The Role of Health Behaviors and Food Insecurity in Predicting Food Intake in Low-Income Children

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The Role of Health Behaviors and Food Insecurity in Predicting Food Intake

in Low-Income Children

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Abstract

Research supports the importance of adequate fruit and vegetable intake during childhood. Despite this fact, there is still much to be learned with regard to predictors of food intake in childhood. The current project examines relationships between physical activity, sedentary behavior, sleep, food insecurity, and food intake in elementary-aged children (i.e., ages 5 – 10). A measurement model was specified to ensure good fit between the data and predictive model. Following this step, the structural model was conducted and several significant findings emerged. Food insecurity significantly predicted vegetable intake (latent regression coefficient = -0.18, $p < .05$), such that children with higher food insecurity consumed fewer servings of vegetables. Physical activity also significantly predicted fruit intake (latent regression coefficient = 0.32, $p < .01$) and vegetable intake (latent regression coefficient = 0.26, $p < .01$), such that children who were more physically active consumed more servings of fruits and vegetables. Implications of the current findings and directions for future research are discussed.

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The Role of Health Behaviors and Food Insecurity in Predicting Food Intake in Low-Income Children

Food consumption is an important health variable to consider for children and adolescents. Consumption of healthy food during childhood has numerous health benefits. In addition to the direct impact that food consumption has on weight gain or weight loss, adequate fruit and vegetable consumption during childhood has been linked to a range of health benefits including decreased risk of chronic illness in adulthood (e.g., cancer; Maynard, Gunnell, Emmett, Frankel, & Smith, 2003) and reduction of body mass index (BMI) for overweight children (Epstein, Paluch, Beecher, & Roemmich, 2008). Despite proven health benefits, the majority of children consume fewer daily servings of fruits and vegetables than recommended by the USDA (Epstein et al., 2001; Gross, Davenport Pollack, & Braun, 2010; Guenther, Dodd, Reedy, & Krebs-Smith, 2006). Some evidence indicates that elementary-aged children are less likely to consume the USDA recommended amount of fruits and vegetables than younger children (Lorson, Melgar-Quinonez, & Taylor, 2009). However, results encouragingly suggest that fruit and vegetable intake may be a modifiable health behavior. For example, Epstein and colleagues (2001) found that specifically targeting fruit and vegetable intake in a health promotion intervention was most beneficial for families with the poorest baseline eating habits (e.g., high consumption of high-fat, high-sugar foods). For these reasons, among others, food consumption is of critical importance for pediatric psychologists working to promote healthy lifestyles for children and adolescents.

The United States government has targeted increased consumption of fruits and vegetables among children as one of its *Healthy People 2020* objectives (U.S. Department of Health & Human Services, 2012), and numerous governmental programs and partnerships currently exist with the goal of increasing the accessibility and subsequent consumption of fruits and vegetables during childhood (e.g., National School Lunch Program; State Nutritional Action Plans; U.S. Department of Defense Fresh Fruit and Vegetable Program; U.S. Department of Agriculture Food and Nutrition Service, 2008). Despite national initiatives such as these, research consistently highlights that there are subgroups of children who are not accessing or consuming recommended amounts of fruits and vegetables. Specifically, evidence indicates that ethnic minority and socioeconomically disadvantaged youth are less likely than their peers to consume fruits and vegetables (Granner et al., 2004; Rasmussen et al., 2006). Additional evidence from Rasmussen and colleagues (2006) indicates that high socioeconomic status and home availability/accessibility of fruits and vegetables were among several factors consistently and positively associated with increased childhood fruit and vegetable consumption. The fact that low socioeconomic status is associated with decreased fruit and vegetable consumption is particularly disconcerting because many of the aforementioned government programs intentionally target socioeconomically disadvantaged children and families. For example, First Lady Michelle Obama's "Let's Move" campaign, designed to help children develop healthy lifestyles habits including eating fruits and vegetables and increasing exercise, specifically tailors health-information to low-income families (U.S. Department of Agriculture, Center for Nutrition Policy and Promotion, 2011).

In addition to receiving increased national attention, childhood fruit and vegetable consumption fits within the scope of recent conceptual models that describe the etiology of pediatric obesity from a multisystemic perspective. In their (2009) chapter on health promotion, Wilson and Lawman discussed an integration of biopsychosocial and ecological approaches to behavior change as an effective strategy for (a) promoting healthy lifestyle in children and adolescents, and (b) preventing health-compromising behaviors in children and adolescents. Specifically, Wilson and Lawman (2009) used Bronfenbrenner's (1979) ecological model to develop a model of health promotion that considers how microsystemic factors (e.g., caregiver factors), mesosystemic factors (e.g., school factors), exosystemic factors (e.g., community factors), and macrosystemic factors (e.g., public policy initiatives) interact and create health behaviors for a specific child. This model should be useful in advancing the field from cross-sectional intervention studies to "real world" intervention studies with the capacity to create broad and lasting changes. Wilson (2009) furthered this model by proposing an ecologically grounded model that specifically targets health disparities and obesity interventions in youth. She discussed the important role of environmental subsystems on intrapersonal factors, and the role of community level research to better understand the development of obesity-related behaviors (e.g., sedentary behavior) in underserved youth (Wilson, 2009). In order to develop culturally sensitive and appropriate interventions, more research is needed to understand the mechanism through which different factors interact to create and sustain health disparities and behaviors. Further, models such as these highlight the importance of considering a wide range of health behaviors that may increase or decrease the risk of pediatric obesity for a particular child.

Although increased fruit and vegetable consumption and decreased consumption of high-fat foods are key components of recent obesity-prevention models and initiatives, few studies have examined factors that impact fruit and vegetable consumption in childhood. Specifically, while studies do exist examining relationships between health behaviors and food consumption in adolescents and teenagers (e.g., Neumark-Sztainer, Wall, Perry, & Story, 2003), fewer studies have examined this relationship among elementary-aged children. Existent data highlights the importance of considering specific health behaviors that may impact food consumption. Thus, the current study makes a contribution to the literature by examining the impact of three specific health behaviors (sedentary behavior, physical activity, and sleep) on fruit and vegetable consumption, as well as the impact of food insecurity. The following section describes the specific health variables that will be examined in the current dissertation study.

Health Behaviors and Food Consumption

Physical activity and food consumption. Few studies have examined the relationship between physical activity and food consumption in children. Evidence from a recent review (Nelson et al., 2011) indicates that children who participate in sports are more likely than non-athletes to consume healthy foods, although children who play sports may also "overcompensate" for their physical activity via consumption of fast food and sugary sports drinks (e.g., Gatorade®). Nutrition interventions including a specific physical activity component have been associated with increased post-intervention consumption of fruits and vegetables (Rosario et al., 2012). Some evidence indicates that physical activity and consumption of fruits and vegetables are positively associated for elementary-aged girls (Craig, McNeill, Macdiarmid, Masson, & Holmes, 2010).

Sedentary behavior and food consumption. Although sedentary behavior and physical activity may appear to be different names for the same construct, it is possible for children to be both highly active and highly sedentary. For example, a child might participate in after-school sports for several hours each day, and also watch television for several hours each day. Sedentary behavior has been implicated in the development and maintenance of pediatric obesity and overweight (e.g., Mitchell, Pate, Beets, & Nader, 2013). Previous research indicates that sedentary behavior (e.g., "screen time") is positively correlated with poor diet quality and negatively correlated with healthy food intake (Lipsky & Iannotti, 2012; Moreira et al., 2010;

Pearson & Biddie, 2011). Yannakoulia and colleagues (2004) found that television viewing was positively associated with the consumption of unhealthy foods in a population of Greek adolescents who reported eating a high percentage of fruits and vegetables daily. Similar results from Utter and colleagues (2003) suggest that high television/video use is negatively correlated with fruit and vegetable consumption in adolescents. Boynton-Jarrett and colleagues (2003) found that both baseline amount of television watching and increases in television watching from baseline were independent predictors of decreased fruit and vegetable consumption. They suggested that the role of advertisements for unhealthy food is a potential mechanism underlying this finding (Boynton-Jarrett et al., 2003). While much of the existent research regarding sedentary behavior and food intake focuses on adolescents, research suggests a connection between sedentary behavior (e.g., screen time) and decreased fruit and vegetable consumption in childhood. More information is essential to determine whether a similar relationship exists between food intake and sedentary behavior for younger children.

