5-2018

Examining Food Insecurity Among High School Students: A Risks and Resources Model

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Examining Food Insecurity Among High School Students: A Risks and Resources Model

A thesis submitted in partial fulfillment
of the requirements for the degree of
Master of Arts in Sociology

by

Jill Niemeier
University of Arkansas
Bachelor of Arts in Sociology, 2016

May 2018
University of Arkansas

This thesis is approved for recommendation to the Graduate Council.

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Abstract

This study examined the relationships between food insecurity, risks, and resources among adolescents attending a large high school in Northwest Arkansas. In a sample of 1,493 students, in which the majority are Hispanic/Latino and receive free and reduced lunch, food insecurity relationships were first assessed controlling for a number of sociodemographic variables, such as ethnicity, gender, and social class. In addition, a number of risk and resource variables were identified at four ecological levels: individual, family, school/peer, and community. These risks and resources were analyzed using a three-step ordinal regression model in order to examine how sociodemographic controls, risks, and resources were related to food insecurity. Statistical analyses revealed that depression, household structure, student risk, and neighborhood risk all were positively associated with food insecurity, controlling for sociodemographic variables. In addition, self-esteem, eating meals with family, and peer social capital were all significantly associated with lower levels of food insecurity, but did not immediately impact the "effects" of the risk variables. Collectively, these findings tell an important story about adolescent food insecurity and the role that social and psychological circumstances play in determining varying levels of food insecurity. This study highlights that children and adolescents can be reliable respondents and spokespersons of their own experiences with food insecurity.

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INTRODUCTION

Food security is one of several essential conditions for maintaining a healthy population. The United States Department of Agriculture (USDA) defines food security as "access by all people at all times to enough food for an active, healthy life" (Coleman-Jensen et al., 2017). While a desired goal of any nation, more than one in six, or 13 million, children live in food insecure households in the United States (Coleman-Jensen et al., 2017). Although the USDA found that younger children were often protected by the negative effects of food insecurity, survey results with adult respondents are unclear as to how food insecurity impacts older children and adolescents. Additional research finds that there seem to be important differences in the ways that adults report their child's food insecurity compared to the ways in which children report their own food insecurity; adults are not always aware of their child's experiences regarding food insecurity (Fram et al., 2011; Harvey, 2016). Fram et al. (2011) found that children are aware of food insecurity and take responsibility and implement strategies to manage food resources independent of their parents. As such, first-hand reporting of food insecurity by youth remains a vital part of the general knowledge gap and in part, motivates the need to collect more extensive data directly from youth as survey respondents.

Adolescence is a period of transition from childhood to adulthood and many of the health and behavioral patterns formed in adolescence predict adult health (Sawyer et al., 2012; Spear, 2002). Research suggests that there are several negative consequences associated with food insecurity during adolescence, including obesity, poorer mental and physical health, and lower grades. A few studies concluded that food insecurity was positively associated with greater weight status and obesity and these correlations appear as early as 6 years old (Casey et al., 2006; Kaur, Lamb, and Ogden, 2015; Willis and Fitzpatrick, 2016). Shanafelt et al. (2016) found

that children self-reporting food insecurity also self-reported poorer physical health, less exercise, and lower grades. In addition to the physical health outcomes, studies also have indicated that food insecurity was associated with poorer mental health and increased likelihood of mental disorders (Burke et al., 2016; Lachance et al., 2014). Moreover, Willis and Fitzpatrick (2016) found that psychosocial factors, such as perceived social status and depression, can act as mediators to food insecurity and its association with negative health outcomes among adolescents. Although studies have found correlates between psychosocial factors and food insecurity as well as negative outcomes associated with food insecurity, there is no research targeted specifically at psychosocial risks and resources of food insecurity among adolescents.

This study aims to build upon and fill the current gap in literature regarding which specific social and behavioral factors, controlling for sociodemographic variables, are associated with increased risk for food insecurity and which factors are resources mitigating risk and acting as protective mechanisms against negative health outcomes. Understanding the risks and resources associated with adolescent food insecurity can help researchers and practitioners contextualize and address the issue from multiple levels. Thus, our central research questions are as follows:

1) Are risk factors at various ecological levels, such as individual, familial, peer, and community, associated with increased food insecurity?
2) Are resource factors at various ecological levels associated with decreased food insecurity? And do they mitigate the impact of risk factors on food insecurity?

We examine this issue utilizing survey data collected from nearly 1,500 students attending a large high school in Northwest Arkansas.

THEORY AND EVIDENCE

Health, Development, and Adolescent Food Insecurity

Adolescence is an important transitional life stage from childhood to adulthood in which the opportunities for health and future patterns of adult health are established (Sawyer et al., 2012). This is the only time in life where the growth rate is as rapid as that of early infancy (Spear, 2002). Food intake and diet quality are of particular importance to ensuring healthy growth and development. Increased velocity of growth associated with hormonal, physical, cognitive, and emotional changes during adolescence make this a nutritionally demanding and vulnerable time of life (Spear, 2002). It is also a period of heightened cognitive and psychosocial development. Brain maturation and development of cognitive abilities enable adolescents to use logical reasoning for decision-making processes (Steinberg et al., 2009). It is a time when individuals form personal and social identities and hone social skills. Personal identity is shaped not only by family, but also by friends and peers, teachers, and other role models. Successful identity development during adolescence depends on successfully interacting with one's environment—especially, among school, home, and community environments (Sturdevant and Spear, 2002). Since this is such a critical time for physical, cognitive, and social development and a period of time that health patterns are established, it is important to understand how adolescent health is affected by various ecological levels of influence.

