factors that influence teen diet and menarche. Since I was looking at early menarche, which seems to precede strong ideas of what one’s body should like, I do not feel that perspectives on body image played a significant role in the diets of my participants at age of menarche. However, I do feel that it can have an influential effect on the diets of girls after the onset of puberty and could therefore still impact growth and development. To control for the effect of disordered eating, researchers should go beyond the simple question of whether someone has been diagnosed with an eating disorder. Perhaps add questions regarding skipping of meals or eating less relative to body image and mental health.

**My Personal Demographics**

As mentioned in the reflections, I feel my personal demographics could have been a barrier to getting participants to open up and be honest with me. As the majority of my participants were African
American or Hispanic, and I white, this could have posed limitations. Also, many times caretakers viewed me as a child, mentioning that they did not believe I was old enough to be in college or married. While I took this a compliment, it could mean that guardians did not take me as seriously they would a peer.

**Lacking Linguistics**

Incorporating a linguistic analysis would make the research more holistic and providing a better understanding of the entire picture in regards to food choices. Food discourse is everywhere in U.S society, specifically within the media. Children today are bombarded with food media from social media apps on their phones to commercials on the television, to the billboards they see on the streets. Extended participant observation could be used to assess and understand the current discourse surrounding food, specifically discourse targeting adolescents and used by this age group, as well as how food language and language of food shapes behaviors and beliefs. Since I did not conduct extensive participant observation, I did not have the opportunity to observe food discourse and language. However, I feel this is a huge limitation to any dietary research, specifically within anthropology. From this research and my readings on nutritional anthropology, I have adopted the belief that one cannot study these phenomena, particularly in developed societies like the U.S., without incorporating language. If not the direct study of food language, the proxy inclusion of how food language shapes participants’ beliefs and food habits should at the least be included in the research questions and theoretical background. Therefore, future research should include a linguistic perspective and theories of food language when studying diet and nutrition.

**Skipping School Meals**

Further research is needed to understand why children are not eating at school or at summer programs. While other literature has found that taste and preference are a significant reason why students prefer not to eat school-provided food (Janavi et al. 2016; Contento et al. 2006; Neumark-Sztainer et al. 1999; Poppendieck 2010), stigma and negative attitudes toward school lunch also play a role in skipping school lunch (Cullen et al all. 2007; Poppendieck 2010; Hamersa and Kim 2016; Popkin et al. 2016). More research is needed to further understand whether there are other factors that lead students away from eating school food besides the taste and appearance of the food. Specific questions should ask about
stigma and embarrassment relative to free or reduced-priced lunch, peer pressure, body image, and division between the a la carte items for sale and the school-provided entrée. In addition, research is needed to understand how the national school lunch program can be improved or change in ways that will increase participation. Talking to the students, staff, and faculty and obtaining their opinions and recommendations will help develop successful interventions.
CHAPTER 8: APPLICATION OF THE RESEARCH

On page 51 I discussed personal reflections I felt at the beginning of the research process. Reflecting back, I quickly got over my fear and feelings of being in danger when conducting interviews in impoverished neighborhoods. I regained my trust in people and also gained a large sense of trust in my participants, even before I had conducted the interviews. I am not sure if it was because of their maternal characteristics or I simply internally put my biases to rest after many positive experiences. With new eyes, though, my biases were removed and instead I saw the larger macro assemblies that prevent food security and keep people at risk for social and health disparities. From this, my feelings of fear turned to sadness. As my research went on, the emotions became more and more taxing. Continually going into impoverished neighborhoods and homes and hearing about the complexities of food insecurity weighed on me. In addition, the more ALICE families I met who were food insecure the more “messy” food insecurity and its determinants became. I often felt like researching food insecurity for positive change was an impossible task when considering all the dynamic structures that cause and magnify this issue.