Sleep and food consumption. Accumulated evidence suggests that short sleep duration (< 7 hours per night) is associated with poor quality food consumption (i.e., low fruit and vegetable consumption, high-fat diet) and high BMI for adults (Baron, Reid, Kern, & Zee, 2011; Stamatakis & Brownson, 2008). Similar evidence exists for adolescents, whereby those adolescents who slept less than eight hours nightly had a lower probability of consuming fruits and vegetables and a higher probability of consuming energy-dense foods than adolescents who slept for at least eight hours nightly (Garaulet et al., 2011). Evidence suggests that longer sleep duration is associated with intake of fruits and vegetables (Moreira et al., 2010) and short sleep duration in childhood is associated with higher intake of energy-dense unhealthy foods and lower intake of healthy foods (Moreira et al., 2010; Westurland, Ray, & Roos, 2009). Additional evidence from systematic reviews and meta-analyses suggests that inadequate sleep is an important factor to consider in the development of pediatric obesity (Cappuccio et al., 2008; Taheri, 2006). Further, longitudinal analyses indicate that increased nightly sleep is associated with decreased risk of pediatric obesity or overweight (Carter, Taylor, Williams, & Taylor, 2011). Kjeldsen and colleagues (2014) found that short sleep duration and sleep problems in childhood were associated with an energy-dense diet and high intake of added sugar, although the directionality of this relationship could not be determined. Additionally, Golley, Maher, Matricciani, and Olds (2013) found that sleep timing was associated with childhood diet quality such that children with early bedtimes consumed more fruits and vegetables than children with later bedtimes. Furthermore, children with later bedtimes consumed more energy-dense, nutrient-poor foods (Golley et al., 2013).

Although the mechanism responsible for this relationship is not yet clearly established, a growing body of literature has linked shorter sleep duration to increased levels of ghrelin, an important appetite stimulating hormone, and decreased levels of leptin, an appetite suppressing hormone (e.g., Spiegel et al., 2004; Spiegel, Tasali, Penev, & Van Cauter, 2004). Additional biological mechanisms linking sleep timing to food intake have been postulated, with a clear call for more information regarding the relationship between sleep and food intake in childhood.

Food Insecurity and food consumption. Research has indicated that perceived and actual accessibility of healthy foods has an impact on food consumption and health. The evidence indicates that food insufficiency significantly predicts poor health among low-income and middle-income children, even after controlling for factors that are frequently associated with food insecurity (e.g., family income, race; Alaimo, Olson, Frongillo, & Briefel, 2001). Similarly, neighborhood availability of vegetables is an important indicator of vegetable consumption (Bodor, Rose, Farley, Swalm, & Scott, 2007) and the quality of available food in low-income areas impacts grocery shopping and food consumption (Hendrickson, Smith, & Eikenberry, 2006). In their systematic review of the literature, Jago, Baranowski, and Baranowski (2007) found that availability of fruits and vegetables in the home was consistently associated with increased intake among children and adolescents. This finding is supported by additional research specific to children in low-income schools (Gross et al., 2010). Kratt, Reynolds, and Shewchuk (2000) used multi-group structural equation modeling to test the moderating influence of availability of fruit and vegetables on the relationship between motivating factors for eating fruits and vegetables (outcome expectations, self-efficacy, and behavioral capability/knowledge) and actual fruit and vegetable consumption. They found that availability did moderate the relationship between these variables, such that families with high and medium availability consumed more fruits and vegetables than families with low availability. Further, in addition to children in the high availability group eating more fruits and vegetables than children in the low and medium availability groups, results suggested that parents in the high availability group had more influence on their child's fruit and vegetable consumption and were more likely to endorse their consumption. Additional research suggests that low-income children are oftentimes aware of their financial situation and may overeat whenever food is available in the home (Dammann & Smith, 2010); in this regard, food insecurity and availability may "override" positive health behaviors for low-income children. Further, low-income mothers may recognize the health benefits of eating fruits and vegetables but perceive these items to be too expensive, particularly towards the end of the month when Supplemental Nutrition Assistance Program (SNAP; formerly food stamps) allotments are used up (Wiig & Smith, 2008). This possibility is consistent with evidence from a national survey on eating habits of low-income families that indicates that, as food insecurity increases, parents are less likely to purchase healthy food due to perceived cost, despite a desire to prepare healthy food for their children (Share Our Strength, 2012).

Consistent with their objective of increasing childhood consumption of fruits and vegetables, decreased food insecurity and decreased rate of childhood obesity are also targeted goals of the *Healthy People 2020* initiative (U.S. Department of Health & Human Services, 2012). Further, policy experts have found that increasing the availability and affordability of locally grown fruits and vegetables through state-level programs (e.g., double value coupon programs that match dollar-by-dollar amounts spent at farmers' markets by individuals using funds from SNAP) drastically increases the amount of fruits and vegetables consumed by low-income families (Kramer & Zakaras, 2011). Despite these admirable initiatives, such programs are uncommon and food insecurity remains an important variable to consider when exploring childhood food consumption.

Current Study

Research indicates a clear link between specific health behaviors and food intake. Food intake is important for a variety of reasons; among them is the apparent link between food consumption and the development of pediatric obesity. Despite the fact that theoretical models include food/nutrition as a critical factor in the development of pediatric obesity and that ambitious government programs exist on the state and national level to increase the consumption of healthy foods in childhood, there is still much to be learned with regard to predictors of food intake. The current study seeks to address this gap by examining relationships between key health behaviors and food intake in elementary-aged children (i.e., ages 5 – 10). Further, the role of food insecurity on fruit and vegetable consumption will be evaluated. By including individual-level factors (e.g., physical activity) and broader community-level factors (e.g., service usage), the current study represents an ecologically-informed approach to fruit and vegetable consumption. Based on the relatively nascent body of literature, the following hypotheses have been formed: (1) positive health behaviors (i.e., sleeping an adequate amount per night, engaging in adequate amounts of physical activity, engaging in appropriate non-excessive amounts of screen time) will be related to consumption of fruits and vegetables, such that children who engage in positive health behaviors will consume more fruits and vegetables than other children; (2) food insecurity will be related to consumption of fruits and vegetables, such that children living in households that are not characterized by food insecurity will consume more fruits and vegetables than children living in households categorized by food insecurity; and (3) children of "repeat" participants in a program intended to increase access to healthy food (e.g., "double value coupon program") will have increased fruit and vegetable consumption, compared to children from similar socioeconomic backgrounds whose parents do not regularly participate in such a program.

Method

Participants

Participants in the current study were eligible parents or caregivers of children between the ages of 5-10. Participants were eligible to participate in the study if they were English speaking, had a child in their care between the ages of 5-10, and received services through an organization devoted to serving low-income individuals in the Kansas City metro area. Data were collected from 171 individuals. However, 23 individuals who completed the survey were excluded prior to data analysis for the following reasons: individual completed measures about a child who was outside of the designated age range for inclusion (n = 12), individual provided insufficient information about child (did not provide date of birth, *n* = 4; did not provide any information except date of birth, *n* = 1), individual was non-English speaking and completed survey with assistance of interpreter (*n* = 3), individual had previously completed the measures for a different child (*n* = 3). Data from 148 participants were retained for statistical analysis.

Of these 148 individuals, 109 participants were recruited while receiving services through the Kansas City Beans & Greens Program. The Beans & Greens program aims to increase access to healthy food for families receiving SNAP benefits by providing a weekly match (up to $25 per week) for families using SNAP allowances to purchase healthy, locally-sourced food. Thirty nine participants were recruited while receiving services (e.g., childcare, access to food pantry, case management) through other organizations in the Kansas City Area (i.e., Operation Breakthrough, Harvesters, Ailey Camp).

