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Fruit and Vegetable Intake of US Hispanics by Food Store Type: Findings from NHANES

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Abstract

This study examined fruit and vegetable intake by food store type shopped among US Hispanics. Using National Health and Nutrition Examination Survey 2011–2012 data, *T* test and chi-square tests examined differences between Hispanic consumers by food store type. Negative binomial regression analyses estimated associations between fruit and vegetable intake and food store type. Hispanics who only purchased fruits and vegetables from convenience stores were younger and more likely US born. They reported lower intakes of fruit and vegetables than individuals who purchased these foods from supermarket/grocery stores. Those who primarily purchased fruits and vegetables from supermarkets/grocery stores consumed 0.92 ($p < .001$) greater fruit cup equivalents and 0.26 ($p = .001$) greater vegetable cup equivalents than those who only purchased from convenience stores. Research on the influence of shopping in multiple food store types is needed to develop targeted in-store intervention strategies to encourage healthier food purchases. Results provide support for policy-level research such as minimum stocking requirements for healthy foods in convenience stores.

Keywords

Hispanic health; Dietary behaviors; Food purchasing; Retail food environment; Food store type; Fruit and vegetable intake

Introduction

Promoting the intake of specific dietary patterns, such as those based on high fruit and vegetables intake, is a promising strategy to improve diet and overall health outcomes.

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Research demonstrates that higher intakes of fruits and vegetables are associated with a lower risk of cardiovascular disease [1, 2], type 2 diabetes [3, 4], and stroke [5]. Fruit and vegetable intake is also associated with a reduction in mortality due to ischaemic heart disease, cardiovascular disease, and cancer [6–8]. Substituting higher calorie foods with fruits and vegetables may also aid in healthy weight management [9].

Current dietary guidelines recommend that US American adults consume 1.5–2 cup equivalents of fruit and 2–3 cup equivalents of vegetables daily depending on their age and sex [10, 11]. However, US Hispanics are not meeting these recommendations. Per an epidemiological study using data from the National Health and Nutrition Examination Survey (NHANES), the median cup equivalent intake (e.g., defined as one small apple or 12 baby carrots) among US Hispanics was 0.78 cups for fruit and 1.33 cups for vegetables [12]. Another study using California Health Interview Survey data found that English-speaking and limited English-speaking Hispanics had lower vegetable intake, 0.74 and 0.61 times per day respectively, compared to 1.10 times per day among non-Hispanic Whites [13]. Two additional studies examining the dietary intake of US Hispanics also demonstrated their low intakes of fruit. One study found that fruit intake only contributed 3.6–6.4% of total energy intake [14] while another study demonstrated fruit intake to only be between 0.75 and 1.5 cups per day depending on Hispanic background [15]. However, another study demonstrated favorable fruit intake among limited English speaking Hispanics at 1.21 times per day versus 0.98 times per day among non-Hispanic Blacks [13]. Despite indications that consumption may be higher for Hispanics, this subgroup, along with other health disparate populations, are not meeting dietary guidelines. Thus, strategies are needed to increase fruit and vegetable intake among Hispanics.

Dietary behaviors occur within social, economic, and physical environments [16, 17]. The retail food environment, such as the type of food store in which an individual or family shops, is a particularly important context to study given that the greatest contributors to energy intake in the USA are from foods and beverages purchased in food stores [18]. Research is needed to examine the relationship between the food store type in which one purchases foods and beverages and dietary intake. Glanz, Sallis, Saelens, and Frank's (2005) conceptual framework of nutrition environments posits that the environment individuals encounter within a food store has product and other physical characteristics that influence purchasing decisions and dietary intake; these include product placement, product assortment, product quality, price, and marketing [19]. Such characteristics can vary by type of store (e.g., supermarket versus convenience store), which is why it is important to study whether where one purchases foods and beverages is related to dietary intake. Currently, there is limited research examining how purchasing foods and beverages from different food store types are associated with fruit and vegetable intake, particularly among the US Hispanic population.

