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Home Availability of Vegetables, Barriers to Purchasing and Preparing Vegetables, and Vegetable Intake in a Sample of Primarily Low-Income, Hispanic Children

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Home Availability of Vegetables, Barriers to Purchasing and Preparing Vegetables, and Vegetable Intake in a Sample of Primarily Low-Income, Hispanic Children

by

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Abstract

Home Availability of Vegetables, Barriers to Purchasing and Preparing Vegetables, and Vegetable Intake in a Sample of Primarily Low-Income, Hispanic Children

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The University of Texas at Austin, 2018

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Background: Obesity prevalence in American children disproportionately affects low-income children. Consumption of vegetables is a dietary factor that is often targeted to promote weight loss and decrease risk of obesity, and has shown a relationship with home vegetable availability, though no studies have examined this relationship in a large, predominantly low-income, Hispanic sample.

Objective: To examine the association between availability of different types of vegetables in the home, perceived parental barriers to vegetable purchase and preparation, and child vegetable intake in a low-income, Hispanic sample.

Design: Secondary cross-sectional analysis of TX Sprouts.

Participants: 1925 students from twelve elementary schools who have >50% Hispanic enrollment and >50% of children receiving free and reduced lunches in the Greater Austin area.

Main Outcomes Measures: Parents/guardians completed a questionnaire packet that included information about free/reduced lunch program (FRL) participation, availability of fresh, canned,

frozen, and cut-up vegetables and salad in the home, and perceived barriers to purchasing/preparing vegetables. Child-reported dietary intake data was collected via 14-item validated dietary screener.

Statistical Analyses Performed: Negative binomial regression was used to examine the relationship between home vegetable availability and vegetable intake. Chi-square analyses were conducted to assess the relationship between barriers to purchasing/preparing vegetables and home vegetable availability.

Results: Children who had fresh vegetables, cut-up vegetables, and salad available in the home "all of the time" consumed more vegetables than those who had them in the home "never", "sometimes", or "most of the time" ($p<0.05$). Participants were less likely to have vegetables in the home "all of the time" if they perceived them as expensive, inaccessible, or perishable, or if they did not have the time, skills, or family assistance to prepare/cook vegetables ($p<0.01$).

Conclusions: Addressing barriers to the purchase and preparation of vegetables in the home may be a cost-effective policy target to promote vegetable intake for children of all socioeconomic backgrounds.

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Introduction

Obesity prevalence in American children has more than tripled in the last forty years, with approximately one-third of children classified as overweight or having obese[1]. Childhood obesity is linked to several unhealthy conditions, including sleep apnea, bone and joint problems, type II diabetes, and risk factors for heart disease[2-6]. Further, children with obesity are more likely to suffer from depression and low self-esteem and to become obese as an adult, which itself is associated with type II diabetes, metabolic syndrome, and several cancers[7-10]. Obesity-related medical care and obesity-related absenteeism, combined, are between $150 and $153 million annually[11,12]. Both obesity and type II diabetes disproportionately affect children of low-income and ethnic minority status[13]. Considering the rising epidemic of children with obesity, its implications for risk of obesity and associated health complications later in life, as well as the presently shifting health care system in the United States, novel insight into obesity prevention is warranted to prevent its escalation.

Vegetable consumption is associated with reduced risk of obesity, possibly due to it's role in suppressing adipose tissue growth and tendency to replace more energy-dense, obesogenic foods in the diet[14-18]. Consumption of vegetables is therefore a dietary factor that has been targeted to promote healthier body weight. Several studies have demonstrated a positive relationship between vegetable intake and the home food environment[19-30]. However, studies demonstrating this relationship use an aggregate score for vegetable availability in the home and only a few ask about specific types and locations of vegetables available in the home. Robinson, et al. examined how child-reported (as compared to parent-reported) home fruit and vegetable availability was related to child fruit and vegetable intake in a sample of 73 children, and found that child-reported fruit and vegetable availability explained 26.7% of the variance in child fruit

and vegetable intake[19]. However, the only availability question regarding vegetable preparation asked the extent to which participants agreed that cut-up vegetables were available in the fridge for them to consume. In addition, the sample size was fairly small and included predominately Non-Hispanic children with a mean age of ten years. Loth, et al. conducted a similar study in 2,383 parent/child dyads which also asked about cut-up vegetables in the home and found that aggregated home food availability scores that classified as "healthy" were positively associated with fruit and vegetable intake[31]. This study was also conducted in a demographically heterogeneous sample, and cut-up vegetables were the only method of preparation included in the aggregate availability score. Grant et al. found that home fruit and vegetable availability was associated with vitamin C intake, but considered canned vegetables present in the home and was conducted in adults, over 50 years of age, living in New Zealand[27]. Only one study has examined this relationship in a low-income, primarily Hispanic population. Amuta et al. showed that home vegetable availability explained 27% of the variance in vegetable intake among 298 low-income, mostly Hispanic, rural families with children 8 and 9 years of age[30]. However, vegetable availability was assessed in this study rather vaguely by asking about home vegetables over the past seven days. To our knowledge, no studies have examined the relationship between vegetable form/method of preparation and intake in a large sample of low-income Hispanics.

Hispanics and individuals of low socioeconomic status (SES) are disproportionately more likely to develop overweight or obesity, cancer, heart disease, and diabetes[1,32-34]. Ogden et al. reported in 2015 that Hispanics and non-Hispanic black adults and youth of all ages are more likely to be overweight or have obesity than any other racial/ethnic group, and Hispanics children 6-11 years of age are most likely to have overweight/obesity compared to children of other ages[1]. It is presently not well understood why this disparity exists, though duration of

residence in the United States, degree of acculturation, and SES have all been identified as plausible causes. According to a 2016 report by the Federal Reserve, the median income for Hispanics in the United States is $20,700, while the median income for Non-Hispanic whites is $171,000[35]. Latino youth and adults are less capable of paying for healthcare costs, and have shown an aversion to routine care due to financial barriers[35-39]. Low-income Hispanics have been shown to have less access to supermarkets compared to high- and low-income Non-Hispanic whites, and better supermarket access has shown an inverse association with risk of obesity[40-42]. Additionally, second-generation Hispanics who have adopted a western lifestyle are consuming fewer servings of fruits and vegetables daily and more fast food, which has been cited as a risk factor for overweight/obesity[43]. Low-income parents have also reported barriers to purchasing and preparing vegetables including financial barriers, the feeling that vegetables are inconvenient and take too much time to prepare, and lack of nutrition and preparation knowledge and cooking skills[44-58]. Studies investigating the relationship between home vegetable availability and intake may serve to address these barriers and provide insight into easily implemented strategies by which to combat obesity and related comorbidities in a low-income, Hispanic population. However, the majority of the research conducted assessing this relationship has either not controlled for SES or has been conducted in upper middle-class non-Hispanic white populations.

