



Examining food insecurity among high school students: A risks and resources model

Jill Niemeier, Kevin M. Fitzpatrick*

Department of Sociology and Criminology, University of Arkansas, USA

ARTICLE INFO

Keywords:

Food insecurity
Adolescence
High school
Risks and resources

ABSTRACT

Food insecurity is associated with several negative health outcomes, many of which can be detrimental to youth during the vulnerable life stage of adolescence. Among a sample of 1493 high school students, the current study utilizes a risks and resources model to examine ways that risks and resources come together to shape the lives and health of youth, making them more vulnerable or shielding them from food insecurity and its related negative health outcomes. A number of factors are proposed as important correlates of food insecurity measured at four perceived levels of aggregation: individual, family, school/peer, and community. These risks and resources are analyzed using a three-step ordinal regression model. Analyses reveal depression, intact family, student risk, and neighborhood risk are positively related to food insecurity, despite significant sociodemographic differences. In addition, self-esteem, eating meals with family, and peer social capital are all significant and negatively related to food insecurity. Collectively, these findings tell an important story about adolescent food insecurity and the relationships that social and psychological circumstances have with varying levels of food insecurity. This study highlights the importance of children and adolescents as reliable respondents and spokespersons of their own experiences with food insecurity.

1. Introduction

Food security is one of several necessary 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, Rabbitt, Gregory, & Singh, 2017). While a desired goal of any nation, currently 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 are often buffered from the negative effects of food insecurity through some effort on their parent's part, survey results with adult respondents, as informants, remain unclear as to how food insecurity might be directly impacting older children and adolescents. Additional research finds important differences regarding the way that adults report their child's food insecurity compared to children's report of their own food insecurity; adults are not always aware of their child's experiences regarding food insecurity and hunger (Fram et al., 2011; Harvey, 2016). Fram et al. (2011) found that children are aware of food insecurity and often 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.

We know that adolescence is an important period of transition from childhood to adulthood and many of the health and behavioral patterns formed during adolescence are replicated and can often become reliable predictors of adult health (Sawyer et al., 2012; Spear, 2002). Research suggests several negative consequences associated with food insecurity during adolescence, including over-eating and obesity, poorer mental and physical health, and lower academic performance. Although studies have found correlates between psychosocial factors and food insecurity as well as negative health outcomes associated with food insecurity, there is no comprehensive body of research targeting any understanding of the role that psychosocial risks and resources play or are correlated with varying levels of food insecurity among adolescents. As a result, this study aims to fill the current gap in a literature regarding which specific social and behavioral factors, controlling for sociodemographic variables, are associated with varying levels of food insecurity. Additionally, we further ask what resources, if any, mediate or moderate these negative risks and potentially act as protective mechanisms against higher levels of food insecurity.

* Corresponding author.

E-mail address: kfitzpa@uark.edu (K.M. Fitzpatrick).

1.1. A risks and resources model

The current study utilizes a risk and resource framework to examine a set of factors that have been documented or hypothesized, a priori, as important correlates of food insecurity among adolescents, while recognizing the importance of the intermingled social environments of home, school, community, etc. as varying levels of aggregation at which these risks and resources can be found. The risks and resources model places importance on the relationships among risks that negatively impact health and the social and psychological resources that potentially mitigate those negative risks (Fitzpatrick & LaGory, 2011). 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 in a way to make them more vulnerable or shielded from adverse health effects.

The multilevel nature of adolescent physical and psychosocial development certainly justifies the usefulness of a multi-level risk and resource model for studying food insecurity among adolescents. The current study examines risks and resources at four unique levels of perception as self-reported by adolescents: individual, family, school/peer, and community. Since adolescence is a time where future health behavior patterns emerge, adolescents are crucial targets for health interventions. How risk or support is perceived at these varying levels may be important toward the systematic development of programming and targeted intervention strategies that help to minimize risk or bolster resources that might not occur equally across all four levels of aggregation.

