

## Food-purchasing patterns for home: a grocery store-intercept survey

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### Abstract

*Objectives:* To identify the most common frequency of food-purchasing patterns and relate this pattern to characteristics of individuals and families.

*Design:* A customer-intercept survey was conducted in the greater Houston area, Texas, USA, in 2002. The frequency of food shopping at supermarkets, convenience stores and restaurants to buy food for eating at home was assessed.

*Subjects:* A total of 823 adults (78.5% female; mean age 37.4 years) who went to any of several grocery or convenience stores, including European, Hispanic and African Americans, and Asian/Pacific Islanders.

*Results:* Major food-shopping patterns were a weekly big trip with a few small trips (34.9%), biweekly big trips with a few small trips (21.9%), no big shopping trips (15.4%), a weekly big trip without small trips (13.9%), a monthly big trip (8.3%), and biweekly big trips without small trips (6.4%). While 61.1% of participants never went to convenience stores to buy fruit and vegetables (F&V) for eating at home, 67% went to restaurants for F&V. African American families shopped for food least frequently, while Asian American families shopped for food most frequently. Educational level was negatively associated with the use of convenience stores and positively associated with takeaway from restaurants.

*Conclusions:* There is substantial variability in the frequency of food shopping. Future research on food shopping should incorporate this variable.

### Keywords

Food-shopping practices  
Food availability  
Customer-intercept survey  
Fruit  
Vegetables  
Ethnic diversity

Eating fruit and vegetables (F&V) reduces the risk of cardiovascular disease<sup>1–3</sup> and some cancers<sup>2,4</sup>. The national 2005 Dietary Guidelines for Americans advises people to eat 5 to 13 servings of F&V every day depending on one's recommended energy level (<http://www.healthierus.gov/dietaryguidelines/>). However, less than half of US adults followed this recommendation according to the 1995 Continuing Survey of Food Intakes by Individuals and only 30% of children met this recommendation<sup>5</sup>.

Children tended to consume more F&V when they are available at home<sup>6,7</sup>. What food people eat at home is the result of a chain of events beginning with availability in local stores, marketing, grocery store purchases, management of the home pantry, home food preparation and serving of foods<sup>8</sup>. In this chain of events, food-shopping practices are important in food resource management. People can go shopping for F&V for home consumption at grocery or convenience stores, or obtain them from restaurants as takeaway. Frequent food shopping enables a family to keep a variety of fresh F&V at home while less frequent food shopping would appear to require purchase

of frozen and canned F&V to enhance home availability. Therefore, frequency of F&V shopping practices should be a major determinant of the type of F&V available at home, and perhaps the amount. Understanding home F&V shopping practices holds the promise to elucidate the influences on home availability and consumption.

A first step in understanding food-shopping practices is to know the distribution of families on the frequency of food shopping. Since home F&V availability has been measured at a single point in time<sup>6,7</sup>, the time from food shopping to the point of assessment of home food availability has implications for the F&V left in the home (the longer the interval, the less will be available). Less frequent shopping suggests larger amounts of foods, including F&V, will be purchased, which also has implications for the amount of F&V available in the home. Counting amounts of F&V on grocery store receipts provides an alternative mechanism for assessing home F&V availability. Knowing the frequency of food shopping allows investigators to know the time interval over which grocery store receipts should be collected and analysed. It is also possible for F&V to come into the home from

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leftover foods purchased in restaurants or fast-food eateries and less likely, but possible, from purchases in convenience stores. At the time of planning of this study we could find no publication reporting the distribution of families with children by the frequency of food shopping at grocery stores, or of bringing F&V home from restaurants or convenience stores. Thus, our first step in a planned series of studies was to identify the frequency of such food shopping.

Several factors may influence home food-shopping patterns, e.g. socio-economic status (SES) of individuals<sup>9-12</sup>, family characteristics including the number of adults and children in the household<sup>9</sup>, and who goes shopping or prepares foods at home<sup>13</sup>. Individuals from different cultural backgrounds likely have different frequencies of food-shopping habits (e.g. people of Asian descent have learned to prepare foods without much refrigeration, which forces them to shop more frequently). Knowing the demographic correlates of frequency of food shopping would enable more refined designs of ensuing research by being able to time data collection and questions to the known frequency of food purchasing. Thus, the aim of the present study was to identify the major frequency of food shopping (including grocery, convenience stores and restaurants) patterns using customer-intercept surveys and to relate the food-shopping patterns to characteristics of individuals and families in one urban area.

## Methods

### Study design

To enable us to recruit individuals who likely varied by ethnic and SES group, we recruited stores that varied by the dominant ethnic group and SES characteristic. A customer-intercept survey of usual shopping patterns was conducted in front of several supermarkets, local grocery and convenience stores in the greater Houston area, Texas, USA, from 11 March to 22 June 2002. Customer-intercept interviews were conducted with people as they

were walking into the store to make their purchases and were designed to take 10 min or less (preferably 5 min or less) because of the nature of the contact. An attempt was made to maximise the diversity of the sample with respect to ethnicity and SES to be sure to detect unusual food-shopping patterns. Therefore, samples of supermarkets, local grocery and convenience stores were selected strategically.

