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Mexican households' food shopping patterns in 2015: analysis following nonessential food and sugary beverage taxes

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Abstract

Objective: To examine patterns of taxed and untaxed food and beverage shopping across store types after Mexico's sugary drink and non-essential food taxes, the nutritional quality of these patterns and the socio-economic characteristics associated with them.

Design: We performed *k*-means cluster analyses using households' percentage of food and beverage purchases from each store type (i.e. convenience stores, traditional shops (e.g. bodegas, tiendas, mom-and-pop shops), supermarkets, wholesalers and others). We calculated adjusted mean proportions of taxed and untaxed products (ml or g/capita per d) purchased in each pattern. We studied the associations between households' SES and shopping patterns using multinomial logistic regressions. Within shopping patterns, we obtained mean volumes and proportions of taxed and untaxed food and beverage subgroups and calculated the proportion of products purchased at each store type.

Setting: Mexico.

Participants: Urban Mexican households (*n* 5493) from the Nielsen Mexico Consumer Panel Survey 2015.

Results: We found four beverage shopping patterns and three food shopping patterns, driven by the store type where most purchases were made. For beverages, 48 % of households were clustered in the Traditional pattern and purchased the highest proportion of taxed beverages. Low-SES households had the highest probability of clustering in the Traditional beverage shopping pattern. For foods, 35 % of households were clustered into the Supermarket pattern. High-SES households had the highest probability of clustering in the Supermarket food shopping pattern.

Conclusions: The combination of store types where Mexican households purchase packaged foods and beverages varies. However, households in all shopping patterns and SES purchase taxed beverages mainly at traditional stores. Store-level strategies should be developed to intervene on traditional stores to improve the healthfulness of purchases.

Keywords
Mexico
Shopping patterns
Food stores
Taxes
Socio-economic status

Mexico, with one of the world's highest prevalence of childhood obesity (32 %) and adult overweight and obesity (72 %), has declared obesity and diabetes public health emergencies[1–3]. In response, in 2014, Mexico implemented a one peso/l tax on sugary drinks (approximately 10 %) and an 8 % tax on all non-essential foods with ≥275 kcal (1150·6 kJ)/100 g to encourage better dietary behaviours in the population[4,5]. In the first 2 years after the implementation of the taxes, purchases of taxed packaged foods and beverage decreased on average 6 and 8 %, respectively[6,7].

However, factors other than price variation, such as the type and characteristics of food retailers available to the consumers, can influence purchasing behaviours[8,9]. The type of store where people shop for food has been linked to the quality of their food purchases and to the quality of their dietary intake in high-income countries[10–14]. However, food shopping and store patronage are complex, since households do not shop at a single store type, but rather shop at multiple food stores, and must decide which and how many stores to use and how to allocate purchases among the variety of store types and formats[8,15–19]. As the

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nutrient quality of purchased foods might vary by store type and by the combination of stores where purchases occur (store-type shopping patterns)[15,20,21], households' food availability and nutritional quality might also vary by their store-type shopping pattern[15,20–24]. Identifying multiple-store shopping patterns can help characterise households' preferences and decisions to shop for more or less healthy products across the array of stores where they shop[17]. In addition, understanding multiple-store shopping patterns is relevant for designing retailer-focused food policies and interventions. For instance, if households buy mainly unhealthy products in shopping patterns dominated by small traditional family-owned stores as contrasted to supermarkets and modern convenience stores, this would require a focused intervention on the family-owned retailers (e.g. healthy corner store initiatives or healthy food financing). However, if households buy unhealthy options across all store types within each shopping pattern, it would suggest that a policy that applies to all point-of-purchase settings might be more effective at improving the nutritional profile of purchases.

In the USA, there is a small but growing body of literature that shows 27 % of households shop at a combination of large and small stores, while the rest shop primarily either at grocery stores or at mass merchandisers, varying by income and race/ethnicity[25]. However, store shopping patterns have never been studied or considered in Mexico and other Latin American countries, in which the food environment and food retailer categories and mix might be comparable[26,27].

In Mexico, there has been a single study that examined food purchases across store types (i.e. traditional shops (small family-owned shops, e.g. bodegas, tiendas, mom-and-pop shops) and supermarkets) and found variations observed by socio-economic status (SES)[28]. These variations included low-SES households purchasing primarily at traditional retailers and middle- and high-SES households primarily at supermarkets. Understanding households' food shopping behaviour by studying the sociodemographic characteristics associated with their multiple store-type shopping patterns[29] is important since differences in food access might underlie nutritional and health disparities[21].

Moreover, it is unclear whether consumers' multiple-store shopping patterns vary in response to policies like the sugary drinks and junk food taxes, which may differentially impact consumers at different store types. The aforementioned study suggested that in Mexico, the 2014 sugary drinks and non-essential foods tax could have shifted the proportion of healthy and unhealthy foods consumers buy at each store differentially. For example, purchases of taxed beverages decreased at supermarkets but increased at traditional stores[28]. In this regard, prior to the tax, the food industry's anti-taxation movement targeted traditional shops, where they incentivised store owners to display posters noting that the store and its clients were against the soda tax; the industry also claimed the tax would put small traditional shops out of business. Thus, it remains important to understand how taxed food and beverage purchases shifted across the array of store types where people shop in order to further develop point-of-purchase policies to improve the healthfulness of foods.

To our knowledge, no research has described the food and beverage multiple store-type shopping patterns of Mexican households, the socio-economic characteristics associated with them, nor the type and amount of foods and beverages purchased according to households' store-type shopping combinations. Characterising Mexican households' multiple food store shopping patterns and their determinants will further our understanding of their shopping behaviours after the taxes implementation and inform store-based nutritional interventions to improve food-purchasing choices.