Food insecurity has been linked to poor physical, social, and mental well-being and to a decreased quality of life in various U.S. sub-populations, including adolescents and young children (Rose and Bodor, 2006; Tarasuk, 2001). Documented physical health consequences of food insecurity in children include decreased nutrient intake, asthma, anemia, oral health problems, and poorer general health (Kirkpatrick et al., 2010; Eicher-Miller et al., 2009;

Muirhead et al., 2009). Documented social and mental health issues include cognitive problems, higher levels of aggression, higher levels of anxiety, dysthymia, behavioral problems, and lower academic performance (Howard, 2011; Jyoti, Frongillo, and Jones, 2005; Alaimo, Olson, and Frongillo, 2001). The plethora of negative health consequences associated with food insecurity combined with the vulnerable period of adolescence ascertains the necessity to highlight this issue.

Risks and Resources Model

The current study utilizes a risk and resource framework to examine factors that have been documented or are hypothesized as important determinants for food insecurity among adolescents, while recognizing the importance of the intermingled environments of home, school, community, etc. The risks and resources model places importance on the relationships among risks that negatively affect health and the social and psychological resources that potentially mitigate the impact of those risks (Fitzpatrick & LaGory 2011). Through the risk and resources model, our goal is to identify individual and social risks for food insecurity and the social and psychological resources that might help to mitigate these risks. We conceptualize resources as not simply the inverse of risks, but qualitatively unique in their ability to adapt to risk (Fitzpatrick, Piko, & Wright, 2005). Risks and resources come together to shape the lives and health of individuals to make them more vulnerable or shielded from adverse health effects.

One aspect of risks and resources is their multidimensional character. Urie Bronfenbrenner's (1979) ecological model provides a useful foundation for conceptualizing how various sociodemographic and social risks/resources influence adolescent food insecurity. Bronfenbrenner's model posits that the ecological environment exists along several concentric circles of influence—micro, meso, exo, and macrosystems—nested within one another. These

circles of influence emphasize the interconnectedness between a developing individual and the micro and macro environment in which they are situated (DiClemente, Salazar, and Crosby, 2013). Bronfenbrenner's model (1979) lends itself to health models that help us better understand the way in which multiple levels of influence affect individual health behaviors. A risk and resource model is a direct by-product of this work that can help to pinpoint the influence of risks and resources on health outcomes across individuals, families, schools, and communities. Positive health outcomes are constrained and enabled not only by individual behaviors, but by family, schools, peers, neighborhoods, and other social structures (Fitzpatrick & LaGory, 2011).

The multilevel nature of adolescent physical and psychosocial development certainly justifies the usefulness of an ecological risk and resource model for studying food insecurity among adolescents. The current study examines risks and resources at four unique levels of measurement: individual, family, school/peer, and community. Since adolescence is a time where future health behavior patterns emerge, adolescents are crucial targets for health interventions. Utilizing a combination of a risks and resources model and an ecological model should provide a well-rounded understanding of the risks and resources related to food insecurity among adolescents, which can help us better understand how to improve these outcomes on a number of different levels.

Risks

Identifying potential risks for food insecurity at various ecological levels will help us develop a clearer understanding of the issue and how we might begin to develop concrete solutions to address it. In order to examine risks for food insecurity, we will use an approach beginning with individual-level factors reaching community level factors. The first level of analysis is individual risks. We examine two individual-level risk factors, depressive symptoms

and BMI, due to the amount of research that points to both of these as individual correlates to food insecurity. McLaughlin and colleagues (2012) utilized a national survey of adolescents 13-17 years of age and found that food insecurity is associated with a wide range of mental disorders, including depression, independent of other socioeconomic factors. Many studies mimic that food insecurity is linked to mental health disorders and/or symptomology among adolescents (Burke et al. 2016; Chung et al., 2016; Willis & Fitzpatrick, 2016). *We would expect to find a similar relationship in our data with higher depressive symptomatology related to higher levels of food insecurity among adolescents.*

Weight status, overweight and obesity, is often associated with food insecurity (Barriuso et al., 2015; Scheier, 2005), particularly among adults and women (Franklin et al. 2012; Larson & Story, 2011; Casey et al., 2006; Alaimo, Olson, & Frongillo, 2001). This has been explained by positing that individuals experiencing food insecurity rely on less expensive, calorie-dense, less nutritious foods (Kendall, Olson, & Frongillo, 1996). However, studies that have examined the correlation between overweight and obesity in adolescents and food insecurity present mixed results—positive, negative, and null (Eisenmann et al., 2011). Why does it appear in some samples or populations and not others? This lack of clarity is why this particular risk factor was selected for analysis in the current study. *We hypothesize that as a risk variable, higher BMI levels will be associated with increased food insecurity.*