### Setting

The US Census 1990 data for Houston were used to maximise the ethnic and socio-economic diversity of the survey. (Census 2000 data were not available at the time of planning this study.) Three hundred and eighteen census tracts were selected for a predominant ethnic group (>50% residents from that ethnic group) from the four most common ethnicities in Houston: African, Asian, European and Hispanic Americans. (Since no census tract met this criterion for families of Asian descent, those census tracts were selected by having >20% residents of Asian descent.) The ethnic dominant census tracts were then divided into upper/middle and lower SES census tracts, in which lower SES census tract was defined as a census tract with >20% of families with children (<18 years) living below poverty. Census tracts having supermarkets, local grocery stores or convenience stores were selected to represent each of eight ethnicity-SES cells and to maximise diversity of the type of stores (see Table 1). The managers of each store were contacted, informed of the purpose of the study and permission obtained to conduct surveys at the entrance as people walked in. Sometimes we were required to request permission from regional managers and local store managers. Not all regional or local store managers provided permission to conduct the interviews. These stores were removed from the pool of available stores and selections to meet ethnic-SES distribution proceeded from there.

Customer-intercept interviews were conducted at the entrances of 13 supermarkets, 10 small grocery stores and

**Table 1** Distribution of census tracts in Houston, and sample stores by ethnic and socio-economic status characteristics of census tract

		Predominant (>50%) ethnic group			
		African American	Asian American	Hispanic American	European American
Census tracts ( <i>n</i> = 318)	≥20% of families with children below poverty	59	1	25	16
	<20% of families with children (<18 years) living below poverty	6	5	2	204
Supermarkets ( <i>n</i> = 13)	≥20%	1	0	1	3
	<20%	1	2	3	2
Local groceries ( <i>n</i> = 10)	≥20%	2	2	2	0
	<20%	1	2	1	0
Convenience stores ( <i>n</i> = 5)	≥20%	1	0	1	1
	<20%	1	0	0	1
Census tracts with stores ( <i>n</i> = 25)	≥20%	4	2	3*	4
	<20%	3	3*	4	2*

\* Indicates census tract contains two stores, all other tracts contain one store.

five convenience stores within 25 census tracts. A supermarket was defined as a grocery store that was part of a national or regional chain and carried a large variety of fresh produce, brand names and sizes. A small grocery store was defined as an independently owned 'Mom and Pop' establishment carrying some produce and a limited variety of brand names and sizes. Convenience store was defined as a food mart primarily engaged in retailing a limited line of goods that generally includes milk, bread, soft drinks and snacks. Stores linked to gas stations were included in the latter.

### **Types of participants**

To maximise the diversity of respondents according to their time of shopping, five interviews were conducted per store in the morning (8–11 am), five in the afternoon (noon–5 pm) and five in the evening (6–10 pm) on weekdays and again on weekends (30 per store). Nine trained interviewers matched with the ethnicity of each census tract contacted every second person entering the store after they started or completed an interview, according to a standardised protocol, irrespective of any personal characteristic, until the quota for interviews for that store and time interval was completed. Interviewers explained the purpose of the study to those customers and asked them to participate. Among those who agreed to participate, only customers who were 19 years or older, had one or more children (18 years of age or younger) living at home and usually did the food shopping for their family were eligible. Interviewers recorded gender, ethnicity and age group (three categories: young adults, middle-aged, seniors) of those who refused participation and of those who agreed to participate but were not eligible. For participants who were unable to communicate with interviewers in English, the interview was done in another language (Spanish, Chinese or Vietnamese) in which participants could communicate. Each interview lasted approximately 5 min. Customers who completed the interviews received a \$5 coupon to be used at that store as an incentive. The protocol for this research was approved by the Institutional Review Board of the Baylor College of Medicine.

### **Measurement**

Data were collected from customers on demographics and shopping habits, including the frequency of usual food shopping, day and time of usual big shop for food, travel time for shopping trips, usual shopping place (very large supermarkets, regular supermarkets, local grocery stores and convenience stores, according to the predetermined list) and transportation used to get to the grocery store. Qualitative formative work in the development of the questionnaire revealed that people did not separate F&V shopping from general food shopping. The main frequency of shopping question, therefore, was posed as frequency of food shopping. The frequency of going to a convenience

store and going to restaurants (including fast-food eateries) that sell already prepared food to purchase F&V and take it home was also assessed. Separating specific F&V shopping in these outlets made most sense to our formative sample. The highest level of education completed was used as a marker for participants' SES. The number of adults and children in the household was also recorded.

To minimise the time commitments and inconvenience of shoppers in entering a store, extensive pre-testing with adults of all ethnic groups was done to identify several categories describing the number and type of food-shopping trips at grocery stores. Extensive pre-testing was then done on the whole questionnaire, written in English. The refined questionnaire was translated into Spanish, Chinese (Mandarin and Cantonese) and Vietnamese, and translated back into English to verify that the translation preserved the meaning and was decentred<sup>14</sup> to equate English and other language versions. The Spanish, Chinese, Vietnamese and reversed English versions were again pre-tested to simplify and clarify wordings. The Spanish translation, back translation and pre-testing involved Mexican, Puerto Rican, Dominican, Argentinean, Colombian and Salvadoran dialects.

