

Is Household Food Insecurity Predictive of Health Status in Early Adolescence? A Structural Analysis Using the 2002 NSAF Data Set

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Abstract

We used data from the 2002 National Survey of American Families to examine a structural model of the relations among food insecurity, poor nutritional status, parental mental health problems, quality of parenting, adolescents' emotional distress, and poor health status for a national sample of 5366 12-to-14 year-olds. The results revealed that: first, food insecurity was associated with elevated levels of parental mental health problems, diminished quality of parenting, elevated levels of adolescents' emotional problems, and higher incidence of poor nutritional and health statuses. Second, parental mental health problems were associated with diminished quality of parenting and higher incidence of poor health status; and quality of parenting had a negative effect on emotional distress, but not on health status. Finally, poor nutritional status was associated with elevated levels of emotional distress and higher incidence of poor health status; and emotional distress was predictive of poor health status. The findings of this study highlight the mediating role of nutritional status, parenting factors and adolescents' emotional well-being in the link between food insecurity and health; and point to the complex interaction between food insecurity and health status.

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Food insecurity, which refers to problems associated with the availability of, or accessibility to nutritionally adequate and safe foods in socially acceptable ways (Bickel, Nord, Price, Hamilton, and Cook, 2000) is still prevalent in the US. For example, a 2006 US Department of Agriculture (USDA) report showed that the percentage of households that were food insecure increased from approximately 10 percent (10.5 million households) in 1999 to roughly 12 percent (13.5 million households) in 2004. However, in 2005, there was a reduction in the percentage of households that were food insecure to about 11 percent (12.5 million households). The 2005 decline in prevalence of food insecurity reversed an upward trend between 1999 and 2004 (Nord, Andrews, and Carlson, 2006).

Although the level of food insecurity declined in 2005, in about 270,000 households, one or more children experienced reduced food intake and disrupted eating patterns at some time during the

year. And, in 32,000 to 43,000 households, children experienced disrupted eating daily (Nord et al., 2006). The rates of food insecurity varied significantly among different types of households. The prevalence of food insecurity was about twice as high for households with children compared with households without children. Single-mother households were more vulnerable (about a third of them were food insecure). Also, Black and Hispanic households had rates of food insecurity more than twice those of White non-Hispanic households as were households with incomes below the federal poverty line (Nord et al., 2006).

Background to the Study

In an attempt to conceptualize food insecurity, its risk factors, and consequences, Campbell (1991) raised the question of whether food insecurity is the nutritional outcome of economic risk factors, or a predictor of poor health. In Campbell's model she concluded that food insecurity was both an outcome of risk

factors as well as a predictor of poor health. Her model indicates that risk factors for poor diet (e.g., food insecurity) lead to effects on diet and nutritional status. In addition, these outcomes (diet and nutritional status) in turn predict physical health and quality of life. Specifically, Campbell (1991) indicated that one of the outcomes of poor nutritional status was poor health, and that food insecurity can affect health either directly or indirectly through nutritional status.

The research literature has provided considerable support for various aspects of Campbell's model. For example, being below the federal poverty level is associated with a greater incidence of food insecurity (Nord et al., 2006; Poppendieck, 1997). In this sense, food insecurity is seen as an outcome of limited household resources, or the percentage of available resources available for purchasing food (Gundersen and Oliviera, 1998). Other research in support of Campbell's (1991) thesis has revealed differences in nutrient intake among food-insecure children and adults compared with their food-secure counterparts (Cristofar and Basiotis, 1992; Rose, 1999; Rose and Oliviera, 1997; Tarasuk and Beaton, 1999). For example, Cristofar and Basiotis (1992) reported that children classified as food-insufficient had lower intakes of fruits and vegetables.

Thus, it is reasonable to assume that if there is a link between food insecurity and nutritional deficiencies, then there may be an association between food insecurity and nutritional status that mediates poor health status. For example, Rose (1999) reported that intakes of folate, vitamin C, carotene, fiber, food energy, and carbohydrates were significantly lower in food-insufficient children than in food-sufficient children. And, Alaimo, Olson, Frongillo, and Briefel (2001) found that low-income, food-insecure children had a higher prevalence of iron deficiency than their high-income food-secure counterparts. These studies, at least, provide evidence that food insecurity could predict poor health through its effect on nutrition-related disease risk factors.

The literature in support of Campbell's (1991) framework also shows that food insecurity has a direct effect on children's health status (Alaimo et al., 2001; Ashiabi, 2005; Casey et al., 2001, 2005; Cook et al., 2004; Dunifon and Kowaleski-Jones, 2003; Weinreb et al., 2002). For example, Alaimo et al. (2001) in an investigation of the associations among family income, food insufficiency, and health among US preschool and school-aged children found that independent of other factors, food-insufficient children were significantly more likely to have poorer health status and to experience more frequent stomachaches and headaches than food-sufficient children; preschool food-insufficient children also had more frequent colds.

Weinreb et al. (2002) also found that for school-aged children, severe hunger was a significant predictor of chronic illness, and for preschoolers, moderate hunger was a significant predictor of health conditions. Cook et al. (2004) reported that food insecure children had odds of fair/poor health nearly twice as great, and greater odds of being hospitalized than food-secure children. In conclusion, Cook et al. suggested that food insecurity is associated with adverse health outcomes in children even when it does not involve reductions in the quantity of food intake sufficient to involve measurable hunger.