Procedure

Data collection occurred in July-September of 2013 at various locations in the Kansas City metro area. Potential participants were approached by the principal investigator during their usual service usage (e.g., during SNAP transaction at a farmer's market; during pick-up from childcare) and asked to participate in the survey through an informed consent procedure. Prior to completing the survey, participants were asked whether they had previously used Beans & Greens services. If interested participants had more than one child in the eligible age range, they were instructed to randomly select one child about whom to answer the survey questions. Participants received a $6 voucher for use at any Beans & Greens location upon completion of the survey. All study procedures were approved by the Institutional Review Board at the University of Kansas.

Measures

Demographics. Parents/caregivers provided basic demographic information, including gender, race/ethnicity, annual income, and family size. Parents/caregivers also provided information about the child about whom they were answering questions, and about the frequency of their Beans & Greens use.

Food Intake. Food intake was assessed using the What Foods Did You Eat measure, which is a brief fruit and vegetable screener (Weber Cullen et al., 1999). This measure was initially designed for and used in a study examining food intake in an urban African-American sample of 9-14 year old children, and collects information on weekly consumption of a range of fruits and vegetables. The questionnaire was adapted for parents in the current study. A Cronbach's alpha of 0.95 was obtained for the current sample, reflecting excellent internal consistency.

Food Insecurity. The U.S. Household Food Security Survey Module was utilized to determine food security/insecurity of study participants (Economic Research Service, 2012). This 18-item questionnaire is recommended for measurement of food insecurity by the USDA. The Household Food Security Survey assesses whether a household can afford to meet its basic food needs and behavior related to having enough food in the household (e.g., skipping meals; Bickel, Nord, Price, Hamilton, & Cook, 2000). In addition to household level questions, the survey contains adult-specific and child-specific questions and yields three separate index scores (i.e., household food security status, adult food security status, child food security status). This division makes it possible to discern whether food insecurity affects parents and children differently. The measure uses cutoff scores to determine level of household food insecurity. The survey is designed to be administered as an interview; to protect participant anonymity and decrease potential social desirability bias regarding this sensitive topic, the survey was reformatted to be a self-administered questionnaire for the current study. A Cronbach's alpha of 0.75 was achieved for the current sample, reflecting good internal consistency.

Physical Activity and Sedentary Behavior. Data regarding physical activity and sedentary behavior were collected using items adapted from the National Youth Risk Behavior Survey (YRBS; Center for Disease Control, 2013). The National Youth Risk Behavior Survey is a widely used survey designed to assess a wide range of child and adolescent health behaviors. The measure is typically administered as a self-report survey for adolescents, and was adapted for parents for the purpose of this study. Specifically, questions from the YRBS regarding daily time spent watching television, daily time spent on the computer, and daily time spent in physical activity were reworded such that parents could respond about their children. For the current study, the overall Cronbach's alpha was 0.59, reflecting adequate internal consistency. The Cronbach's alpha for the four questions about sedentary behavior was 0.79, reflecting good internal consistency. The Cronbach's alpha for the two questions about physical activity was 0.25, reflecting poor internal consistency.

Sleep. The Children's Sleep Habits Questionnaire (CHSQ; Owens, Spirito, & McGuinn, 2000) was used as a parent-reported indicator of sleep duration and quality. The CHSQ is a 35-item valid and reliable measure for children ages 4-10 years old, and is regarded as a "well-established" pediatric sleep measure (Lewandowski, Toliver-Sokol, & Palermo, 2011, p. 788). Items are scored on a three point scale, with higher scores representing more frequent occurrences of problem behavior. Select items are reverse scored to remain consistent with this interpretative pattern. In addition to information about weekly sleep schedule (i.e., bedtime and wakeup), the CHSQ provides subscale scores for a range of problematic sleep behaviors (e.g., sleep anxiety, nighttime waking) and a summative Total Sleep Problems index score. The authors note that a total score of 41 or higher tends to reflect sleep problems, although no established norms exist. A Cronbach's alpha of 0.82 was achieved for the current sample, reflecting good internal consistency.

Analytic Method

Structural equation modeling (SEM) techniques were utilized in the current project (Kline, 2005), and all analyses were conducted in Mplus 7th Edition (Muthén & Muthén, 1998 – 2012). The current analyses were adequately powered, per an a priori power analysis (Schoemann, Preacher, & Coffman, 2010). There were very little missing data in the current analyses (i.e., less than 5% missing data for most variables included in the measurement and structural models); however, full information maximum likelihood (FIML) techniques were used in order to accurately capture and account for any missing data. Data analyses began by specifying and fitting a measurement model using confirmatory factor analysis (CFA). This step determines whether item-level indicators are appropriately loading on latent variables, specifies relationships between item-level indicators and estimated latent variables, and allows for any re-specification of the model based on suboptimal fit. For latent variables reflecting fruit and vegetable consumption, indicator items were grouped into parcels in order to promote greater parsimony in the model (Little, Cunningham, Shahar, & Widaman, 2002). For the latent variable reflecting food insecurity, sum scores for adult food insecurity and child food insecurity were used as indicators. The decision to use sums as opposed to parcels was made because many of the items comprising the food insecurity measure were on different scales, and there was no meaningfully way to equate these scales. Utilizing the sum scores that were created for scoring and interpreting the measure ensured maximum interpretability of the model and regression paths.

Because the chi-square test of model fit is highly sensitive to sample size, the fit of the measurement model was assessed via alternate, commonly utilized fit indices. Specifically, model fit was assessed via the Root Mean Square Error of Approximation (RMSEA), CFI/TLI, and Standardized Root Mean Square Residual(SRMR) fit indices. Commonly accepted guidelines suggestive of good fit were utilized; specifically, a value of 0.95 was utilized for CFI/TLI, a value of 0.06 was utilized for RMSEA, and a value of 0.08 was utilized for SRMR (Hu & Bentler, 1999).

Following specification of the measurement model, the structural model was run. Based upon evidence in the literature, gender and age were included as covariates in the model (e.g., Rasmussen et al., 2006). Low socioeconomic status is another commonly cited correlate of fruit and vegetable intake in the literature; however, socioeconomic status was not included as a covariate because low socioeconomic status was required for participation in the current study. In order to discern whether food consumption was impacted by Beans & Greens service usage, a variable reflecting service usage was also added to the model. Please refer to Figure 1 for a visual depiction of the final structural model.

Results

Descriptive Statistics

The majority of study participants were female *(n* = 127; 85.8%), and identified themselves as the parent of the 5-10 year old child (*n* = 125; 84.5%). Parents/caregivers were between the ages of 22.93 – 95.71 (*M* = 35.23; *SD* = 9.59). One hundred and thirty two participants (89.2%) reported that they lived with the target child all of the time, with the remaining 16 participants reporting partial or shared custody. The sample was racially diverse, with the majority of participants identifying as Caucasian (*n* = 81; 55.5%) or African American (*n* = 62; 42.5%). Regarding ethnicity, 68.9% (*n* = 93) of the sample indicated that they were not Hispanic/Latino. The majority of participants reported an annual income not exceeding $20,000 (*n* = 94; 65.8%), and had completed some college (*n* = 59; 41.0%). Most participants reported that they lived in a house (*n* = 75; 51.4%), with an average of 4.49 other individuals (range = 0 – 12). Participants reported an average of 2.78 children per household (range = 1-10).

Child gender was evenly split between male (*n* = 76, 51.4%) and female. The most frequently reported child racial identities were White (*n* = 78, 53.4%) or African American (*n* = 74, 50.7%), with two participants not providing information about racial identity. The average age of target children was 7.73 (range = 5.05-10.91; *SD* = 1.67). See Table 1 for complete demographic information.