Two previous studies, one conducted in Canada and another among US non-Hispanic Blacks, found that, adjusting for socioeconomic status, individuals who shop at convenience stores report more frequent purchases of unhealthy food (e.g., soda and potato chips) than individuals who shop at supermarkets [20, 21]. It was also found that those who frequently shopped in convenience stores consumed fruits and vegetables less often than those who did

not shop in convenience stores [21]. Previous research conducted in the UK suggests that shopping in a discount supermarket is associated with 9% fewer fruit and vegetable purchases than shopping in a higher-cost supermarket, even after accounting for socioeconomic status [22]. This finding is consistent with research conducted in Canada and with US non-Hispanic Black and non-Hispanic White populations indicating that shopping at specialty supermarkets and farmers markets is associated with a higher odds of consuming fruits and vegetables compared to those who never shop in these types of stores or markets or shop in convenience stores or independent grocers [21, 23, 24]. These findings may be due to the fact that supermarkets generally have the highest availability of fruits and vegetables compared to other retail food outlets such as grocery stores and convenience stores [25–27]. Importantly, none of the studies reviewed were conducted with a US Hispanic population. However, one study did find that Hispanics purchased higher percentages of fresh fruits and vegetables compared to non-Hispanic Blacks yet still purchased lower percentages than non-Hispanic Whites [28]; this further demonstrates the need to understand the fruit and vegetable purchasing behaviors of Hispanics. Thus, this study fills a gap in the literature regarding how purchasing healthy foods, specifically fruits and vegetables, from different food store types is associated with the fruit and vegetable intake of US Hispanic adults.

Approximately 42.5% of Hispanics in the USA are obese, which is higher than the national prevalence rate of 34.9% [29]. This disparity is important to address given that the Hispanic population is projected to comprise more than one quarter of the total US population by 2060 [30]. Another reason to address this disparity is the association between both weight gain and excess weight gain and an increased risk of hypertension, cardiovascular disease, diabetes, and certain cancers [31]. Diet is a modifiable risk factor related to obesity and obesity-related chronic diseases that should be targeted to reduce and prevent disparities between US Hispanics and other racial/ethnic groups in the USA. While individual characteristics, such as taste preferences, undoubtedly influence purchasing decisions, environmental characteristics such as in-store marketing, availability, quality, and pricing also influence purchasing decisions that have implications on long-term health [32–34].

This study examined fruit and vegetable intake by food store type among US Hispanic adults who participated in the 2011–2012 NHANES. In this wave of NHANES, self-reported food store type separated supermarket/grocery stores from convenience stores for the first time. Given the existing evidence on the relationship between shopping at convenience stores versus supermarket/grocery stores and fruit and vegetable purchasing and intake, the following is hypothesized:

US Hispanics who only (defined as 100% of the time) purchased their fruit and vegetables from convenience stores will report lower intakes of fruits than US Hispanics who purchased any of their fruits and vegetables from supermarket/grocery stores.

US Hispanics who only purchased their fruits and vegetables from convenience stores will report lower intakes of vegetables than US Hispanics who purchased any of their fruit and vegetables from supermarket/grocery stores.

Methods

Data Source

NHANES was designed to assess the health and nutritional status of adults and children in the USA. The program began in the early 1960s and has been conducted as a series of surveys focusing on different population groups or health topics. In 1999, NHANES became continuous and has since surveyed approximately 5000 individuals of all ages each year. Participants are interviewed in their homes and complete a health examination. The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions. The health examination consists of medical, dental, and physiological measurements, as well as laboratory tests.

NHANES uses a complex, multistage probability design to sample individuals in all 50 states. Sample selection for NHANES followed these stages: (1) selection of primary sampling units (PSUs), which are counties or small groups of contiguous counties, (2) selection of segments within PSUs that constitute a block or group of blocks containing a cluster of households, (3) selection of specific households within segments, and (4) selection of individuals within a household. The NHANES study design has changed occasionally to sample larger numbers of certain subgroups of particular public health interest. This was done to ensure reliability in health status indicators for these population subgroups.

The 2011–2012 NHANES data oversampled the following subgroups: Hispanics, non-Hispanic Blacks, non-Hispanic Asians, non-Hispanic White and other persons at or below 130% of the poverty level, and non-Hispanic White and other persons aged 80 years and older. Approximately 25% of the 2011–2012 NHANES sample identified as Mexican American or Other Hispanic. Further information regarding the NHANES sampling design, questionnaires, clinical measures, and individual-level data can be found on its web portal (http://www.cdc.gov/nchs/nhanes.htm). The NHANES program is approved by the NCHS Research Ethics Review Board (ERB).