The second level analysis is the family. Single-parent households are more likely to be food insecure than households with two parents, and female-headed households are more at risk for food insecurity than those headed by men (Coleman-Jensen et al., 2017). Balistreri (2017) found that child food insecurity was more likely among single mother households than married biological or married stepfamilies and that marriage has a protective effect beyond economic

resources. Thus, we examine whether or not lack of family intactness, or lack of a two-parent household are risk factors for adolescents *and expect that less intact households, will report higher levels of food insecurity.*

Our third level risk is school. Schools are where children spend 8 hours of their day, 5 days a week, determining their future educational and economic outcomes. However, all educational experiences are not equal and health disparities appear to be related to educational inequality (CDC, 2015). Academic performance and behavioral issues have both been found to be related to food insecurity (Shankar, Chung, & Frank, 2017). One longitudinal study found that increased food insecurity was predictive of a decrease in academic performance and an increase in negative behavioral issues (Jyoti, Frongillo, & Jones, 2005). Thus, it is important to understand how schools may act as a potential risk environment in determining levels of food insecurity among adolescents. *We expect that increased student risk will be positively associated with higher levels of food insecurity.*

Finally, at the community-level, there are several risks that may constrain or enables one's ability to adequately access nutritious food. Social and economic features and the inequality of neighborhoods have been linked with general health status (Pickett & Pearl, 2001). There are key resources missing as a result of place-based inequalities that may contribute to food insecurity, such as fewer organizational resources, inadequate transportation options and lack of retail investment (Dinwiddie et al., 2014; Sharkey, 2013; Hipp 2007; Small and McDermott, 2006). Also, high-crime neighborhoods are likely to have fewer grocery stores and a higher prevalence of fast food, liquor, and convenience stores making fresh produce and nutritionally-dense food harder to access (Larson, Story, & Nelson, 2009). *As such, we expect that the more unsafe an individual's neighborhood, the more food insecure they will be*.

Resources

Health is not only constrained by multiple levels of a person's environment; it is also enabled by it. First, we will examine an individual resource, self-esteem. Positive self-concepts and social supports can lessen the negative impact of certain social factors (Fitzpatrick & Willis, 2017). High self-esteem, for example, indicates a positive self-concept that can protect against significant life stressors (Pearlin et al. 1981). High self-esteem has been linked to positive mental and physical health outcomes (Dielman et al., 1987; Fitzpatrick & Willis, 2017; Mann et al., 2004). *We anticipate that higher levels of self-esteem will be related to lower levels of food insecurity*.

Second, the family will be examined as a social resource to mitigate food insecurity. A child's social life is shaped by his or her family. Bonds between parents and children promote children's development and social adjustment (Parcel & Bixby, 2015). *Thus, we would expect that adolescents who exhibit tighter bonds with their families will report lower levels of food insecurity.* Third, we will examine a peer level resource, social capital. In a study of 5^{th}-7^{th} grade students, Willis and Fitzpatrick (2017) found that increased familial social capital was associated with lower food insecurity among adolescents. Similarly, the quality of peer and community social ties can be important for health outcomes. Willis and Fitzpatrick (2017) found that while the number of close friends that an adolescent has is not associated with food insecurity outcomes, the quality of those friendships, such as time spent together and meals shared, *as such we would expect that adolescents reporting higher levels of peer social capital will report less food insecurity.*

Finally, at the community level, how connected an individual feels to their community may act a positive health resource to mitigate food insecurity. Bernat and Resnick (2009) posit

that the connections that young people have to adults in their communities a key determinant to achieving good health in adolescence. Additionally, Dean and Sharkey (2011) found that collective social functioning correlates with food insecurity. For example, being able to borrow a car, or to carpool with a neighbor, is an important resource for some rural residents who may live great distances from their nearest grocer. *Finally, we expect that if a person perceives closer connectedness to their community, they will report lower levels of food insecurity.*

DATA AND METHODS

Sample

This study is based on data collected in Fall 2015 from a sample (n=1493) of 10^{th}-12^{th} grade students attending a high school in Northwest Arkansas (Fitzpatrick and Collier, 2016). The sampling frame for the survey included all 10^{th}-12^{th} grade students enrolled at in high school in a Northwest Arkansas school district. The number of enrolled students at the time was 2,148. Ten classrooms (116 students) were unable to participate at the time of the survey, which shifted the eligibility number to 2,032. Of the 2,032 eligible students, approximately 22 percent refused to participate and 105 students were absent from school yielding a response rate of approximately 78 percent and a sample size of 1,493. The final sample was composed of 53 percent Hispanic/Latino and 14 percent Marshallese students. We believe this sample to be representative of the Springdale school district, where Hispanic/Latino and Marshallese are the most prominent minority groups. 68 percent of the sample reported that they received free and reduced lunch, this is consistent with the Arkansas Department of Education's most recent data that 68 percent of the school district receive free and reduced lunch (Fitzpatrick and Collier, 2016).