Table 1

Demographic Characteristics of Study Participants

Variable	**Mean (SD)**	**Range**	**% Missing Data**
Child Age	7.73 (1.67)	5.05-10.91	
Caregiver Age			
Individuals in Household	4.49 (2.05)	0 – 12	
Children in Household	2.78 (1.59)	1 – 10	
	N	**Valid Percentage**	**% Missing Data**
Caregiver Gender			0
Male	21	14.2	-
Female	127	85.8	-
Caregiver Race			1.4
White	81	55.5	-
African American	62	42.5	-
Asian	2	1.4	-
Indian	8	5.5	-
Islander	1	0.7	-
Other	7	4.8	-
Caregiver Ethnicity			8.8
Hispanic/Latino	12	8.9	-
Not Hispanic/Latino	93	68.9	-
Caregiver Marital Status			0

Married	39	26.4	-
Single	70	47.3	-
In a relationship, cohabitating	30	20.3	-
In a relationship, not cohabitating	5	3.4	-
Other	4	2.7	-
Annual Income			3.4
Below $10,000	46	32.2	-
Between $10,001-$20,000	48	33.6	-
Between $20,001-$30,000	29	20.3	-
Between $30,001-$40,000	15	10.5	-
Between $40,001-$50,000	4	2.8	-
Between $50,001 - $60,000	1	0.7	-
Caregiver Education Obtained			2.7
Some High School	10	6.9	-
High School Graduate/GED	34	23.6	-
Trade School or Community College	14	9.7	-
Some College	59	41.0	-
College Graduate	24	16.7	-
Graduate/Professional School	3	2.1	-
Repeat User of Beans & Greens			0.7
Yes	92	62.2	-
No	55	37.2	-
Child Gender			1.4
Male	76	51.4	-
Female	72	48.6	-
Child Race			1.4
White	78	53.4	-
African American	74	50.7	-
Asian	4	2.7	-
Indian	9	6.1	-
Islander	2	1.4	-
Other	12	8.2	-
Child Ethnicity			8.8
Hispanic/Latino	14	10.4	-
Not Hispanic/Latino	121	89.6	-
Child grade completed			2.7
Preschool	21	14.6	-
K	28	19.4	-
1^{st}	25	17.4	-
2^{nd}	28	19.5	-
3^{rd}	24	16.7	-
4^{th}	15	10.4	-
5^{th}	2	1.4	-
6^{th}	1	0.7	-

Parents/caregivers reported a mean household food insecurity score of 6.22 (*SD* = 4.61), corresponding to high food insecurity. A mean adult food insecurity score of 4.41 (*SD* = 3.19) was reported, corresponding to high food insecurity for adults in the household, and a mean child food insecurity score of 1.83 (*SD* = 1.91) was reported, corresponding to marginal/high food insecurity for children in the household. Parents/caregivers reported that their children were typically active on 5.72 days of the week (*SD* = 1.71), and, on average, had a Total Sleep Problems score of 44.19 (*SD* = 7.45). This Total Sleep Problems score is above the suggested cut-off score of 41 for identifying children with clinical sleep problems (Owens, Spirito, & McGuinn, 2000). Refer to Tables 2-5 for complete descriptive information about child food consumption, household food insecurity, physical activity, sedentary behavior, and sleep behavior.

Table 2

Child Fruit and Vegetable Consumption

Variable	**Mean (SD)**	**Range**	**Skew**	**Kurtosis**	**% Missing Data**
Bananas	2.00 (1.09)	0-5	.02	-0.30	2.7
Apples	2.09 (1.09)	0-4	-.28	-0.47	1.4
Melon	1.11 (1.11)	0-4	.60	-0.64	3.4
Grapes	1.81 (1.09)	0-5	.09	-0.27	2.0
Pears	0.83 (1.20)	0-5	1.39	1.10	2.7
Plums	0.65 (1.08)	0-5	1.74	-0.71	3.4
Kiwi	0.70 (1.07)	0-5	1.60	2.50	4.7
Berries	1.79 (1.21)	0-5	0.72	-0.72	4.1
Pineapple	0.92 (1.08)	0-4	0.87	-0.32	2.7
Grapefruit	0.37 (0.82)	0-4	2.38	5.10	2.0
Fruit Salad	1.16 (1.30)	0-5	0.98	0.31	1.4
Watermelon	1.37 (1.27)	0-5	0.82	0.31	3.4
Peaches	1.06 (1.14)	0-4	0.69	-0.75	2.7
Carrots	1.62 (1.22)	0-4	0.19	-0.98	3.4
Celery	0.90 (1.09)	0-4	1.02	0.04	2.7
Leafy Greens	1.66 (1.38)	0-5	1.38	-0.91	2.0
White potatoes	1.54 (1.15)	0-5	1.15	-0.46	3.4
Corn	1.68 (1.14)	0-5	1.14	-0.60	2.7
Green Peas	1.10 (1.17)	0-5	1.17	-0.10	3.4
Tomatoes	1.58 (1.27)	0-5	1.27	-0.86	2.7
Broccoli	1.58 (1.21)	0-4.5	1.21	-0.85	2.0
Lettuce	1.70 (1.23)	0-5	1.23	-0.80	2.0

Green Beans	1.84 (1.11)	0-5	1.11	-0.26	2.0
Cooked beans	1.17 (1.26)	0-5	1.26	0.64	1.4
Sweet potatoes	0.82 (1.09)	0-4	1.09	0.86	2.0
Cabbage	0.91 (1.18)	0-5	1.18	0.58	2.0

Note. 0 = no servings; 1 = 1 serving; 2 = 2-3 servings; 3 = 4-6 servings; 4 = 8 – 14 servings; 5 = 15 or more servings. A survey error exists such that "7 servings" was omitted from the survey.

Table 3

Food Insecurity Status

Variable	**Mean (SD)**	**Range**	**Skew**	**Kurtosis**	**% Missing Data**
Household	6.22 (4.61)	0 – 17	0.43	-0.62	0
Adult	4.41 (3.19)	0 – 10	0.18	-1.13	0.7
Child	1.83 (1.91)	0 – 8	1.32	1.32	0

Note. Household: 0 = low food insecurity, 1-2 = marginal food insecurity, 3-7 = high food insecurity, 8-18 = very high food insecurity; Adult: 0 = low food insecurity, 1-2 = marginal food insecurity, 2-5 = high food insecurity, 6-10 = very high food insecurity; Child: 0-1 = low or marginal food insecurity, 2-4 = high food insecurity, 5-8 = very high food insecurity.

Table 4

Physical Activity and Sedentary Behavior

Variable	**Mean (SD)**	**Range**	**Skew**	**Kurtosis**	**% Missing Data**
Days Active	5.72 (1.71)	0 – 7	-1.43	1.63	0.7
Days PE	2.85 (1.82)	0 – 7	0.42	-0.31	4.1
Weekday Hours TV	2.54 (1.47)	0 – 6	0.32	0.001	0.7
Weekend Hours TV	3.37 (1.53)	0 – 6	-0.24	-0.29	0.7
Weekday Hours Computer	1.56 (1.34)	0 – 6	0.71	-0.01	1.4
Weekend Hours Computer	1.91 (1.57)	0 – 6	0.67	0.007	0.7

Note. Days Active & Days PE: 0 = 0 days, 1 = 1 day, 2 = 2 days, 3 = 3 days, 4 = 4 days, 5 = 5 days, 6 = 6 days, 7 = 7 days; Weekday Hours TV, Weekend Hours TV, Weekday hours computer, Weekend hours computer: 0 = none, 1 = less than 1 hour/day, 2 = 1 hour/day, 3 = 2 hours/day, 4 = 3 hours/day, 4 = 3 hours/day, 5 = 4 hours/day, 6 = 5 or more hours/day