Using data on urban Mexican households' food and beverage purchases in 2015, this study aims to classify Mexican households into multiple store-type shopping patterns based on the amount of packaged taxed and untaxed foods and beverages purchased at different store types and examine the socio-demographic characteristics associated with being in each pattern. We also determine whether the proportion of purchased taxed and untaxed foods vary across store-type shopping patterns.

Methods

Population and data

We used the volume information of packaged food and beverages purchased from the Nielsen Company's Mexico Consumer Panel Services (Nielsen CPS) data set for 2015. Data on this sample have been previously published[6,7,28,30,31]. Our analytical sample contains 218 437 household-month observations from 5493 randomly sampled households of urban areas with >50 000 inhabitants in Mexico. Nielsen CPS collects purchasing information of packaged products with an available barcode through audits conducted by an interviewer who visits households every 2 weeks. Purchasing records are gathered from receipts and purchasing diaries kept by households, and from pantry inspections and re-scan of available items with a barcode. Nielsen CPS weights households according to household composition, locality and socio-economic measures to ensure representativeness of the Mexican urban population.

Food and beverages categorisation

Trained dieticians reviewed and grouped all available food and beverage barcodes in Nielsen CPS into categories according to the products they include. These food/beverages groups were further categorised into taxed

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and untaxed according to the Mexican legislation, under which all beverages with added sugar have a 1 peso/l tax, and all non-essential foods with an energy density of 275 kcal/100 g have an 8 % tax. This taxation-based classification aimed not only to differentiate between healthier and less healthy foods and beverages but also to reflect nutritional differences within those categories. For example, a food (i.e. ice cream) with high sugar and fat content can be less healthy, but if its energy density is below the established cut-off, it was not taxed. Moreover, the detailed food and beverages subgroup categorisation provided insight on whether specific food/beverage types were responsible for the differences observed between taxed and untaxed foods purchases by store type and SES. Since this work intends to understand whether taxation changed how and where people shopped for foods, we will refer to foods and beverages as taxed and untaxed henceforth and assume that the healthiness of the products is reflected by their taxation status (i.e. less healthy products are taxed and vice versa). See online supplementary material, Supplemental Table 1 presents a detailed description of the taxed and untaxed food and beverage subgroups.

Store type definition and categorisation

The Nielsen CPS provides information on the place where every packaged food and beverage shopping episode occurred. Based on the size of the store, the merchandise they sell and the additional services offered to consumers, we further categorised stores into the following groups: convenience stores (e.g. 7-eleven), supermarkets (e.g. Walmart), wholesalers (e.g. Costco), traditional stores (small family-owned shops usually attended by the owner, including traditionally fixed stores installed in permanent public markets) and others (e.g. department stores, pharmacies, movie theatres, etc.).

Home delivery was available as an additional beverage source, since the delivery of 20-litre jugs of potable water to households is a common practice in Mexico. Nonetheless, we excluded home delivery as a beverage source given that our interest in shopping behaviour focuses on store types only. Hence, all water-related results represent water purchased at all the store-type categories other than home delivery.

Covariates

We used the socio-economic (SES) categories defined as low, middle and high based on tertiles of an asset-based index provided by Nielsen CPS. This index is based on seven household assets (number of rooms, type of floor, number of bathrooms, shower, gas range, number of light bulbs and number of cars) and the education level of the household member with the largest income contribution (head of the household). Nielsen CPS has validated this measure of SES, and research on Mexican food and beverage purchases has previously used it[6,7,28,30,31].

For these analyses, we used the information on household size (number of household members), household composition (presence of children in the household, age of all household members) and region, using the six National Institute of Statistics and Geography (Instituto Nacional de Estadística Geografía e Informática, INEGI) categories: Mexico City, central north, central south, north east, north west and south. We included each state's quarterly unemployment rate from INEGI (except Nayarit and Quintana Roo's which are not included in Nielsen CPS) and the geographic area-specific minimum daily wage for 2015 from the National Commission of Minimum Wage as contextual measures to control for cost of living and spending power differentials across the country[32,33].

Beverage and food store-type shopping patterns

To understand Mexican households' multiple store-type shopping patterns, we used continuous variables of the proportion of volume of packaged foods and beverages purchased at each store type. This proportion was relative to the total volume of purchases across all store types and was calculated to cluster households into mutually exclusive categories according to the combination of stores where they shop. We conducted *k*-means cluster analyses using SAS FASTCLUST, SAS version 9.4 (SAS Institute Inc.), with an iterative process of 1000 replications using randomly selected seeds. We generated separate clusters for foods and for beverages.

We tested patterns restricted to two, three, four or five cluster solutions and used the pseudo *F*-statistic (Calinski and Harabasz) and the *r*-squared (R^2) of each solution to identify the optimal number of clusters. A higher *F*-statistic value indicated a better intra-cluster homogeneity and inter-cluster heterogeneity[34], while a higher R^2 indicated a larger proportion of the variance of purchases volume explained by the cluster solution. We selected the final cluster solutions for beverages and foods that maximised both pseudo *F*-statistic and R^2, while remaining meaningful and interpretable. For beverages, the four-cluster solution was optimal (pseudo $F = 4579{\cdot}95$, $R^2 = 0{\cdot}71$), while for foods, the three-cluster solution was best (pseudo $F = 8504{\cdot}96$, $R^2 = 0{\cdot}76$). We named the shopping patterns according to the store type where the highest percentage volume of purchases occurred. See online supplementary material, Supplemental Table 2 presents the goodness-of-fit (R^2 and pseudo *F*-statistic) of each tested cluster solution for beverages and food store shopping patterns.

We modelled the clusters using all households without representing separately those that did not purchase at a given store type. Because not purchasing at a store type can be considered a pattern itself, we conducted a sensitivity cluster analysis using binary variables reflecting whether

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a food group was purchased or not at each store type and found very similar store shopping pattern results.

Statistical analyses

For all analysis other than the *k*-means cluster analysis, we used Stata version 14 (StataCorp) and included the sampling weights provided by Nielsen. We included Nielsen weights to generate nationally representative estimates of populations in areas with more than 50 000 inhabitants.