Dietary Interview

The 2011–2012 NHANES wave incorporated two 24-hour dietary recalls, with the first collected in-person and the second by phone. In both interviews, each food item and its corresponding quantity were recorded. A set of measuring guides, including glasses, bowls, mugs, spoons, measuring cups and spoons, drink boxes and bottles, beanbags, a ruler, and thickness sticks were made available to the participant during in-person interviews to report quantity of foods and beverages. Upon completion of the in-person interview, participants were provided with measuring guides and a food model booklet, which contained two-dimensional drawings of the measuring guides, to use for reporting food quantities during the phone interview. Phone interviews were conducted 3–10 days after the in-person interview. The calorie and nutrient contents of each reported food item were systematically determined with the US Department of Agriculture Food and Nutrient Database for Dietary Studies.

Fruit and Vegetable Intake

Food intake reported in the dietary interview was converted into a Food Patterns Equivalents Database (FPED) [35]. The FPED converts foods and beverages into 37 USDA Food Pattern components, including the number of cup equivalents of fruits and vegetables. Total fruit and vegetable intake includes all dietary sources, regardless of form (e.g., whole, juice), processing (e.g., canned, frozen, fresh), or other ingredients. For the purposes of this study, cup equivalents of fruits and vegetables were examined separately.

Food Store Type and Food Store Type Categories

Dietary interviews asked about where foods and beverages were purchased by inquiring about the type of food store for each individual food and beverage item consumed. In the 2011–2012 wave, food store type separated convenience store from supermarket/grocery store for the first time. For the purposes of this study, food store type was classified into three categories: (1) supermarket and grocery store (coded as “store—grocery/supermarket”), (2) convenience store (coded as “store—convenience”), and (3) non-store (coded as “restaurant—fast food,” “restaurant—waiter/waitress,” “bar/tavern/lounge,” “restaurant—no additional information,” “community food program,” “gift,” “dining facility,” “street vendor,” “vending machine,” and “other source”). Given the low frequency of fruits and vegetables purchased from non-store locations (0.2%), these data were not included in the present study.

Participants were categorized based on where they purchased their fruits and vegetables. These food store type categories were created based on the distribution of the data and evidence demonstrating the lack of healthy food availability in convenience stores. The five food store type categories created were as follows: (1) only (defined as 100% of the time) from supermarket/grocery stores, (2) primarily (defined as > 50–99.9% of the time) from supermarket/grocery stores, (3) equally (defined as 50% from convenience stores and 50% from supermarket/grocery stores) between convenience stores and supermarket/grocery stores, (4) primarily from convenience stores (defined as > 50–99.9% of the time), and (5) only (defined as 100% of the time) from convenience stores.

Sociodemographic Characteristics

The following sociodemographic characteristics were examined for inclusion in statistical models given previous evidence from Hispanic food purchasing research which supports the association between demographics, acculturation, and dietary intake [36–38]. Sociodemographic characteristics considered for inclusion were as follows: age (continuous), sex (categorical: female, male), education (categorical: college education and above, high school graduate or lower), marital status (categorical: married, not currently married), household income level (categorical: income to poverty ratio (IPR) < 130%, 130% ≤ IPR < 300%, and IPR ≥ 300%), household size (continuous), food security (categorical: full food security, marginal food security, low food security, and very low food security), and two proxies of the acculturation process [39]: country of birth and length of time in the USA (categorical: born in the USA, born outside of the USA and spent less than 15 years in the USA, born outside of the USA and spent 15 years or more in the USA).