Although research for a greater part has supported Campbell's (1991) theoretical formulation, Reid (2000) using height-for-age and weight-for-age (as measures of health) found no evidence that food insecurity has a negative impact on child health. Reid argued that maybe the extent of food insecurity in the U.S. is not as severe as that observed in the developing world. Although Reid's argument is tenable, the conflicting findings suggest that perhaps the choice of health outcome examined makes a difference in whether food insecurity is associated with poor health.

It is also possible that the 10-item scale used in Reid's (2000) study were not sensitive enough to capture the extent and severity of food insecurity in children; thus the lack of an association

between food insecurity and health. Also, because the level of food insecurity in the US may not be as severe as that in the developing world, using a global health index may be an appropriate strategy as it assesses general malaise and not specific anthropomorphic measures of health. In fact, a majority of the studies that have found an association between food insecurity and health have focused on general health, instead of specific health outcomes (e.g., Casey et al., 2005; Cook et al., 2004).

Another possibility is that the disparate items used as indicators of food insecurity, and the different samples used in these studies were responsible for these conflicting findings. For example, Cook et al. (2004) used the 18-item USDA food security module to assess the association of food-insecurity with health status for children (age ≤ 3) from inner-city settings in six geographical locations; whereas, Reid (2000) used a 10-item scale of food insecurity to assess anthropomorphic measures of health for national sample of children (age ≤ 10).

A further gap in the literature is that a majority of these studies have only focused on the negative effects of food insecurity on children or adult's health, without any attention to how food insecurity might affect the physical well-being of adolescents. Furthermore, most of the existing research has provided support for the association between food insecurity and each of the constructs proposed by Campbell (1991), but has not examined the association among all the model components simultaneously. Specifically, the processes through which food insecurity exerts its deleterious effects on health have not been investigated.

Finally, a missing piece of the Campbell (1991) formulation is that she did not theorize on how parental psychological resources (parental mental health problems and quality of parenting) and children's emotional distress will mediate the relation between food insecurity and adolescent health. It is within this context that this study proposes to examine the association between food insecurity and health status in early adolescence. Specifically, the purpose was

to examine a structural equation model (SEM; Figure 1) of the associations among food insecurity, poor nutritional status, parental mental health problems, quality of parenting, adolescents' emotional distress, and health status for a national sample of 12-to-14 year-olds (adjusting for the effects of adolescents' sex, parental education, income-to-poverty ratio, and race/ethnicity).

Before we proceed, we provide our conceptualization of food insecurity for this study, with its limitations in mind. Pursuant to that, we discuss research pertaining to our theoretical model, and explicate how food insecurity might be related to health status in adolescence. Finally, we offer hypotheses regarding the associations among the constructs in the model (Figure 1) based on the evidence reviewed.

The Present Study

Conceptualizing Food Insecurity

Food insecurity is a multifaceted phenomenon that varies along phases of increasing severity. Each stage is typified by conditions and experiences of food insufficiency, and behavioral responses of household members to these conditions (Bickel et al., 2000). In short, food insecurity consists of reduction of household food stores, eating unsuitable food, worrying about food supply, or acquiring food in socially unacceptable ways, such as, begging (Alaimo, Olson, and Frongillo, 1999). Because food insecurity assesses both the quality and quantity of food, it could affect children even if it does not occur along with child hunger (Alaimo et al., 1999).

Household food insecurity is assessed using an 18-item scale developed by the USDA (Price, Hamilton, and Cook, 1997). At its less severe levels, food insecurity does not involve reducing the quantity of food intake below normal levels, but is evident in adult's concerns about the sufficiency of food supply and reductions in diet quality and variety (Bickel et al., 2000). At moderately severe levels, adults reduce meal or serving sizes, skip meals, or both, sometimes leading to hunger. At more severe levels of food insecurity, households with children reduce

children's food intake to an extent that the children experience hunger, whereas adults with or without children experience even more extensive reductions in food intake (Bickel et al., 2000).

These definitions imply that hunger and under-nutrition may occur be a consequence of food

insecurity, depending on its severity and duration (Bickel et al., 2000). A majority of households that are food insecure avoid hunger by limiting the types of food they buy; by relying on public-assistance, private-assistance (food banks and soup kitchens), or both types of food assistance programs (Daponte, 2000).