Table 5

Sleep Behavior

Variable	***N***	**Valid Percentage**	**% Missing Data**
Child Weekday Wakeup			2.7
Before 5 AM	1	0.7	-
5:00 AM – 6:00 AM	28	19.5	-
6:01 AM – 7:00 AM	73	50.7	-
7:01 AM – 8:00 AM	30	20.8	-
8:01 AM – 9:00 AM	10	7.0	-
After 9:00 AM	2	1.4	-
Child Weekday Bedtime			2.7
6:00 PM – 7:00 PM	2	1.4	-
7:01 PM – 8:00 PM	31	21.5	-
8:01 PM – 9:00 PM	86	59.7	-
9:01 PM – 10:00 PM	24	16.7	-
10:01 PM – 11:00 PM	1	0.7	-
Child Weekend Wakeup			2.7
5:00 AM – 6:00 AM	7	4.9	-
6:01 AM – 7:00 AM	20	13.9	-

7:01 AM – 8:00 AM	40	27.8	-
8:01 – 9:00 AM	39	27.1	-
9:01 AM – 10:00 AM	19	13.2	-
After 10 AM	6	4.2	-
No set time	13	9.1	-
Child Weekend Bedtime			3.4
6:00 PM – 7:00 PM	1	0.7	-
7:01 PM – 8:00 PM	7	4.9	-
8:01 PM – 9:00 PM	43	30.1	-
9:01 PM – 10:00 PM	47	32.9	-
10:01 PM – 11:00 PM	27	18.9	-
11:01 PM – 12 AM	11	7.7	-
After midnight	1	0.7	-
No set time	6	4.2	-

CHSQ Subscale	Mean (SD)	Range	Skew	Kurtosis	% Missing Data
Bedtime Resistance	7.94 (2.60)	6 – 17	1.52	1.58	0.7
Sleep Onset Delay	1.39 (0.66)	1 – 3	1.46	0.82	0.7
Sleep Duration	3.63 (1.14)	3 – 8	1.87	2.78	0.7
Sleep Anxiety	5.33 (1.98)	4 – 12	1.78	2.64	0.7
Night Waking	3.75 (1.14)	3 – 8	1.75	3.08	0.7
Parasomnias	8.59 (2.03)	7 – 18	2.05	5.77	0.7
Disordered Breathing	3.40 (0.92)	3 – 9	3.16	12.47	0.7
Sleepiness	11.79 (2.82)	8 – 21	0.79	0.47	1.4
Total Problems	44.19 (7.45)	34 – 76	1.41	2.98	3.4
Weekday Duration*	10.21 (1.02)	5 – 13.5	-0.58	4.87	3.4
Weekend Duration*	10.52 (1.35)	5 – 13.5	-0.89	2.45	14.2

Note. For all subscales (Bedtime resistance – sleepiness), higher scores are indicative of more problem behaviors. * = Weekday duration and weekend duration are not subscales on the CHSQ, but was computed for use in the measurement and structural models. If a specific time was not reported (e.g., "no set time," the value was recoded as missing to compute these variables.

Measurement Model

Prior to completing the structural model, the data were checked for univariate normality by assessing skew and kurtosis for each parcel and indicator that was utilized to comprise latent variables. Refer to Table 6 for complete information regarding skew and kurtosis. Despite univariate normality across estimators, a robust maximum likelihood estimator (i.e., MLR) was used to correct for any potential non-normality in the data and provide the most accurate standard error values and test statistics. Following data checking for normality, the measurement model was specified. All parameters were freely estimated. The variance for all latent variables was fixed to one. For factors that were comprised of one observed variable (i.e., physical activity), the variance of the indicator variable was fixed to zero. Additionally, the error variance of one indicator (i.e., adult food insecurity status) was fixed to zero, as it was on the boundary of inadmissibility. The measurement model met criteria for good fit per previously discussed cut off values. Specifically, the measurement model obtained an RMSEA of 0.05, TLI of 0.97, CFI of 0.98, and SRMR of 0.04. Chi-square test of model fit was 94.30 (p = 0.03; df = 71). Factor loadings were all strong (i.e., standardized loadings greater than 0.6), and R^2 values were generally favorable (i.e., greater than 0.5 for all indicators except child food insecurity). Refer to Table 7 for parameter estimates.

Several changes were made to the initial measurement model to improve model fit, based upon correlations between items comprising proposed latent variables. First, a variable reflecting days of participation in PE classes was removed from the model because this variable was uncorrelated with other indicator variables. This lack of correlation suggests that parents/caregivers who completed the measure may have lacked information about physical activity class participation by their children. Alternately, the question may have been confusing because data collection occurred over the summer when children were not in school. After removing this variable from the model, the latent construct reflecting physical activity was comprised of an indicator variable reflecting days in which the child was active for more than 60 minutes. An initially specified latent variable reflecting sedentary behavior was divided into two separate latent variables, one reflecting time spent watching television (i.e., during the week and over the weekend) and the other reflecting time spent using the computer (i.e., during the week and over the weekend). This decision was made because the two variables reflecting television viewing were highly correlated with one another and the two variables reflecting computer usage were highly correlated with one another, but the television and computer variables were not correlated. Additionally, the subscales measuring sleep behavior on the CHSQ (e.g., sleep disturbances, sleep onset delay) were poorly correlated with one another and did not adequately reflect the sleep latent variable. Further, the nascent literature regarding sleep and fruit and vegetable intake generally suggests that sleep duration is important to consider, as opposed to sleep quality. As such, two variables indicative of sleep duration (weekend and weekday) were utilized to comprise the latent variable of sleep, and subscales were discarded from the model. These changes improved model fit and reflect the most appropriate measurement model.

The latent variable reflecting fruit consumption had a 0.87 correlation with the latent variable reflecting vegetable consumption. Fruit consumption had a -0.12 correlation with food insecurity, a 0.32 correlation with physical activity, a 0.16 correlation with television usage, a 0.04 correlation with computer usage, and a -0.07 correlation with sleep. Vegetable consumption had a -0.16 correlation with food insecurity, a 0.24 correlation with physical activity, a 0.19 correlation with television usage, a -0.01 correlation with computer usage, and a -0.01 correlation with sleep. Food insecurity had a -0.19 correlation with physical activity, a -0.01 correlation with television usage, a -0.20 correlation with computer usage, and a 0.26 correlation with sleep. Physical activity had a 0.18 correlation with television usage, a 0.11 correlation with computer usage, and a -0.33 correlation with sleep. Television usage had a correlation of 0.47 with computer usage, and a correlation of -0.10 with sleep. Computer usage had a -0.06 correlation with sleep.

Table 6

Loading and Intercept Values, Residuals, and R^2 Values for Indicators, and Estimated Latent Variance from Measurement Model

Indicator		Equated Estimates Loading (SE)	Equated Estimates Intercept (SE)	Loading (SE)	Standardized Theta	R^2
Fruit Intake						
	Parcel 1	0.78 (0.06)	1.47 (0.07)	0.89 (0.03)	0.21	0.79
	Parcel 2	0.74 (0.08)	1.14 (0.07)	0.86 (0.03)	0.26	0.74
	Parcel 3	0.79 (0.08)	1.16 (0.07)	0.90 (0.03)	0.19	0.81
Vegetable Intake						
	Parcel 1	0.84 (0.06)	1.34 (0.08)	0.92 (0.02)	0.15	0.85

Parcel 2	0.76 (0.06)	1.32 (0.07)	0.85 (0.03)	0.28	0.72
Parcel 3	0.81 (0.06)	1.53 (0.08)	0.87 (0.03)	0.25	0.75
Food Insecurity					
Adult Insecurity Status	3.18 (0.12)	4.41 (0.26)	1.00 (0.00)	0.00†	1.00
Child Insecurity Status	1.15 (0.15)	1.82 (0.16)	0.61 (0.05)	0.63	0.34
Physical Activity					
Days Active	1.82 (0.10)	2.82 (0.15)	1.00 (0.00)	0.00	1.00
Sleep					
Weekday Duration	0.81 (0.17)	10.21 (0.09)	0.79 (0.12)	0.37	0.63
Weekend Duration	0.99 (0.22)	10.48 (0.12)	0.74 (0.13)	0.45	0.55
Television (TV) Usage					
TV hours weekday	1.42 (0.19)	2.54 (0.12)	0.96 (0.11)	0.08	0.93
TV hours weekend	1.14 (0.17)	3.37 (0.13)	0.75 (0.10)	0.43	0.57
Computer Usage					
Computer hours weekday	1.25 (0.17)	1.57 (0.11)	0.93 (0.11)	0.13	0.87
Computer hours weekend	1.26 (0.18)	1.90 (0.13)	0.80 (0.10)	0.36	0.64

Note. † indicates that error variance was fixed to zero.