While availability of vegetables in the home is related to healthier dietary intake in children, the majority of these studies have examined aggregate availability scores rather than specific types of preparation/methods of storage, and have not been conducted with low-income, high-risk Hispanic youth populations. Considering the rising prevalence of obesity among children in the United States and the magnitude of the economic implications of this epidemic, research investigating cost-effective protective behaviors linked to increase vegetable

consumption is warranted. Thus, the aims of the present study are: 1) to examine the relationship of specific types of availability of vegetables in the home with child vegetable intake, while controlling for weight and household income; and 2) to examine what perceived barriers are linked to decreased availability of vegetables in the home. We hypothesize that increased availability of different types of vegetables in the home will be associated with vegetable intake.

Methods

Study Design

The present study is a secondary, cross-sectional analysis of TX Sprouts, an ongoing cluster-randomized controlled trial examining the effect of a one-school year cooking, gardening, and nutrition education program on dietary behaviors and childhood obesity levels in elementary school children in the Greater Austin, Texas area. Inclusion criteria for participating schools include the following: 1) located within 60 miles of the University of Texas at Austin, 2) at least 50% Hispanic population, 3) at least 50% of children participating in the free and reduced lunch program, and 4) no previously established school gardening program. This study utilizes baseline data from the first 12 schools. Third, fourth, and fifth grade students at each participating school were recruited to participate in the study during "Back to School" and "Meet the Teacher" events at the onset of the academic year.

Measures

Baseline measures are collected during the first six weeks of the school year. Anthropometrics including height via a free-standing stadiometer to the nearest 0.1 cm (Seca, Birmingham, UK), and weight and bioelectrical impedence using Tanita (model TBF 300, discontinued) were collected. Variables including demographics such as age, sex, and race/ethnicity[59] and dietary intake[60] were collected via survey packet administered to the child.

Dietary intake was assessed using a 14-item validated School Physical Activity and Nutrition (SPAN) screener[60]. For this analysis, six questions asked about intake frequency of different vegetables intake. Vegetable intake was totaled for an aggregate score based on participants' responses to each of six vegetable intake items on the child questionnaire. For each of the six items, "No, I didn't eat any of those vegetables yesterday" will receive a score of 0, "Yes, I ate at least 1 of these vegetables 1 time yesterday" will receive a score of 1, "Yes, I ate at least 1 of these vegetables 2 times yesterday" will receive a score of 2, and "Yes, I ate at least 1 of these vegetables 3 or more times yesterday" will receive a score of 3. Thus, the possible aggregate scores range from 0 to 18 (continuous variable).

Parents also completed a questionnaire packet where questions on demographics (including sex and race/ethnicity) and household income (using participation in the free and reduced lunch program) were obtained[59]. Parents/guardians were also asked to assess vegetable availability in the home via validated 4-item questionnaire which was used in the Texas, Grow! Eat! Grow! cluster-randomized controled trial, and had a Crohnbach's alpha of 0.70[61]. Four types of vegetable availability was assessed: "fresh vegetables in your home", "canned, frozen, or dried vegetables in your home", "salad in your home", and "cut up fresh vegetables in a place that is easy for kids to reach". For each of these items, a "never" response equates to a score of zero for that question, "some of the time" equates to 1, "most of the time" equates to 2, and "all of the time" equates to 3. Perceived barriers to purchasing and preparing or cooking vegetables were assessed by asking the following: (1) "do you experience any of the following challenges when buying vegetables for meals in your home?" to which answer choices included "vegetables are too expensive", "I can't find "quality fruits and vegetables", "the stores near me do not sell fresh fruits and vegetable", "other", and "none", and (2) "do you experience any of the following

challenges when preparing or cooking vegetables in your home", to which answer choices included "it's hard to use fresh vegetables before they spoil", "my family doesn't like vegetables", "I don't know how to prepare vegetables", "I don't have simple and quick recipes", "my family is not involved in helping me cook", "other", and "none". Participants were instructed to select all applicable responses.

Statistical Analysis

Histograms and boxplots were used to assess normality of aggregated vegetable intake. Data were leptokurtotic and positively skewed, which was confirmed via Shapiro-Francia test (V'=125.5, p=0.00). These data were not successfully transformed via log-transformation, and vegetable intake data was over-dispersed. Thus, multivariate negative binomial regression were used to analyze the relationship between vegetable intake and home vegetable availability, controlling for child participation in the free/reduced lunch program and overweight/obesity status. Separate models were run for each type of home vegetable availability to estimate incidence rate ratios (IRR) for responses compared to the referent group. For each category of vegetable availability that was found to be significant, post-hoc analyses included predictive mean vegetable intake by levels of availability, and pairwise comparisons to assess differences between each level of availability. Chi-square analyses were used to assess the relationship between barriers to purchasing and preparing vegetables and availability of vegetables in the home.

IRB Approval

The University of Texas Institutional Review Board approved the study protocol. Adult participations provided written assent and informed consent for their child and child participants provided written assent.

Results

Participants were included in the analysis if they completed the survey assessing dietary intake, and their parent/guardian completed the parent survey, resulting in a total of 1925 participants. **Table 1** details child and parent demographics. Approximately 64% of participants were identified by their parent/guardian as Hispanic/Latino, and approximately 70% participated in the free/reduced lunch program. Among parents/guardians 83% of those who completed the survey were mothers, and 58% had not completed education beyond high school.

The distribution of vegetable consumption is shown in **Table 2**. For each of the six vegetable questions with the exception of root vegetables (carrots, beets, sweet potatoes, and radishes), over half of the participants reported not consuming any vegetables the day prior. The median reported aggregated vegetable intake frequency from the day prior was three, while 75% of participants reported a vegetable intake frequency of six or fewer the previous day.

Over half (53%) of parents/guardians reported having fresh vegetables in the home all of the time, and over 60% reported having canned/frozen/dried vegetables, salad, and cut-up vegetables in a place that is easy for kids to reach most or all of the time. **Table 3** shows participants' average vegetable intake frequency by home vegetable availability for fresh, canned/frozen/dried, cut-up vegetables and salad. Availability of canned/frozen/dried vegetables in the home was not significantly associated with child vegetable intake. Negative binomial regression post-hoc pairwise comparisons of vegetable intake by levels of home availability showed that children who had fresh vegetables, cut-up vegetables and salad in the home "all of the time" consumed more vegetables than did those who had them in the home "never", "some of the time", or "most of the time" ($p<0.05$).