1.2. Risks

In order to examine risks for food insecurity, we assess a breadth of factors from individual to community level. The first two individual-level risk factors are depressive symptomatology and self-reported BMI. McLaughlin et al. (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 have found that food insecurity is linked to mental health disorders and/or symptomatology among adolescents (Burke, Martini, Cayir, Hartline-Grafton, & Mead, 2016; Chung, Kim, Cho, Lee, & Shin, 2016; Willis & Fitzpatrick, 2016). Thus, we would expect to find a similar relationship in our data with depressive symptomatology positively related to food insecurity among adolescents.

Weight status, overweight and obesity, is often associated with food insecurity (Barruso et al., 2015; Scheier, 2005), particularly among adults and women (Alaimo, Olson, & Frongillo, 2001; Casey et al., 2006; Franklin et al., 2012; Larson & Story, 2011). 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/obesity in adolescents and food insecurity report mixed results—positive, negative, and null (Eisenmann, Gundersen, Lohman, Garasky, & Stewart, 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, BMI levels will be positively related to food insecurity.

The second level of the perceived aggregation in the analysis is the family. Single-parent households are more likely to report higher levels of food insecurity than households with two parents, and female-headed households are typically 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 compared to married biological or married stepfamilies and that marriage acted as a protective effect independent of 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 families will be positively related to food insecurity.

Our third level of perceived risk is the school. Schools are places where children spend an inordinate amount of time and continue to be important in determining their future educational and economic outcomes. Studies have found relationships between increased negative behavioral issues among school-aged children and increased food insecurity (Jyoti, Frongillo, & Jones, 2005; Shankar, Chung, & Frank, 2017). Thus, it is important to understand how schools act as a potential risk environment in determining levels of food insecurity among adolescents. We expect that student risk will be positively related to food insecurity.

Finally, at the community-level, there are several perceived risks that may constrain one's ability to adequately access nutritious food. Social and economic features and the overall degree of inequality in 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, Gaskin, Chan, Norrington, & McLeary, 2014; Hipp, 2007; Sharkey, 2013; Small & 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 more unsafe perceptions of one's neighborhood will be positively related to food insecurity.

1.3. Resources

Health is not only constrained by multiple levels of aggregation in a person's environment; it is also enabled by it. We examine several resources that respondents may perceive to exist at a variety of levels and have been argued as links to food insecurity. First, we examine the individual resource, self-reported self-esteem. Positive self-concepts and social support can lessen the negative impact of certain social factors on a wide-range of health outcomes (Fitzpatrick & Willis, 2017). Higher self-esteem, for example, indicates a positive self-concept that can protect against significant life stressors and minimize negative effects on health (Pearlin, Menaghan, Lieberman, & Mullan, 1981). Higher self-esteem has been linked to both positive mental and physical health outcomes (Dielman, Campanelli, Shope, & Butchart, 1987; Fitzpatrick & Willis, 2017; Mann, Hosman, Schaalma, & De Vries, 2004). As such, we anticipate that higher levels of self-esteem will be negatively related to food insecurity among adolescents.

Second, the family is examined as a social resource to protect youth from the ill effects of food insecurity; his or her family shapes a child's social life. Bonds between parents and children promote children's development and social adjustment (Parcel & Bixby, 2016). Thus, we would expect that eating more meals with families would be negatively related to food insecurity. Third, we examine a peer level resource factor, social capital. In a study of 5th-7th 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 also 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, was. As such, we would expect that peer social capital would be negatively related to food insecurity.

Finally, at the community level, how individuals perceive their connectedness to their community may act as a positive health resource and minimize the negative risks related to food insecurity. Bernat and Resnick (2009) posit that the connections that young people have to adults in their communities' act as 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. Thus, we expect that perceived connectedness to community would be negatively related to food insecurity.

2. Materials & methods

2.1. Sample

This study is based on data collected in Fall 2015 from a sample ($n = 1493$) of 10th–12th grade students attending a high school in Northwest Arkansas (Fitzpatrick & Collier, 2016). The sampling frame for the survey included all 10th–12th-grade students enrolled at in high school in a Northwest Arkansas school district. The number of enrolled students at the time was 2148. Ten classrooms (116 students) were unable to participate at the time of the survey, which shifted the eligibility number to 2032. Of the 2032 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 1493. The final sample was composed of 53 percent Hispanic/Latino and 14 percent Marshallese students. We believe this sample to be representative of the school district we collected data from, where Hispanic/Latino and Marshallese are the most prominent minority groups. Sixty-eight percent of the sample reported receiving free and reduced lunch, which is consistent with the Arkansas Department of Education's (2016) most recent data that 68 percent of the school district being examined receive free and reduced lunch (Fitzpatrick & Collier, 2016).