Statistical Analyses

Descriptive statistics on the sociodemographic characteristics of the sample and characteristics of each food store type category were obtained. Descriptive statistics for fruit and vegetable cup equivalent intake were also obtained. Differences between all sociodemographic characteristics by food store type categories were examined using the PROC SURVEYFREQ procedure to calculate the Rao-Scott *F*-adjusted chi-square statistic for categorical variables and the PROC SURVEYMEANS procedure to examine mean differences for continuous variables. Next, the unadjusted relationship between sociodemographic characteristics and cup equivalents of fruit and vegetable intake was evaluated via a series of bivariate analyses using PROC SURVEYREG. Sociodemographic characteristics with a $p < 0.20$ value were included in the final models. Results from bivariate associations warranted the inclusion of the following control variables: age, food security, country of birth, and length of time in the USA. The vegetable cup equivalent intake model controlled for age and food security.

Tests for multicollinearity were conducted to assess for linear relationships among control variables. Given that all variance inflation factor values were less than ten, all sociodemographic characteristic identified in bivariate analyses were included in the final models. Two models were estimated by negative binomial regression models (using PROC GENMOD) to examine the association between food store type categories and fruit and vegetable cup equivalent intake, separately, while controlling for sociodemographic characteristics [40]. Separate linear regression models, by fruit cup equivalent intake and vegetable cup equivalent intake, were also estimated (using PROC SURVEYREG), but due to the binomial distributions of both fruit cup equivalent intake and vegetable cup equivalent intake, the negative binomial models were more appropriate [41, 42]. An alpha level of $p < .05$ was used for all statistical tests.

Given the complex sampling design of the 2011–2012 NHANES, all descriptive statistics, bivariate analyses, and the multivariate regression analyses were survey-weighted to account for the survey design. All statistical analyses were performed using SAS software, version 9.4 of the SAS System for Windows (SAS Institute Inc., Cary, NC, USA). Analyses of publicly available federal data are exempt from human subject review by San Diego State University and the University of California at San Diego.

Results

Sample Population

Table 1 displays the sociodemographic characteristics and fruit and vegetable cup equivalent intake for the US Hispanic adult sample (20 years old and older) in the 2011–2012 NHANES with complete fruit and vegetable intake data ($N = 837$), as well as for individuals by each food store type category (full sample). There was equal representation of males and females in the full NHANES sample, and they were on average 40 years old. About a third of the full sample was either born in the USA (36%), born outside of the USA and have spent less than 15 years in the USA (30%), or were born outside of the USA and have spent 15 years or more in the USA (34%). Almost half of respondents had an IPR less than 130%

and reported full food security, most reported being married or living with a partner, and more than half reported no more than a high school education. For all respondents, the mean intake for fruit was 1.1 (SE = 0.06) cup equivalents and for vegetables it was 1.6 (SE = 0.04) cup equivalents. For the reported fruits and vegetables consumed, 49% of respondents reported purchasing these foods only from supermarkets/grocery stores, 13% reported purchasing primarily from supermarkets/grocery stores, 9% reported purchasing equally from convenience stores and supermarkets/grocery stores, 11% reported purchasing primarily from convenience stores, and 18% reported purchasing only from convenience stores.

Food Store Type Category Differences

Table 1 also displays the overall p-values for the PROC SURVEYFREQ and PROC SURVEYMEANS procedures used to test for differences between food store type categories and sociodemographic characteristics. Significant differences were found for age, country of birth and length of time in the USA, and fruit and vegetable intake. Compared to individuals who purchased from supermarkets/grocery stores, those who only purchased from convenience stores (M = 36.6, SE = 1.20, p < .001) and those who primarily purchased from convenience stores (M = 38.1, SE = 0.89, p = .002) were significantly younger. Differences were also seen for country of birth and length of time in the USA. Approximately, 48% of individuals who only purchased from convenience stores were born in the USA, whereas 30% of individuals who only purchased from supermarkets/grocery stores were born in the USA (p = .002).

Patrons of the various food store type categories also differed in their intakes of fruit. Those who only purchased fruits and vegetables from convenience stores had significantly lower intakes of fruit (M = 0.6, SE = 0.14, p < .001) compared to consumers of other food store type categories. Additionally, those who primarily purchased from convenience stores (M = 1.3, SE = 0.16, p < .016) and those who equally purchased from convenience stores and supermarket/grocery stores (M = 1.2, SE = 0.15, p < .023) had significantly lower intakes of fruit compared to those who primarily purchased from supermarkets/grocery stores M = 1.7, SE = 0.11). Individuals who primarily purchased from supermarkets/grocery stores had higher intakes of fruit than those who only purchased from supermarkets/grocery stores (M = 1.0, SE = 0.07, p < .001).