Measurement

We assessed a wide range of student needs and behaviors, including physical health, mental health, eating and exercise behaviors, food security, and social activities. All 10^{th}-12^{th} graders in the school were eligible to complete the survey, administered by their teachers, as long as their classroom participated. Teachers distributed the questionnaire and were asked to limit their involvement during the administration of the survey. Spanish versions of the survey were provided to all students upon request. Students were asked questions about their demographics, household/family structure, social class, friendships, health behaviors, risk behaviors, food security, and physical and mental well-being.

Food Insecurity

Food insecurity is the dependent variable in this analysis and is measured using a metric drawing from the USDA food insecurity module. Connell et al. (2004) used cognitive interviewing methods to develop a module for assessing food insecurity through adolescent self-reporting. Five items from the original USDA food security module were deemed appropriate for a modified adolescent survey. Students were asked the following questions (using the time frame "in the past year): 1) Did you worry that food at home would run out before your family got money to buy more; 2) Did the food that your family bought run out and you didn't have money to get more; 3) How often were you not able to eat a balanced meal because your family didn't have enough money to buy food; 4) Did your meals include a few kinds of cheap foods because your family was running out of money to buy food; 5) Have your meals been smaller because your family didn't have enough money to buy food?

Students responses to the questions included "never," "sometimes," and "a lot." These items were coded from 0 to 2 in the order listed, beginning with "never" coded as 0. The original

scale was reliable (Cronbach's alpha = .88; Mean = 1.62; S.D. = 2.23). This scale was recoded into an ordinal variable using the following categories: no food insecurity, low food insecurity, moderate food insecurity, and high food insecurity. Based on self-reported measures regarding food insecurity, 20 percent of the sample reported moderate food insecurity and 7 percent reported high food insecurity.

Sociodemographic Variables

A number of sociodemographic variables were introduced as standard controls that have been used in studies examining the relationship between risks, resources, and food insecurity (Willis and Fitzpatrick, 2017). Sociodemographic variables were chosen based on previous evidence as well as by their relevancy to our particular sample. These variables included gender, ethnicity, immigrant status and social class. Gender is coded as female = 1; ethnicity is coded as Hispanic/Latino = 1. Fifty-three percent of our sample is Hispanic or Latino. Immigrant status was determined via proxy of whether or not one's parents were born in the United States; parents not born in the U.S. = 1. 864 students answered that their parents were not born in the U.S and of these, 72 percent were Hispanic or Latino and 22 percent were Marshallese while the remaining percent reported some other ethnicity. Finally, social class was examined using a proxy of free and reduced lunch; receiving free and reduced lunch = 1. Sixty-eight percent reported their lunch was paid for by the free and reduced lunch program, which matches closely the statistics reported for the school district, suggesting that poverty in our sample is similar to that found in the larger school district.

Risk Variables

Weight Status. Due to the prevalence of literature regarding the connection between weight status and food insecurity, a measure of weight status was included as a potential risk

factor for food insecurity. Weight status is measured using BMI calculations based on students' self-reported height and weight. Since much of the literature indicates that there is a relationship among overweight and/or obese with food insecurity, a dichotomous variable was used for analysis. This variable is coded as overweight/obese = 1. Thirty-seven percent of the students are classified as overweight or obese in the sample.

Depression. A measure of depressive symptomatology was included as a potential risk for food insecurity. This variable was measured with a shortened version of the 20-item Center for Epidemiological Studies for Depression (CES-D) Scale which has been used extensively to measure depressive symptoms in adolescents (Radloff, 1977). For our purposes, eight items from the CES-D scale were used to assess depressive symptomatology in our sample of high school students. The scale was reliable (Cronbach's alpha = .92; Mean = 19.59; S.D. = 15.84).

Students were asked how often over the past couple weeks they had felt sad, lonely, worrisome, or had trouble sleeping, getting up in the morning, etc. Possible responses ranged from 0 (Less than one day) to 3 (five to seven days) for each item. The shortened CES-D scale used here was weighted by 2.5 (the number of items in the original measure divided by the number of items in our shortened measure) for comparison with studies using the full 20-item questionnaire.

Household Structure. According to the USDA, food insecurity is highest among households with children. However, among households with children, those headed by a married couple showed lower rates of food insecurity (Coleman-Jensen et al., 2017). The instrument did not ask about the marital status of parents, instead it asked about the composition of households so that we can understand how this might influence food insecurity. Students were asked, "Who do you live with most of the time?" Possible responses included; both parents, one parent and

step parent, mother, father, brother or sister, grandparents, aunt or uncle, and other. These responses were coded from 1 to 8 in the order I just listed, starting with both parents as 1. The variable was recoded with 0 = both parents; 1 = one parent; 2 = no parents present so that the variable could be analyzed as a risk factor for food insecurity.