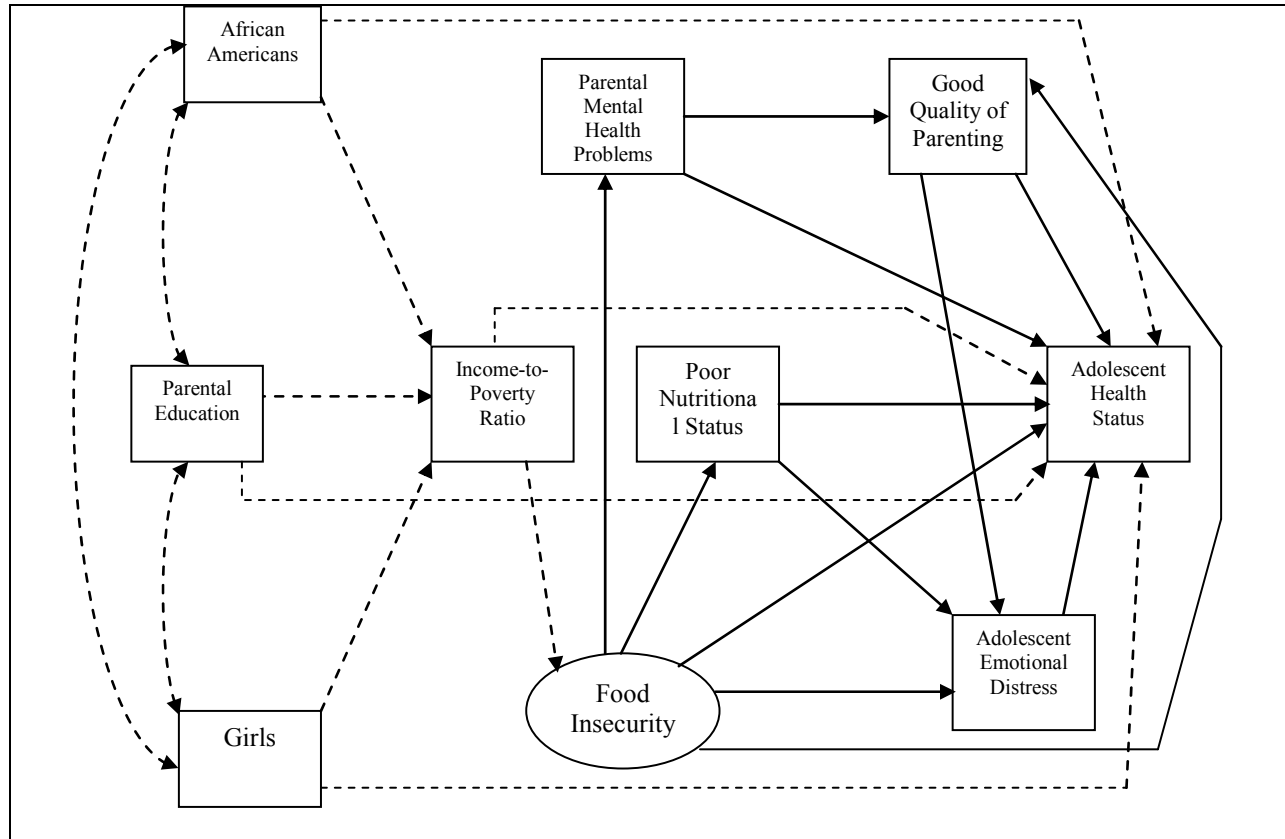


Figure 1
Structural Model Linking Food Insecurity to Adolescents' Health Status

The National Survey of American Families (NSAF) data set that we used in this study to assess food insecurity and nutritional status relied on four items from the USDA food insecurity questionnaire to minimize respondents' burden. This of necessity means that the measure of food insecurity and nutritional status available to us in this study is less reliable; thus it cannot identify the more

severe range of food insecurity. The first question asked whether in that past 12 months the household worried that their food would run out before they had money to buy more. The second question asked whether in the past 12 months the household had experienced food shortage, that is, whether food that was bought didn't last and they didn't have money to get more. The third question asked whether in the

past 12 months the household has cut or skip meals for lack of money. And, the final question asked about the frequency of cutting or skipping meals in the past 12 months if the household indicated they had ever cut the size of their meals or skipped meals.

These four questions attempt to address the experiential and behavioral stages that households go through as food insecurity becomes severe. For example, the first two questions regarding worries about whether food would run out and the experience of food shortage attempt to capture and describe households' first stage reaction to and experience of food insecurity. The third and fourth questions describe situations of reduced food intake at the household level. This also implies that individuals who cut, skip, or reduce the quality of their meals, could also experience micronutrient/nutritional deficiencies.

Before proceeding, a caveat is in order. Because in the NSAF food insecurity was measured at the household level, the only inference we can make about adolescents' hunger is that adolescents in food-insecure households are at increased risk of hunger compared with other adolescents (Bickel et al., 2000).

Mechanisms Linking Food Insecurity to Adolescents' Health

In this section, we postulate and discuss the processes through which food insecurity might affect adolescents' health. Our discussion and review of the literature is necessarily limited.

Food insecurity and adolescent health.

Research on the negative effect of food insecurity on adolescent health is scant. Most of the findings in that area have either used adult samples (e.g., Vozoris and Tarasuk, 2003) or combined child and adolescent samples—school age (e.g., Alaimo et al., 2001; Casey et al., 2005; Weinreb et al., 2002). The studies that used school-age samples repeatedly show that food insecurity is correlated with poor health, and that the link between food insecurity and health is independent of other factors.

There are various mechanisms (biological, parenting, and psychological) that could explain the link between food insecurity and health. For example, from a biological perspective, food insecurity affects health through such means as reduced food intake, food quality, and micronutrient deficiencies — nutritional status (Alaimo et al., 2001; Cook et al., 2004). Specifically, if the (a) nutritional quality and frequency of meals in food-insecure households were reduced to such an extent that micronutrient deficiencies result; or (b) variety of foods available in food-insecure households were severely constrained to such an extent that it results in malnutrition (Cook et al., 2004); then any one of these conditions or a combination of them could explain the link between food insecurity and health.

Food insecurity, parenting factors, and health. The second process through which food insecurity could negatively affect adolescent health is through parenting variables, such as, parental mental health problems and quality of parenting (Alaimo et al., 2001; Weinreb et al., 2002). Food insecurity can affect adolescent health because of increased parental stress, depression, and feelings of deprivation, or through parental food deprivation that results in changes in parenting practices (Alaimo et al., 2001).