Figures 1-3 show the differences in vegetable intake between home availability of different types of vegetables. Children who had fresh vegetables in the home "all of the time" compared to "never" consumed vegetables 39% more frequently (p=0.035; IRR=1.39, 95% CI: 1.02-1.88). Children who had salad "all of the time" in the home compared to "never" consumed vegetables 42% more frequently (p=0.002, IRR=1.42, 95% CI: 1.13-1.78). Children who had cut-up vegetables "all of the time" compared to "never" consumed vegetables 31% more frequently (p=0.001, IRR=1.31, 95% CI: 1.12-1.53). All of these findings were independent of FRL and overweight/obesity status of the child.

Table 4 details the relationship between participants' guardians' perceived barriers to purchasing and cooking/preparing vegetables and availability of vegetables in the home. Parents who reported that they perceived vegetables as too expensive or that they did not know how to prepare vegetables were less likely to report any type of vegetable available in the home "all of the time". Parents who reported that they had fresh vegetables, cut-up vegetables, or salad available in the home less than "all of the time" were more likely to report that they couldn't find quality vegetables, they didn't have quick and simple recipes, lack of time to prepare vegetables, and that their family was not involved in helping them cook. Parents who reported that canned/frozen/dried vegetables were available in the home "all of the time" were more likely to report that it's hard to use fresh vegetables before they spoil. The perception that it is hard to use fresh vegetables before they spoil was associated with not having fresh vegetables, cut-up vegetables, or salad available in the home "all of the time"; conversely, parents who reported this concern about perishability of fresh vegetables were more likely to have canned/frozen/dried vegetables available in the home "all of the time".

Discussion

The present study aimed to assess how availability of different types of vegetables in the home relates to child vegetable consumption, and what barriers exist to acquiring and preparing vegetables. It was found that the greatest reported levels of cut-up and fresh vegetables as well as salad available in the home were positively associated with self-reported daily vegetable intake. This finding is consistent with previous research showing a relationship between the home food environment and vegetable intake. It was also found that perceived barriers of expense and lack of preparation knowledge were associated with not having any type of vegetable available in the home "all of the time"; inability to find quality vegetables, concerns about perishability, lack of time, knowledge, help and simple and quick recipes were associated with not having fresh vegetables, cut-up vegetables, or salad available in the home "all of the time". Participants who were concerned about fresh produce perishability or who reported that local stores did not sell fresh vegetables were more likely to have canned/frozen/dried vegetables available in the home "all of the time".

This study is among the first to consider vegetable form as opposed to an aggregate score of home vegetable availability or other aspects of the home food environment[23-29,62,63]. Additionally, this study used a primarily low-income, Hispanic sample. Low-income and Hispanic individuals are disproportionately affected by obesity, type II diabetes, and the metabolic syndrome, and the susceptibility of obesity is compounded by decreased vegetable intake[13,14,64,65]. The present study suggests that provision of fresh and cut-up vegetables and salad at home may be a simple, cost-effective strategy to facilitate vegetable intake in high risk Hispanic pediatric populations despite perceived barriers to obtaining vegetables that may exist on behalf of parents/guardians.

The method of vegetable preparation may moderate vegetable intake, though this specific facet of the home food environment is largely understudied. To our knowledge, only three studies have scrupulously assessed vegetable form/preparation method. Kratt et al. asked participants about type of vegetables present in the home, location of vegetables, and whether the vegetables were washed/cut-up and found that those who reported the highest levels of home vegetable availability consumed the most vegetables[23]. However, this study was comprised of predominately non-Hispanic white families of middle income. Bryant et al. used the Exhaustive Home Food Availability Inventory (EHFI), which includes questions regarding fresh, dried, frozen, canned, and jarred vegetables, and found that low-income, black mother/infant dyads with the highest tertile of home vegetable availability consume the most vegetables[63]. Despite the precision of this study's vegetable availability measure, the sample included only 80 black participant dyads and was analyzing mothers and infants, rather than children. A cross-sectional study conducted in 2011 with 396 primarily non-Hispanic white preschool children found that canned, frozen, fresh, and dried vegetables in the home was positively associated with child vegetable intake[29]. The current study uses a low-income, Hispanic population at disproportionate risk for the chronic diseases conferred by inadequate vegetable intake.

Socioeconomic factors such as household income have been shown in numerous studies to be a strong predictor of children's dietary intake, children's health outcomes, and perceived barriers to vegetable intake[44,46,47,50,51,58,66-71]. Keim et al. showed that low-income Mexican Americans perceive cost as more of a barrier to fruit and vegetable purchase than low-income non-Hispanic whites[46]. Previous research has also shown that low-income groups may also experience increased perishability of fresh produce, compounding the lack of preparation knowledge and posing an additional disincentive to purchase it[72,73]. Findings from this study

show that children are more likely to consume vegetables if they have fresh vegetables, cut-up vegetables, or salad available in the home.

Barriers identified with lack of vegetables in the home include: perception of vegetables as too expensive, inaccessible, perishable, difficult or time-consuming to prepare, not having simple recipes, or if their families are uninvolved in meal preparation. Thus, interventions are warranted to assist families with overcoming these perceived barriers to vegetable acquisition/preparation in order to promote vegetable consumption among children. Such interventions should focus on teaching families how to purchase vegetables in a cost-effective manner as well as how to then prepare and store vegetables efficiently, quickly, and simply to minimize waste and incentivize consumption. Components of these interventions may include teaching families how to buy fresh vegetables in bulk, cut up vegetables and store in a location that is easily accessible to children, and pre-prepare salad. Teaching families how to grow vegetables and herbs is another inexpensive way to have fresh vegetables in the home, and would address several of the barriers reported by parents including expense, lack of availability in stores, and low quality of vegetables that are available in stores. Lombard, et al. reported that $6 in produce was yielded for every $1 invested in a small garden[74]. Families may also yield enough produce to sell excess; thus, gardening may be an economically advantageous tool to address low vegetable intake and financial barriers in this low-income population. Gardening interventions would also address the concern about perishability, as vegetables do not spoil prior to harvest, and thus could remain in the garden until ready for use. Moreover, gardening may help parents overcome the barrier of families' distaste of vegetables. Carney, et al.showed that gardening may become a family engagement, and that children who participated in the garden were more likely to eat vegetables because of feelings of investment in their cultivation[75]. Interventions that

include gardening and cooking components may also serve to help minimize the barriers of lack of time, knowledge, and quick and simple recipes to cook vegetables by teaching families easy ways to prepare vegetables they harvest.