Significant differences were also found for vegetable intake. Those who only purchased from convenience stores had lower intakes of vegetables (M = 1.6, SE = 0.11) compared to those who primarily purchased from supermarkets/grocery stores (M = 2.0, SE = 0.11, p = .007). However, those who primarily purchased from convenience stores (M = 1.9, SE = 0.15, p = .018) and those who primarily purchased from supermarkets/grocery stores (M = 2.0, SE = 0.11, p < .001) had significantly higher intakes of vegetables than those who only purchased from supermarkets/grocery stores (M = 1.4, SE = 0.05).

Fruit and Vegetable Intake by Food Store Type Categories, Adjusting for Sociodemographic Characteristics

Results from the negative binomial regression analyses on the association between cup equivalents of fruit and vegetable intake by food store type category, adjusting for sociodemographic characteristics, are presented in Table 2. The results demonstrate that those who primarily purchased from supermarkets/grocery stores consumed 0.92 ($p < .001$) greater fruit cup equivalents compared to those who only purchased from convenience stores, adjusting for age, food security, country of birth, and length of time in the USA. Additionally, those who purchased equally from convenience stores and supermarkets/grocery stores consumed 0.61 ($p = .003$) greater fruit cup equivalents and those who primarily purchased from convenience stores consumed 0.70 ($p = < .001$) greater fruit cup equivalents compared to those who only purchased from convenience stores. It was also found that foreign born individuals who reported spending more than 15 years in the USA consumed 0.37 ($p = .001$) greater fruit cup equivalents than individuals born in the USA.

As for vegetable intake, those who primarily purchased from supermarkets/grocery stores consumed 0.26 ($p = .004$) greater vegetable cup equivalents as compared to those who only purchased from convenience stores, adjusting for age and food security. Additionally, those who primarily purchased from convenience stores consumed 0.21 greater vegetable cup equivalents ($p = .046$) compared to those who only purchased from convenience stores.

Discussion

Findings from this study indicate that consumers from each food store type category differed on several sociodemographic characteristics. Those who only purchased fruits and vegetables from convenience stores tended to be younger and were more likely to be US born compared to those who only or primarily purchased their fruits and vegetables from supermarkets/grocery stores. This finding is consistent with previous research demonstrating that US born Hispanics spend less money at supermarket/grocery stores than those born outside of the USA [43]. Overall, study findings illustrate that US Hispanics shop in multiple food store types, providing evidence that US Hispanics are following the purchasing patterns of other consumers in the USA. For example, national consumer data from the Food Marketing Institute shows that US shoppers are increasingly relying on multiple food stores for their groceries and no longer claiming one store type as their primary food store [44]. Similar findings were seen in a study using Nielsen Homescan data, which showed that Hispanics had a higher, although non-significant, probability of being classified into a multiple food store type group than non-Hispanic Whites [45].

Additionally, results from this study reveal that US Hispanics who only purchased fruits and vegetables from convenience stores had lower intakes of fruits and vegetables compared to individuals who also shopped in supermarket/grocery stores, even after accounting for sociodemographic characteristics. Specifically, results indicated that compared to US Hispanics who primarily purchased their fruits and vegetables from supermarket/grocery stores, US Hispanics who only purchased them from convenience stores had significantly lower intakes of both fruits and vegetables. These findings are consistent with previous research demonstrating that shopping in convenience stores is associated with decreased

fruit and vegetable purchasing and intake [21]. This negative relationship may be due to the high availability of energy-dense foods in convenience stores, which may be more tempting to shoppers [46, 47]. Additionally, the association between primarily shopping in supermarkets/grocery stores and increased fruit and vegetable intake is consistent with previous research conducted both in the USA and the UK [21, 22, 24].