Borrowing from the family stress hypothesis (Conger, et al., 1992; McLoyd, 1990) which suggests that the negative impact of economic adversity on adolescent well-being may be both direct and indirect, we contend that food insecurity can be conceptualized as a form of economic hardship. In that vein, food insecurity is likely to elevate levels of parental stress (Weinreb et al., 2002), and parental mental health problems (Siefert, Heflin, Corcoran, and Williams, 2001; Wu and Schimmele, 2005) and adversely affect adolescents nutritional status and health. Specifically, elevated levels of parental mental health problems adversely impact quality of parenting, and ultimately adolescents' emotional distress and health. This is because parental mental health problems may interfere with parents' ability to provide for adolescents' nutritional needs when budgets are

constrained and focused attention is needed (Weinreb et al. 2002). In essence, increased parental mental health problems and poor quality of parenting conspire to affect adolescents' emotional well-being and health.

In fact, several lines of research suggest that parents experiencing mental health problems provide poor quality care to their children (Bettes, 1988) and are less responsive to them (Livingwood, Daen, and Smith, 1983). Such poor quality parental behaviors have been associated with poor health outcomes for children (Repetti, Taylor, and Sherman, 2002). In short, parental mental health problems affect quality of parenting and parental behaviors that compromise the health of their children (Ashman and Dawson, 2002).

Food insecurity, emotional distress, and health. A third process through which food insecurity could impact health is via emotional well-being. One study (Alaimo et al., 2002) that utilized a multi-ethnic adolescent sample found that food-insecure adolescents experience a variety of psychological problems, such as, depressive disorder and suicidal ideation. This finding suggests that it is possible for adolescents to experience anxiety and depression as a consequence of unpredictable and intermittent meals, and that food insecurity may elevate the risk of emotional distress through the stress associated with lack of food.

Another possibility is that adolescents who experience food insecurity are exposed to parental mental health problems and poor quality parenting, which ultimately affect their emotional well-being. Finally, it is conceivable that the emotional distress experienced by adolescents arises through biological mechanisms, such that, food insecurity or poor nutritional status causes or maintains negative affect and depressed mood (Garner, 1997).

Adolescents' emotional well-being may also have implications for their health. For example, Weinreb et al. (2002) speculated that food insecurity may adversely affect health through psychologic means. If we consider food insecurity as a source of stress and emotional

distress, then it is logical to assume that food insecurity can have adverse effects on health through psychological processes. In particular, the notion of stress provides a conceptual and physiological link between food insecurity and health (McEwen, 1998).

Research has shown that increased level of stress is known to be the beginning of an ongoing process that when it proceeds, leads to allostatic load (McEwen, 2000). This means, if adolescents experience prolonged periods of food insecurity, the otherwise functional role of cortisol production has the unintended effect of breaking down important physiological processes. This process, described as allostasis or allostatic load may have deleterious associations with health (McEwen, 1998; Seeman, McEwen, Rowe, and Singer, 2001).

Research Hypotheses

Based on the literature reviewed, we examined the following hypotheses. First, we hypothesized that food insecurity would be positively associated with parental mental health problems, poor nutritional status, adolescents' emotional distress, and poor health status; and negatively correlated with good quality of parenting. Second, we hypothesized that parental mental health problems will have a negative effect on good quality of parenting and a positive effect on poor health status; and that good quality of parenting will have a negative effect on both poor health status and emotional problems. Third, we hypothesized that poor nutritional status will have a positive effect on adolescents' emotional distress and poor health status.

Methodology

The Data and Sample

Data from the 2002 National Survey of America's Families (NSAF) data set (a survey of the economic, health, and social characteristics of children and adults under the age of 65, and their families) were used. Data collection was conducted from February 2002 through October 2002 (Abi-Habib, Safir, and Triplett, 2003). The sample consisted of a random-digit dial (RDD) survey of households with telephones, and a supplemental area probability sample of households without telephones. Interviews were

conducted in stages for both the RDD and area sample. First, a five-minute screening interview was conducted to determine household eligibility, followed by a 27- to 50-minute extended interview to eligible households. Telephone interviewers located in centralized facilities conducted all interviews for households with and without telephones using computer-assisted telephone interviewing (CATI). In-person interviewers provided cellular telephones to respondents in non-telephone households to connect them with interviewing centers for the CATI interview (Abi-Habib et al., 2003). A total of 133,503 households were screened, resulting in 43,157 extended interviews in telephone households yielding information on more than 100,000 persons under the age of 65 (Abi-Habib et al., 2003).

In households with children under the age of 18, up to two children were sampled for in-depth study; one under the age of 6 and another between the age of 6 and 17. Interviews were conducted with the most knowledgeable adult — the adult in the household who was most knowledgeable about the health care, education, and well-being of the sampled child. In a majority of cases, this adult was a mother, and hereafter referred to as the parent. Over 28,000 extended interviews were conducted with the primary caregivers of children. For the present study, data on a subset of 5366 adolescents (12-14 years) were used. Descriptive statistics of the sample are reported (Table 1).