First, we used weighted means to describe the proportion of total purchases (ml or g/capita per d) made at each store type within each of the food and beverage store-type shopping patterns.

Then, we conducted multinomial logistic regressions using the shopping patterns identified by the cluster analysis as dependent variable to study the associations between the shopping patterns with household's SES (independent variable). Separate multinomial models were used to predict the three shopping patterns for foods and the four patterns for beverages.

We cross-tabulated households in the beverage patterns and the food patterns to understand the proportion of households that overlapped in similar patterns and used a χ^2 to test the independence of the association between patterns.

We used multivariate linear regressions where beverage and foods subcategories were the dependent variables and the beverage and food clusters were the independent variables to obtain mean volumes and proportions of taxed and untaxed beverage and food subgroups by store-type shopping patterns We used pairwise comparisons (P-value $< 0{\cdot}05$) to test mean differences between all beverage and food store-type shopping patterns using the Bonferroni method[35] to account for multiple comparisons.

We used multivariate linear regressions modelling the proportions of taxed and untaxed foods and beverages as dependent variables to obtain mean percentage purchases of taxed and untaxed beverage and foods at each store type within store-type shopping patterns.

We adjusted all regression analyses for household size and composition, region, minimum wage and unemployment rate and set statistical significance at a P-value $\leq 0{\cdot}05$.

Results

In 2015, households in The Nielsen CPS sample were predominantly in the middle SES (52 %). The majority of the households included between four and five household members (41 %) and had between two and three children between the ages 0 and 19 years (42 %). A quarter of the sample resided in Mexico City. Overall, households were more likely to purchase beverages at traditional stores and foods mostly at supermarkets (Table 1).

Table 1 General characteristics of Nielsen Mexico Consumer Panel Service (CPS) households of areas >50 000 inhabitants in 2015*

	n	%
Number of households	5493	
Number of projected households	17 191 566	
Household-year observations	27 465	
Socio-economic status		
Low	1170	25
Middle	2690	52
High	1633	23
Household size		
2–3	608	14
4–5	2181	41
6–7	1330	22
≥8	1374	24
Number of children in household (0–19 years)		
0–1	1960	41
2–3	2441	42
4–5	796	12
≥6	296	5
Region		
Mexico City	909	25
Central North	1572	20
Central South	535	15
Northeast	1470	20
Northwest	557	11
South	450	10
Proportion of volume of beverage purchases by store type (% mean)		
Convenience stores	7	
Traditional stores	53	
Supermarkets	22	
Wholesaler/price clubs	3	
Other	15	
Proportion of volume of foods purchases by store type (% mean)		
Convenience stores	2	
Traditional stores	43	
Supermarkets	48	
Wholesaler/price clubs	4	
Other	3	

*Source: Authors' own analyses and calculations based on data from Nielsen through its Mexico CPS for the food and beverage categories for January 2015–December 2015. The Nielsen Company, 2016. Nielsen is not responsible for and had no role in preparing the results reported herein. Socio-economic status classification is based on the socio-economic index provided by Nielsen that includes seven household assets (number of rooms, type of floor, number of bathrooms, shower, gas range, number of light bulbs and number of cars), and the education level of the head of the household. Region is categorised using the National Institute of Statistics and Geography (Instituto Nacional de Estadística Geografía e Informática, INEGI) categories. All means and proportions are weighted using projection factors provided by Nielsen to represent populations in areas with more than 50 000 inhabitants.

Beverage and food store-type shopping patterns

Beverage clusters

For beverages, four distinctive shopping patterns emerged: a cluster in which most beverages were purchased at traditional stores (e.g. small tiendas ['Traditional' pattern]); most purchased at supermarkets ('Supermarket' pattern); purchases at a combination of supermarket and convenience and traditional stores ('Mixed stores' pattern) and most purchased at other stores (e.g. pharmacies, movie theatres, etc. ['Others' pattern]).

The Traditional pattern was most prevalent (48 % of households), while the Supermarket pattern was the least

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prevalent (14 % of households) (Fig. 1, panel A). In the Traditional, Supermarket and Others patterns, the proportion of beverages purchased at the store type after which they were named was over 60 %. However, in the Mixed stores pattern, beverage purchases were not dominated by a single store type, but instead distributed across stores, with the highest overall proportion of beverages purchased at traditional stores (38 %) (Fig. 1, panel A).

Table 2 presents the predicted probabilities for households to cluster into each beverage store-type shopping pattern according to their SES based on results from the multinomial logit analyses. Low-SES households had the highest probability of clustering into the Traditional pattern and the lowest probability of clustering into the Supermarket pattern (59 and 8 %, respectively). The opposite was true for high-SES households, which were significantly more likely to cluster into the Supermarket and the Mixed stores patterns (23 and 32 %, respectively), but had the lowest probability of clustering into the Traditional pattern (29 %). The probabilities of the middle-SES households to cluster into the different shopping patterns resembled those of low-SES households. SES did not significantly predict the clustering of households into the other beverage shopping pattern (Table 2).

Food clusters

For foods, three shopping patterns emerged which were named after the store type where most purchases occurred. A third of households was clustered into the Supermarket pattern, while another third was clustered into the Traditional pattern. Each of these patterns had purchases dominated by the store type for which they were named. Another third of households was in a Mixed pattern, in which food purchases were nearly evenly split between traditional stores and supermarkets (Fig. 1, panel B).

In the Traditional and Supermarket shopping patterns, households shopped for 80 % of foods at the store type after which the patterns were named. In contrast, in the Mixed stores pattern, purchases were more spread out across store types: households purchased 41 % of foods at traditional stores and 45 % of foods at supermarkets (Fig. 1, panel B).