Although previous research has examined associations between food store type and fruit and vegetable intake, no studies to our knowledge have reported the association between shopping for fruits and vegetables in multiple store types and its influence on intake. Findings suggest benefits to purchasing fruits and vegetables from various food store types and that each store type may have their own health promoting or inhibiting aspects in terms of influencing purchasing behavior. For instance, one study found that because of limited space, convenience stores were more likely to display fruits and vegetables at the front of the store, which was associated with a decrease in Hispanic and Non-Hispanic Black consumers' purchases of unhealthy beverages [48]. They also found that the odds of purchasing fruits and vegetables from a convenience store decreased as the number of fruit and vegetable varieties decreased [48]. This illustrates a convenience stores' potential to be both a health promoting and an inhibiting environment, which is important to note given that from 2015 to 2016, there was a 3% increase in the number of US consumers reporting fairly often or almost always shopping in a convenience store for grocery type items [44].

There was no association between only purchasing at supermarket/grocery stores and fruit and vegetable intake, which was unexpected. This lack of association may be due to the fact that although supermarket/grocery stores have greater availability of fruits and vegetables than convenience stores, supermarket/grocery stores also have a greater availability of unhealthy foods and at potentially lower prices than convenience stores making unhealthy foods more enticing [49]. Previous research has shown that supermarkets have the greatest number of fruit and vegetable displays compared to other store types, yet supermarkets also have the greatest number of energy-dense snack foods displays [50, 51]. This may mean that the increased exposure to unhealthy foods in supermarkets, despite the exposure to fruits and vegetables, may be limiting fruit and vegetable purchases and increasing the purchases of unhealthy foods. In fact, one study found that the introduction of a new supermarket in a food desert was not associated with increased intakes of fruits and vegetables but was associated with an increase in percentage of kilocalories from solid fats, added sugars, and alcohol consumed [52]. Additionally, individuals who shop at supermarkets shop less frequently than those who shop in convenience stores, which may mean these individuals are purchasing greater amounts of processed foods as opposed to fruits and vegetables that have a shorter shelf life [53].

Limitations and Strengths

The present study does have a few limitations. Purchases and intake of fruits and vegetables were examined; therefore, these findings may not generalize to other dietary behaviors, such as the purchasing and intake of energy dense foods. Analyses are based on cross-sectional data and therefore cannot be used to determine causal relationships. Dietary intakes in NHANES were self-reported and subject to measurement error, differential misclassification

bias based on nativity status, and social desirability bias [54]. In addition, intake was documented for 24-h periods so it likely does not fully represent participants' dietary behaviors or the full spectrum of food store types in which they obtained fruits and vegetables. Additionally, self-reported food store type for the foods and beverages reported in the dietary interview may be affected by recall bias. Also, this study could not account for variation between food store types or within store types [55]. Although analyses controlled for sociodemographic characteristics, the present study could not account for unobserved differences in psychosocial variables such as knowledge and attitudes towards eating fruits and vegetables [56]. Proxy measures of acculturation (country of birth and length of time in the USA) were used, which are frequently used in Latino health studies [39]; however, they are not as comprehensive as acculturation scales for measuring this complex phenomenon [57]. Likewise, given the lack of data from NHANES, this study could not examine differences by Hispanic subgroup and how this may influence the relationship between fruit and vegetable intake and food store type. A final limitation was the inability to account for distance to stores or access to transportation, such as car access for food shopping trips [58], or the role of neighborhood-level measures such as poverty, segregation, and urbanicity and the availability of various food store types [59].

Study strengths include the large sample size and use of data from a representative sample of the US population. Another strength was the use of a validated 24-h dietary recall [60, 61], which was administered in the participants' preferred language (English or Spanish) by trained bilingual dietary interviewers [62]. Additionally, this study fills a research gap as it focuses its analyses on the US Hispanic sample within NHANES and examines the influence of purchasing fruits and vegetables from multiple food store types. In short, this study identified differences among US Hispanic consumers of multiple food store types allowing one to identify segments of shoppers by sociodemographic characteristics, which is useful for future interventions and public health communication campaigns.