Table 1
Unweighted Descriptive Statistics of Study Sample

	Mean (SD)	N	Range
Family Structure			
# Lives with no parent		254	1-4
# Lives with single parent		1604	1-4
# Lives in blended (step) family		663	1-4
# Lives in biological/adoptive family		2841	1-4
Race/Ethnicity			
# African Americans (1)		798	0-1
# Other Ethnic/Racial Groups		4568	0-1
Demographic Variables			
# Boys		2740	0-1
# Girls (1)		2626	0-1
# Mothers		4372	1-2
# Fathers		994	1-2
Adolescents' age	13.01 (.82)	5366	12-14
Parental age	41.76 (7.36)	5366	18-85
Parental education level	7.10 (3.01)	5335	1-12
Income-to-poverty ratio	2.91 (1.19)	5366	.50-4.00
Food Insecurity Items			
Worried food would ran out	1.34 (.61)	5172	1-3
Food bought did not last	1.27 (.55)	5167	1-3
Poor Nutritional Status			
Cut/skip meals for lack of money	.28 (.75)	5172	0-3
Parental Variables			
Parental emotional distress	9.24 (2.73)	5284	5-20
Good quality of parenting	13.78 (1.94)	5288	4-16
Outcome Variable			
Poor health status	1.74 (.91)	5366	1-5

Measures

Covariates. The following variables were adjusted for: adolescent sex, parental education, family income, and race/ethnicity. Adolescents' sex was dummy-coded (girls = 1, boys = 0). Race/ethnicity was also dummy-coded as African American (1) and other race/ethnicity (0). Parental education was also controlled for because it is known to be a strong predictor of family income. Parental education was the number of years of schooling completed, and it was categorized as completed 8th grade (1) to graduate/professional degree (12). The mean years of schooling completed was about 7 (that is, up to the vocational or technical certificate level). Income-to-poverty ratio was also controlled for because it is associated with food insecurity. Income-to-poverty ratio is a variable in the NSAF data set that compared total family income received (from all sources such as wages or salary; social security; supplemental security income; public assistance and alimony) during 2001 to the Census Bureau's Federal poverty threshold for that year, given family size and numbers of children in the family. Income-to-poverty ratio was categorized as less than 50% of 2001 poverty line (.5) to greater than or equal to 300% of 2001 poverty line (4). The mean for income-to-poverty ratio was about 3 ($200 \leq \text{income-to-poverty ratio} \leq 300$).

Food insecurity. Two questions in the NSAF data set were used as indicators of the latent construct of food insecurity. The first question asked whether food bought didn't last. It was answered often true (1) to never true (3). This item was reverse coded (never true = 1 to often true = 3) so that a higher score reflected increased food insecurity. The second question asked respondents if they worried whether food would run out. This was answered often true (1) to never true (3). This item was reverse coded (never true = 1 to often true = 3) so that higher scores indicated increased food insecurity.

Poor nutritional status. This item was a proxy measure based on two food security questions in the NSAF. We used these items from the NSAF data set to indicate nutritional status, because they involve questions related to reductions in

food intake, which by extension implies nutritional deficiencies. A preliminary question which asked respondents whether in the previous 12 months they had cut or skip meals (yes = 1 or no = 2) was combined with a follow-up question that asked how often respondents had cut/skip meals for lack of money if they answered yes to the preliminary question. The follow-up question was answered almost every month (1), some months but not very much (2), and only 1 or 2 months (3). The two questions were combined, and reverse coded so that higher scores reflected increased frequency of cutting or skipping meals (poor nutritional status). The range was no (0) through almost every month (3).

Parental mental health problems. The NSAF data included a scale measuring parental emotional distress that has good psychometric properties (Ehrle and Moore, 1999). The five items that were summed and used in creating the scale asked for example, how often in the past month the parent (a) had been a very nervous person, (b) felt downhearted and blue, and (c) felt so down in the dumps that nothing could cheer him/her up. The response categories included all of the time (1) to none of the time (4). Responses were totaled, creating a score ranging from 5 to 20. The scale scores were reverse-coded so that a higher score was indicative of increased parental mental health problems.

Good quality of parenting. This scale was available in the NSAF data and has good psychometric properties (Ehrle and Moore, 1999). It was created by summing responses to four items, for example: how often in the past month the parent felt (a) the child was much harder to care for than most; (b) he or she was giving up more of his/her life to meet the child's needs than he/she ever expected; and (c) angry with the child. The response categories included none of the time (1) to all of the time (4). The scale score ranged from 4 to 16, with a higher score indicating good quality of parenting.

Adolescent emotional distress. This was a scale available in the NSAF data set with good

psychometric properties (Ehrle and Moore, 1999). It was created by summing responses to six items concerning parental perceptions about the child's behavior in the past month, such as, child (a) can't concentrate or pay attention for long; (b) has been sad, or depressed; and (c) has trouble sleeping. The response categories (often true = 1 through never true = 3) were totaled, creating a score ranging from 6 to 18. The scores were reverse-coded so that a higher score indicated increased emotional distress.

Poor health status. A subjective, parental report of global health status answered on a 5-point scale from excellent (1) to poor (5) was used. Subjective measures of health have been used in maternal ratings of children (Montgomery, Kiely, and Pappas, 1996). 1996), and they offer a way of assessing perceptions of health by combining the subjective experience of acute and chronic diseases and feelings of well-being like feeling run-down (Idler and Benyamini, 1997).

Data Analytic Procedure

The model (Figure 1) was tested using a stepwise structural equation model (SEM) based on maximum likelihood estimation with the AMOS 6.0 program (Arbuckle, 2005). A 5-step approach was used. In step 1, the baseline model was used to examine the direct effect of food insecurity on health status. In step 2 (nutritional mediators model) nutritional status was added to the baseline model. This was used to examine the change in the effect of food insecurity on health status. In step 3 (parental mediators model) parental mental health problems and quality of parenting were added to the baseline model (minus the nutritional mediators). In step 4 (adolescent mediators model) adolescents' emotional distress was added to the baseline model minus the parental mediators. Step 5 (full model) included all the constructs in the model.