### **Statistical analysis**

Continuous variables (age, number of people or children in the household) were examined for outliers (values over three standard deviations). Normality was assessed using histograms, box plots, skewness and kurtosis indices. Frequencies were performed on categorical variables to detect responses not listed as valid selections. Fourteen cases were deleted due to the low quality of the interview per the quality rating made by the interviewer. Because not all participants had complete information, pairwise deletion of cases was used. Frequencies, percentages and chi-square test statistics were used to describe and compare the demographic characteristics among the three participation groups: those who agreed to participate and were eligible, those who agreed but were not eligible, and those who rejected participation. Participants were divided into three age groups: young adults (19–39 years old), middle-aged (40–59 years old) and seniors (60 years old and older). Frequencies and percentages were used to describe the major food-purchasing patterns among those who agreed to participate and were eligible. Chi-square test statistics were used to explore the relationship between food-purchasing patterns and individual and family characteristics. Chi-square test statistics included (1) the Pearson chi-square to examine the association between two nominal variables, (2) the extended Mantel–Haenszel chi-square to detect differences in row mean responses for nominal–ordinal variables, and (3) the Mantel–Haenszel chi-square to detect zero correlation (no linear trend) for two ordinal variables<sup>15</sup>.

Forward stepwise polytomous logistic regression (PR) analyses were used to investigate the relationship

(with and without adjusting for significant demographic characteristics) between frequency of food purchasing and the use of convenience stores and/or restaurants to purchase prepared F&V<sup>16</sup>. Odds ratios and corresponding 95% confidence intervals for the adjusted and unadjusted PR models were computed to describe the magnitude of the effect of the variables to frequency of food purchasing. PR analyses were performed using BMDP New System 2.0 (Statistical Solutions Ltd, Crosses Green, Cork, Ireland); all other analyses were performed using SAS version 8 (SAS Institute, Cary, NC, USA).

## Results

A total of 2762 people were contacted for the survey. Table 2 shows the comparison of demographic and store information among those who agreed to participate in the survey and were qualified ( $n = 823$ ), those who agreed but were not qualified ( $n = 594$ ) and those who refused ( $n = 1345$ ). There were proportionally more women, young adults and Hispanic or African Americans among those who agreed and were qualified. Those who did not agree to participate in the study included more

middle-aged and seniors, and European and Asian Americans. While customers visiting stores located in the low-SES tracts were more likely to agree to participate in the survey, customers visiting stores in predominantly European and Asian American census tracts were less likely to agree to participate in the survey.

A big weekly trip with a few small shopping trips was the most common food-shopping pattern (34.9%) among those who agreed to take part in the study and were qualified (Table 3). Biweekly big trips with a few small shopping trips (21.9%), no big trip with small shopping as needed (15.4%), a weekly big trip without small shopping (13.1%), a monthly big trip (8.3%) and biweekly big trips without small shopping (6.4%) followed.

Those who went shopping more frequently had somewhat more people in their household, but fewer children, and were more likely to be Hispanic or Asian/Pacific Islanders (Table 3). They were less likely to be African American and more likely to go to stores located in the predominantly European and Asian American census tracts. Although more than 70% of participants across the food-shopping pattern groups preferred shopping at larger size stores, frequent shoppers were more likely to prefer

**Table 2** Frequencies, percentages and results from the comparison between demographic characteristics and participation status (agreed and qualified, agreed and not qualified, refused)

Demographic characteristic	Agreed & qualified ( $n = 823$ )	Agreed & not qualified ( $n = 594$ )	Refused ( $n = 1345$ )	<i>P</i> -value
Female, $n$ (%)	644 (78.5)	331 (56.8)	808 (60.6)	<0.0001§
Age group, $n$ (%)				<0.0001¶
Young adults (19–39 years)	488 (59.7)	219 (46.7)	690 (52.0)	
Middle-aged (40–59 years)	301 (36.8)	198 (42.2)	534 (40.2)	
Senior ( $\geq 60$ years)	29 (3.5)	52 (11.1)	103 (7.8)	
Ethnicity, $n$ (%)				<0.0001§
European American	97 (11.9)	178 (30.5)	383 (28.8)	
Hispanic American	301 (36.8)	93 (16.0)	250 (18.8)	
African American	240 (29.4)	129 (22.1)	193 (14.5)	
Asian/Pacific Islander	171 (20.9)	183 (31.4)	500 (37.6)	
Other	8 (1.0)	0 (0.0)	3 (0.2)	
Interview time of day				0.157§
Morning (8–11 am)	280 (34.1)	208 (35.0)	443 (33.0)	
Afternoon (noon–5 pm)	289 (35.2)	195 (32.8)	424 (31.5)	
Evening (6–10 pm)	251 (30.6)	191 (32.2)	477 (35.5)	
Interviewed on weekend	407 (49.5)	284 (47.8)	620 (46.1)	0.310§
Interviewed at large store, $n$ (%)*	391 (47.5)	261 (43.9)	722 (53.7)	0.0001¶
Interviewed at low-SES store, $n$ (%)†	405 (49.2)	215 (36.2)	487 (36.2)	<0.0001¶
Interviewed at store representing... $n$ (%)‡				<0.0001§
European American	207 (25.2)	185 (31.1)	465 (34.6)	
Hispanic American	235 (28.5)	96 (16.2)	238 (17.7)	
African American	208 (25.3)	131 (22.1)	140 (10.4)	
Asian American	173 (21.0)	182 (30.6)	502 (37.3)	

SES – socio-economic status.