Student Risk. A student risk scale was utilized in this analysis to represent a category of social stressors that may impact a student's well-being. A scale for student risk was constructed and consisted of four items asking students how many times, in the past month, they had: 1) Been to the principal's office; 2) Cut or skipped school without an excuse; 3) Been in a physical fight; and 4) Been threatened by someone. Students could choose from five possible responses ranging from None = 0 to Six or More times = 4. The scale was moderately reliable (Cronbach's alpha = .60; Mean = 2.44; S.D. = 2.77).

Neighborhood Risk. We are examining perceptions of neighborhood safety as a risk for food insecurity. The neighborhood safety scale is a scale that ranges from 3 to 15 with 3 being the safest and 15 being the least safe. The scale is based off of three Likert-scale measures of perceptions of neighborhood safety.

Students were asked how much the agreed or disagreed with the following statements: "I feel safe in the area where I live," "I think the area I live is a good place to live," and "It is safe for younger children to play outside during the day." The scale was reliable (Cronbach's alpha = .89; Mean = 6.04; S.D. = 2.73).

Resource Variables

Self-esteem. In this study, self-esteem is included as a potential individual-level resource to mitigate food insecurity. We used a shortened version of Rosenberg's 10-item self-esteem index to measure how students perceive themselves in general and in contrast with their peers

(Rosenberg, 1986). The five items we use include; 1) I feel that I am a person of worth, at least on an equal plane with others; 2) I feel that I have a number of good qualities; 3) I am able to do things as well as most other people; 4) I take a positive attitude toward myself; and 5) On the whole, I am satisfied with myself. Possible responses ranged from Strongly Agree = 4 to Strongly Disagree = 1. The scale was reliable (Cronbach's alpha = .87; Mean = 10.36; S.D. = 2.98).

Meals at Home. In this model we included a measure related to how often students ate meals at home with their families. Following the prompt, "Thinking about the places you usually eat," students were asked eight questions pertaining to where and with whom they eat their meals. This index was then coded into two variables, one for frequency of meals eaten at home, and the other for frequency of meals eaten out. The scale of meals eaten at home ranged from 0 to 16.

Peer Social Capital. A social capital index is included to measure social capital among students' peers as a potential resource. This variable focuses on connections that students have with peers and the quality of those connections. Four variables assessing social relationships/ friendships among students make up the index variable of social capital: Number of close friends; Has best friend; How often did they see their best friend; How often did they have other types of contact with their best friend?

Student responses for the first question were a numeric value. Responses to the second question was no = 0 and yes = 1. Possible responses for last two questions included; never or hardly ever, several times a year, at least once a month, once a week, several times a week, every day, and he/she lives with me. These responses were coded from 1 to 7 in the order they have

been presented beginning with never or hardly ever, coded as 1, and ending with he/she lives with me, coded as 7. This left us with a social capital scale ranging from 3 to 19.

Community Connectedness. Community connectedness was introduced as a potential community-level resource. Community connectedness is measured using a one-item pictorial scale based on the Psychological Sense of Community measure and the Inclusion of Others in the Self scale (McMillan & Chaves, 1986; Aron & Aron, 1986). Students were shown six images of overlapping circles and asked to select the image that best represents his or her relationship with the community, as shown in Figure 1. The circles with no overlap represent the lowest sense of inclusion, and the circles with the most overlap represent a high sense of inclusion with the community.

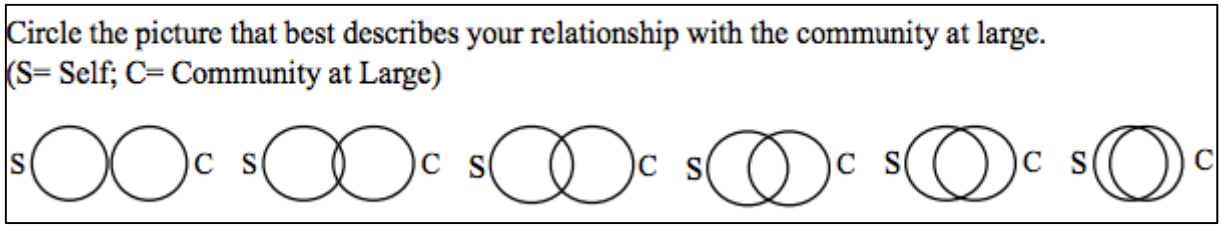

Figure 1. Inclusion of Community in the Self Scale

This variable is coded on a scale from 1 to 6 with 1 being the least connected and 6 being the most.

Analytic Strategy

The analysis for the current study begins with an exploration of descriptive statistics and bivariate correlations. This preliminary analysis provides us with basic information regarding the variables examined in the model and correlations between them. Following this, ordinal regression is used to test the sociodemographic variables, the risk variables, and the resource variables. The ordinal regression is performed using the PLUM (Polytomous Universal Model)

procedure. This type of regression analysis is used for predicting an ordinal variable, such as our categorical food insecurity variable.

RESULTS

Descriptive Statistics

As shown in Table 1, nearly three quarters of the sample report having no or low food insecurity. This leaves approximately 27 percent of the sample that would be classified as food insecure—20 percent with moderate food insecurity and 7 percent with high food insecurity. The sample is approximately 54 percent female and is comprised of 53 percent Hispanic/Latino students, which is representative of the Springdale, Arkansas population. Fifty-eight percent of the students' parents were not born in the United States; more than two-thirds of students in the sample received free and reduced lunch, which again was representative of the entire school district.