Canning, freezing, and drying vegetables are methods of preservation that transform perishable produce into food items that can be consumed year round, and provide a less expensive alternative to fresh vegetables. The 2015-2020 Dietary Guidelines for Americans acknowledges canned and frozen vegetables as options for increasing vegetable intake[76]. Miller, et al. found that canned vegetables cost less per edible cup than fresh and frozen, and some frozen vegetables are less expensive per edible cup than fresh[77]. Canned and frozen vegetables thus are theoretically shown to provide means to overcome the perceived cost barrier to consuming vegetables that is prevalent in low-income and Hispanic population, however our findings showed that having canned, frozen, and dried vegetables in the home were not associated with vegetable intake. However, presence of canned/frozen/dried vegetables in the home "all of the time" was associated with perceived perishability of fresh vegetables, and unavailability of fresh vegetables in nearby stores. It is therefore evident that while families are more likely to purchase canned/frozen/dried vegetables in response to concerns of perishability and unavailability, the presence of these vegetables in the home may not incentivize consumption. This paradox may also be addressed with interventions that teach families how to grow and prepare their own vegetables.

The findings cannot be properly discussed without consideration of a number of limitations. This analysis is cross-sectional, and therefore no causal relationship can be inferred, and it includes a homogeneous Hispanic low-income population. While this serves as a strength considering the lack of research that presently exists regarding the home food environment and

child vegetable intake in a low-income, Hispanic population, these findings are not generalizable to other demographics. The use of self-reported dietary data leaves room for memory/recall bias and consequent over- or under-reporting of daily vegetable intake. Though dietary data was collected using a validated questionnaire, this may explain why vegetable intake was non-normal. Moreover, the questionnaire reflects frequency of intake rather than servings per day, disenabling analysis of portion sizes for a more direct public health message. Finally, the questionnaire did not examine fruit availability, precluding analysis of the relationship between home fruit availability and child fruit intake for a more comprehensive analysis of the relationship between the home food environment and children's diet.

Considering the prevalence of childhood obesity, its association with chronic disease onset, and its disproportionate affect among the low-income Hispanic population, it is important to identify factors present in the home that may be easily manipulated to combat this epidemic. The present study showed that presence of fresh and easily accessible cut-up vegetables and salad in the home is associated with child vegetable consumption, regardless of household income and overweight/obesity status. These findings are consistent with prior research, though it asserts the unprecedented notion that in this high-risk, low-income, Hispanic population, method of vegetable preparation matters with regard to promoting child vegetable consumption. This study also highlighted the several barriers to having fresh vegetables in the home, such as vegetables being too expensive, nearby stores not selling fresh vegetables, and too hard to use fresh vegetables before they spoil. Intervention studies should target improving access and reducing cost of fresh vegetables, as well as teaching families how to garden, cook, and preserve fresh vegetables.

Appendix

Tables and Figures

Table 1. Demographics of Children and Parents/Guardians participating in TX Sprouts (n=1925).

Child (n=1925)	
Age	9.3 ±0.9
Sex (male)	918 (47.7)
Overweight/Obese	895 (46.5)
Free/Reduced Lunch	1326 (68.9)
Ethnicity	
White	408 (21.2)
Hispanic/Latino	1222 (63.5)
Black	192 (10.0)
Other	107 (5.6)
Parent (n=1925)	
Mothers	1640 (85.2)
Education Level	
Less than 8th Grade	207 (10.8)
Finished 8th Grade	240 (12.5)
Some High School	265 (13.8)
High School Graduate	394 (20.5)
Some College/Vocational School	433 (22.5)
College Graduate	291 (15.1)
Graduate/Professional Training	92 (4.8)

Data are mean ±SD or n (%).

Table 2. Distribution of Children's Self-Reported Total Vegetable Intake (n=1925).

Questions:	**No, I didn't eat any of these vegetables yesterday**	**Yes, I ate at least 1 of these vegetables 1 time yesterday**	**Yes, I ate at least 1 of these vegetables2 times yesterday**	**Yes, I ate at least 1 of these vegetables 3 or more times yesterday**
Yesterday, did you eat any of these vegetables:				
Carrots, beets, sweet potatoes, or radishes?	931 (48.4)	492 (25.6)	263 (13.7)	236 (12.3)
Squash, green beans or cucumbers?	1118 (58.1)	496 (25.8)	180 (9.4)	130 (6.8)
Tomatoes or peppers?	1264 (65.7)	458 (23.8)	119 (6.2)	84 (4.4)
Broccoli, cauliflower, or cabbage?	1214 (63.1)	458 (23.8)	138 (7.2)	115 (6.0)
Leafy green vegetables (like spinach, collard greens, swiss chard, or romaine lettuce)?	1222 (63.5)	438 (22.8)	152 (7.9)	109 (5.7)
Starchy vegetables: potatoes, corn, or peas? (Do not count French fries or chips)	970 (50.4)	598 (31.1)	202 (10.5)	154 (8.0)

Data are n (%).

Table 3. Parent-Reported Home Availability of Vegetables and Differences in Vegetable Intake by Availability (n=1925).

Now tell us about the foods that were AVAILABLE IN YOUR HOME LAST WEEK:	**Never**	**Some of the Time**	**Most of the Time**	**All of the Time**	**Post-Hoc Comparisons**
Fresh vegetables in your home	3.1 ±0.6[a]	3.7 ±0.2[b]	3.5 ±0.2[c]	4.1 ±0.1[d]	a vs. d; p=0.035 b vs d; p=0.023 c vs d; p=0.001
Canned, frozen, or dried vegetables in your home	4.4 ±0.3	4..0 ±0.2	3.7 ±0.2	3.8 ±0.1	Not significant
Salad in your home	3.1 ±0.4[a]	3.8 ±0.2[b]	3.7 ±0.2[c]	4.2 ±0.1[d]	a vs d; p=0.002 b vs d; p=0.008 c vs d; p=0.006
Cut up vegetables in a place easy for kids to reach	3.3 ±0.3[a]	3.6 ±0.2[b]	3.7 ±0.2[c]	4.3 ±0.1[d]	a vs d; p=0.001 b vs d; p=0.001 c vs. d; p=0.022

Data are mean ±SE. Negative binomial regression post-hoc pairwise comparisons were run to assess whether significant differences in vegetable intake existed among children with varying levels of home vegetable availability for each category.

Table 4. Percent of Parents who Reported Having Certain Barriers and Challenges by Home Availability of Vegetable Categories.