\* A large store was defined as a grocery store that was part of a national or regional chain and carried a large variety of fresh produce, brand names and sizes. Its counterparts were small grocery stores, which were defined as an independently owned 'Mom and Pop' establishment, and convenience stores, which were food marts primarily engaged in retailing a limited line of goods.

† SES of the census tract in which stores were located was determined from 1990 census data. Low-SES census tract was defined as a census tract with >20% families with children (<18 years) living below poverty.

‡ Predominant ethnicity for census tract in which stores were located was determined for the four most prevalent ethnicities in Houston: African, Asian, European and Hispanic Americans.

§ Pearson chi-square statistic (nominal by nominal).

¶ Cochran–Mantel–Haenszel statistics test for ordinal by nominal data; row mean scores differ (presented as columns in this table).

**Table 3** Frequencies, percentages and results from the comparison between frequency of food-shopping patterns and demographic characteristics

Variable	Big monthly, few small	Big biweekly, no small	Big biweekly, few small	Big weekly, no small	Big weekly, few small	No big, as needed	P-value
Number (%)	69 (8.3)	55 (6.4)	181 (21.9)	106 (13.1)	283 (34.9)	126 (15.4)	<0.0001‡
Female	54 (79.4)	36 (65.5)	157 (86.7)	84 (79.2)	222 (78.7)	89 (71.2)	<0.0001‡
Ethnicity, n (%)							
European American	7 (10.1)	7 (13.0)	23 (12.8)	12 (11.3)	28 (9.9)	20 (16.0)	
Hispanic American	13 (18.8)	6 (11.1)	71 (39.7)	52 (49.1)	124 (44.0)	34 (27.2)	
African American	45 (65.2)	39 (72.2)	78 (43.6)	12 (11.3)	42 (14.9)	24 (19.2)	
Asian/Pacific	3 (4.3)	7 (13.0)	7 (3.9)	29 (27.4)	85 (30.1)	45 (36.0)	
Other	1 (1.4)	1 (1.9)	0 (0.0)	1 (0.9)	3 (1.1)	2 (1.6)	
Mean number in household (SD)	4 (1.3)	4.3 (1.3)	4.6 (1.4)	4.4 (1.4)	4.7 (1.6)	4.5 (1.5)	0.008\$
Mean number of children (SD)	2.2 (1.1)	2.3 (1.1)	2.4 (1.2)	2.0 (1.1)	2.1 (1.0)	2.0 (1.0)	0.001\$
Education level, n (%)							0.622‡
High school graduate	35 (50.7)	24 (44.4)	82 (45.8)	50 (47.2)	136 (48.4)	59 (46.8)	
Some college	21 (30.4)	21 (38.9)	65 (36.3)	21 (19.8)	71 (25.3)	30 (23.8)	
More than college	13 (18.8)	9 (16.7)	32 (17.9)	35 (33.0)	74 (26.3)	37 (29.4)	
Preferred shopping place, n (%)							0.0008‡
Very large	11 (15.9)	16 (29.1)	18 (10.0)	10 (9.5)	18 (6.4)	13 (10.2)	
Large	56 (81.2)	39 (70.9)	159 (88.3)	86 (81.9)	237 (83.7)	93 (73.2)	
Small	2 (2.9)	0	3 (1.7)	9 (8.6)	28 (9.9)	21 (16.5)	
Shopping on weekend, n (%)	16 (50.0)	17 (63.0)	52 (43.7)	40 (60.6)	79 (42.0)	n/a	0.0004‡
Drive own car, n (%)	56 (81.2)	50 (90.9)	162 (89.5)	92 (86.8)	246 (86.9)	119 (93.7)	0.137‡
Interviewed at large store, n (%)	29 (42.0)	12 (21.8)	87 (48.1)	49 (46.2)	141 (49.8)	72 (56.7)	0.001‡
Interviewed at low-SES store, n (%)*	39 (56.5)	20 (36.4)	125 (69.1)	49 (46.2)	120 (42.4)	51 (40.2)	<0.0001‡
Interviewed at store representing... , n (%)†							<0.0001‡
European Americans	12 (17.4)	4 (7.3)	58 (32.0)	24 (22.6)	73 (25.8)	36 (28.3)	
Hispanic Americans	6 (8.7)	6 (10.9)	51 (28.2)	45 (42.5)	98 (34.6)	28 (22.0)	
African Americans	47 (68.1)	42 (76.4)	66 (36.5)	8 (7.5)	29 (10.2)	17 (13.4)	
Asian Americans	4 (5.8)	3 (5.5)	6 (3.3)	29 (27.4)	83 (29.3)	46 (36.2)	

SD – standard deviation; SES – socio-economic status; n/a – not applicable.  
 \* SES of the census tract in which stores were located was determined from 1990 census data. Low-SES census tract was defined as a census tract with > 20% families with children (< 18 years) living below poverty.  
 † Predominant ethnicity for census tract in which stores were located was determined for the four most prevalent ethnicities in Houston: African, Asian, European and Hispanic Americans.  
 ‡ Pearson chi-square statistic (nominal by nominal).  
 § Post hoc comparisons; not significant at P = 0.003 for mean age or number.  
 ¶ Cochran–Mantel–Haenszel statistics test for ordinal by nominal data; row mean scores differ (presented as columns in this table).

small grocery stores. Education level, transportation to get to the stores, mean age, usual shopping time of day, time spent in shopping and distance from home to shopping place were not significantly different across the grocery shopping groups (data not shown).