Low- and middle-SES households were more likely to cluster into the Traditional pattern (45 and 28 %,

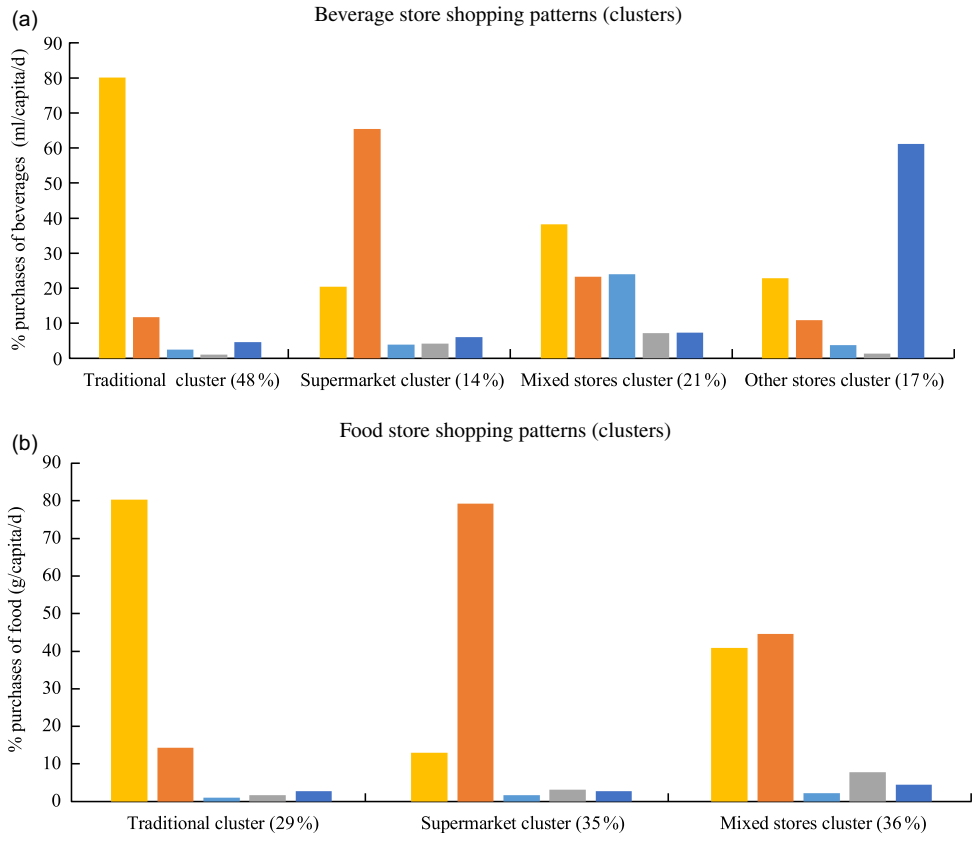

Fig. 1 Mexican households' beverage and foods store shopping patterns for 2015. Source: Authors' own analyses and calculations based on data from Nielsen through its Mexico Consumer Panel Service (CPS) for the food and beverage categories for January 2015–December 2015 The Nielsen Company, 2016. Nielsen is not responsible for and had no role in preparing the results reported herein. Clusters were derived separately for foods and beverages. Values represent means. Values in parenthesis indicate the proportion of households grouped into each cluster. ■, Traditional stores; ■, Supermarkets; ■, Convenience stores; ■, Wholesalers; ■, Others

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Table 2 Predicted probabilities of beverage and food store-type shopping patterns of Mexican households by socio-economic status (SES)*

	Traditional cluster				Supermarket cluster				Mixed cluster				Others cluster			
	Predicted probability		Probability differences		Predicted probability		Probability differences		Predicted probability		Probability differences		Predicted probability		Probability differences	
	%	95 % CI	PP** difference	95 % CI	%	95 % CI	PP difference	95 % CI	%	95 % CI	PP difference	95 % CI	%	95 % CI	PP difference	95 % CI
Beverage store shopping patterns																
SES																
Low	59	54, 64	Ref		8	6, 11	Ref		17	13, 20	Ref		16	12, 20	Ref	
Middle	51[a]	48, 54	−8	−14, −8	13[a]	10, 15	5	1, 5	19	16, 22	2	−2, 2	17	15, 20	1	−3, 15
High	29[b,c]	24, 33	−31	−37, −31	23[b,c]	19, 27	15	10, 15	32[b,c]	27, 37	15	9, 15	17	13, 21	1	−4, 1
Food store shopping patterns																
SES																
Low	45	40, 49	Ref		22	18, 26	Ref		33	29, 38	Ref					
Middle	28[a]	25, 31	−17	−23, −12	35[a]	32, 38	13	8, 18	37	34, 41	4	−2, 10				
High	13[b,c]	10, 17	−32	−37, −26	50[b,c]	46, 55	29	22, 35	36	32, 41	3	−4, 10				

*Source: Authors' own analyses and calculations based on data from Nielsen through its Mexico Consumer Panel Service for the food and beverage categories for January 2015–December 2015 The Nielsen Company, 2016. Nielsen is not responsible for and had no role in preparing the results reported herein. Predicted probabilities obtained from multinomial logistic regressions performed for beverages and food clusters separately and adjusted by household size and composition, region, minimum salary and unemployment rates; and weighted to be representative of populations in areas with more than 50 000 inhabitants. SES based on the socio-economic index provided by Nielsen that includes seven household assets (number of rooms, type of floor, number of bathrooms, shower, gas range, number of light bulbs and number of cars), and the education level of the head of the household.

** Percentage points difference. Difference in the probability of being grouped into a cluster across SES with a *P*-value < 0·05 specified as[a] between low and middle SES,[b] between low and high SES and[c] between middle and high SES.

respectively) than high-SES households (13 %), while high-SES households had the highest probability of clustering into the Supermarket pattern (50 %) compared with the middle- and low-SES households (Table 2). The probability of clustering into the food Mixed stores food shopping pattern was similar across SES (Table 2).