Home Availability of:	**Too expensive**		**Can't find quality**		**Nearby stores don't sell**		**Hard to use before perishing**		**I don't know how to prepare**		**I don't have time to prepare**		**No quick and simple recipes**		**Family does not help cook**	
Fresh Vegetables	*n(%)*	*p-value*	*n(%)*	*p-value*	*n(%)*	*p-value*	*n(%)*	*p-value*	*n(%)*	*p-value*	*n(%)*	*p-value*	*n(%)*	*p-value*	*n(%)*	*p-value*
Never	21 (1.1)	**0.000**	6 (0.3)	**0.004**	0 (0)	0.459	10 (0.5)	**0.000**	13 (0.7)	**0.000**	2 (0.1)	**0.000**	17 (0.9)	**0.000**	5 (0.3)	**0.000**
Sometimes	120 (6.2)		45 (2.3)		12 (0.6)		91 (4.7)		45 (2.3)		24 (1.2)		95 (4.9)		30 (1.6)	
Most of the Time	133 (6.9)		43 (2.2)		12 (0.6)		99 (5.2)		34 (1.8)		27 (1.4)		81 (4.2)		28 (1.5)	
All of the time	162 (8.4)		75 (3.9)		28 (1.5)		111 (5.8)		39 (2.0)		17 (0.9)		117 (6.1)		28 (1.5)	
Canned/Frozen/Dried																
Never	66 (3.4)	**0.000**	15 (0.8)	0.146	14 (0.7)	**0.007**	20 (1.0)	**0.004**	23 (1.2)	**0.001**	8 (0.4)	0.282	34 (1.8)	**0.115**	14 (0.7)	0.274
Sometimes	112 (5.8)		39 (2.0)		12 (0.6)		67 (3.5)		37 (1.9)		15 (0.8)		72 (3.7)		25 (1.3)	
Most of the Time	116 (6.0)		47 (2.4)		11 (0.6)		80 (4.1)		36 (1.9)		22 (1.1)		83 (4.3)		23 (1.2)	
All of the time	141 (7.3)		68 (3.5)		16 (0.8)		146 (7.6)		36 (1.9)		26 (1.3)		122 (6.3)		31 (1.6)	
Salad																
Never	23 (1.2)	**0.000**	8 (0.4)	**0.000**	1 (0.1)	0.373	24 (1.2)	**0.000**	16 (0.8)	**0.000**	8 (0.4)	**0.000**	28 (1.4)	**0.000**	12 (0.6)	**0.000**
Sometimes	184 (9.5)		77 (4.0)		12 (0.6)		124 (6.4)		60 (3.1)		33 (1.7)		132 (6.8)		37 (1.9)	
Most of the Time	102 (5.3)		35 (1.8)		14 (0.7)		76 (3.9)		29 (1.5)		17 (0.9)		72 (3.7)		27 (1.4)	
All of the time	127 (6.6)		49 (2.6)		26 (1.3)		89 (4.6)		28 (1.4)		12 (0.6)		804.1)		17 (0.9)	
Cut-up Vegetables																
Never	65 (3.4)	**0.000**	26 (1.3)	**0.000**	5 (0.3)	0.349	56 (2.9)	**0.000**	33 (1.7)	**0.000**	13 (0.7)	**0.000**	60 (3.1)	**0.000**	20 (1.0)	**0.000**
Sometimes	145 (7.6)		64 (3.3)		10 (0.50		114 (5.9)		44 (2.3)		39 (2.0)		112 (5.8)		44 (2.3)	
Most of the Time	105 (5.5)		28 (1.5)		17 (0.9)		71 (3.7)		24 (1.2)		13 (0.7)		58 (3.0)		15 (0.8)	
All of the time	120 (6.2)		51 (2.7)		21 (1.1)		72 (3.7)		31 (1.6)		5 (0.3)		81 (4.2)		14 (0.7)	

Data are n (%) of participants who reported a certain barrier or challenge. Chi-square analyses used to assess significance (bold).

Figure 1. Fresh Vegetable Availability and Vegetable Intake

Vegetable intake is higher among children participating in TX Sprouts who have fresh vegetables available in the home "all of the time" (*b*) compared to "never", "sometimes", and "most of the time" (*a*) after controlling for free/reduced lunch program participation and overweight/obesity status ($p<0.05$) (n=1925).

Figure 2. Salad Availability and Vegetable Intake

Vegetable intake is higher among children participating in TX Sprouts who have salad available in the home "all of the time" (*b*) compared to "never", "sometimes", and "most of the time" (*a*) after controlling for free/reduced lunch program participation and overweight/obesity status ($p<0.05$) (n=1925).