Alternative pathways to get F&V for home use are convenience stores and takeaway from restaurants. A majority (61.1%) of participants never went to convenience stores to buy F&V (Table 4). A quarter of subjects (25.7%) went to convenience stores to buy F&V more than once a week, followed by once a week or less at 13.2%. Those who went to convenience stores more than once a week had more people in the household, and a greater proportion of European Americans and a smaller proportion of African Americans, than never-users or the once a week or less group. The proportion of people who drove their own cars to get to the grocery store was the lowest among those who went to the convenience store once a week or less. Food-shopping day of the week and preferred grocery-shopping place were not significantly different across the three groups (data not shown).

The proportion of people who answered they went to restaurants more than once a week to buy already

prepared food that contained F&V (37.5%) was similar to that of those who never did (37.1%), while the proportion who did so once a week or less was lower (25.4%) (Table 5). Those who went to restaurants to buy such foods more than once a week included proportionally more Asian Americans, and fewer African Americans. There was a tendency for high school graduates or less to never purchase F&V at restaurants for eating at home, and those with more than a college education to purchase F&V at a restaurant for home consumption more than once a week. Those who drove their own car were somewhat more likely to purchase F&V from a restaurant for consumption at home.

Using PR analyses, the odds ratios and 95% confidence intervals, unadjusted and adjusted for significant demographic characteristics, from the joint associations of grocery-shopping patterns with convenience store use and restaurant use for prepared F&V eaten at home are presented in Table 6. The 'no big trips, shopping as needed' category was deleted from the unadjusted PR model because there were no cases for the category in the adjusted PR model once cases were deleted due to missing demographic values.

**Table 4** Frequencies, percentages and results from the comparison between the use of the convenience stores to buy fruits and vegetables to eat at home and demographic characteristics

Variable	Never	<1/week	>1/week	P-value
Number (%)	494 (61.1)	107 (13.2)	208 (25.7)	
Female, <i>n</i> (%)	397 (80.4)	74 (69.2)	161 (78.5)	0.038‡
Ethnicity, <i>n</i> (%)				0.004‡
European American	53 (10.8)	5 (4.7)	39 (18.8)	
Hispanic American	175 (35.6)	42 (39.3)	84 (40.4)	
African American	141 (28.7)	47 (43.9)	43 (20.7)	
Asian/Pacific Islander	117 (23.8)	10 (9.3)	42 (20.2)	
Other	5 (1.0)	3 (2.8)	0 (0.0)	
Mean number in household (SD)	4.4 (1.5)	4.4 (1.3)	4.8 (1.5)	0.003§
Mean number of children (SD)	2.1 (1.1)	2.2 (1.1)	2.3 (1.1)	0.030§
Education level, <i>n</i> (%)				0.003¶
High school graduate	211 (43.0)	63 (58.9)	107 (51.4)	
Some college	138 (28.1)	34 (31.8)	57 (27.4)	
More than college	142 (28.9)	10 (9.3)	44 (21.2)	
Preferred shopping place, <i>n</i> (%)				0.654¶
Very large	56 (11.3)	15 (14.0)	10 (4.8)	
Large	390 (78.9)	90 (84.1)	185 (88.9)	
Small	48 (9.7)	2 (1.9)	13 (6.3)	
Shopping on weekend, <i>n</i> (%)	118 (45.0)	28 (49.1)	56 (50.5)	0.839‡
Drive own car, <i>n</i> (%)	448 (90.5)	80 (74.8)	190 (91.3)	<0.001‡
Interviewed at large store, <i>n</i> (%)	245 (49.5)	30 (28.0)	113 (54.3)	0.001¶
Interviewed at low-SES store, <i>n</i> (%) *	226 (45.7)	55 (51.4)	116 (55.8)	0.0124¶
Interviewed at store representing... , <i>n</i> (%)†				<0.001‡
European Americans	116 (23.4)	21 (19.6)	70 (33.7)	
Hispanic Americans	128 (25.9)	33 (30.8)	74 (35.6)	
African Americans	129 (26.1)	43 (40.2)	26 (12.5)	
Asian Americans	122 (24.6)	10 (9.3)	38 (18.3)	

SD – standard deviation; SES – socio-economic status.

\* SES of the census tract in which stores were located was determined from 1990 census data. Low-SES census tract was defined as a census tract with >20% families with children (<18 years) living below poverty.

† Predominant ethnicity for census tract in which stores were located was determined for the four most prevalent ethnicities in Houston: African, Asian, European and Hispanic Americans.

‡ Pearson chi-square statistic (nominal by nominal).

§ *Post hoc* analysis showed no significant contrast for age and number of children; for number in household, a significant ( $P = 0.003$ ) difference between never and more than once a week was observed.

¶ Cochran–Mantel–Haenszel statistics test for ordinal by nominal data; non-zero correlation (linear-by-linear association).