Table 7

Mean, Range, Skew, Kurtosis for Parcels and Indicator Variables

Indicator	Mean(SD)	Range	Skew	Kurtosis
Fruit Intake				
Parcel 1	1.46 (0.88)	0.00 – 4.00	0.82	0.50
Parcel 2	1.13 (0.87)	0.00 – 4.33	1.21	1.34
Parcel 3	1.15 (0.87)	0.00 – 4.00	1.26	1.31
Vegetable Intake				
Parcel 1	1.34 (0.92)	0.00 – 4.00	0.69	0.02
Parcel 2	1.30 (0.89)	0.00 – 4.00	0.78	0.14
Parcel 3	1.52 (0.94)	0.00 – 4.20	0.52	-0.14
Food Insecurity				
Adult Insecurity Status	4.41 (3.19)	0.00 – 10.00	0.18	-1.13
Child Insecurity Status	1.83 (1.91)	0.00 – 8.00	1.32	1.32
Physical Activity				
Days Active	2.85 (1.82)	0.00 – 7.00	0.43	-0.31
Sleep				
Weekday Duration	10.21 (1.02)	5.00 – 13.50	-0.58	4.87
Weekend Duration	10.52 (1.35)	5.00 – 13.50	-0.89	2.45
Television (TV) Usage				
hours weekday	2.54 (1.48)	0.00 – 6.00	0.32	0.00
hours weekend	3.37 (1.53)	0.00 – 6.00	-0.24	-0.29
Computer Usage				
hours weekday	1.56 (1.34)	0.00 – 6.00	0.71	-0.01
hours weekend	1.91 (1.57)	0.00 – 6.00	0.67	0.01

Structural Model

Similar to the techniques used for estimation of the measurement model, a robust maximum likelihood estimator (i.e., MLR) was used for the structural model to correct for any potential non-normality in the data and provide the most accurate standard error values and test statistics. All parameters were freely estimated. The variance for all latent variables was fixed to one. For factors that were comprised of one observed variable (i.e., physical activity), the variance of the indicator variable was fixed to zero. As was done in the measurement model, the error variance of one indicator (i.e., adult food insecurity status) was fixed to zero, as it was on the boundary of inadmissibility. Indicator variables for age and gender were included in the structural model as covariates, based upon previously published literature. In an examination of hypothesis #3, Beans & Greens service usage was also included in the structural model as an indicator variable. One individual was excluded from the structural model by MPlus because information about service usage was missing, and FIML procedures do not account for missing data among covariates. The structural model had reasonably good fit; specifically, the model obtained an RMSEA of 0.06, TLI of 0.94, CFI of 0.95, and SRMR of 0.06. Chi-square test of model fit was 165.19 ($p < .01$; $df = 110$). Factor loadings were all strong (i.e., standardized loadings greater than 0.6), and R^2 values were favorable (i.e., greater than 0.5 with the exception of child food insecurity). Refer to Table 8 for parameter estimates.

Several paths in the structural model were significant after controlling for gender and age. Physical activity significantly predicted fruit intake ($p < .01$) and vegetable intake ($p < .01$), such that children who were more physically active consumed more servings of both fruit and vegetables. Food insecurity predicted vegetable intake ($p < .05$), such that children with higher food insecurity consumed fewer servings of vegetables. Beans & Greens service usage did not have a statistically significant impact on fruit and vegetable consumption. For complete information on regression coefficients in the predictive model, refer to Table 9.

The latent variable reflecting fruit consumption had a 0.87 residual correlation with the latent variable reflecting vegetable consumption. Food insecurity had a -0.17 correlation with physical activity, a -0.01 correlation with television usage, a -0.22 correlation with computer usage, and a 0.26 correlation with sleep. Physical activity had a 0.18 correlation with television usage, a 0.13 correlation with computer usage, and a -0.35 correlation with sleep. Television usage had a correlation of 0.47 with computer usage, and a correlation of -0.10 with sleep. Computer usage had a -0.05 correlation with sleep. The low correlation coefficients among indicator variables suggests that each latent variable comprises a unique construct.

Table 8

Loading and Intercept Values, Residuals, and R^2 Values for Indicators, and Estimated Latent Variance from Structural Model

Indicator	Equated Estimates		Standardized		
	Loading (SE)	Intercept (SE)	Loading (SE)	Theta	R^2
Fruit Intake					
Parcel 1	0.72 (0.05)	1.66 (0.34)	0.88 (0.03)	0.22	0.78
Parcel 2	0.69 (0.06)	1.33 (0.34)	0.86 (0.03)	0.26	0.74
Parcel 3	0.73 (0.06)	1.37 (0.35)	0.91 (0.02)	0.18	0.82
Vegetable Intake					
Parcel 1	0.78 (0.05)	0.86 (0.35)	0.93 (0.02)	0.14	0.86
Parcel 2	0.70 (0.05)	0.89 (0.31)	0.85 (0.03)	0.28	0.72
Parcel 3	0.75 (0.05)	1.07 (0.33)	0.86 (0.03)	0.25	0.75
Food Insecurity					
Adult Insecurity Status	3.18 (0.12)	4.43 (0.26)	1.00 (0.00)	0.00†	1.00
Child Insecurity Status	1.15 (0.15)	1.83 (0.16)	0.60 (0.05)	0.64	0.36
Physical Activity					
Days Active	1.79 (0.10)	2.80 (0.15)	1.00 (0.00)	0.00	1.00
Sleep					
Weekday Duration	0.75 (0.15)	10.21 (0.09)	0.74 (0.10)	0.46	0.54
Weekend Duration	1.09 (0.20)	10.46 (0.12)	0.83 (0.10)	0.31	0.69
Television (TV) Usage					
TV hours weekday	1.44 (0.19)	2.53 (0.12)	0.98 (0.12)	0.05	0.95
TV hours weekend	1.13 (0.17)	3.37 (0.13)	0.74 (0.10)	0.45	0.55
Computer Usage					
Computer hours weekday	1.25 (0.16)	1.58 (0.11)	0.93 (0.11)	0.13	0.87
Computer hours weekend	1.26 (0.17)	1.92 (0.13)	0.80 (0.09)	0.36	0.64
Gender*	-	-	-	-	-
Age*	-	-	-	-	-
Beans & Greens Usage*	-	-	-	-	-

Note. * = included in model as covariate. † indicates that error variance was fixed to zero.