Implications for Practice, Research, and Policy

Findings from the present study have important implications for practice, research, and policy. As indicated, purchasing fruits and vegetables primarily from supermarkets/grocery stores is associated with higher intakes of these foods than only purchasing these foods from convenience stores. This suggests developing nutrition intervention strategies that encourage Hispanics to diversify where they shop for food, including, but not limited to, supermarkets/grocery stores, to ensure they have access to health promoting resources such as fruits and vegetables. To encourage this behavior, it is important to consider their level of acculturation and how acculturation influences decisions on where to purchase foods [36, 63, 64]. Intervention strategies should be developed that support US-born Hispanics' ability to maintain some of the healthier food behaviors practiced in their Hispanic culture such as purchasing foods from more traditional food store types such as supermarket/grocery stores [43].

This study also provided a profile of consumers of different food store types, supporting the need for more targeted food store interventions. For example, with the information that those who only purchase from convenience store tend be younger than those who only or

primarily purchase from supermarket/grocery stores, social marketing campaigns can be developed in convenience stores that are targeted to a younger demographic to promote the purchasing of fruits and vegetables within convenience stores [65]. Lastly, cross-sectional and longitudinal research is needed on how purchasing foods from multiple food store types influences dietary behavior. This research could examine the environmental characteristics of various types of stores to identify their unique health promoting characteristics, how shopping at multiple store types encourages or hinders customers' ability to diversity their food baskets [52], and how additional sociodemographic (e.g., occupation) or health status (e.g., BMI) characteristics influences where consumers purchase foods.

Potential policy implications, which should be supported by additional research, suggest that more needs to be done to change the convenience store environment to promote fruit and vegetable purchases. For instance, such policy strategies could include the mandating of minimum fruit and vegetable stocking requirements [66, 67]. In addition, to aid individuals' diversity in where they shop for foods may mean increasing their access to these food stores. One potential policy strategy to improve access is to increase public transportation options to assist individuals in getting to various types of food stores [68].

Conclusion

Study results suggest that purchasing fruits and vegetables in multiple food store types, particularly if some are purchased from supermarket/grocery stores, is associated with greater intake of fruits and vegetables. Purchasing fruits and vegetables only from supermarket/grocery stores is not associated with the intake of these foods, thereby indicating a somewhat protective factor of shopping in both convenience stores and supermarket/grocery stores. Future studies should examine this phenomenon among US Hispanic subgroups and even other racial/ethnic populations to identify what segments of the population shop in multiple food store types and how doing so affects their diet.

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Table 1

Sociodemographic characteristics of 2011–2012 NHANES Hispanic adult fruit and vegetable consumers and food store categories

	Full sample (*N* = 837)[a] % (weighted N) mean (SE)	Only supermarket/ grocery store (*N* = 407)	Primarily supermarket/ grocery store (*N* = 106)	Equal convenience stores and supermarket/grocery store (*N* = 78)	Primarily convenience store (N = 92)	Only convenience store (N = 152)	*p*
Sociodemographic characteristics							
Age	40.63 (0.63)	43.48 (1.02)	40.65 (1.84)	38.58 (1.40)	38.15 (0.89)	36.67 (1.20)	.001
Sex							.445
Male	50.98 (419)	47.49 (192)	54.61 (58)	51.86 (38)	49.79 (45)	57.39 (86)	
Female	49.02 (418)	52.51 (215)	45.39 (48)	48.14 (40)	50.21 (47)	42.61 (66)	
Education							.941
High school education or less	62.91 (542)	63.08 (267)	65.98 (69)	58.80 (47)	63.67 (59)	61.78 (98)	
College education or greater	37.09 (295)	36.92 (140)	34.02 (37)	41.20 (31)	36.33 (33)	38.22 (54)	
Marital status							.684
Not currently married	52.04 (420)	51.12 (205)	46.56 (49)	51.84 (38)	55.90 (47)	55.78 (79)	
Married or living with partner	47.96 (417)	48.88 (202)	53.44 (57)	48.16 (40)	44.10 (45)	44.22 (73)	
Household income level							.696
IPR < 130%	46.23 (392)	50.41 (204)	48.65 (52)	42.58 (33)	43.79 (42)	38.00 (59)	
130% ≤IPR <300%	29.82 (256)	26.33 (114)	30.30 (32)	33.25 (27)	31.15 (30)	35.18 (53)	
IPR ≥ 300%	23.95 (189)	23.26 (89)	21.05 (22)	24.17 (18)	25.06 (20)	26.82 (40)	
Household size	3.76 (0.09)	3.70 (0.09)	3.65 (0.25)	3.93 (0.19)	3.76 (0.17)	3.85 (0.12)	.621
Food security[a]							.767
Full food security	54.68 (471)	55.32 (231)	58.95 (66)	52.33 (42)	52.11 (47)	53.92 (85)	
Marginal food security	16.52 (136)	15.29 (63)	11.19 (12)	19.69 (15)	18.04 (16)	19.86 (29)	
Low food security	18.43 (146)	19.98 (75)	22.78 (19)	16.38 (13)	17.26 (17)	14.43 (22)	
Very low food security	10.37 (82)	9.50 (36)	7.08 (9)	11.60 (8)	12.59 (12)	11.79 (16)	
Country of birth and length of time in the USA[b]							.002
US born	35.94 (266)	30.44 (109)	26.61 (27)	36.37 (26)	46.74 (36)	48.01 (68)	
Foreign born and less than 15 years in the USA	30.25 (226)	29.63 (105)	35.45 (32)	34.35 (23)	28.57 (26)	26.85 (39)	