Despite how hard and hopeless researching social issues of inequity can feel, I am reminded that this study in particular was made possible due the efforts of the Hunger Action Alliance (HAA) and has a purpose beyond simple research. The HAA partnership allowed me to work directly with Feeding Tampa Bay, a network of Feeding America. Feeding Tampa Bay serves 10 counties and more than 700,000 Florida residents. In partnering with such a valuable community organization, as well as the many additional organizations within the HAA, I am able to ensure that my research and knowledge will be distributed back to the community and local gatekeepers. In addition, it is partnerships like these that make the application of research possible. My goal from the start was to find a project that can and will be applied in some way. Aside from providing a report of my findings to the Hunger Action Alliance, I will
also provide recommendations to Feeding Tampa Bay and Feeding America to better improve local and national food assistance programs. For example, I will argue for a change in the way food is distributed to food pantry clients, in that the amount of food should be based on household size and the age of children in the household. Lastly, I plan to present my findings to local hunger groups, including the Childhood Hunger Initiative.

The application of this research will not stop at writing a report and presenting the findings to partners and community groups, as I witness all-too-often. I plan to work with Feeding Tampa Bay, the Childhood Hunger Initiative, and local schools to design and implement interventions. I hope that together we can attempt and evaluate pilot projects that may have a lasting positive effect.

Within my practice, I will be writing a separate report to the local school boards of Hillsborough and Pinellas Counties. This report will focus on the school lunch program, including my findings relative to children skipping provided meals, the concerns surrounding available foods (for purchase and not), food preferences of adolescents, why and how the current school lunch system could be significantly increasing food insecurity, and the risks involved with adolescent food insecurity. I will present recommendations based on the literature and my research and ultimately hope that the school boards will meet with me and others to further discuss changes, solutions, or more research.

In addition, a policy proposal will be conducted as well. This will target the USDA Supplement Nutrition Assistance Program (SNAP). I will propose that SNAP account for the age of children living in the household rather than simply household size when deciding monthly allotment.

Lastly, but not least importantly, I will be writing scholarly publications to help fill in the current gap in the literature and add to anthropological knowledge specifically within the expanding subfield of biocultural anthropology. I will also be presenting my research at various scholarly conferences. I hope with this research I can set a precedent for studying the connection of food insecurity and maturation in the United States and convince others of its importance.
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APPENDIX A. USF INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

1/31/2017

Mecca Burris  Anthropology
3911 101st Street W.
Bamboo Terrace
Bradenton, FL 34210

RE:  Expedited Approval for Initial Review
IRB#:  Pro00028412
Title: Food Insecurity and Age of Menarche: Using a Biocultural Approach and Life History Theory to Assess the Embodiment of Food Insecurity Among Adolescents in Tampa, FL

Study Approval Period: 1/30/2017 to 1/30/2018

Dear Ms. Burris:

On 1/30/2017, the Institutional Review Board (IRB) reviewed and APPROVED the above application and all documents contained within, including those outlined below.

Approved Item(s):
Protocol Document(s):
Study Protocol IRB.docx

Consent/Assent Document(s)*:
*Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent documents are valid until the consent document is amended and approved. **Verbal assent forms are unstamped*

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45CFR46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review category:

(6) Collection of data from voice, video, digital, or image recordings made for research purposes.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

**Research Involving Children as Subjects (45 CFR §46.404)**
Per CFR 45 Part 46, Subpart D, this research involving children was approved under the minimal risk category 45 CFR 46.404: Research not involving greater than minimal risk.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval via an amendment. Additionally, all unanticipated problems must be reported to the USF IRB within five (5) calendar days.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

Kristen Salomon, Ph.D., Vice Chairperson

USF Institutional Review Board
APPENDIX B. STUDY INSTRUMENTS

Figure 15: Recruitment flyer for parents.
Are you a girl who has started puberty within the last two years? (≈9 - 15 years old)

If YES, we want to hear from you!

YOU and your PARENT can be part of a research study about girls and food!

This research wants to learn about what girls your age are eating and why. It also wants to see how food security and diet may impact the age that girls begin puberty. Participate in an interview and survey and take pictures of your food for 3 days with a provided camera.

For Participation:
- Girls will get a $15 giftcard
- Parents/Guardians will get $20

* Both girls and adults can participate

Time commitments:
- Girls: 2 - 3 hours (over weeks time)
- Parents: 1 hour

Benefits: free food security and dietary assessment, and education about girls and health

Interested? Contact Mecca Burris to schedule your interview!