Goodness-of-fit. It was used to determine whether the hypothesized model should be accepted or rejected based on the value of the χ^2 statistics. However, given that the χ^2 value is

affected by sample size, the Comparative Fit Index (CFI), and the Root Mean Square Error of Approximation (RMSEA) for which a test for close fit (PCLOSE) is calculated were used to augment the χ^2 value. For a good fit, Hu and Bentler (1999) suggested a CFI value of at least .95, and RMSEA of $p < .06$; and Loehlin (1998) argued for PCLOSE of $p > .05$.

Results

Model Building

First, we report the results of the stepwise SEM (Table 2) after which we present the findings for the full model (Figure 2). As shown, the baseline model (Step 1) had a reasonable fit to the data. Also, food insecurity had a significant effect on health status ($\beta = .26$), while the baseline model explained 11 percent of the variation in health status. The nutritional mediators model (Step 2) had a good fit to the data; it showed that there was a decline in the effect of food insecurity on health status ($\beta = .19$), but was not associated with an improvement in the percentage of variation in health status ($R^2 = 11$).

The parental mediators model (Step 3) had a good fit to the data; it was also associated with a decrease in the effect of food insecurity on health status ($\beta = .15$), and an improvement in the percentage of variation in health status ($R^2 = 13$). The model with the adolescent mediators (Step 4) had a good fit to the data. It also had a decrease in the effect of food insecurity on health status ($\beta = .18$), and an improvement in the proportion of variation in health status explained by the model ($R^2 = .15$).

The Full Model

The goodness-of-fit indices for the full model (Step 5), shows that it has a good fit to the data [χ^2 (30 df) = 415.63, $p < .001$; CFI = .98; RMSEA = .05; PCLOSE = .65]. This implies that the hypothesized associations among the constructs in the model (Figure 2) are plausible. The full model also shows a decrease in the effect of food insecurity on health status ($\beta = .09$), whereas the percentage of variation in the outcome predicted by the model improved slightly ($R^2 = .16$).

Table 2
Summary of Stepwise Structural Equation Model Building

Steps in the Model	Health Status Goodness-of-fit
Step 1: Baseline Model (Covariates + Food Insecurity)	
Unstandardized β (SE) ^a	.26 (.03)**
R ² for the outcome	.11
χ^2 (df) for model	89.42 (7)
CFI/RMSEA/PCLOSE	.99; .05; .71
Step 2: Nutritional Mediators Model (Baseline + Nutritional Status)	
Unstandardized β (SE) ^a	.19 (.04)**
R ² for the outcome	.11
χ^2 (df) for model	119.98 (12)
CFI/RMSEA/PCLOSE	.99; .04; .99
Step 3: Parental Mediators Model (Baseline + Parental Mental Health Problems + Quality of Parenting)	
Unstandardized β (SE) ^a	.15 (.03)**
R ² for the outcome	.13
χ^2 (df) for model	150.67 (17)
CFI/RMSEA/PCLOSE	.98; .04; 1.00
Step 4: Adolescent Mediators Model (Baseline + Adolescent Emotional Distress)	
Unstandardized β (SE) ^a	.18 (.03)**
R ² for the outcome	.15
χ^2 (df) for model	155.49 (12)
CFI/RMSEA/PCLOSE	.96; .05; .74
Step 5: Full Model (Baseline + Nutritional + Parental + Adolescent Mediators)	
Unstandardized β (SE) ^a	.09 (.04)*
R ² for the outcome	.16
χ^2 (df) for model	415.63 (30)
CFI/RMSEA/PCLOSE	.98; .05; .65

Effects of covariates. Higher parental education was associated with higher levels of family income ($\beta = .16$), and with reduced incidence of poor health status ($\beta = -.04$). Higher income-to-poverty ratio was associated with reduced incidence of food insecurity ($\beta = -.21$) and poor health status ($\beta = -.08$). Being an African American was associated with greater incidence of poor health status ($\beta = .17$), but there was no significant difference between girls and boys on incidence of poor health status ($\beta = .03$).

Hypotheses testing. In regard to the first set of hypothesis, food insecurity was associated with elevated levels of parental mental health problems ($\beta = 2.19$), diminished levels of good quality of parenting ($\beta = -.34$), elevated levels of adolescents' emotional distress ($\beta = .41$), and

higher incidence of poor nutritional ($\beta = .95$) and health status ($\beta = .09$). The second set of hypotheses revealed that elevated levels of parental mental health problems were associated with diminished good quality of parenting ($\beta = -.22$), and higher incidence of poor health ($\beta = .02$); and that good quality of parenting had a negative effect on adolescents' emotional distress ($\beta = -.50$), but was not associated with poor health status ($\beta = -.01$). In terms of the final set of hypothesis, the results showed that poor nutritional status was associated with elevated levels of adolescents' emotional distress ($\beta = .21$), and higher incidence of poor health status ($\beta = .05$); and that heightened emotional distress was predictive of higher incidence of poor health status ($\beta = .09$).

Mediation analyses and relative effects. The results of the stepwise SEM (Table 2) indicate that the direct effect of food insecurity on health status was partially mediated by the nutritional, parental, and adolescent mediators. This is

evident in the reduction of the effect of food insecurity on health status in Step 1 from ($\beta = .26$) to ($\beta = .19$) in Step 2 through Step 5 where ($\beta = .09$).