The dichotomous weight status variable indicates that 37 percent of the students in the sample were reporting being overweight or obese. Students in this study scored an average of 19.59 on the CES-D scale which is indicative of a high rate of meeting clinical diagnosis criteria. The household structure frequency indicated that the majority of the sample live in two-parent households, with 69 percent reporting both parents at home. Twenty-four percent of the sample lived in one-parent households and 7 percent lived in a household with neither parents present. Self-reported student risk was relatively low with an average score of 2.44 and a standard deviation of 2.77 on a scale of 0 to 20. Self-reported neighborhood risk has an average score of 6.04 with a standard deviation of 2.73 on a scale of 3 to 15.

Table 1. Descriptive Statistics for Model Variables (n=1493)			
	%	**Mean**	**S.D**
Dependent Variable			
Food Insecurity			
No Food Insecurity	50.3%	--	--
Low Food Insecurity	22.1%	--	--
Moderate Food Insecurity	20.1%	--	--
High Food Insecurity	7.0%	--	--
Sociodemographics			
Gender (1=Female)	53.9%	--	--
Ethnicity (1=Hispanic)	52.8%	--	--
Parents Birthplace (1=Not Born in U.S.)	57.9%	--	--
Free and Reduced Lunch (1=Receiving)	68.4%	--	--
Risks			
Weight Status (1=Overweight)	37.0%	--	--
CES-Depression Scale (0-60)	--	19.59	15.84
Household Structure (0-2)	--	.380	.614
Student Risk (0-20)	--	2.44	2.77
Neighborhood Risk (3-15)	--	6.04	2.73
Resources			
Self Esteem (0-15)	--	10.36	2.98
Meals at Home (0-16)	--	7.89	2.78
Peer Social Capital (3-19)	--	13.09	2.34
Community Connectedness (1-6)	--	2.89	1.33

On our 15-point self-esteem scaled, based on Rosenberg's model, students in the sample scored an average of 10.36 on the self-esteem scale with a standard deviation of 2.98. When asked how many meals students ate at home versus a restaurant or convenience store, students responded, on average, with 7.89 on a 16-point scale indicating that a typical student eats fewer than half of all meals at home with family or friends. The average distance of any score from the mean meals eaten at home was 2.78. The peer social capital variable is meant to capture the

quality of students' relationships with peers. Within the computed scale ranging from 3 to 19, students averaged a social capital score of 13.09 with a standard deviation from the mean of 2.34. The average self-reported community connectedness score, or how close one feels their relationship to the community is, was moderate with 2.89 and a standard deviation of 1.33 on a scale of 1 to 6.

Bivariate Relationships

Correlations between variables in the ordinal regression model, including our dependent variable, sociodemographic control variables, risk variables, and resource variables, can be seen in Table 2. All of our control and independent variables are significantly correlated with our dependent variable, food insecurity. Gender and ethnicity are negatively correlated with food insecurity indicating that in this sample, boys and individuals that are not of Hispanic descent are more likely to be food insecure. The parents born outside of the United States and students who reported being on free and reduced lunch were both positively associated with food insecurity. As expected, all the risk variables were positively associated with food insecurity and all resource variables were negatively associated with food insecurity.

Table 2. Bivariate Correlations among Model Variables (n=1493)

		1	2	3	4	5	6	7	8	9	10	11	12	13
Dependent Variable														
1.	Food Insecurity													
Demographics														
2.	Gender	-.057*												
3.	Ethnicity	-.082**	.025											
4.	Parents Birthplace	.065**	.017	.464**										
5.	Free and Reduced Lunch	.210**	-.003	.281**	.383**									
Risks														
6.	Weight Status	.062**	-.071**	-.017	-.004	.008								
7.	CES-Depression	.194**	.268**	-.058*	-.080**	-.038	-.022							
8.	Household Structure	.132**	.002	-.082**	-.036	.076**	.031	.050*						
9.	Student Risk	.182**	-.032	-.073**	-.063**	.005	.034	.205**	.129**					
10.	Neighborhood Risk	.239**	.056*	.013	.073**	.108**	-.013	.122**	.073**	.086**				
Resources														
11.	Self Esteem	-.166**	-.143**	-.008	.024	-.021	-.046*	-.412**	-.056*	-.125**	-.264**			
12.	Meals at Home	-.120**	-.024	-.047*	.033	.067**	-.086**	-.144**	-.054*	-.003	-.072**	.146**		
13.	Peer Social Capital	-.085**	-.055*	-.021	-.024	-.018	-.014	-.093**	-.021	.010	-.030	.115**	.135**	
14.	Community Connectedness	-.085**	-.055*	-.050*	.053*	.023	-.013	-.243**	-.035	-.061**	-.178**	.312**	.199**	.118**

p <.05*, p <.01** (One-tail t-test)

Multivariate Relationships

Table 3 presents the results of an ordinal regression model, using the same variables analyzed in the correlations table above. For our analysis, we used ordinal regression with a link function of negative log-log, –ln(–ln(γ)), since lower categories are more probable in our food insecurity variable (no and low food insecurity account for nearly three-quarters of sample). In Table 3, 'b' represents the log of odds estimate and 'exp b', or exponent b, is the odds ratio, which was calculated using e^x. The Nagelkerke R^2 ($R^2_N = \frac{R^2_{CS}}{1-L(B^{(0)})^{2/n}}$) is an R^2-like statistic to measure the strength of association. It is used, in our model, primarily to display the change in association from model to model.