502-751-0200
mehowe@mail.usf.edu

The study is conducted by the University of South Florida and Feeding Tampa Bay. IRB Study # 00028412

Figure 16: Recruitment flyer for girls.
Dyadic Interview Guide

Explain this study is anonymous. Only name will be on the consent forms.

Do not have to answer any questions you don’t feel comfortable answering. You can choose to end the interview or participation at any time.

Adolescent’s age: ________________ Adolescent’s grade level: _______________________________

Parent/Guardian(s) age: _________ Parent/Guardian(s) highest level of education: ____________

Identified ethnicity of Adolescent: __________________________________________________________

Identified ethnicity of parent/guardian(s): __________________________________________________

Annual Household Income
(estimate to the best of your ability)

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<tr>
<th>Current</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>When child started puberty</td>
<td></td>
</tr>
</tbody>
</table>

Questions regarding the adolescent

Current health issues: ___________________________________________________________________
_____________________________________________________________________________________

Past health issues and age at occurrence: __________________________________________________
_____________________________________________________________________________________

Has the adolescent ever been diagnosed with an eating disorder? ☐ Yes ☐ No

8. If yes, please describe the disorder: ____________________________________________________
Age of first menstrual cycle: _____________________________________________________________
Date of first menstrual cycle (if remembered): _______________________________________________
Birth weight of adolescent: ______________________________________________________________

Feeding practice(s) primarily used when the adolescent was a baby up until 6 months (e.g. breastfeeding, formula):
____________________________________________________________________________________

Do your children eat different foods than you or other adults in the household eat?
____________________________________________________________________________________
- Probe: do they eat outside of the home a lot? With friends or driving themselves.

Anything else you would like to discuss about the adolescent?

Questions regarding the household/parents

Current health issues of the parent/guardian(s): _____________________________________________
____________________________________________________________________________________

Past health issues and age at occurrence: _________________________________________________
____________________________________________________________________________________

Maternal age of first menstruation: ________________________________________________________

Where do you get most of the food for the household? (e.g. supermarket, food bank, fast-food restaurant):
____________________________________________________________________________________

Is anyone in the household currently participating in any food assistance programs (e.g. SNAP, WIC)?
□ Yes □ No
a. If yes, please describe which programs: ____________________________

Please choose which factors are important for the food choices of your family:

☐ Location (e.g. where you live in relation to stores/restaurants)  ☐ Costs/prices  ☐ Healthiness
☐ Time/effort   ☐ Taste/desire   ☐ Family/friends preferences

a. Please describe which factor influences the foods your family eats THE MOST and why:

______________________________________________________________________________

Has the type of foods your family eats changed a lot overtime or recently?  ☐ Yes  ☐ No

8. If Yes, please explain when and why this occurred: ________________________________

______________________________________________________________________________

Are there any techniques you do to make sure the children have enough food that you wouldn’t mind sharing?

Is there anything else you would like to discuss?
Revision Notes: The food security questions in the 6-item module are essentially unchanged from those in the original module first implemented in 1995 and described previously in this document.

September 2012:
- Added coding specification for “How many days” for 30-day version of AD1a. July 2008:
- Wording of resource constraint in AD2 was corrected to, “…because there wasn’t enough money for food” to be consistent with the intention of the September 2006 revision.

January 2008:
- Corrected user notes for coding AD1a.

September 2006:
- Minor changes were introduced to standardize wording of the resource constraint in most questions to read, “…because there wasn’t enough money for food.”
- Question numbers were changed to be consistent with those in the revised Household Food Security Survey Module.
- User notes following the questionnaire were revised to be consistent with current practice and with new labels for ranges of food security and food insecurity introduced by USDA in 2006.

Overview: The six-item short form of the survey module and the associated Six-Item Food Security Scale were developed by researchers at the National Center for Health Statistics.