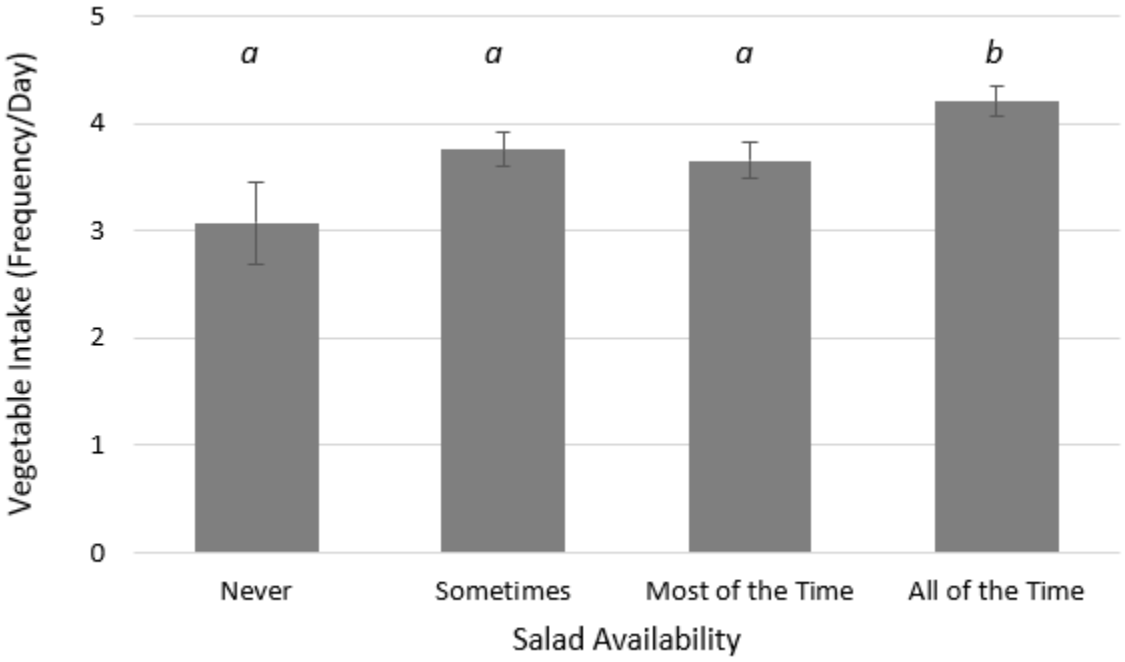
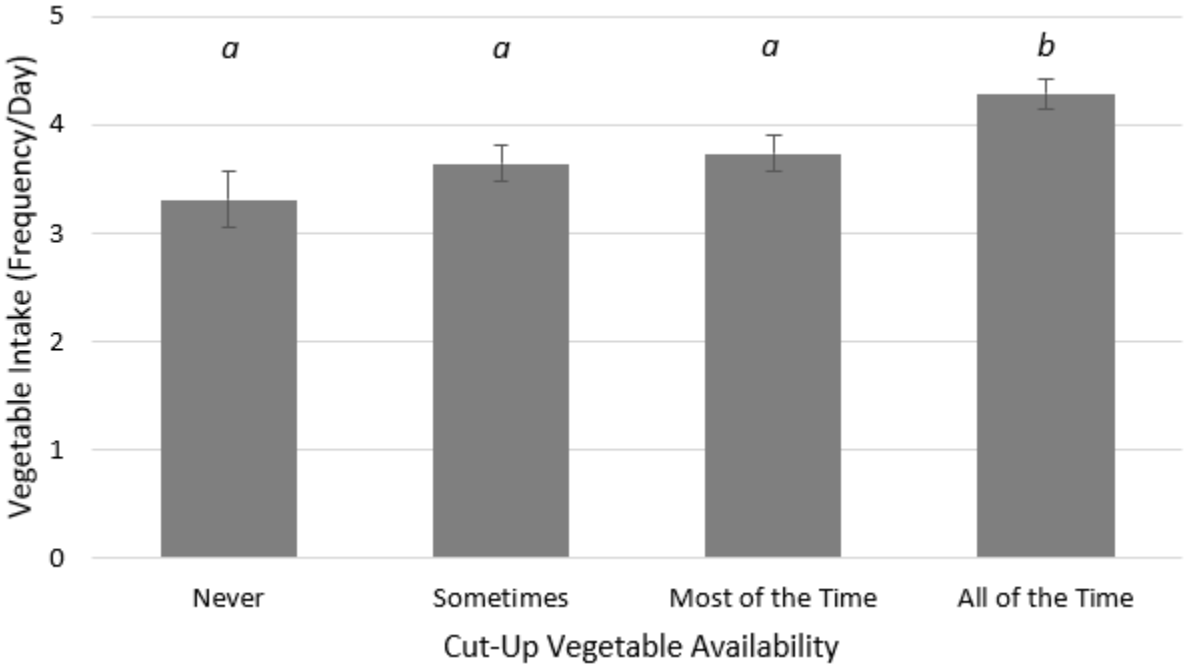


Figure 3. Cut-Up Vegetable Availability and Vegetable Intake

Vegetable intake is higher among children participating in TX Sprouts who have cut-up vegetables in a place that is easy for children to reach available in the home "all of the time" (*b*) compared to the "never", "sometimes", and "most of the time" (*a*) after controlling for free/reduced lunch program participation and overweight/obesity status ($p<0.05$) (n=1925).



References

1. Ogden CL, Carroll MD, Fryar CD, Flegal KM. Prevalence of Obesity Among Adults and Youth: United States, 2011-2014. *NCHS Data Brief.* 2015(219):1-8.

2. Committee on Accelerating Progress in Obesity P, Food and Nutrition B, Institute of M. In: Glickman D, Parker L, Sim LJ, Del Valle Cook H, Miller EA, eds. *Accelerating Progress in Obesity Prevention: Solving the Weight of the Nation.* Washington (DC): National Academies Press (US) Copyright 2012 by the National Academy of Sciences. All rights reserved.; 2012.

3. Office of the Surgeon G. Reports of the Surgeon General. In: *The Surgeon General's Vision for a Healthy and Fit Nation.* Rockville (MD): Office of the Surgeon General (US); 2010.

4. Must A, Hollander SA, Economos CD. Childhood obesity: a growing public health concern. *Expert Review of Endocrinology & Metabolism.* 2006;1(2):233-254.

5. Freedman DS, Mei Z, Srinivasan SR, Berenson GS, Dietz WH. Cardiovascular risk factors and excess adiposity among overweight children and adolescents: the Bogalusa Heart Study. *J Pediatr.* 2007;150(1):12-17.e12.

6. May AL, Kuklina EV, Yoon PW. Prevalence of cardiovascular disease risk factors among US adolescents, 1999-2008. *Pediatrics.* 2012;129(6):1035-1041.

7. Griffiths LJ, Parsons TJ, Hill AJ. Self-esteem and quality of life in obese children and adolescents: a systematic review. *Int J Pediatr Obes.* 2010;5(4):282-304.

8. Puhl RM, Luedicke J. Weight-based victimization among adolescents in the school setting: emotional reactions and coping behaviors. *J Youth Adolesc.* 2012;41(1):27-40.

9. President WHTFoCORtt. White House Task Force on Childhood Obesity, Solving the Problem of Childhood Obesity within a Generation. In. Washington, DC2010.

10. Hoelscher DM, Kirk S, Ritchie L, Cunningham-Sabo L. Position of the Academy of Nutrition and Dietetics: interventions for the prevention and treatment of pediatric overweight and obesity. *J Acad Nutr Diet.* 2013;113(10):1375-1394.

11. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual medical spending attributable to obesity: payer-and service-specific estimates. *Health Aff (Millwood).* 2009;28(5):w822-831.

12. Trogdon JG, Finkelstein EA, Hylands T, Dellea PS, Kamal-Bahl SJ. Indirect costs of obesity: a review of the current literature. *Obes Rev.* 2008;9(5):489-500.

13. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among US children and adolescents, 1999-2000. *Jama.* 2002;288(14):1728-1732.

14. Slavin JL, Lloyd B. Health Benefits of Fruits and Vegetables1. In: *Adv Nutr.* Vol 3.2012:506-516.

15. Gonzalez-Castejon M, Rodriguez-Casado A. Dietary phytochemicals and their potential effects on obesity: a review. *Pharmacol Res.* 2011;64(5):438-455.

16. Alinia S, Hels O, Tetens I. The potential association between fruit intake and body weight--a review. *Obes Rev.* 2009;10(6):639-647.

17. Kanungsukkasem U, Ng N, Van Minh H, et al. Fruit and vegetable consumption in rural adults population in INDEPTH HDSS sites in Asia. *Glob Health Action.* 2009;2.