2.2. Measurement

We assessed a wide range of perceived student needs and behaviors, including self-reported physical health, mental health, eating and exercise behaviors, food security, and social activities. All 10th–12th 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.

2.3. Food insecurity

Food insecurity was the dependent variable in this analysis and is measured using a metric drawing from the USDA food insecurity module. Connell, Nord, Lofton, and Yadrick (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 both because of time constraints with the students in the current study as well as previous work confirming that this shortened version was comparable to work that reported using the longer version. 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? As suggested earlier, this reduced measure has been demonstrated to be both reliable and valid as reported in earlier work that examined children and youth as the primary respondents for assessing perceptions of food insecurity (e.g. Willis, 2013; Willis & Fitzpatrick, 2017).

Student's 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). The original variable lacked linear integrity, and exhibited a skewed distribution that made it difficult to examine food insecurity as a linear, interval variable. As a result, the scale was recoded into an ordinal one using the following four categories: no food insecurity, low food insecurity, moderate food insecurity, and high food insecurity to create categories for comparison. Based on these self-reported items measuring food insecurity, 20 percent of the sample reported moderate food insecurity and 7 percent reported high food insecurity. This matches closely with other samples of self-reporting food insecurity by children and adolescents (e.g. Willis & Fitzpatrick, 2017).

2.4. Sociodemographic variables

A number of sociodemographic variables were introduced as standard controls that have been used in other studies examining the relationship between risks, resources, and food insecurity (Willis & Fitzpatrick, 2017). Sociodemographic controls were selected 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 was coded as female = 1; ethnicity as Hispanic/Latino = 1. Fifty-three percent of our sample was 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. Eight hundred and sixty-four 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, we examined the variable free and reduced lunch = 1. To assess class differences, we used a variable that provided a rudimentary proxy for poverty in the analysis. Because eligibility for free and reduced lunch is based on household income, the variable assesses an important class related difference. Sixty-eight percent reported participating in the free and reduced lunch program, which matches closely with the statistics reported by the school district.

2.5. Risk variables

2.5.1. 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 was 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 was coded as overweight/obese = 1. Thirty-seven percent of the students were classified as overweight or obese in the sample.

2.5.2. 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 that 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 weighted 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. The eight items

selected are those measuring primary affect. This symptom cluster has been noted elsewhere as being particularly relevant to assessing the perception of exposure to stress-related circumstances across multiple environments among youth, particularly in the context of food insecurity (e.g. Willis & Fitzpatrick, 2016, 2017).

2.5.3. Family intactness

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.

2.5.4. 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).

2.5.5. 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).

2.6. Resource variables

2.6.1. Self-esteem

In this study, self-esteem is included as a potential individual-level resource to protect one against the negative risks associated with 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). In this particular instance, we examined

both the full scale and reduced one and found very little difference. Because of the significant time constraints placed on the survey, we elected to go with this shortened version.

2.6.2. Meals at home

In this model, we included a measure of how often students ate meals at home with their families. Following the prompt, “Thinking about the places you usually eat,” students were asked a series of eight questions pertaining to where and with whom they eat their meals. Four of these questions were specifically related to eating meals with friends, relatives, and family, and at home. The responses to those questions about how often were none of the time = 0 to all of the time = 4. The scale of meals eaten at home ranged from 0 to 16. It was moderately reliable (Cronbach’s alpha = .61; Mean = 7.8; S.D. = 2.7).

2.6.3. 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.

2.6.4. 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 (Aron & Aron, 1986; McMillan & Chavis, 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 Fig. 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.