Background: The six-item short form of the survey module and the associated Six-Item Food Security Scale were developed by researchers at the National Center for Health Statistics in collaboration with Abt Associates Inc. and documented in “The effectiveness of a short form of the household food security scale,” by S.J. Blumberg, K. Bialostosky, W.L. Hamilton, and R.R. Briefel (published by the American Journal of Public Health, vol. 89, pp. 1231-34, 1999). ERS conducted additional assessment of classification sensitivity, specificity, and bias relative to the 18-item scale.

If respondent burden permits, use of the 18-item U.S. Household Food Security Survey Module or the 10-item U.S. Adult Food Security Survey Module is recommended. However, in surveys that cannot implement one of those measures, the six-item module may provide an acceptable substitute. It has been shown to identify food-insecure households and households with very low food security with reasonably high specificity and sensitivity and minimal bias compared with the 18-item measure. It does not, however, directly ask about children’s food security, and does not measure the most severe range of adult food insecurity, in which children’s food intake is likely to be reduced.

[Begin Six-Item Food Security Module]

Transition into Module:
These next questions are about the food eaten in your household in the last 12 months, since (current month) of last year and whether you were able to afford the food you need.

**NOTE:** If the placement of these items in the survey makes the transition/introductory sentence unnecessary, add the word “Now” to the beginning of question HH3: “Now I’m going to read you....”

FILL INSTRUCTIONS: Select the appropriate fill from parenthetical choices depending on the number of persons and number of adults in the household.

HH3. I’m going to read you several statements that people have made about their food situation. For these statements, please tell me whether the statement was often true, sometimes true, or never true for (you/your household) in the last 12 months—that is, since last (name of current month).

The first statement is, “The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true
[ ] DK or Refused

HH4. “(I/we) couldn’t afford to eat balanced meals.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

[ ] Often true
[ ] Sometimes true
[ ] Never true
[ ] DK or Refused

AD1. In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn’t enough money for food?

[ ] Yes
[ ] No (Skip AD1a)
[ ] DK (Skip AD1a)

AD1a. [IF YES ABOVE, ASK] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?
Almost every month
Some months but not every month
Only 1 or 2 months
DK

AD2. In the last 12 months, did you ever eat less than you felt you should because there wasn’t enough money for food?
Yes
No
DK

AD3. In the last 12 months, were you ever hungry but didn’t eat because there wasn’t enough money for food?
Yes
No
DK

[End of Six-Item Food Security Module]
User Notes

(1) Coding Responses and Assessing Households’ Food Security Status:

Responses of “often” or “sometimes” on questions HH3 and HH4, and “yes” on AD1, AD2, and AD3 are coded as affirmative (yes). Responses of “almost every month” and “some months but not every month” on AD1a are coded as affirmative (yes). The sum of affirmative responses to the six questions in the module is the household’s raw score on the scale.

Food security status is assigned as follows:

- Raw score 0-1—High or marginal food security (raw score 1 may be considered marginal food security, but a large proportion of households that would be measured as having marginal food security using the household or adult scale will have raw score zero on the six-item scale)
- Raw score 2-4—Low food security
- Raw score 5-6—Very low food security

For some reporting purposes, the food security status of households with raw score 0-1 is described as food secure and the two categories “low food security” and “very low food security” in combination are referred to as food insecure.
For statistical procedures that require an interval-level measure, the following scale scores, based on the Rasch measurement model may be used:

<table>
<thead>
<tr>
<th>Number of affirmatives</th>
<th>Scale score</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NA</td>
</tr>
<tr>
<td>1</td>
<td>2.86</td>
</tr>
<tr>
<td>2</td>
<td>4.19</td>
</tr>
<tr>
<td>3</td>
<td>5.27</td>
</tr>
<tr>
<td>4</td>
<td>6.30</td>
</tr>
<tr>
<td>5</td>
<td>7.54</td>
</tr>
<tr>
<td>6 (evaluated at 5.5)</td>
<td>8.48</td>
</tr>
</tbody>
</table>

However, no interval-level score is defined for households that affirm no items. (They are food secure, but the extent to which their food security differs from households that affirm one item is not known.)

(2) **Response Options:** For interviewer-administered surveys, DK (“don’t know”) and “Refused” are blind responses—that is, they are not presented as response options but marked if volunteered. For self-administered surveys, “don’t know” is presented as a response option.