18. Pem D, Jeewon R. Fruit and Vegetable Intake: Benefits and Progress of Nutrition Education Interventions- Narrative Review Article. In: *Iran J Public Health.* Vol 44.2015:1309-1321.

19. Robinson-O'Brien R, Neumark-Sztainer D, Hannan PJ, Burgess-Champoux T, Haines J. Fruits and vegetables at home: child and parent perceptions. *J Nutr Educ Behav.* 2009;41(5):360-364.

20. Hanson NI, Neumark-Sztainer D, Eisenberg ME, Story M, Wall M. Associations between parental report of the home food environment and adolescent intakes of fruits, vegetables and dairy foods. *Public Health Nutr.* 2005;8.

21. Haire-Joshu D, Elliott MB, Caito NM, et al. High 5 for Kids: the impact of a home visiting program on fruit and vegetable intake of parents and their preschool children. *Prev Med.* 2008;47(1):77-82.

22. Cullen KW, Baranowski T, Owens E, Marsh T, Rittenberry L, de Moor C. Availability, accessibility, and preferences for fruit, 100% fruit juice, and vegetables influence children's dietary behavior. *Health Educ Behav.* 2003;30(5):615-626.

23. Kratt P, Reynolds K, Shewchuk R. The role of availability as a moderator of family fruit and vegetable consumption. *Health Educ Behav.* 2000;27(4):471-482.

24. Knowlden AP, Sharma M. Social cognitive maternal-mediated nutritional correlates of childhood obesity. *Int Q Community Health Educ.* 2015;35(2):177-191.

25. Jackson JA, Smit E, Manore MM, John D, Gunter K. The Family-Home Nutrition Environment and Dietary Intake in Rural Children. *Nutrients.* 2015;7(12):9707-9720.

26. Loth KA, Friend S, Horning ML, Neumark-Sztainer D, Fulkerson JA. Directive and non-directive food-related parenting practices: Associations between an expanded conceptualization of food-related parenting practices and child dietary intake and weight outcomes. *Appetite.* 2016;107:188-195.

27. Grant E, Gearry RB, Wilson R, Pearson J, Skidmore PML. Home availability of fruit and vegetables and obesogenic foods as an indicator of nutrient intake in 50 year olds from Canterbury, New Zealand. *Asia Pac J Clin Nutr.* 2017;26(3):524-530.

28. Hendrie GA, Coveney J, Cox DN. Defining the complexity of childhood obesity and related behaviours within the family environment using structural equation modelling. *Public Health Nutr.* 2012;15(1):48-57.

29. Wyse R, Campbell E, Nathan N, Wolfenden L. Associations between characteristics of the home food environment and fruit and vegetable intake in preschool children: a cross-sectional study. *BMC Public Health.* 2011;11:938.

30. Amuta AO, Jacobs W, Idoko EE, Barry AE, McKyer EL. Influence of the Home Food Environment on Children's Fruit and Vegetable Consumption: A Study of Rural Low-Income Families. *Health Promot Pract.* 2015;16(5):689-698.

31. Loth KA, MacLehose RF, Larson N, Berge JM, Neumark-Sztainer D. Food availability, modeling and restriction: How are these different aspects of the family eating environment related to adolescent dietary intake? *Appetite.* 2016;96:80-86.

32. Cowie CC, Rust KF, Ford ES, et al. Full Accounting of Diabetes and Pre-Diabetes in the U.S. Population in 1988–1994 and 2005–2006. 2009.

33. Balfour PC, Ruiz JM, Talavera GA, Allison MA, Rodriguez CJ. Cardiovascular Disease in Hispanics/Latinos in the United States. *J Lat Psychol.* 2016;4(2):98-113.

34. Mozaffarian D, Benjamin EJ, Go AS, et al. Heart disease and stroke statistics--2015 update: a report from the American Heart Association. *Circulation.* 2015;131(4):e29-322.

35. Dettling LJ, Joanne W. Hsu, Lindsay Jacobs, Kevin B. Moore, and Jeffrey P. Thompson. Recent Trends in Wealth-Holding by Race and Ethnicity: Evidence from the Survey of Consumer Finances. In. Washington: Board of Governors of the Federal Reserve System: FEDS Notes; September 27, 2017.

36. Livingston GM, Susan Cohn, D'Vera. Utilization of a Usual Health Care Provider and Satisfaction with Health Care. 2008; http://www.pewhispanic.org/2008/08/13/iii-utilization-of-a-usual-health-care-provider-and-satisfaction-with-health-care/.

37. Rodríguez MA, Vargas Bustamante A, Ang A. Perceived Quality of Care, Receipt of Preventive Care, and Usual Source of Health Care Among Undocumented and Other Latinos. In: *J Gen Intern Med.* Vol 24.2009:508-513.

38. Alegria M, Cao Z, McGuire TG, et al. Health Insurance Coverage for Vulnerable Populations: Contrasting Asian Americans and Latinos in the United States. *Inquiry.* 2006;43(3):231-254.

39. Weinick RM, Byron SC, Bierman AS. Who Can't Pay for Health Care? *J Gen Intern Med.* 2005;20(6):504-509.

40. Bower KM, Thorpe RJ, Jr., Rohde C, Gaskin DJ. The intersection of neighborhood racial segregation, poverty, and urbanicity and its impact on food store availability in the United States. *Prev Med.* 2014;58:33-39.

41. Moore LV, Diez Roux AV, Nettleton JA, Jacobs DR, Jr. Associations of the local food environment with diet quality--a comparison of assessments based on surveys and geographic information systems: the multi-ethnic study of atherosclerosis. *Am J Epidemiol.* 2008;167(8):917-924.

42. Hilmers A, Hilmers DC, Dave J. Neighborhood disparities in access to healthy foods and their effects on environmental justice. *Am J Public Health.* 2012;102(9):1644-1654.

43. Gordon-Larsen P, Nelson MC, Page P, Popkin BM. Inequality in the Built Environment Underlies Key Health Disparities in Physical Activity and Obesity. *Pediatrics.* 2006;117.

44. Yeh MC, Ickes SB, Lowenstein LM, et al. Understanding barriers and facilitators of fruit and vegetable consumption among a diverse multi-ethnic population in the USA. *Health Promot Int.* 2008;23(1):42-51.

45. SD K, T B, KD R, G T, D B. Children's fruit and vegetable intake - Socioeconomic, adult-child, regional, and urban-rural influences. *Journal of Nutrition Education.* 1995;8:261-271.