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

2.7. 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 examine the relationships between food insecurity and sociodemographic, risk, and 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, like our four-category food insecurity variable. For the current analysis, we used ordinal regression with a link function of

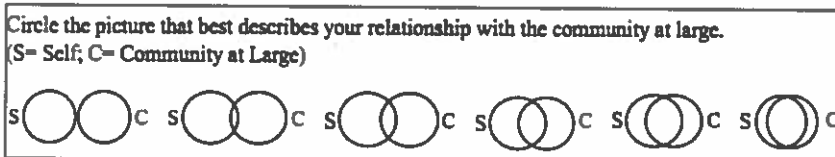


Fig. 1. Inclusion of community in the self scale.

Table 1
Descriptive statistics for model variables (n = 1493).

	%	Mean	S.D
<i>Dependent Variable</i>			
Food Insecurity			
No Food Insecurity	50.3%	-	-
Low Food Insecurity	22.1%	-	-
Moderate Food Insecurity	20.1%	-	-
High Food Insecurity	7.0%	-	-
<i>Sociodemographics</i>			
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%	-	-
<i>Risks</i>			
Weight Status (1 = Overweight)	37.0%	-	-
CES-Depression Scale (0–60)	-	19.59	15.84
Family Intactness (0–2)	-	.380	.614
Student Risk (0–20)	-	2.44	2.77
Neighborhood Risk (3–15)	-	6.04	2.73
<i>Resources</i>			
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

negative log-log, $-\ln(-\ln(y))$, since lower categories were more probable in the food insecurity variable (no and low food insecurity account for nearly three-quarters of sample). In the PLUM analysis presented, 'b' represents the log of odds estimate and 'exp b', or exponent b, is the odds ratio, which was calculated using e^b . The Nagelkerke R^2 is an R^2 -like statistic to measure the strength of association that we used primarily to examine the change in explained variation from one model to the next.

3. Results

3.1. Descriptive statistics

As seen in Table 1, nearly three quarters of the sample report having no or low food insecurity; 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.

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 the independent variables are significantly correlated with our dependent variable, food insecurity. Gender and ethnicity are negatively correlated with food insecurity indicating that for this sample, boys and non-Hispanics are more likely to be food insecure. The parents born outside of the United States variable 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 the resource variables were negatively associated with food insecurity.

3.2. Multivariate relationships

Table 3 presents the results of an ordinal regression model, using the

same variables analyzed in the correlations table above. 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, high school boys were more likely to report being food insecure than high school girls ($p < .01$). Non-white Hispanics were more likely to be food insecure than their White counterparts ($p < .01$). Students reporting their parents were born in the United States were less likely to report being food insecure compared to students whose parents were born outside the United States ($p < .05$). Students not participating in free and reduced lunch were less likely to report being food insecure compared to those students who were participating in the federal assistance program ($p < .01$). The Nagelkerke R^2 for this model was 0.095.

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 or no change. The Nagelkerke R^2 for this model increased significantly to 0.202.

In Model 3, the resource variables were added to examine the relationships of self-esteem, meals at home, peer social capital, and community connectedness with food insecurity. All of the resource variables, except community connectedness, were significantly and negatively associated with food insecurity. None of the demographic or risk variables changed in significance or direction between Model 2 to Model 3, suggesting on the surface, that mediation or moderation was not taking place as we might have thought it was. The Nagelkerke R^2 for the final model was 0.221.

Overall, our model indicated 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 report food insecurity, even after controlling for both risks and resources. CES-Depression, family intactness, student risk, and neighborhood risk all act as significant risk factors associated with higher levels of food insecurity. Self-esteem, meals at home, and peer social capital were all associated with lower levels of food insecurity.

4. Discussion

Our findings show that food insecurity is related to a number of factors at various perceived levels of influence, including individual, family, peer, school, and community. By using a risk and resource model, we tested and identified significant social factors associated with food insecurity at a variety of self-perceived levels of aggregation, even after controlling for sociodemographic characteristics.

Although not directly part of our research question, we found that food insecurity differed across a variety of sociodemographic groups, including social class, gender, ethnicity, and immigrants. Some of the results regarding the sociodemographic variables were interesting and worth noting. For example, 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 counter to what other research on food insecurity has found concerning adult men and women. However, this finding is similar to a recent study where teenage boys were reported to be more food insecure than teenage girls (Popkin, Scott, & 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). It may also be due to various social factors, such as older boys feeling pressure to act as the "man of the family" and make sacrifices for the younger or female siblings. More research needs to be done in order to better understand

Table 2
Bivariate correlations among model variables (n = 1493).