(3) **Screening:** If it is important to minimize respondent burden, respondents may be screened after question AD1. Households that have responded “never” to HH3 and HH4 and “no” to AD1 may skip over the remaining questions and be assigned raw score zero. In pilot surveys intended to validate the module in a new cultural, linguistic, or survey context, however, screening should be avoided if possible and all questions should be administered to all respondents.

(4) **30-Day Reference Period:** The questionnaire items may be modified to a 30-day reference period by changing the “last 12-month” references to “last 30 days.” In this case, item AD1a must be changed to read as follows:

AD1a. [IF YES ABOVE, ASK] In the last 30 days, how many days did this happen?

    _______ days

    [ ] DK
Responses of 3 days or more are coded as “affirmative” responses.

(5) Self Administration: The six-item module has been used successfully in mail-out, takehome, and on-site self-administered surveys. For self-administration, question AD1a may be presented in one of two ways:

- Indent AD1a below AD1 and direct the respondent to AD1a with an arrow from the “Yes” response box of AD1. In a parenthetical following the “No” response box of AD1, instruct the respondent to skip question AD1 and go to question AD2.
- Present the following response options to question AD1 and omit question AD1a:
  
  o Yes, almost every month
  o Yes, some months but not every month
  o Yes, only 1 or 2 months
  o No

  In this case, either of the first two responses is scored as two affirmative responses, while “Yes, only 1 or 2 months” is scored as a single affirmative response.

The two approaches have been found to yield nearly equal results. The latter may be preferred because it usually reduces the proportion of respondents with missing information on how often this behavior occurred.
Anthropometric Data Collection Form

Adolescent #______________

<table>
<thead>
<tr>
<th>Measurement</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (kg)</td>
<td></td>
</tr>
<tr>
<td>Height (m)</td>
<td></td>
</tr>
<tr>
<td>Leg Length (cm)</td>
<td></td>
</tr>
<tr>
<td>Sitting Height (m)</td>
<td></td>
</tr>
<tr>
<td>Waist Circumference (cm)</td>
<td></td>
</tr>
<tr>
<td>Hip Circumference (cm)</td>
<td></td>
</tr>
</tbody>
</table>

**BMI** (weight / height²):

**Sitting Height Ratio** (SH / H):

**Waist-to-Hip Ratio** (waist C/ hip C):

**Notes:**
### APPENDIX C. FIGURES AND GRAPHS

#### Nutrition Information on Foods Items Sold Ala Carte 2017-2018

**NOTE:** Student Nutrition Services attempt to provide nutrition information that is as accurate as possible. It is based upon standard portion product guidelines, and variations of serving sizes and ingredient content may occur. Nutritional information is provided by manufacturers and USDA, and is subject to change without notification. Revised August 1, 2017