46. Keim KS, Swanson MA, Cann SE. Caucasian and Mexican American low-income children's thoughts about vegetables and fruits. *Ecology of Food and Nutrition.* 2001;40(5):525-544.

47. Dibsdall LA, Lambert N, Bobbin RF, Frewer LJ. Low-income consumers' attitudes and behaviour towards access, availability and motivation to eat fruit and vegetables. *Public Health Nutr.* 2003;6(2):159-168.

48. Cluss PA, Ewing L, King WC, Reis EC, Dodd JL, Penner B. Nutrition Knowledge of Low Income Parents of Obese Children. *Translational behavioral medicine.* 2013;3(2):218-225.

49. Howard-Pitney B, Winkleby MA, Albright CL, Bruce B, Fortmann SP. The Stanford Nutrition Action Program: a dietary fat intervention for low-literacy adults. *Am J Public Health.* 1997;87(12):1971-1976.

50. Monge-Rojas R, Garita C, Sanchez M, Munoz L. Barriers to and motivators for healthful eating as perceived by rural and urban Costa Rican adolescents. *J Nutr Educ Behav.* 2005;37(1):33-40.

51. Gellar LA, Schrader K, Nansel TR. Healthy Eating Practices: Perceptions, Facilitators, and Barriers Among Youth With Diabetes. *Diabetes Educ.* 2007;33(4):671-679.

52. Hill L, Casswell S, Maskill C, Jones S, Wyllie A. Fruit and Vegetables as Adolescent Food Choices in New Zealand. *Health Promotion International.* 1998;13(1):55-65.

53. Kubik MY, Lytle L, Fulkerson JA. Fruits, vegetables, and football: findings from focus groups with alternative high school students regarding eating and physical activity. *J Adolesc Health.* 2005;36(6):494-500.

54. Neumark-Sztainer D, Story M, Perry C, Casey MA. Factors influencing food choices of adolescents: findings from focus-group discussions with adolescents. *J Am Diet Assoc.* 1999;99(8):929-937.

55. Beliefs, knowledge, and values held by inner-city youth about gardening, nutrition, and cooking | SpringerLink. 2018.

56. O'Dea J A. Why do kids eat healthful food? Perceived benefits of and barriers to healthful eating and physical activity among children and adolescents. *J Am Diet Assoc.* 2003;103(4):497-501.

57. McKinley MC, Lowis C, Robson PJ, et al. It's good to talk: children's views on food and nutrition. *Eur J Clin Nutr.* 2005;59(4):542-551.

58. Dwyer J, Needham L, Simpson JR, Heeney ES. Parents report intrapersonal, interpersonal, and environmental barriers to supporting healthy eating and physical activity among their preschoolers. *Appl Physiol Nutr Metab.* 2008;33(2):338-346.

59. Wardle J, Robb K, Johnson F. Assessing socioeconomic status in adolescents: the validity of a home affluence scale. *J Epidemiol Community Health.* 2002;56(8):595-599.

60. Thiagarajah K, Fly AD, Hoelscher DM, et al. Validating the food behavior questions from the elementary school SPAN questionnaire. *J Nutr Educ Behav.* 2008;40(5):305-310.

61. Evans A, Ranjit N, Hoelscher D, et al. Impact of school-based vegetable garden and physical activity coordinated health interventions on weight status and weight-related behaviors of ethnically diverse, low-income students: Study design and baseline data of the Texas, Grow! Eat! Go! (TGEG) cluster-randomized controlled trial. *BMC Public Health.* 2016;16:973.

62. de Jong E, Visscher TL, HiraSing RA, Seidell JC, Renders CM. Home environmental determinants of children's fruit and vegetable consumption across different SES backgrounds. *Pediatr Obes.* 2015;10(2):134-140.

63. Bryant M, Stevens J, Wang L, Tabak R, Borja J, Bentley ME. Relationship between home fruit and vegetable availability and infant and maternal dietary intake in African-American families: evidence from the exhaustive home food inventory. *J Am Diet Assoc.* 2011;111(10):1491-1497.

64. Falkner B, Cossrow ND. Prevalence of metabolic syndrome and obesity-associated hypertension in the racial ethnic minorities of the United States. *Curr Hypertens Rep.* 2014;16(7):449.

65. Razzouk L, Muntner P. Ethnic, gender, and age-related differences in patients with the metabolic syndrome. *Curr Hypertens Rep.* 2009;11(2):127-132.

66. Drewnowski A, Specter SE. Poverty and obesity: the role of energy density and energy costs. *Am J Clin Nutr.* 2004;79(1):6-16.

67. Darmon N, Drewnowski A. Does social class predict diet quality? *Am J Clin Nutr.* 2008;87(5):1107-1117.

68. Ryden PJ, Hagfors L. Diet cost, diet quality and socio-economic position: how are they related and what contributes to differences in diet costs? *Public Health Nutr.* 2011;14.

69. Nilsen SM, Krokstad S, Holmen TL, Westin S. Adolescents' health-related dietary patterns by parental socio-economic position, The Nord-Trondelag Health Study (HUNT). *Euro J Public Health.* 2010;20.

70. Crawford PB, Obarzanek E, Schreiber GB, et al. The effects of race, household income, and parental education on nutrient intakes of 9- and 10-year-old girls NHLBI growth and health study. *Annals of Epidemiology.*5(5):360-368.

71. Compernolle S, Oppert JM, Mackenbach JD, et al. Mediating role of energy-balance related behaviors in the association of neighborhood socio-economic status and residential area density with BMI: The SPOTLIGHT study. *Prev Med.* 2016;86:84-91.

72. Brug J, Lechner L, De Vries H. Psychosocial determinants of fruit and vegetable consumption. *Appetite.* 1995;25(3):285-296.

73. Myths about food and low income - Social Care Online. 2018; https://www.scie-socialcareonline.org.uk/myths-about-food-and-low-income/r/a11G000000182o8IAA.

74. Lombard KA, Forster-Cox S, Smeal D, O'Neill MK. Diabetes on the Navajo nation: what role can gardening and agriculture extension play to reduce it? *Rural Remote Health.* 2006;6(4):640.

75. Carney PA, Hamada JL, Rdesinski R, et al. Impact of a Community Gardening Project on Vegetable Intake, Food Security and Family Relationships: A Community-based Participatory Research Study. *Journal of community health.* 2012;37(4):874-881.

76. Agriculture UDo, Services UDoHaH. Dietary Guidelines for Americans, 2015-2020. In. 8th ed. Washington, DC: Government Printing Office 2015.

77. Miller S, Knudson W. Nutrition and Cost Comparisons of Select Canned, Frozen, and Fresh Fruits and Vegetables. 2014;8(6):430-437.