Model 1 includes only the sociodemographic controls, assessing the role of gender, ethnicity, place of parents' birth, and social class in predicting food insecurity. All of the demographic controls in this model were dichotomous variables coded (0, 1) and 1 is the reference category for analysis. In this model, sex has a positive relationship with food insecurity and is significant ($p < .01$). Ethnicity had a positive relationship with food insecurity and was significant ($p < .01$). Parents birthplace had a negative relationship with food insecurity and was significant ($p < .05$). Free and reduced lunch had a negative relationship with food insecurity and was also significant ($p < .01$). The Nagelkerke R^2 for this model was .095.

In Model 2, the risk variables were added to examine the association of weight status, depression, student risk, and neighborhood risk with food insecurity. All of the risk variables except for weight status were positively associated with food insecurity and significant ($p < .01$). The demographic variables remained significant with little change. The Nagelkerke R^2 for this model increased significantly to .202.

In Model 3, the resource variables were added to examine the influence of self-esteem, meals at home, peer social capital, and community connectedness on food insecurity. All of the predictive variables except community connectedness were significantly and negatively associated with food insecurity. Self-esteem and peer social capital were significant ($p < .05$); meals at home was also significant ($p < .01$). None of the demographic or risk variables changed in significance or direction from Model 2 to Model 3. The Nagelkerke R^2 for the final model was .221.

Overall, our model indicates that boys, non-Hispanics, students whose parents were not born in the United States, and students receiving free and reduced lunch were more likely to be food insecure, even after controlling for both risks and resources. CES-Depression, household structure, student risk, and neighborhood risk all act as significant risk factors related to higher levels of food insecurity. Self-esteem, meals at home, and peer social capital were all negatively related to food insecurity and were related to lower levels of, food insecurity. Although the resources are associated with a significant decrease in food insecurity, they do not appear to mediate the risks associated with food insecurity.

Table 3. Food Insecurity Ordinal Regressions (n=1493)

Variables	**Model 1**		**Model 2**		**Model 3**	
	b (exp b)	95% CI	b (exp b)	95% CI	b (exp b)	95% CI
Demographics						
Gender (1=Female)	.192 (1.21)**	.046 to .338	.389 (1.48)**	.227 to .551	.316 (1.37)**	.137 to .495
Ethnicity (1=Hispanic)	.590 (1.80)**	.426 to .754	.583 (1.79)**	.407 to .759	.613 (1.85)**	.418 to .809
Parents Birthplace (1=Not born in US)	-.220 (.803)*	-.394 to -.047	-.320 (.726)**	-.505 to -.135	-.325 (.723)**	-.530 to -.121
Free and Reduced Lunch (1=Receiving)	-.854 (.426)**	-1.05 to -.661	-.806 (.447)**	-1.01 to -.606	-.861 (.423)**	-1.08 to -.638
Risks						
Weight Status (1=Overweight)			-.126 (.882)	-.282 to .030	-.088 (.916)	-.261 to .085
CES-Depression			.018 (1.02)**	.013 to .023	.014 (1.01)**	.008 to .020
Household Structure			.194 (1.21)**	.075 to .313	.184 (1.20)**	.052 to .316
Student Risk			.040 (1.04)**	.013 to .067	.042 (1.04)**	.011 to .073
Neighborhood Risk			.099 (1.10)**	.071 to .126	.098 (1.10)**	.067 to .129
Resources						
Self Esteem					-.033 (.968)*	-.066 to .000
Meals at Home					-.044 (.957)**	-.076 to -.012
Peer Social Capital					-.038 (.963)*	-.073 to -.003
Community Connectedness					.011 (1.01)	-.057 to .079
Degrees of Freedom	4		9		13	
Nagelkerke R^2	.095		.202***		.221***	

p <.05*, p <.01**, p <.001*** (R^2-Change)

DISCUSSION AND CONCLUSION

Discussion

Our findings clearly showed that food insecurity is affected by a number of factors at various levels of influence, including individual, family, peer, school, and community. We found that social location and environmental circumstances were key factors influencing adolescents' risk for food insecurity in the sample. By using a risk and resource ecological model, we were able to test and identify significant influences of food insecurity at every ecological level examined, even after controlling for important sociodemographic characteristics.