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Kcals (gm)</th>
<th>%Kcals from Fat</th>
<th>%Fat (gm)</th>
<th>%Sat Fat (gm)</th>
<th>Trans Fat (gm)</th>
<th>Protein (gm)</th>
<th>Carbs (gm)</th>
<th>Sodium (mg)</th>
<th>Dietary Fiber (gm)</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goldfish Cheese Crackers</td>
<td>160</td>
<td>4.0</td>
<td>23%</td>
<td>1</td>
<td>6%</td>
<td>0</td>
<td>2</td>
<td>30</td>
<td>10</td>
<td>Whole Grain</td>
</tr>
<tr>
<td>Kellogg® Nutri grain Bar</td>
<td>160</td>
<td>6.0</td>
<td>1.2%</td>
<td>1</td>
<td>0.4%</td>
<td>0</td>
<td>2</td>
<td>10</td>
<td>3</td>
<td>Whole Grain</td>
</tr>
<tr>
<td>Little Mozzarella String Cheese Portion</td>
<td>60</td>
<td>6.0</td>
<td>66%</td>
<td>3.5</td>
<td>39%</td>
<td>0</td>
<td>7</td>
<td>1</td>
<td>210</td>
<td>20% (RDA) for Calcium</td>
</tr>
<tr>
<td>Smart Cookies</td>
<td>100</td>
<td>3.0</td>
<td>27%</td>
<td>1</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>18</td>
<td>70</td>
<td>Whole Grain</td>
</tr>
<tr>
<td>Sunflower Kernels (per)</td>
<td>170</td>
<td>18.0</td>
<td>11%</td>
<td>0</td>
<td>11%</td>
<td>0</td>
<td>2</td>
<td>18</td>
<td>110</td>
<td>Whole Grain</td>
</tr>
<tr>
<td>Beef Jerky Stick</td>
<td>115</td>
<td>7.0</td>
<td>54%</td>
<td>3</td>
<td>23%</td>
<td>0</td>
<td>10</td>
<td>3</td>
<td>100</td>
<td>Whole Grain</td>
</tr>
<tr>
<td>Mini Cinnamon Bliz</td>
<td>120</td>
<td>3.5</td>
<td>26%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>22</td>
<td>36</td>
<td>Whole Grain</td>
</tr>
<tr>
<td>Mott's® Fruit Snacks</td>
<td>100</td>
<td>0.0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>37</td>
<td>55%</td>
<td>Good Source of Vitamins C, E &amp; Beta Carotene</td>
</tr>
<tr>
<td>Nature Valley Oat N' Honey Granola Bar</td>
<td>90</td>
<td>3.0</td>
<td>30%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>15</td>
<td>80</td>
<td>Whole Grain</td>
</tr>
<tr>
<td>Nature Valley Chewy Chocolate Granola Bar</td>
<td>90</td>
<td>2.0</td>
<td>20%</td>
<td>0.5</td>
<td>5%</td>
<td>0</td>
<td>1</td>
<td>19</td>
<td>55</td>
<td>Whole Grain</td>
</tr>
<tr>
<td>Whole Grain Donkin Stick</td>
<td>160</td>
<td>6.0</td>
<td>30%</td>
<td>1.5</td>
<td>8%</td>
<td>0</td>
<td>3</td>
<td>26</td>
<td>170</td>
<td>Whole Grain</td>
</tr>
</tbody>
</table>

#### Chips (1 oz. bag)

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Kcals (gm)</th>
<th>%Kcals from Fat</th>
<th>%Fat (gm)</th>
<th>%Sat Fat (gm)</th>
<th>Trans Fat (gm)</th>
<th>Protein (gm)</th>
<th>Carbs (gm)</th>
<th>Sodium (mg)</th>
<th>Dietary Fiber (gm)</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plain Baked Lay</td>
<td>120</td>
<td>2.0</td>
<td>15%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>23</td>
<td>135</td>
<td>Baked</td>
</tr>
<tr>
<td>Baked BBQ Lay</td>
<td>110</td>
<td>3.0</td>
<td>25%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>19</td>
<td>190</td>
<td>Baked</td>
</tr>
<tr>
<td>Popchips® Sour Cream</td>
<td>120</td>
<td>4.0</td>
<td>30%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>18</td>
<td>200</td>
<td>Baked</td>
</tr>
<tr>
<td>Popchips® Crazy Hot</td>
<td>120</td>
<td>4.5</td>
<td>34%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>18</td>
<td>270</td>
<td>Baked</td>
</tr>
<tr>
<td>Popcorn Indiana Kettle Corn</td>
<td>130</td>
<td>5.0</td>
<td>35%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>1</td>
<td>21</td>
<td>130</td>
<td>Whole Grain</td>
</tr>
<tr>
<td>Tostitos* Baked Scoope®</td>
<td>110</td>
<td>3.0</td>
<td>26%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>18</td>
<td>125</td>
<td>Whole Grain</td>
</tr>
</tbody>
</table>