Table 9

Latent Regression Estimations of Latent Variables in Structural Model

Indicator	Latent Regression Estimate (SE)	Standardized Latent Regression Estimate (SE)
Fruit Intake		
Food Insecurity	-0.08 (0.10)	-0.07 (0.09)
Physical Activity	0.35 (0.11)**	0.32 (0.09)**
Television Usage	0.13 (0.14)	0.12 (0.13)
Computer Usage	-0.09 (0.15)	- 0.08 (0.14)
Sleep	0.06 (0.12)	0.05 (0.11)
Gender	0.20 (0.18)	0.09 (0.09)
Age	-0.08 (0.06)	-0.13 (0.08)
Beans & Greens Usage	0.12 (0.19)	0.05 (0.09)
Vegetable Intake		
Food Insecurity	-0.20 (0.10) *	-0.18 (0.09)*
Physical Activity	0.28 (0.11)**	0.26 (0.09)**
Television Usage	0.24 (0.14)	0.22 (0.12)
Computer Usage	-0.20 (0.15)	-0.19 (0.13)
Sleep	0.17 (0.11)	0.16 (0.10)
Gender	0.26 (0.19)	0.12 (0.09)
Age	0.01 (0.05)	0.02 (0.08)
Beans & Greens Usage	0.19 (0.20)	0.09 (0.09)

Note. ** = $p < .01$, * $p < .05$

Discussion

The current study had several significant findings that may be important for understanding the relationship between food insecurity, sleep, physical activity, sedentary behavior, and childhood fruit and vegetable consumption. First, hypothesis #1 was partially supported, such that children who were more physically active had higher consumption of fruit and vegetables. This is consistent with previous literature that found a positive correlation between physical activity and fruit and vegetable consumption in elementary-aged girls (Craig et al., 2010); however, in the current study, this relationship was not impacted by gender. The relationship between physical activity and fruit and vegetable consumption may suggest the existence of a “cluster” of health promoting behaviors in childhood, wherein children who exercise are also more likely to eat healthily. Although sleep, television usage, and computer usage were not significantly related to fruit and vegetable consumption, the direction of the relationships between sleep and computer usage and fruit and vegetable intake were as expected. Specifically, children with longer sleep duration consumed more fruits and vegetables (standardized latent regression coefficient = 0.05 for fruit intake and 0.16 for vegetable intake), and children who used the computer for more hours each day consumed fewer servings of fruits and vegetables (standardized latent regression coefficient = -0.08 for fruit intake and -0.19 for vegetable intake). The direction of the relationship between television viewing and fruit and vegetable intake was the opposite of what was predicted (standardized latent regression coefficient = 0.12 for fruit intake and 0.22 for vegetable intake). This relationship was not significant, but may suggest that children are more likely to eat while watching television, regardless of the nutritional quality of the food.

Hypothesis #2 was also partially supported, in that higher levels of food insecurity significantly predicted decreased vegetable consumption. While the relationship between food insecurity and fruit consumption was not statistically significant, the direction of this relationship was the same. This finding may suggest that families living with high food insecurity are not able to purchase fresh produce, or may shop for groceries at locations where vegetables are cost prohibitive or not available. Although very few prior studies have examined the relationship between fruit and vegetable intake and food insecurity, this finding is consistent with previous literature suggesting that children in households characterized by high food insecurity generally have poor health and psychosocial outcomes. For example, previous literature has found that high food insecurity is associated with poor health-related and total quality of life (Casey et al., 2005), as well as poor academic performance (Jyoti, Frongillo, & Jones, 2005). Additionally, one study found that low-income children in households with high food insecurity ate fewer servings of dark greens and nuts/seeds than low-income food secure children (e.g., Casey, Szeto, Lensing, Bogle, & Weber, 2001), although they also consumed fewer servings of added sugar and consumed more eggs. Additional research suggests that adolescents with high food insecurity are significantly more likely to have iron deficiency anemia, providing further evidence regarding the health risks of food insecurity in childhood (Eicher-Miller, Mason, Weaver, McCabe, & Boushey, 2009). Given the significant role that fruits and vegetables play in adequate nutrition, it will be important to consider exploring these relationships. Additionally, it will be necessary to consider food consumption as a key factor target when developing interventions to promote positive health behavior in children with high food insecurity.

Hypothesis #3 was not supported by the current data. There are several potential explanations for the lack of influence of Beans & Greens participation on childhood fruit and vegetable consumption. All participants in the current study were recruited from agencies committed to serving low-income families. It is possible that all participants were receiving relatively equal and adequate levels of support via these agencies, such that the specific type of support (e.g., double value coupon at farmer's market, free bag of groceries) was less important than the fact that support was available and utilized. Of note, most of these agencies included some food-specific resources, although the type and magnitude of these resources varied. Additionally, accessing and utilizing support services requires some level of organization and motivation. All participants in the current study were recruited during a period of active service use (e.g., before using Beans & Greens, picking up a child from HeadStart); thus, it is plausible that there are some common factors among low-income parents who seek out services from community agencies, and that differences would be apparent between low-income service users and low-income parents who do not utilize any available services. Previous research examining the effect of intervention type on food consumption among low-income adult WIC users found that all intervention participants consumed more fruit and vegetables than control, but that no significant differences emerged between intervention groups (Herman, Harrison, Afifi, & Jenks, 2008). Another potential explanation for the lack of difference between Beans & Greens users and non-users is related to length of intervention. Beans & Greens is only available for the duration of the summer and, although "repeat" users indicated that they had used the service at least once before, it is possible that more extended or regular service use would be necessary to detect any differences between groups.

Several interesting points for discussion were apparent from the demographic information provided by participants. Participants reported overall high levels of food insecurity at the household, adult, and child level. Reported levels of child food insecurity, although still classified as "high," were lower than reported levels for the overall household and for adults. While response bias is one possibility for this finding, future researchers should consider utilizing additional research methods (e.g., qualitative interviews or observations) to further investigate whether or not differences exist between parents and children regarding food insecurity. If this finding is confirmed by future research, it may suggest that parents in low-income households protect their children by sacrificing their own nutrition and food intake. This could have important policy implications, as it may be an indication that efforts to improve nutrition for low-income families are beneficial for children but not for parents and caregivers.

Although the high levels of food insecurity may seem disheartening when considering participants' level of service use, this could suggest that the service organizations were reaching their intended populations (i.e., low-income families with high food insecurity). This finding is also consistent with literature on food insecurity in other service-using populations. For example, a report on SNAP usage by Nord and Golla (2009) found that individuals who enrolled in SNAP reported high levels of food insecurity at the time of enrollment. Additional evidence from the USDA Economic Research Service found that 57% of households with food insecurity participated in at least one federal food and nutrition assistance program in 2011 (Coleman-Jensen, Nord, Andrews, & Carlson, 2012). Thus, levels of food insecurity reported in the current study provide additional support for the notion that in-need populations are likely to access services to alleviate hunger and food insecurity, although said services may not necessarily change the food insecure status of participants.

The current findings may have additional implications for policy development and implementation, particularly regarding food insecurity and food consumption. It is possible that programs that seek to improve health outcomes for low-income families would benefit from additional services that extend beyond increasing access. For example, providing healthy food may not be beneficial if families lack knowledge and skills regarding food preparation and cooking techniques. Future researchers should consider an examination of state and federal programs that aim to promote positive health behavior in low-income communities, with a specific focus on whether these programs provide resources and support to help individuals "bridge the gap" from access to effective service use. It may be the case that well-intentioned programs would benefit from more careful attention to helping individuals meaningfully utilize the services available to them. Additionally, future researchers should explore the impact of state and federal changes to food assistance programs (e.g., budgetary cuts) to determine whether food insecurity at the adult and child level is impacted by changes in funding.

Information about fruit and vegetable intake was collected for individual fruits and vegetables, in an attempt to most accurately represent weekly consumption. Parents generally reported that children were consuming between 1-3 servings of most fruits and vegetables each week, with weekly total servings of fruit and vegetables averaging greater than 15 servings. Although recommended daily consumption of fruits and vegetables for children varies by factors such as age, gender, and activity level, the USDA generally recommends that children consume 1-1 ½ servings of fruit daily (United States Department of Agriculture, n.d.), and 1 ½ - 2 ½ servings of vegetables daily (United States Department of Agriculture, n.d.). Further, the USDA also provides weekly guidelines for recommended consumption of various vegetables throughout childhood (United States Department of Agriculture, n.d). Based upon parental report, children in the current study were generally within these suggested ranges. Parents reported that, on average, children were active for at least 60 minutes of 5-6 days of the week, which is slightly below the recommended 60 minutes of daily activity for children (Center for Disease Control, 2011). Children in the current study were also highly sedentary, with parents reporting that children watched 1-3 hours of television daily, and 1 – 2 hours of computer time daily. Parents reported that their children slept for an average of 10-11 hours a night on both weekdays and weekends. This is consistent with recommendations from the National Heart, Lung, and Blood Institute (National Heart, Lung, and Blood Institute, 2012).