	1	2	3	4	5	6	7	8	9	10	11	12	13
<i>Dependent Variable</i>													
1. Food Insecurity													
<i>Demographics</i>													
2. Gender		-.057*											
3. Ethnicity		-.082**	.025										
4. Parents Birthplace		.065**	.017	.464**									
5. Free and Reduced Lunch		.210**	-.003	.281**	.383**								
<i>Risks</i>													
6. Weight Status		.062**	-.071**	-.017	-.004	.008							
7. CES-Depression		.194**	.268**	-.058*	-.080**	-.038	-.022						
8. Family Intactness		.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**			
<i>Resources</i>													
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**

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

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 camaraderie that can occur among marginalized populations. Additionally, this sample was certainly unique in that roughly 14 percent of non-Hispanic students in the sample were Pacific Islander Marshallese, which could be accounting, in part, for this non-Hispanic “effect.”

All the risk variables were positively associated with food insecurity except weight status. The other individual-level risk variable, depression, however, was associated with 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, family intactness, 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 R² value, the risks in our model explain a bulk of the variation in food insecurity between the groups.

Our resource factors did not act as moderators or mediators. We evaluated their potential role using both interaction effects (moderation) and Sobel tests (mediation). In the case of all the resource variables, there was no evidence of significant moderation/mediation. The resource variables were all negatively related to food insecurity. The individual-level resource, self-esteem, was related to lower food insecurity, such that students reporting higher self-esteem were found to

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
<i>Demographics</i>						
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
<i>Risks</i>						
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
Family Intactness			.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
<i>Resources</i>						
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*** (R² Change).

be less food insecure. Our family and peer level variables, more meals eaten at home and higher levels of 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.

4.1. Limitations

This study has linked various risk and resource variables to food insecurity. However, the 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. While the data are cross-sectional, and unable to determine causal order of the specified relationships, the findings, regardless, provide significant support for the importance of examining risks and resources among varying levels of food insecurity. While a limiting factor of the current study is that all of the data is self-reported by adolescents, they have proven to be typically reliable respondents, particularly when being asked questions about individual behaviors that they see as relatively benign (i.e. eating, food access, general health and well-being symptoms). Finally, we acknowledge that a few of the variables that are used in the analysis were shortened from their original format. In addition to time constraint, these variables have been used in their shortened version elsewhere and were found to be both reliable and valid assessments for the particular issue(s) under investigation. While we acknowledge these modifications, the variables as presented and used here in the analysis were deemed to be both reliable and appropriate for the data collection strategy that was adopted.

Our findings certainly lend some credence to the notion that adolescents are capable of answering self-administered surveys. Treating them as intelligent, unbiased, observant participants, rather than passive objects, in their own social world may yield more accurate accounts of their own experiences regarding food insecurity specifically, 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.

5. Conclusions

Perceived socio-ecological factors have an important set of relationships with 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 perceived environments outside of just their families alone—schools, peers, and communities are crucial to influencing adolescent's 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 helps to fill a gap in the literature by examining the perceived holistic, socio-ecological perspective of adolescent food insecurity and its risks and resources, which could prove to be useful when examining how best to address possible solutions to the address the problem of food access and hunger.

Findings support the use of a risk and resource model to examine food insecurity. The model utilized risks and resources on a number of perceived levels of aggregation, including individual, family, school,

peer, and community. These risk and resource variables had significant associations with food insecurity independent of socio demographic characteristics, such as the poverty and ethnicity proxies. 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 perceived levels of aggregation support the notion that positive health outcomes are constrained and enabled not only by individual behaviors, but also by our perceptions of social contexts like the family, schools, peers, neighborhoods, and other social structures (Fitzpatrick & LaGory, 2011).

Acknowledgments

The authors wish to acknowledge the generous support of the Tyson Foods Foundation in Springdale, AR. The Tyson Foundation supported this work, however, it is not responsible for any of the conclusions reached regarding the findings found in this study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.appet.2018.12.028>.

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