#### Hot Snack Items

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Kcals (gm)</th>
<th>%Kcals from Fat</th>
<th>%Fat (gm)</th>
<th>%Sat Fat (gm)</th>
<th>Trans Fat (gm)</th>
<th>Protein (gm)</th>
<th>Carbs (gm)</th>
<th>Sodium (mg)</th>
<th>Dietary Fiber (gm)</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oven-Baked Curly Fries</td>
<td>100</td>
<td>3.0</td>
<td>27%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>1</td>
<td>17</td>
<td>150</td>
<td></td>
</tr>
<tr>
<td>Oven-Baked Emoji Fries</td>
<td>130</td>
<td>4.5</td>
<td>31%</td>
<td>0.5</td>
<td>3%</td>
<td>0</td>
<td>2</td>
<td>20</td>
<td>180</td>
<td></td>
</tr>
<tr>
<td>Product Description</td>
<td>Kcal</td>
<td>Fat (g)</td>
<td>%Kcal from Fat</td>
<td>Sat Fat (g)</td>
<td>%Sat Fat</td>
<td>Trans Fat (g)</td>
<td>Protein (g)</td>
<td>Carbs (g)</td>
<td>Sodium (mg)</td>
<td>Dietary Fiber (g)</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------</td>
<td>---------</td>
<td>----------------</td>
<td>-------------</td>
<td>----------</td>
<td>---------------</td>
<td>-------------</td>
<td>-----------</td>
<td>-------------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Fruit Smoothies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orange Daze Smoothie</td>
<td>143</td>
<td>2.0</td>
<td>13%</td>
<td>1</td>
<td>0%</td>
<td>0</td>
<td>5</td>
<td>27</td>
<td>60</td>
<td>1</td>
</tr>
<tr>
<td>Purple Daze Smoothies</td>
<td>88</td>
<td>0.0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>Apple Cinnamon swirl Smoothie</td>
<td>130</td>
<td>2.0</td>
<td>14%</td>
<td>1</td>
<td>7%</td>
<td>0</td>
<td>5</td>
<td>24</td>
<td>57</td>
<td>0</td>
</tr>
<tr>
<td>Summer Daze Smoothie</td>
<td>43</td>
<td>0.0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>12</td>
<td>1</td>
</tr>
<tr>
<td><strong>Ice Cream</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chocolate Fudge Ice Cream Bar</td>
<td>130</td>
<td>3.5</td>
<td>10%</td>
<td>1</td>
<td>7%</td>
<td>0</td>
<td>5</td>
<td>25</td>
<td>95</td>
<td>1</td>
</tr>
<tr>
<td>Chocolate Sundae Ice Cream Bar</td>
<td>160</td>
<td>0.0</td>
<td>0%</td>
<td>1.5</td>
<td>8%</td>
<td>0</td>
<td>5</td>
<td>25</td>
<td>76</td>
<td>1</td>
</tr>
<tr>
<td>Chocolate/Vanilla Ice Cream Cup</td>
<td>70</td>
<td>1.0</td>
<td>13%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>2</td>
<td>14</td>
<td>36</td>
<td>2</td>
</tr>
<tr>
<td>Blue Raspberry Lemonade Bar</td>
<td>50</td>
<td>0.0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Sour Cherry Ice Cream/dairy</td>
<td>90</td>
<td>0.0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Strawberry Shortcake Bar</td>
<td>130</td>
<td>3.5</td>
<td>26%</td>
<td>1</td>
<td>7%</td>
<td>0</td>
<td>1</td>
<td>22</td>
<td>46</td>
<td>0</td>
</tr>
<tr>
<td>Cotton Candy Ice Cream Bar</td>
<td>70</td>
<td>1.0</td>
<td>13%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>1</td>
<td>15</td>
<td>40</td>
<td>0</td>
</tr>
<tr>
<td>Ice Cream Sandwich</td>
<td>130</td>
<td>2.0</td>
<td>14%</td>
<td>1</td>
<td>7%</td>
<td>0</td>
<td>2</td>
<td>25</td>
<td>130</td>
<td>2</td>
</tr>
<tr>
<td><strong>Assorted Milk Flavors Box</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk - 1% (Low Fat)</td>
<td>110</td>
<td>2.5</td>
<td>20%</td>
<td>1</td>
<td>12%</td>
<td>0</td>
<td>9</td>
<td>12</td>
<td>116</td>
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<td>Milk - Fat Free Chocolate</td>
<td>130</td>
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<td>0%</td>
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<td>0%</td>
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<td>Milk - Fat Free Skim</td>
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<td>0%</td>
<td>0</td>
<td>9</td>
<td>12</td>
<td>115</td>
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<tr>
<td>Milk - Fat Free Strawberry</td>
<td>130</td>
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<td>0</td>
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<td>0</td>
<td>8</td>
<td>23</td>
<td>100</td>
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<tr>
<td>Soy Milk, Vanilla (8 oz.)</td>
<td>140</td>
<td>3.0</td>
<td>15%</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>8</td>
<td>30</td>
<td>170</td>
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<td><strong>Condiments</strong></td>
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<tr>
<td>Ken's - Honey Mustard (1oz)</td>
<td>120</td>
<td>12.0</td>
<td>90%</td>
<td>2</td>
<td>15%</td>
<td>0</td>
<td>9</td>
<td>5</td>
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Official USDA Food Plans: Cost of Food at Home at Four Levels, U.S. Average, July 2014