Overlap of beverage and food store-type shopping patterns

There was agreement between beverage shopping patterns and food shopping patterns (χ^2 $P < 0{\cdot}001$). The greatest overlap was for households clustered in the Supermarket pattern for foods and beverages. That is, 72 % of the households clustered into the Supermarket beverage shopping pattern were also clustered into the Supermarket food shopping pattern (Table 3).

Proportion of purchases of beverage and food subgroups by store-type purchasing patterns

Households in the Traditional beverage shopping pattern purchased the highest proportion of taxed beverages (41 %), while households in the Other pattern purchased the lowest proportion of taxed beverages (17 %) compared with households in the other beverage shopping patterns. The proportion of purchases of taxed and untaxed beverages by household in the Supermarket and Mixed stores patterns was comparable. Households in the Traditional pattern and in the Other pattern purchased the highest and lowest proportion of taxed sodas (33 and 12 %), respectively (Table 4).

Households in all food shopping patterns purchased similar proportions of overall taxed and untaxed foods. Nonetheless, households in the Traditional food shopping pattern purchased a significantly higher proportion of untaxed dairy and tortillas, breads and rolls than households in other food shopping patterns but lower proportions of untaxed sweets and packaged fruits and vegetables (Table 4). The absolute mean volume of purchases of all beverage and food subgroups by store-type shopping patterns is presented in Supplemental Table 3.

Purchases of taxed and untaxed products by store type within shopping patterns

Figure 2 shows the proportion of taxed and untaxed beverage and foods that were purchased at each store type within store shopping patterns. Overall, across shopping patterns, there were few differences in the proportion of taxed and untaxed beverages purchased at given store types (Fig. 2). In all four beverage clusters, the highest proportion of taxed beverages was purchased at traditional stores (i.e. approximately 46–55 % of beverage purchases made at traditional store were for taxed beverages) (Fig. 2, panel A). Across the beverage shopping patterns, approximately one-third of all beverages purchased at supermarkets, wholesalers and other stores was taxed, except for the Other stores pattern, where 98 % of purchases at other stores were untaxed beverages.

Table 3 Proportion of households in the beverage store-type shopping patterns clustered into the food store-type shopping patterns*

	Beverage clusters							
	Traditional		Supermarket		Mixed stores		Others stores	
	n	%	*n*	%	*n*	%	*n*	%
Food clusters								
Supermarket	534	20	654	72	434	39	385	43
Mixed stores	928	36	164	26	479	44	350	34
Traditional	1130	44	10	2	173	17	252	23

*Source: Authors' own analyses and calculations based on data from Nielsen through its Mexico Consumer Panel Service for the food and beverage categories for January 2015–December 2015 The Nielsen Company, 2016. Nielsen is not responsible for and had no role in preparing the results reported herein. Chi-squared $P < 0{\cdot}001$.

Similar to beverages, the proportion of taxed and untaxed food purchases at each store type did not vary much by store-type pattern. The highest proportion of taxed foods was purchased at convenience stores, regardless of shopping pattern, with approximately half of all food purchases being taxed. Between 30 and 35 % of foods purchased at wholesalers and other stores were taxed, while only 20–25 % of foods purchased at supermarkets or traditional stores were taxed, regardless of shopping pattern (Fig. 2, panel B).

See online supplementary material, Supplemental Table 4 presents the proportion of beverages and food subcategories purchased by Mexican households across SES at each store type. For beverages, all SES households purchased most of their total taxed beverages at Traditional stores. Our subgroup analyses show that these taxed beverages were mainly composed of sugar-sweetened sodas in which purchasing proportion was similar across SES.

For foods, the largest differences across SES and store types were observed for the taxed sweetened cereals, such as cookies.

Discussion

This study found that households clustered into patterns of food and beverage shopping by store type. For beverages, four patterns emerged, with the Traditional store type being the most prevalent (about half of households). Although the store type after which they were named dominated the Traditional, Supermarket, and Other beverage shopping patterns, households in these patterns still purchased about 20–39 % of beverages at store types other than the predominant store one. In addition, the households in the Mixed stores beverage shopping pattern (21 % of households) distributed their beverage purchases across store types, without a single store type dominating beverage purchasing. For all food shopping patterns, only a small proportion of foods (<15 %) were purchased at stores other than traditional stores or supermarkets.

These results provide evidence that Mexican households vary in their shopping patterns for foods and beverages. For beverages, households do not rely on a single store type but purchase different types of beverages at multiple store types, even when they purchase a large proportion of their beverages at a single store type. This is less true for food purchases. A smaller proportion of food was purchased at store types other than the one that dominated a given food shopping pattern.

We observed that the overlap in the Supermarket beverage and food shopping patterns was over 70 % for households. This indicates that households that use supermarkets as their primary beverage source are more inclined to purchase most of their foods there as well, or vice versa. In contrast, the overlap between households in the Traditional pattern for food and beverages was only 44 %, suggesting that people who predominantly shopped for beverages at traditional stores were also not necessarily predominantly shopping there for foods. In other words, households in the Traditional beverage cluster are more likely to purchase different types of products (foods *v.* beverages) at different store types. It is unclear what drives these patterns. In the case of supermarkets, it is likely that the wide assortment of products they offer is convenient for multi-purpose shopping (including all foods and beverages) and optimise the time spent shopping.