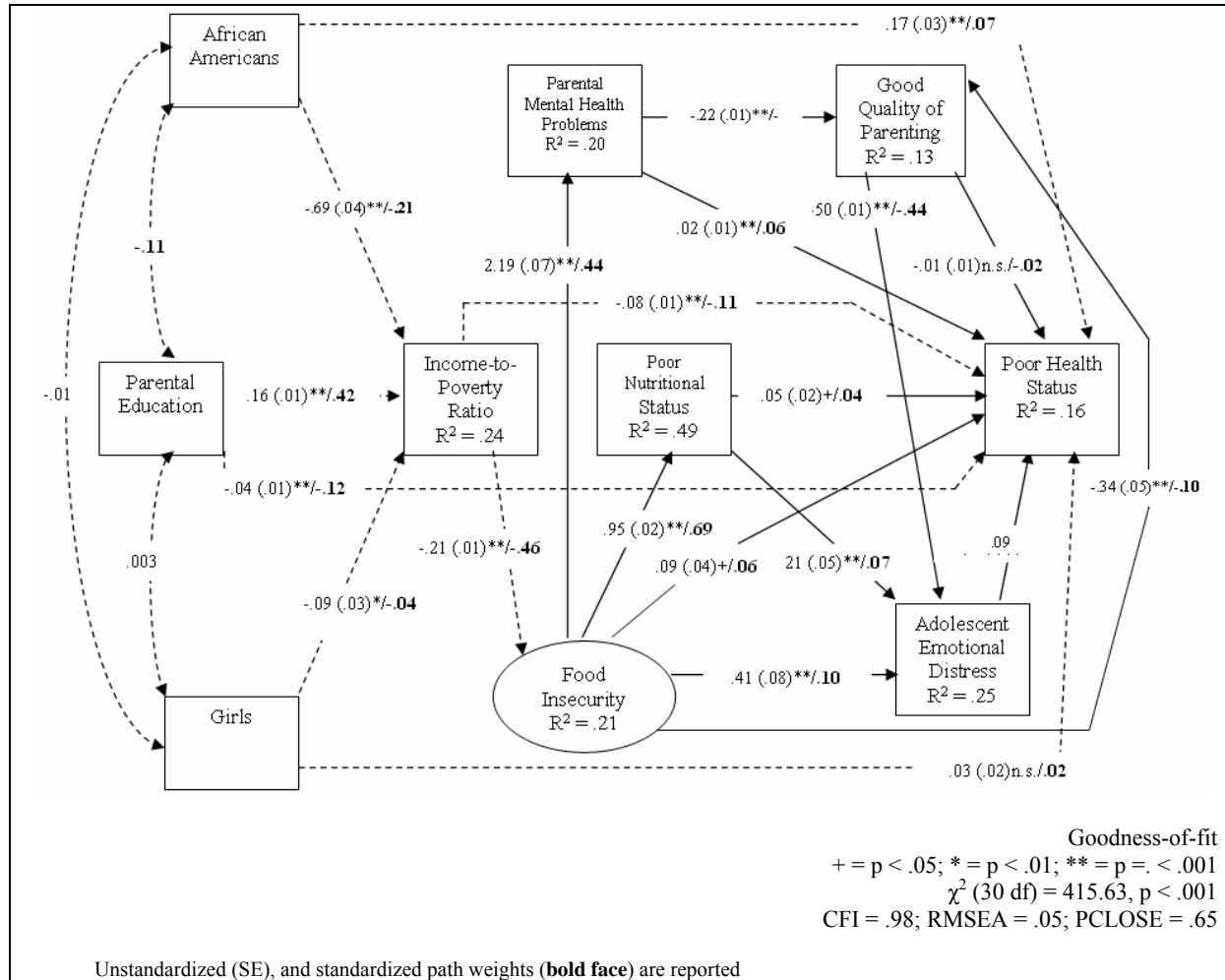


Figure 2
 Structural Model of Food Insecurity and Adolescents' Health Status.

In order to place the relative magnitude of food insecurity in the context of the other constructs (income-to-poverty ratio, parental mental health problems, good quality of parenting, nutritional status, and adolescents' emotional distress), the standardized total relation between each construct and health problems were examined. The findings revealed that adolescents'

emotional distress ($B = .21$) and income-to-poverty ratio ($B = -.19$) had the strongest total effects on health status compared with food insecurity ($B = .17$).

Discussion

This study examined a structural model of the associations among food insecurity, poor

nutritional status, parental mental health problems, good quality of parenting, adolescents' emotional problems, and poor health status for a national sample of 12-to-14 year-old adolescents. Specifically, we hypothesized that that food insecurity would be positively associated with parental mental health problems, poor nutritional status, adolescents' emotional distress, and poor health; and negatively correlated with good quality of parenting. Second, we hypothesized that parental mental health problems will have a negative effect on good quality of parenting and a positive effect on poor health; and that good quality of parenting will have a negative effect on both poor health status and emotional problems. Third, we hypothesized that poor nutritional status will have a positive effect on adolescents' emotional distress and poor health status.

The results show that the hypothesized associations fit the data well. In terms of the first set of hypothesis, the findings revealed that food insecurity predicted elevated levels of parental mental health problems, adolescents' emotional distress, and poor nutritional and health status, and diminished levels of good quality of parenting. These findings show that food insecurity elevates levels of parental mental health problems (Siefert et al., 2001; Wu and Schimmele, 2005), and reduces levels of good quality of parenting. Specifically, these results suggest that restricted parental food intake results in heightened parental mental health problems and detracts from effective parenting. This may be because as parents worry about the lack of food, reduce their portions, or skip meals, they may have less physical energy and the psychological resources needed to parent effectively.