<table>
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<tr>
<th>Age-gender groups</th>
<th>Weekly cost</th>
<th>Monthly cost</th>
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<tr>
<td></td>
<td>Thrifty plan</td>
<td>Low-cost plan</td>
</tr>
<tr>
<td><strong>Individuals³</strong></td>
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<tr>
<td><strong>Child:</strong></td>
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<tr>
<td>1 year</td>
<td>22.00</td>
<td>29.30</td>
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<tr>
<td>2-3 years</td>
<td>24.00</td>
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<td>4-5 years</td>
<td>25.30</td>
<td>31.70</td>
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<td>6-8 years</td>
<td>32.10</td>
<td>44.70</td>
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<tr>
<td>9-11 years</td>
<td>36.20</td>
<td>48.30</td>
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<tr>
<td><strong>Male (M):</strong></td>
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<td>12-13 years</td>
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<td>14-18 years</td>
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<td>19-50 years</td>
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<tr>
<td>51-70 years</td>
<td>39.50</td>
<td>52.70</td>
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<tr>
<td>71+ years</td>
<td>39.80</td>
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<td><strong>Female (F):</strong></td>
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<td>47.70</td>
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<tr>
<td>14-18 years</td>
<td>38.40</td>
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<tr>
<td>51-70 years</td>
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<td>47.30</td>
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<td>Age Group</td>
<td>Plan 1</td>
<td>Plan 2</td>
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<tr>
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<tr>
<td>71+ years</td>
<td>36.90</td>
<td>46.90</td>
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<tr>
<td>Family (M&amp;F)</td>
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<td>of 2:</td>
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<td>19-50 years</td>
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<td>Family of 4:</td>
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<tr>
<td>Couple (M&amp;F), 19-50 years and children</td>
<td>255.50</td>
<td>568.00</td>
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<tr>
<td>2-3 and 4-5 years</td>
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<tr>
<td>6-8 and 9-11 years</td>
<td>150.10</td>
<td>197.20</td>
</tr>
</tbody>
</table>

1The Food Plans represent a nutritious diet at four different cost levels. The nutritional bases of the Food Plans are the 1997-2005 Dietary Reference Intakes, 2005 Dietary Guidelines for Americans, and 2005 MyPyramid food intake recommendations. In addition to cost, differences among plans are in specific foods and quantities of foods. Another basis of the Food Plans is that all meals and snacks are prepared at home. For specific foods and quantities of foods in the Food Plans, see Thrifty Food Plan, 2006 (2007) and The Low-Cost, Moderate-Cost, and Liberal Food Plans, 2007 (2007). All four Food Plans are based on 2001-02 data and updated to current dollars by using the Consumer Price Index for specific food items.

2All costs are rounded to nearest 10 cents.

3The costs given are for individuals in 4-person families. For individuals in other size families, the following adjustments are suggested:

1-person—add 20 percent; 2-person—add 10 percent; 3-person—add 5 percent; 4-person—no adjustment; 5- or 6-person—subtract 5 percent; 7- (or more) person—subtract 10 percent. To calculate overall household food costs, (1) adjust food costs for each person in household and then (2) sum these adjusted food costs.

4Ten percent added for family size adjustment.

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