However, for the Traditional shopping patterns, it is unclear why households choose different store types to purchase foods *v.* beverages. A possible explanation for these findings is that Traditional stores might offer a limited assortment of beverages consisting of mainly sodas and other sweetened drinks. This might prevent households shopping primarily at traditional stores from having access and therefore choosing untaxed (healthier) beverages options. If that is the case, then households clustered into Traditional beverage shopping patterns could be at risk of having a higher in energy and sugar diet product of purchasing more taxed (and less healthy) beverage options. Our results support this argument since we observed a higher amount of taxed beverages purchased at traditional stores by all households regardless of the store-type shopping pattern where they were clustered and their SES. Limited product assortment might also partially explain why households that purchase beverages predominantly

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Table 4 Mean volume proportion of purchases of foods and beverages subgroups by store-type shopping patterns*

	Traditional cluster		Supermarket cluster		Mixed stores cluster		Others stores cluster	
	% Mean	95 % CI	% Mean	95 % CI	% Mean	95 % CI	% Mean	95 % CI
Beverage store shopping patterns								
Total beverages (ml/capita per d)	100		100		100		100	
Taxed beverages (ml/capita per d)	40·9	40·2, 41·6	33·3[a]	32·3, 34·2	31·92[b]	30·9, 32·8	16·6[c,e,f]	16, 17·2
Sugar-sweetened Sodas	32·7	32, 33·3	18·6[a]	17·8, 19·5	22·4[b,d]	21·6, 23·2	12·0[c,e,f]	11·4, 12·6
Sugar-sweetened beverages (e.g. industrialised flavoured water)	4·3	4·1, 4·6	8·8[a]	8, 9·6	5·3[b,d]	4·9, 5·7	2·7[c,e,f]	2·4, 2·9
Sweetened juices	2·8	2·6, 2·9	3·9[a]	3·6, 4·1	2·8[d]	2·6, 2·9	1·3[c,e,f]	1·2, 1·4
Sweetened and/or flavoured dairy	1·1	1, 1·1	2·0[a]	1·8, 2·1	1·4[b,d]	1·3, 1·5	0·7[c,e,f]	0·6, 0·7
Untaxed beverages (ml/capita per d)	59·1	58·4, 59·8	66·7[a]	65·8, 67·7	68·1[b]	67·2, 69·1	83·4[c,e,f]	82·8, 84
Non-energetic sodas (e.g. diet soda)	1·3	1·2, 1·4	2·2[a]	1·9, 2·6	1·4[d]	1·2, 1·6	0·9[c,e,f]	0·8, 1
Non-energetic sweetened or unsweetened beverages (e.g. tea without sugar)	9·7	9·4, 10·1	25·5[a]	24·6, 26·4	14·7[b,d]	14, 15·4	6·8[c,e,f]	6·3, 7·3
100 % fruit juices	0·5	0·4, 0·5	0·9[a]	0·8, 1	0·5[d]	0·5, 0·6	0·3[c,e,f]	0·3, 0·4
Water (plain and mineral)	29·1	28·4, 29·9	14·0[a]	13,15·1	20·2[b,d]	19·3, 21·2	63·3[c,e,f]	62·3, 64·2
Unsweetened dairy	16·3	15·9, 16·8	22·4[a]	21·5, 23·3	28·9[b,d]	28, 29·9	11·1[c,e,f]	10·6, 11·7
Beer	2·2	2·1, 2·3	1·7[a]	1·5, 2	2·4[d]	2·1, 2·6	0·9[c,e,f]	0·8, 1·1
Food store shopping patterns								
	Mean	95 % CI	Mean	95 % CI	Mean	95 % CI		
Total foods (g/capita per d)	100 %		100 %		100 %			
Taxed foods (g/capita per d)	22·1	21·6, 22·7	20·2[a]	19·8, 20·6	21·9 [d]	21·6, 22·3		
Salty snacks	4·5	4·3, 4·7	3·1[a]	3, 3·2	4·1[b,d]	4, 4·3		
Sweets and desserts	2·6	2·4, 2·7	3·4[a]	3·3, 3·6	3·3[b]	3·2, 3·5		
Sweetened cereals	12·0	11·7, 12·4	8·0[a]	7·7, 8·3	9·0[b,d]	8·8, 9·3		
Ready-to-eat-cereals	3·0	2·9, 3·2	5·7[a]	5·4, 5·9	5·5[b]	5·3, 5·7		
Untaxed foods (g/capita per d)	77·9	77·3, 78·4	79·8[a]	79·4, 80·2	78·1[d]	77·7, 78·4		
Sweets	6·3	6, 6·6	15·4[a]	15, 15·9	11·1[b,d]	10·8, 11·4		
Tortilla, breads & rolls, unsweetened	24·8	24·3, 25·3	21·1[a]	20·8, 21·4	23·4[b,d]	23, 23·7		
Dairy	31·5	30·9, 32·2	24·6[a]	24·1, 25·1	26·4[b,d]	26, 26·8		
Packaged fruits & vegetables	3·2	3, 3·4	5·6[a]	5·4, 5·8	4·6[b,d]	4·4, 4·7		
Other foods	12·0	11·7, 12·3	13·0[a]	12·6, 13·4	12·6[b]	12·4, 12·8		

*Source: Authors' own analyses and calculations based on data from Nielsen through its Mexico Consumer Panel Service for the food and beverage categories for January 2015–December 2015 The Nielsen Company, 2016. Nielsen is not responsible for and had no role in preparing the results reported herein. Means of taxed and untaxed food and beverage subgroups were obtained using multivariate linear regressions adjusted by socio-economic index, household size and composition, region, minimum salary and unemployment rates and weighted to be representative of populations in areas with more than 50 000 inhabitants. For beverage and food patterns, we used pairwise comparisons (P-value < 0·05) to test mean differences among all patterns using Bonferroni's method to account for multiple comparisons.
Differences in percent purchases between beverage store-type patterns (P-value < 0·05) specified as:[a] between Traditional and Supermarket,[b] between Traditional and Mixed,[c] between Traditional and Others,[d] between Supermarket and Mixed, [e] between Supermarket and Others and[f] between Others and Mixed. The same specification was kept to show differences between food store-type patterns.