**Table 5** Frequencies, percentages and results from the comparison between the use of the restaurants for the purchase of prepared fruits and vegetables to eat at home and demographic characteristics

Variable	Never	<1/week	>1/week	P-value
Number (%)	298 (37.1)	204 (25.4)	301 (37.5)	
Female, <i>n</i> (%)	227 (76.7)	155 (76.4)	243 (80.7)	0.382‡
Ethnicity, <i>n</i> (%)				0.018‡
European American	24 (8.1)	33 (16.3)	40 (13.3)	
Hispanic American	96 (32.2)	84 (41.4)	120 (39.9)	
African American	119 (39.9)	49 (24.1)	64 (21.3)	
Asian/Pacific Islander	58 (19.5)	32 (15.8)	76 (25.2)	
Other	1 (0.3)	5 (2.5)	1 (0.3)	
Mean number in household (SD)	4.4 (1.4)	4.6 (1.6)	4.6 (1.4)	0.148
Mean number of children (SD)	2.1 (1.1)	2.3 (1.2)	2.2 (1.1)	0.320
Education level, <i>n</i> (%)				0.001§
High school graduate	161 (54.0)	91 (44.8)	129 (42.9)	
Some college	82 (27.5)	64 (31.5)	80 (26.6)	
More than college	55 (18.5)	48 (23.6)	92 (30.6)	
Preferred shopping place, <i>n</i> (%)				0.006§
Very large	44 (14.8)	17 (8.3)	18 (6.0)	
Large	232 (77.9)	171 (83.8)	259 (86.0)	
Small	22 (7.4)	16 (7.8)	24 (8.0)	
Shopping on weekend, <i>n</i> (%)	57 (40.4)	58 (49.2)	86 (50.6)	0.126‡
Drive own car, <i>n</i> (%)	254 (84.9)	183 (89.7)	275 (91.4)	0.040‡
Interviewed at large store, <i>n</i> (%)	122 (40.8)	106 (52.0)	158 (52.5)	0.004§
Interviewed at low-SES store, <i>n</i> (%)*	124 (41.5)	107 (52.5)	164 (54.5)	0.002§
Interviewed at store representing... , <i>n</i> (%)†				<0.0001‡
European Americans	43 (14.4)	71 (34.8)	91 (30.2)	
Hispanic Americans	77 (25.8)	64 (31.4)	93 (30.9)	
African Americans	120 (40.1)	34 (16.7)	43 (14.3)	
Asian Americans	59 (19.7)	35 (17.2)	74 (24.6)	

SD – standard deviation; SES – socio-economic status.

\*SES of the census tract in which stores were located was determined from 1990 census data. Low-SES census tract was defined as a census tract with >20% families with children (<18 years) living below poverty.

† Predominant ethnicity for census tract in which stores were located was determined for the four most prevalent ethnicities in Houston: African, Asian, European and Hispanic Americans.

‡ Cochran–Mantel–Haenszel statistics test for ordinal by nominal data; row mean scores differ (presented as columns in this table).

§ Cochran–Mantel–Haenszel statistics test for ordinal by nominal data; non-zero correlation (linear-by-linear association).

The Wald chi-square test for convenience store use ( $\chi^2_{\text{Wald}} = 29.41$ ,  $df = 8$ ,  $P < 0.001$ ) and restaurant use ( $\chi^2_{\text{Wald}} = 24.18$ ,  $df = 8$ ,  $P = 0.002$ ) were significant in the unadjusted model, indicating that overall these variables were significantly associated with the frequency of grocery-shopping patterns. Contrast between subgroups was significant only among those who went for a big shopping trip once a month and those who went for a big biweekly trip without small shopping. Those who were more likely to buy F&V at convenience stores less than or equal to once a week more likely went big shopping monthly or biweekly than weekly shoppers with a few small trips. Those who bought F&V at restaurants to take home less than or equal to once a week were less likely to shop monthly versus a big weekly trip with a few small trips. Those who bought F&V at restaurants at all were less likely to do large grocery shopping biweekly versus a big weekly trip with a few small trips. Ethnicity alone accounted for the differences between big monthly and big weekly with a few small trips, with African Americans more likely and Asian Americans less likely to do the monthly shopping. The relationships between big biweekly with no small trips versus big weekly with a few small trips and convenience store and restaurant

purchasing were not significant, however, after adjusting for ethnicity of participants, size of store visited and SES level of the census tract in which the stores were located ( $\chi^2_{\text{Wald}} = 17.63$ ,  $df = 8$ ,  $P = 0.024$  with all 95% confidence intervals containing unity;  $\chi^2_{\text{Wald}} = 13.83$ ,  $df = 8$ ,  $P = 0.086$ ). The main effects of ethnicity and size of the store visited, and SES level of the census tract in which the store was located, were the only significant demographic characteristics ( $\chi^2_{\text{Wald}} = 125.46$ ,  $df = 12$ ,  $P < 0.001$ ;  $\chi^2_{\text{Wald}} = 11.71$ ,  $df = 4$ ,  $P = 0.020$ ;  $\chi^2_{\text{Wald}} = 22.25$ ,  $df = 4$ ,  $P < 0.001$ ) remaining in the PR model. African Americans were 3.9 times more likely to go big monthly shopping and 2.5 times more likely to go big shopping every other week with a few small shopping trips than were European Americans. Asian Americans were less likely to go big monthly or biweekly shopping than European Americans. The model goodness-of-fit likelihood ratio (LR) chi-square indicated that the model exhibited good fit in the unadjusted model ( $\chi^2_{\text{LR}} = 24.22$ ,  $P = 0.085$ ) and the adjusted model ( $\chi^2_{\text{LR}} = 394.64$ ,  $P = 0.768$ ). Only ethnicity and store SES accounted for the difference between big biweekly with a few small versus big weekly with a few small. African Americans were more likely to shop less