The current study has several weaknesses that should be noted, and present interesting opportunities for future research. All information in the current study was collected via parent - report, given evidence that children of this age group are generally poor reporters with regard to dietary intake (e.g., Baranowski et al., 2012). It will be important for future research to attempt to replicate study findings using different data collection methods, such as 5-pass dietary recalls, child report, and direct observational measures. Given the difficulty of conducting research “in the field,” future researchers will want to explore mechanisms for balancing feasibility with “gold standard” data collection methods.

All data collection occurred during the summer months, when various fruits and vegetables were seasonally available in abundance. Thus, it is possible that reported fruit and vegetable intake may have been higher than what is typical, and it will be important for future work in this area to conduct long-term studies of food intake that transcends seasons. Some prior research with a WIC population found that more frequent WIC visits decreased the odds of food insecurity (Metallinos-Katsara, Gorman, Walde, & Kallio, 2011), suggesting that duration and frequency of service use may be important variables to consider when examining food insecurity and intake in low-income populations. Future researchers might also explore more anonymous mechanisms of data collection – such as computer-administered surveys – in order to reduce any potential stigma associated with answering questions about poverty and other sensitive topics.

As mentioned earlier, all participants in the current study were receiving services through community agencies targeting low-income families. It will be important to explore predictors of health behavior in non-service using populations as well. Additionally, although adequate power was achieved to run the full model, the sample may not have been large enough to detect a significant difference between Beans & Greens users and non-Beans & Greens users, particularly given the smaller size of the non-Beans & Greens group. Future research should continue to examine differences between participants receiving services through different organizations, as research on the benefits of one organization over another seems to be mixed (e.g., Herman et al., 2008, found no difference by intervention type; Kroph, Holben, Holcomb, & Anderson, 2007, found difference between farmer's market intervention and WIC). Finally, the current study only explored predictors of fruit and vegetable intake, and did not assess intake of other foods. In order to best understand predictors of food intake in low-income children, a more complete assessment of food intake is warranted. Several previous studies suggest that low-income children generally fail to meet nutritional guidelines, often under consuming healthy food and over consuming unhealthy food (e.g., Leung et al., 2013). Thus, future work would benefit from fully exploring dietary behavior and quality of low-income children.

The Children's Sleep Habits Questionnaire (CHSQ) was selected for the current study based on its reputed strengths and performance in non-clinical populations (Lewandowski, Toliver-Sokol, & Palermo, 2011). The measure provides information about sleep duration, as well as several subscales reflecting a range of potential sleep problems. The subscales were created conceptually, and validity was primarily determined based on the ability of items and scales to differentiate between a clinical and non-clinical population of children (Owens, Spirito, & McGuinn, 2000). The portion of the measure reflecting sleep problems performed very poorly in an early version of the measurement model in the current study, meaning that many items did not load on their intended factors (i.e., subscales). Evidence in the literature suggests that the proposed factor structure of the measure has also been inappropriate for use in other populations (e.g., preschoolers, Sneddon, Peacock, & Crowley, 2014; Dutch elementary-aged children, Waumans et al., 2010; Portuguese children, Silva, Silba, Brage, & Neto, 2014). Further, to the best of the author's knowledge, no factor analysis has ever been performed in an American elementary aged population, which is the target population for this measure. More exploration of the CHSQ is needed in both general community samples and clinical samples; specifically, an exploratory factor analysis should be formed to determine the best factor structure for the measure. Following this important step, confirmatory factor analysis should be utilized to determine whether the factor structure holds in additional populations.

The current study represents one of the first explorations of predictors of fruit and vegetable consumption in low-income children. Significant relationships emerged between food insecurity and vegetable intake, as well as between physical activity and fruit and vegetable intake. It will be important to continue to explore the role of various health behaviors on fruit and vegetable consumption in childhood, given the important role these variables play in child health status. Future researchers should also continue to explore the potential impact of service usage on important health variables such as food consumption and household food insecurity.

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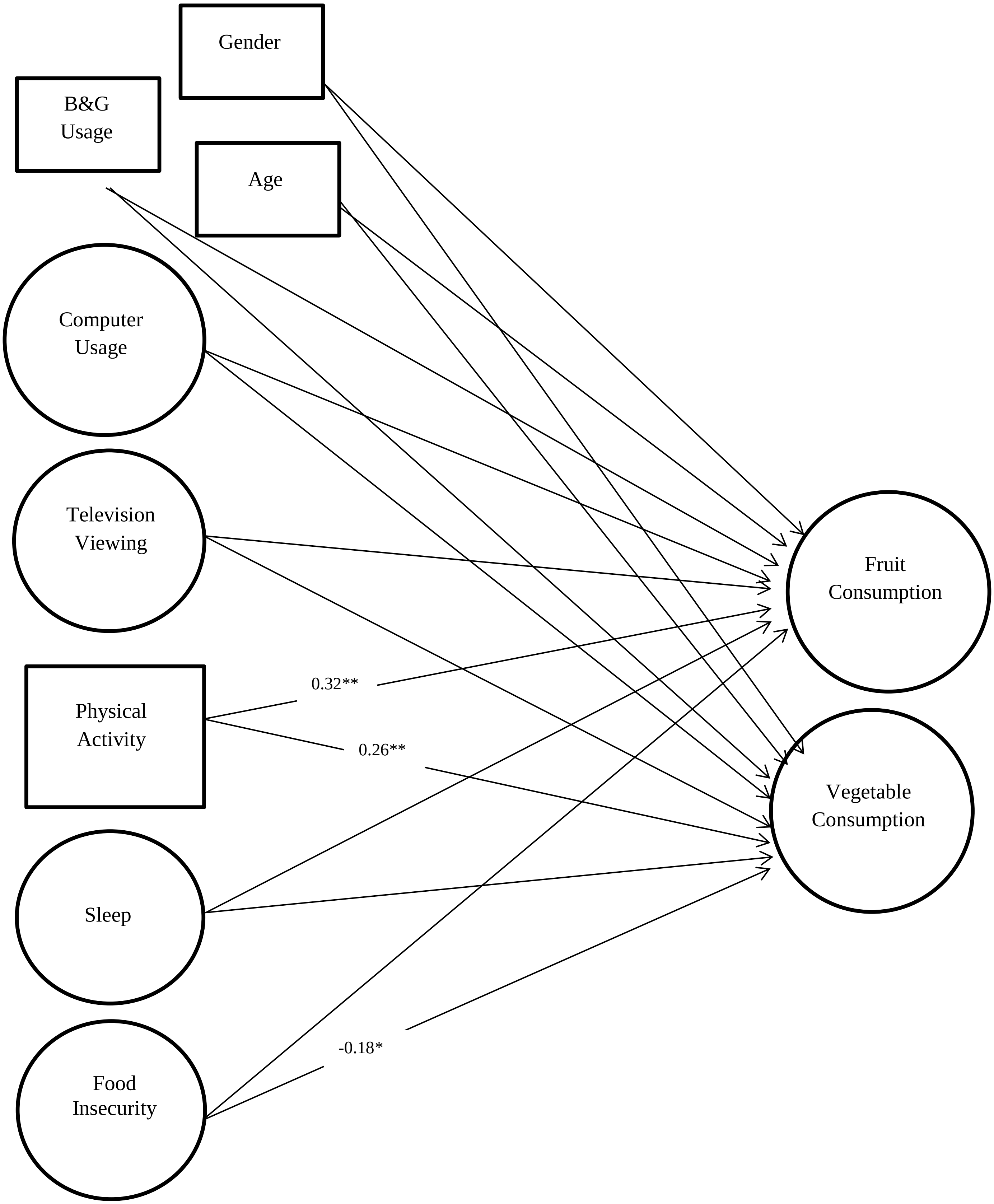
Figure 1

Structural Model with Significant Standardized Latent Regression Estimates



Note. Circle = latent variable, square = observed variable. * = p <.05. ** = p<.01