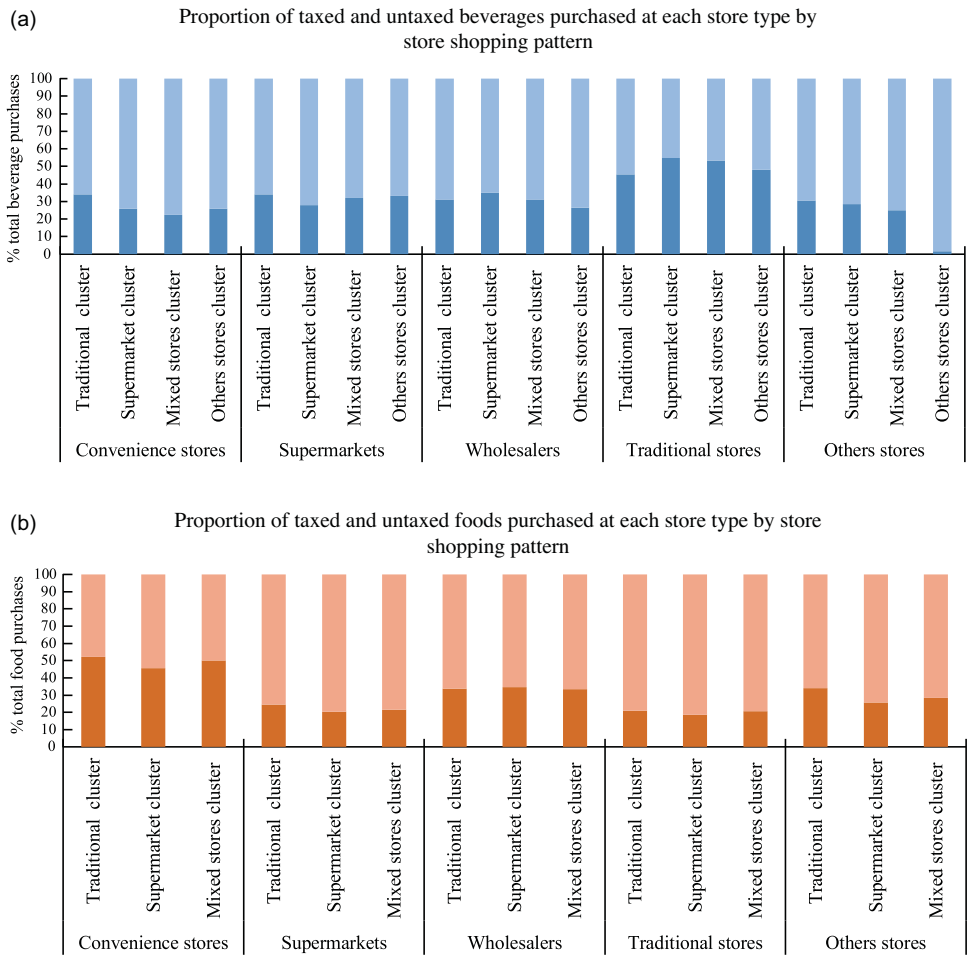

Fig. 2 Proportion of taxed and untaxed beverage and foods purchases at each store type within store shopping patterns. Source: Authors' own analyses and calculations based on data from Nielsen through its Mexico Consumer Panel Service (CPS) for the food and beverage categories for January 2015–December 2015 The Nielsen Company, 2016. Nielsen is not responsible for and had no role in preparing the results reported herein. Means of taxed and untaxed food and beverage purchases by store type within food and beverage purchasing patterns were obtained using multivariate linear regressions adjusted by socio-economic index, household size and composition, region, minimum salary and unemployment rates and weighted to be representative of populations in areas with more than 50 000 inhabitants. ■, Taxed beverages; ■, Untaxed beverages; ■, Taxed foods ■, Untaxed foods

at traditional stores chose to purchase foods at other store types. These findings are consistent with previous research showing that from 2012 to 2015, Mexican households across SES purchased most taxed beverages (between 53 and 85 %) at Traditional retailers[28]. Moreover, although we were unable to study pre- and post-tax changes in store shopping patterns, our results show that households buy the majority of their taxed beverages at traditional shops even after the tax implementation.

In our study, the SES index significantly predicted the probability of households clustering into different beverage and food store-type shopping patterns. Low-SES households had the highest probability of clustering into the Traditional shopping patterns and the lowest probability of clustering into the Supermarket shopping patterns. The opposite was true for high-SES households, which had a higher probability of clustering into the Supermarket shopping patterns but the least probability of clustering into the Traditional shopping patterns.

Assuming that the healthiness of the products analysed in our study is reflected by their taxation status (i.e. healthier products are untaxed and vice versa), our results are consistent with previous studies suggesting that high-SES households and individuals purchase and consume overall healthier beverage and food options than their low-SES counterparts[28,36].

Our results differ from the store-type shopping patterns observed in the USA[25]. Stern *et al.* found that 50 % of households across all SES groups clustered into a shopping pattern where grocery chains (comparable with our supermarket category) dominated food and beverage purchases. In our analyses, only a minority of households exhibited the Supermarket shopping pattern: 14 and 35 % of households for beverages and foods, respectively. Further, in our

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study, household SES was associated with store-type shopping patterns.

One possible explanation for the differences in multiple store-type shopping patterns between Mexico and the USA is the high availability of traditional stores in Mexico (>1 million[37]) that make purchasing at this store type more common, compared with a much lower amount of comparable corner stores (>150 000[38]) in the USA. Hence, traditional stores were expected to be a regular food and beverage source among Mexican but not US households.

Moreover, our results suggest that an array of barriers influences the store types where different SES Mexican households shop for food and beverages including constraints in time and transportation. Mexican consumers with limited time and transportation (who are often lower-SES consumers) might prefer visiting traditional stores for two reasons: shorter travel distances from household to store, and due to a perception that supermarket shopping as time-consuming and intended for stock-up trips that require access to transport[9,39–42]. Exploratory analyses suggested that as the number of cars owned by a household increased, so did the probability of being clustered into Supermarket shopping patterns (see online supplementary material, Supplemental Table 5). Differences in car ownership could partially explain the socio-economic disparities observed in Mexican households' beverage and food shopping choices. Nonetheless, further research is needed to determine if the observed differences between multiple store-type patterns are determined by characteristics of the people who shop at a given store type (such as wealth, income and education), rather than the characteristics of the store itself.