**Table 6** Results (odds ratios (OR) and 95% confidence intervals (CI)) from stepwise polytomous logistic regression analyses for shopping patterns with and without adjustment for demographics

		Big monthly few small vs. big weekly few small		Big biweekly no small vs. big weekly few small		Big biweekly few small vs. big weekly few small		Big weekly no small vs. big weekly few small	
		OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Unadjusted model*									
Buy F&V at convenience stores	Never	1.0		1.0		1.0		1.0	
	≤ 1/week	2.6	(1.3–5.3)§	3.2	(1.5–6.7)§	1.0	(0.5–1.8)	0.6	(0.3–1.4)
	> 1/week	1.1	(0.5–2.2)	0.6	(0.2–1.7)	1.5	(1.0–2.4)	1.0	(0.6–1.6)
Buy F&V at restaurants	Never	1.0		1.0		1.0		1.0	
	≤ 1/week	0.5	(0.2–1.0)*	0.3	(0.1–0.6)§	1.0	(0.6–1.7)	0.6	(0.3–1.2)
	> 1/week	0.8	(0.4–1.5)	0.3	(0.2–0.8)§	1.5	(0.9–2.3)	1.2	(0.7–2.0)
Constant		0.2	(0.2–0.4)	0.3	(0.2–0.4)	0.5	(0.3–0.7)	0.4	(0.3–0.6)
Adjusted models†									
Buy F&V at convenience stores	Never	1.0		1.0		1.0		1.0	
	≤ 1/week	1.7	(0.8–3.7)	2.0	(0.9–4.6)	0.7	(0.3–1.4)	0.6	(0.3–1.4)
	> 1/week	1.1	(0.5–2.4)	0.7	(0.3–2.1)	1.6	(1.0–2.5)	0.9	(0.5–1.6)
Buy F&V at restaurants	Never	1.0		1.0		1.0		1.0	
	≤ 1/week	0.6	(0.3–1.4)	0.5	(0.2–1.2)	1.1	(0.6–1.9)	0.6	(0.3–1.2)
	> 1/week	1.3	(0.7–2.7)	0.7	(0.3–1.6)	1.8	(1.1–3.0)	1.1	(0.7–2.0)
Ethnicity	European American	1.0		1.0		1.0		1.0	
	Hispanic American	0.4	(0.1–1.2)	0.1	(0.0–0.4)§	0.7	(0.4–1.4)	0.9	(0.4–2.0)
	African American	3.9	(1.4–11.0)§	1.9	(0.7–5.3)	2.5	(1.2–5.1)§	0.7	(0.3–1.7)
	Asian American and others	0.1	(0.0–0.6)§	0.1	(0.0–0.3)§	0.1	(0.0–0.3)§	0.7	(0.3–1.5)
Store size	Large	1.0		1.0		1.0		1.0	
	Small–medium	1.4	(0.7–2.6)	3.8	(1.7–8.4)§	1.1	(0.7–1.7)	1.2	(0.8–2.0)
Store SES‡	Low	1.0		1.0		1.0		1.0	
	Middle	0.7	(0.4–1.4)	1.8	(0.9–3.7)	0.4	(0.3–0.7)§	0.9	(0.6–1.5)
Constant		0.2	(0.1–0.7)	0.2	(0.0–0.5)	0.8	(0.4–1.7)	0.5	(0.2–1.2)

F&V – fruit and vegetables; SES – socio-economic status.

\*Unadjusted model goodness-of-fit:  $\chi^2_{LR}$  (df = 16) = 24.22,  $P = 0.085$ ; convenience store use:  $\chi^2_{Wald}$  (df = 8) = 29.41,  $P < 0.001$ ; restaurant use:  $\chi^2_{Wald}$  (df = 8) = 24.18,  $P = 0.002$ .

†Adjusted model goodness-of-fit:  $\chi^2_{LR}$  (df = 416) = 394.64,  $P = 0.768$ ; convenience store use:  $\chi^2_{Wald}$  (df = 8) = 17.63,  $P = 0.024$ ; restaurant use:  $\chi^2_{Wald}$  (df = 8) = 13.83,  $P = 0.086$ ; ethnicity:  $\chi^2_{Wald}$  (df = 12) = 125.46,  $P < 0.001$ ; store size:  $\chi^2_{Wald}$  (df = 4) = 11.71,  $P = 0.020$ ; store SES:  $\chi^2_{Wald}$  (df = 4) = 22.25,  $P < 0.001$ .

‡SES of the census tract in which stores were located was determined from 1990 census data. Low-SES census tract was defined as a census tract with >20% families with children (<18 years) living below poverty.

§ Contrasts significant at  $P < 0.05$ .

frequently while Asians and others were less likely to shop less frequently. Stores in middle-SES areas were less likely to have shoppers who reported big biweekly trips with a few small trips versus big weekly trips with a few small trips.