The results are also consistent with the view that food insecurity increases the likelihood of poor health (Alaimo et al., 2002; Ashiabi, 2005; Casey et al., 2001; Cook et al., 2004), emotional distress (Alaimo et al., 2002; Ashiabi, 2005; Harrison, 2003; Reid, 2000), and poor nutritional status (Alaimo et al., 2001; Cristofar and Basiotis, 1992; Rose, 1999; Rose and Oliviera, 1997; Tarasuk and Beaton, 1999).

These findings imply that food insecurity affects adolescents' health status directly; may heighten their level of emotional distress through the stress associated with lack of food; and results in poor nutritional status because of a reduction in regular intake of nutritious meals.

In regard to the second set of hypotheses, the results show that elevated levels of parental mental health problems were associated with diminished good quality of parenting and higher incidence of poor health status. Furthermore, good quality of parenting was associated with a reduction in levels of adolescents' emotional distress, but not with incidence of poor health status. These results are consistent with findings that parental mental health problems are associated with poor quality parenting and health problems for children (Ashman and Dawson, 2002; Repetti et al., 2000).

The finding that good quality of parenting had an ameliorative effect on adolescents' emotional distress is consistent with research showing that quality of parenting has implications for adolescents' psychological well-being (Conger et al., 1992; McLoyd, 1990). Although, good quality of parenting did not have a significant effect on poor health status, the direction of effect was in the expected direction; that is, it showed a negative association with poor health status.

In relation to the last set of hypotheses, we found that poor nutritional status was correlated with elevated levels of emotional distress and higher incidence of poor health status; and that heightened emotional distress correlated with higher incidence of poor health status. These findings suggest that nutritional deficiencies result in poor health, and are consonant with previous speculations (e.g., Alaimo et al., 2001; Cook et al., 2004), that nutritional deficiencies are associated with poor health. Furthermore, the finding that poor nutritional status elevates emotional distress suggests there may be some biological mechanisms at work, such that, poor nutritional status causes or maintains emotional distress (Garner, 1997). Finally, our finding that emotional distress predicted poor health status is consistent with the view that increased levels of

stress could adversely affect the functional role of cortisol production, break down physiological processes, and have negative effects on health (McEwen, 1998; Seeman, McEwen, Rowe, and Singer, 2001).

In terms of the covariates, the findings, consistent with the literature showed that income-to-poverty ratio was associated with food insecurity and health status (Campbell, 1991; Nord et al., 2006; Poppendieck, 1997). Specifically, at higher levels of income-to-poverty ratio, food insecurity declined as did the incidence of poor health status. Also, parental educational level predicted higher levels of income-to-poverty ratio, and reduced incidence of poor health status. The results also showed that the effects of food insecurity on health status were mediated by parental factors, poor nutritional status, and adolescents' emotional well-being.

Although the current study adds to the existing literature, there are some limitations to the study may bear on our findings. First, we did not control for alternative sources of food and nutrition, for example, participation in the food stamp and national school nutrition programs, or receipt of food from informal sources). Receipt of formal or informal help may influence the degree of food insecurity or the perception of food insecurity experienced. Second, we rely on parental reports to explore relationships between food insecurity and school engagement. Although self-report measures of food insecurity may be associated with inadequacies in nutritional intake, we are unable to rule out the possibility that parents who report higher levels of food insecurity are more likely to perceive adolescents as having lower levels of school engagement, regardless of whether such problems exist or not. Specifically, the concern here is that parents who measure high on emotional distress are more likely to report problems of every sort—food insecurity, poor health status, bad parenting, and adolescent emotional problems.

Third, the NSAF items used to assess food insecurity measured food insecurity at the household level, and not linked to an individual

adolescent. Thus, the extent of nutritional deprivation experienced by an adolescent is hard to estimate. Fourth, we did not control for any preexisting health conditions that could confound the observed association between food insecurity and health status. Fifth, we used a proxy measure of nutritional status, so the relationship between food insecurity and nutritional status; and between nutritional status and health may be underestimated.

Sixth, it is important to bear in mind that our analyses focused on the effects of mild food insecurity on health status. The relationships observed may, therefore, be conservative in nature, and families experiencing more severe forms of food insecurity need to be included in future studies addressing these relationships. Finally, the hypothesized associations among the constructs in this study are not the only relationships that could be used to examine the link between food insecurity and health status. Alternative models specifying different relationships could be used to explore the link between food insecurity and health status.

Conclusions

Despite the limitations, the findings point to the following conclusions. First, food insecurity has an independent effect on adolescents' health status. Second, the effects of food insecurity on health are mediated by parental psychological factors (parental mental health problems and quality of parenting), nutritional status, and adolescent emotional distress. Third, parental psychological resources and poor nutritional status have implications for adolescents' emotional distress. Fourth, it emphasizes the seriousness of food insecurity for parents and adolescents, and efforts that need to be taken to assist households deal with food insecurity.

Finally, in line with Campbell's (1991) thesis, the results of this study reveal that food insecurity is both an antecedent and a consequent. Specifically, food insecurity as an antecedent was predictive of parental mental problems, diminished good quality of parenting, poor nutritional status, increased adolescents' emotional problems, and poor health status. On the other hand, as a consequent the findings

show that food insecurity is associated with income resource limitations. These findings imply that any attempt to deal with issues of food insecurity to enable households to become food secure, should also consider those

antecedents, especially resource limitations that continuously place some households and families at risk and results in making them food insecure.

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