Although not directly part of our research question, we found that food insecurity differed among various sociodemographic groups, including social class, gender, ethnicity, and immigrants. Some of the results regarding the sociodemographic variables were interesting and worth noting. With respect to gender, we found that boys in the sample were more likely to be food insecure than their female counterparts and that gender was an important factor related to food insecurity even after the risk variables were added. This is opposite to the majority of research on food insecurity in adult men and women. However, this finding is similar to the recent study where teenage boys were reported to be more food insecure than teenage girls (Popkin, Scott, and Galvez, 2016). This may be a function, in part, of the fact that teenage boys' physical need for more micro and macronutrients is much higher than their female counterparts, thus increasing their self-reported food insecurity (Spear, 2002). This may be due to various social factors as well, such as older boys feeling to act as the "man of the family" and make sacrifices for the younger or female siblings. More research should be done in order to better understand the gender differences in food insecurity among adolescents.

Another interesting result was that non-Hispanics were significantly more likely to report being food insecure than Hispanics or Latinos. Since nationally-representative studies have found that Hispanic-headed households are more likely to be food insecure than their non-Hispanic counterparts, this may be a result of our unique, Hispanic-majority sample (Coleman-Jensen et al., 2017). This also may be a reflection of the protective influence of community and comradery that can occur among marginalized populations. Additionally, this sample is unique in the fact that roughly 14 percent of the non-Hispanic students in the sample are Pacific Islander Marshallese, which could be accounting, in part, for this non-Hispanic "effect."

In regards to the research questions, our first asked whether or not our risk variables were associated with increased food insecurity. All risk variables were associated with increased food insecurity except weight status. Our other individual-level risk variable, depression, however, did impact food insecurity in that those who were reporting more depressive symptoms were also more likely to be food insecure. Of course, we are unable to determine causal order, but it is clear that the two variables were related and depressive symptoms may be a psychological predictor of food insecurity. Our social risk factors, household structure, student risk, and neighborhood risk, also had a significant relationship to food insecurity. These relationships may be indicating that an adolescent's social environment can exacerbate food insecurity at multiple levels, independent of other sociodemographic variables. The family, school, and community level variables were significant and, judging by the over 10 percent increase in our pseudo R^2 value, the risks in our model explain a bulk of the variation in food insecurity between the groups.

Although our resource factors did not act as moderators or mediators, we did find that they were related to lower levels of food insecurity. Our individual-level variable, self-esteem,

was related to lower food insecurity, such that students reporting higher self-esteem were found to be less food insecure. Our family and peer level variables, more meals at home and increased peer social capital, were also related to lower levels of food insecurity. The smaller increase in our pseudo R^2 value from Model 2 to Model 3 (compared to the increase from Model 1 to Model 2) indicated that the resource variables had less predictive value for food insecurity than the risk variables.

Conclusions

Our findings support the notion that socio-ecological factors are linked to adolescent health. Adolescence is a period of transition from childhood to adulthood and many of the health and behavioral patterns formed in adolescence predict adult health (Sawyer et al., 2012; Spear, 2002). This study supports the idea that adolescents, more than any other time in their lives, become more influenced by their social environments outside of just their families alone. Their schools, peers, and communities are crucial to their individual health. Food insecurity at any stage of life is problematic, but the rapid development of the body, brain, and social identity that occur during adolescence making this a particularly vulnerable stage of life to experience food insecurity. This study fills a gap in the literature by gathering a more holistic, socio-ecological view of adolescent food insecurity and its risks and resources, and could prove to be useful when examining how best to address possible solutions to the problem.

This study supports the use of a risk and resource model to examine food insecurity. Our model utilized risks and resources on multiple levels, including individual, family, school, peer, and community. These risk and resource variables had significant impacts on food insecurity independent of sociodemographic characteristics, such as poverty and ethnicity. Although factors like poverty and ethnicity played an important role in determining differences in levels of food

insecurity in this sample, we found that food insecurity could be exacerbated or dampened via certain risk and/or resource factors. Utilizing the risk and resource model at various socio-ecological levels support the notion that positive health outcomes are constrained and enabled not only by individual behaviors, but also by important social contexts like the family, schools, peers, neighborhoods, and other social structures (Fitzpatrick & LaGory, 2011).

Limitations and Future Research

This study has linked various risk and resource variables to food insecurity. However, causal order is unclear. There is substantive reasoning to support the notion that psychosocial risks and resources affect one's health, but it is also reasonable to suggest that health influences one's psychosocial outcomes as well. Particularly among the individual-level variables, CES-Depression and self-esteem, we can understand how these factors may be impacted by food insecurity. Our data are cross-sectional, which means that we are unable to determine causal order of the specified relationships. These findings, regardless, provide significant support for the importance of examining risks and resources in examining varying levels of food insecurity.

Additionally, this study has successfully called into question the role of parents as spokespersons for the experiences of children. Our findings show that high school adolescents are capable of answering self-administered surveys. Treating children and adolescents as intelligent, observant participants, rather than passive objects, in their own social world may yield more accurate accounts of their own experiences with food insecurity and/or health inequality generally (Fram et al. 2011). In order to intervene or attempt to alleviate food insecurity, we should continue to provide children and adolescents a voice by asking them directly about their own experiences. Future research should focus further on how children

conceptualize their own food insecurity, how this differs from their parents' narratives, and ways to address food insecurity from their perspective.

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