One of the motivations for this study was the lack of food environment and purchasing behaviours research in low- and middle-income countries. Our description of the food and beverage store shopping patterns might be applicable to other Latin American countries where the food environment, in particular, food retailers, might be more comparable[26,27]. Our research sets precedent for Latin American and other low- and middle-income countries on how purchasing practices might function in their populations and how shopping patterns might be related to socio-economic determinants. This also notes that retailer research needs to focus on all the retailers a person might use and not just one store type as is often the case. Moreover, we are providing a basis on which point-of-purchase interventions can be shaped and developed, as food shopping patterns are usually ignored, and single focused retailers are often the targets. In other Latin American countries such as Chile with its strict marketing, advertisement and front-of-pack regulations, it is unclear if patterns of shopping are changing with these regulations and if so how and what this means for monitoring and intervening in the food retail environment. Looking at the changes by store type in Chile would provide insight on future store-level interventions that might be effective in Mexico.

One of our key findings was identifying taxed beverages was mainly purchased at traditional stores across store-type shopping patterns. Thus, we believe interventions focused on these mom-and-pop like stores could potentially improve purchasing and dietary intake behaviours. The most commonly studied store-level strategies include transforming existing stores into healthier food sources, stocking a variety of high-quality healthy foods to increase their availability and visibility, point-of-purchase promotions like shelf labels and posters, monetary incentives, and community engagement through marketing and social nutrition education[43–45]. However, these strategies have not been tested in low- and middle-income countries, and research is needed to determine their effects in low- and middle-income countries contexts[46]. Policy level approaches including tax incentives, healthy food stocking requirements or a healthy inventory certification system could also encourage positive store-level changes[43].

Our study has several limitations given the nature of the data. One limitation of the Nielsen CPS is that it collects information of packaged products only and lacks data on non-packaged food such as loose produce and other products sold in bulk (i.e. fresh meat, cheese, seeds, etc.). Another limitation is that food outlets such as wet and open markets, and other specialty shops are not captured in the data. Not collecting information from products without barcodes or from some types of food outlets also means that home-prepared drinks with sugar (i.e. aguas frescas), concentrates and normal barcoded bottles bought at restaurants, and sugary drinks purchased from street vendors were not accounted for in our research. Thus, our data only partially represent Mexican household's food and beverage purchases and our depiction of the healthfulness of foods and beverages available at home is limited. In addition, there is potential for differential reporting by store type, where products purchased at particular stores (e.g. convenience stores) might be rapidly consumed or purchased by other household members, which might make them less likely to be captured in our data. Further, Nielsen CPS data are representative only of the urban population (>50 000 inhabitants) in Mexico. However, data from the Mexican Health and Nutrition Survey of 2012 (Encuesta Nacional de Salud y Nutrición, ENSANUT 2012) showed that 58 % of food energies come from packaged products[47], while data from the National Institute of Statistics and Geography (Instituto Nacional de Estadística Geografía e Informática, INEGI) indicate that the Nielsen CPS data represented 75 % of foods and beverage expenditures of the Mexican population in 2014[30]. Furthermore, data from the 2016 National Household Income and Expenditure Survey (ENIGH) showed that only 8 % of all food purchases, most of which are fresh produce, are made at open markets in urban areas[48].

The provided SES index in our data was constructed combining variables that measure wealth (i.e. number of rooms in the household, etc.) and education, making it

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impossible to disentangle the independent effects that access to material resources and education have on the multiple store-type shopping patterns that we found. Likewise, we lacked household's income information, which could further explain the differences in shopping behaviours we found by SES.

A limitation regarding our analysis is that even though the k-mean cluster analysis allowed us to identify meaningful multiple store-type shopping patterns, it is a data-driven method involving a certain degree of subjectivity when selecting the number of cluster solutions to test and deciding the number of cluster solutions to maintain, name and interpret.

Finally, we lacked detailed retailer and other household characteristics that prevented us from being able to fully describe all factors that could have further influence the observed results.

To our knowledge, this is the first paper that analyses Mexican household multiple store-type shopping patterns after the 2014 sugary beverage and non-essential junk foods tax using a large and diverse sample with detailed packaged products information. Our use of household level purchasing data minimises the measurement bias that is often present in individual self-reported dietary assessments while reflecting usual shopping habits[49,50]. It also provides objective and precise information of what foods and beverages were purchased at a store-specific level allowing us to examine the distribution of purchases of taxed and untaxed products across store types.

Conclusion

Using beverage and food purchase information, we found that there is variation in the combination of store types where Mexican households purchase packaged foods and beverages, which is highly influenced by the households' socio-economic characteristics. We observed differences between beverage and food shopping patterns suggesting that households might use different criteria or face different barriers when choosing where to shop for beverages and where to shop for foods. Hence, further shopping behaviour research in Mexico should determine the drivers influencing beverage and food shopping differently. Moreover, these complex shopping patterns showing consumers behaviours across store types should be considered in future policy initiatives aimed at improving the food environment.

In agreement with previous research[28], one of the most relevant findings of this study concerning public health is that within the Mexican food environment during the implementation of a fiscal policy, taxed beverages are mainly purchased at traditional stores regardless of store-type shopping patterns and SES status. This suggests that store-level strategies should be developed to intervene on traditional stores to improve this unfavourable purchasing behaviour that could be reflecting unhealthy dietary behaviours. Furthermore, the greater benefits for low- and middle-SES households[43,44,51,52] from effective store-based interventions could positively contribute to social and health equity in Mexico.

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Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/S1368980020001858

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