	Full sample (*N* = 837)[a] % (weighted N) mean (SE)	Only supermarket/ grocery store (*N* = 407)	Primarily supermarket/ grocery store (*N* = 106)	Equal convenience stores and supermarket/grocery store (*N* = 78)	Primarily convenience store (N = 92)	Only convenience store (N = 152)	*p*
Foreign born and more than 15 years the USA	33.80 (343)	39.93 (193)	37.94 (47)	29.28 (29)	24.69 (30)	25.14 (43)	
Fruit and vegetable intake (24-h recall)							
Fruits (mean cup equivalent)	1.12 (0.06)	1.08 (0.07)	1.74 (0.11)	1.23 (0.15)	1.33 (0.16)	0.65 (0.14)	<.0001
Vegetables (mean cup equivalent)	1.65 (0.04)	1.47 (0.05)	2.05 (0.11)	1.77 (0.14)	1.95 (0.15)	1.60 (0.11)	.001

[a]Missing information for two participants

[b]Refusal rate = 0.2%

Table 2

Negative binomial models for fruit cup equivalent intake, vegetable cup equivalent intake, and food store type categories adjusting for sociodemographic characteristics

	Fruit (cup equivalent) intake			Vegetable (cup equivalent) intake		
	Beta (*SE*)	**95% CI**	***p***	**Beta (SE)**	**95% CI**	***p***
Food store type categories						
Only convenience store	Ref			Ref		
Primarily convenience store	0.70 (0.20)	(0.31, 1.09)	<.001	0.21 (0.10)	(−0.00, 0.41)	.046
Equal convenience stores and supermarket/grocery store	0.61 (0.21)	(0.21, 1.01)	.003	0.10 (0.13)	(−0.15, 0.35)	.422
Primarily supermarket/grocery store	0.92 (0.19)	(0.55, 1.30)	<.001	0.26 (0.09)	(0.08, 0.45)	.004
Only supermarket/grocery store	0.44 (0.23)	(−0.03, 0.86)	.043	− 0.07 (0.09)	(−0.24, 0.10)	.411
Sociodemographic characteristics						
Age	−0.00(0.00)	(−0.01, 0.01)	.586	−0.00 (0.00)	(−0.00, 0.00)	.745
Food security						
Full food security	Ref			Ref		
Marginal food security	0.01 (0.14)	(−0.27, 0.29)	.941	0.04 (0.09)	(−0.13, 0.21)	.678
Low food security	−0.27 (0.15)	(−0.57, 0.02)	.068	−0.06 (0.06)	(−0.18, 0.07)	.382
Very low food security	0.19 (0.20)	(−0.21, 0.59)	.346	0.04 (0.13)	(−0.21, 0.29)	.748
Country of birth and length of time in the USA						
US born	Ref			-	-	-
Foreign born and less than 15 years in the USA	0.29 (0.17)	(−0.05, 0.63)	.097	-	-	-
Foreign born and more than 15 years in the USA	0.37 (0.11)	(0.15, 0.59)	.001			