### Discussion

The current study describes the prevalence of usual frequency of grocery store food-shopping patterns, various ways to get F&V for home use and factors influencing these patterns using a customer-intercept survey in an urban setting. The sample was generated to focus on families with children aged 18 years or less at home and to maximise diversity by SES, ethnic group, type of store and time of day, and thereby increase the likelihood of identifying differences in food-shopping patterns by these characteristics.

A weekly or biweekly big trip with a few small shopping trips was the major food-shopping pattern in this large metropolitan area. While convenience stores were not popular places to buy F&V, taking away F&V from restaurants was. Polytomous regression results revealed

that the frequency of shopping at grocery stores was not related to the frequency of shopping at convenience stores or takeaway from restaurants for home use after adjusting for covariates. Food shopping once a week was the most common pattern (42%) among a low-income population in the UK in a study using a mail questionnaire and encompassing urban and rural areas<sup>17</sup>.

Ethnicity and the number of people in the household were related to the frequency of food-shopping trips in our study. People across a broad range of ages in other studies differed in food-consumption patterns by ethnic background<sup>18,19</sup>; whites ate more F&V than blacks<sup>20</sup> or Hispanics<sup>21</sup>. The relationship between the household size and F&V consumption is controversial. While F&V consumption generally decreased with increasing number of children in the household in the UK, women with children under the age of 16 years consumed more vegetables and less fruit than women without children<sup>22</sup>. Family size was negatively associated with the amount of F&V purchased<sup>9</sup> and the amount of fibre consumed<sup>23</sup>. In the present study, those who went food shopping more frequently had more people in the household, but fewer

children. Further research is necessary to clarify these findings.

Little has been reported in the literature about the proportion of shoppers using convenience stores to purchase foods for home, or factors that influence this food-purchasing behaviour. In a study using 1990 US census data, convenience stores along with small grocery stores and convenience stores attached to gas stations were less common in predominantly white and wealthier neighbourhoods<sup>24</sup>. This coincides with our finding that high school graduates were more likely to use convenience stores frequently, while college graduates were least likely. Those who frequented convenience stores once a week or less were the most disadvantaged in our study, in the sense that they were significantly less well educated and fewer of them who drove their own cars.

Education level, an indicator of SES, has been a major influence on food consumption. People with more education had a broad knowledge for 'healthy eating', and knew the need for 'more fruit and vegetables' and 'balance and variety'<sup>25,26</sup>. Although education level did not influence grocery store shopping frequency, people with lower education level were more likely to go to convenience stores to obtain F&V and people with higher education were more likely to go to restaurants to buy F&V for eating at home. These findings suggest that people with lower education might be lower-income people who were shopping at the closest store for small amounts of food. In a study among African American boy scouts, low SES was related with fewer restaurant meals compared with middle-SES boys<sup>27</sup>.

Low SES has been a commonly reported barrier to procure F&V for home in several regards. Low-income women cited the high cost of fresh F&V, short shelf-life and limited storage space as major barriers to F&V consumption<sup>10,11,28</sup>. Low-SES people often lived in areas where there were few large supermarkets, and thereby used smaller shops in which the price of food was high and quality was low<sup>29,30</sup>. Low-income adults have also reported difficulties in obtaining access to large shopping facilities because they lacked private transport or lived in areas where public transport was inadequate<sup>31</sup>. In the current study, however, more than 70% of families with children usually used supermarkets for food shopping and more than 80% of participants drove their car to get to the grocery store across all shopping pattern groups, which means that transportation and availability of grocery stores may not be a big barrier to access the grocery stores for families with children in this urban setting.

These analyses have answered several important issues on research methods. Future research on home F&V availability should also assess the usual frequency of food shopping and time since last food-shopping trip, because of their substantial variability, in order to control statistically for these likely influences on home F&V

availability. Any study involving grocery store receipts should encompass at least a month for collection of receipts since there will be variability across families in the number and timing of receipts to be submitted. Such receipts should include those coming from grocery stores and restaurants, which can also be sources of F&V in the home.

The age group, ethnicity and census tract characteristics of this sample may limit the generalisability of these findings. The stores were a strategically selected sample of those agreeing to participate, which could also limit generalisability. Responses may not reflect the shopping patterns of those who refused to participate in the study: more middle-aged or seniors<sup>32</sup>, European or Asian Americans, and customers visiting stores located in the low-SES census tracts. In addition, since the sampling was designed to maximise diversity by ethnicity, SES, size of store and shopping time in selecting subjects, findings may not be representative of the city as a whole. Food-shopping practices also may differ by study area; for example, people living in New York may use more public transportation than Houstonians and thereby have different shopping practices. Because F&V are not the primary reason why people take away food from restaurants, the frequency of restaurant F&V takeaways may reflect the shopping pattern for take away of other foods.

## Conclusions and implications

Our study findings suggest that the frequency of grocery shopping varied substantially across families; restaurants were a source to get F&V for home use; and there was diversity in purchasing practices for home across ethnicities, educational level and household size. Research on food-shopping practices should measure the frequency of food shopping. Studies attempting to collect data in close proximity to shopping events (e.g. surveys of previous week's shopping practices or collection of grocery store receipts) should allow enough time to be covered in the data collection interval to ensure that a major shopping event will be included. Further research is needed to relate food-purchasing behaviour to home F&V availability and F&V consumption.

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