

Changes in Food and Beverage Purchases Associated With the Coronavirus Disease Pandemic in Mexico

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ARTICLE INFORMATION

Article history:

Submitted 2 January 2023
Accepted 28 July 2023

Keywords:

COVID-19
Mexico
Food purchases
Basic foods
Energy-dense foods

Supplementary materials:

Tables 2, 3, 4, and 7 are available at www.jandonline.org

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<https://doi.org/10.1016/j.jand.2023.07.026>

ABSTRACT

Background Public policies to contain the spread of coronavirus disease in Mexico could have had an effect on food purchase patterns.

Objective The objective of the study was to assess changes in the quantity of food and beverages purchased and proportion spent on food consumed away from home during the coronavirus disease pandemic in Mexican households.

Design This study is a secondary analysis of cross-sectional data from the National Household Income and Expenditure Survey 2014–2020.

Participants/setting The study included 234,631 households with information on food and beverage purchases from 2014 to 2020.

Main outcome measures Food and beverage purchases were classified into six categories: basic, nonbasic energy-dense foods, prepared food for consumption at home, water, milk, and sugar-sweetened beverages. In the National Household Income and Expenditure Survey 2014–2020, expenditures on food and beverages consumed away from home are not classified into any specific items but represents more than 10% of food and beverage expenditures; therefore, the analyses included the proportion of food and beverage expenditures spent on food consumed away from home.

Statistical analyses performed A two-part model was used to evaluate changes in the quantity of food purchased and the proportion spent away from home during the coronavirus disease pandemic in 2020 compared with 2018, adjusting for socio-demographic variables, gross domestic product and previous survey rounds. Results are presented at the national level, by income quintile and by place of residence.

Results Purchases of basic food increased by 17 g/capita/day at the national level and 22.4 g/capita/day in urban areas ($P < 0.001$). Purchases of nonbasic energy-dense foods decreased both at the national level (-4.2 g/capita/day; $P < 0.001$) and by place of residence (-4.8 g/capita/day; $P < 0.001$ in urban areas and -2.5 g/capita/day; $P = 0.001$ in rural settings). Purchases of prepared food increased 16 g/capita/day ($P < 0.001$). In rural areas, purchases of sugar-sweetened beverages increased 7.2 mL/per capita/day ($P < 0.001$). For the lowest income quintile purchases of processed meat increased 2.4 g/capita/day ($P < 0.001$). The proportion spent on food consumed away from home decreased by -44.9% ($P < 0.001$).

Conclusions Results of this study show that during the coronavirus disease lockdown there was an increase in basic and prepared food purchases, whereas purchases of nonbasic energy-dense foods and the proportion spent on food consumed away from home decreased. However, findings showed an increase in sugar-sweetened beverages purchases among rural dwellers and an increase in purchases of processed meat among the lowest income quintile. Various factors such as income reductions, unemployment, mobility restrictions, or increases in prices may have led the observed changes. Future research should be conducted to analyze these potential pathways.

J Acad Nutr Diet. 2023; ■(■):■-■.

IN FEBRUARY 2020, THE FIRST CASE OF CORONAVIRUS disease (COVID-19) was identified in Mexico. From that moment on, the epidemic spread exponentially, placing the country among the top 10 in deaths per 100,000 inhabitants worldwide.¹ To contain the spread of COVID-19, in March 2020, the government implemented

several measures such as social distancing, sanitation measures, lockdown, and the temporary suspension of all nonessential activities in the public, social, and private sectors.²

Although the main objective was to safeguard the population's health, the lockdown and prevention measures have

been associated with changes in the food supply chain, job losses, and reductions in purchasing power—particularly among the population working in the informal sector (activities in business or small companies that are not formally registered, so they do not pay taxes and their workers have no benefits or social security).^{3,4} Several studies have analyzed the association between the COVID-19 lockdown and changes in food and beverage consumption patterns.^{5,6} In Canada, the lockdown was associated with a 1.1-point increase in the Healthy Eating Index 2015, due in part to an increased consumption of whole grains, dairy, fresh vegetables, and legumes.⁷ In Spain, an increase in the consumption of vegetables, fish, and legumes was also observed in the early stages of the lockdown, which was associated with a better adherence to the Mediterranean diet.^{8,9} There is evidence that in some populations, confinement has increased the consumption of organic foods and/or healthy cooking habits.¹⁰⁻¹²

In contrast, some unhealthy dietary outcomes have been documented. For example, during the COVID-19 lockdown, the Chinese population significantly decreased the frequency of fresh fruits and vegetables, rice, soy products, and other staple foods consumption.¹³ In Poland, the number of meals and snacks per day increased, which was associated with body weight gain.¹⁴ In France, the average energy consumption went from 1,700 to 1,935 kcal/day during the first months of the confinement. In this study, a significant increase in the consumption of processed meat, sugar-sweetened beverages (SSB) and alcoholic beverages was observed.¹⁵ In Latin America, there was evidence of an increase in the consumption of SSB and processed or fried foods.¹⁶⁻¹⁸

In Mexico, 58% of the population works in the informal sector and 18% experiences extreme poverty,¹⁹ conditions that challenge the compliance to mitigation measures such as the lockdown. Mexico is among the largest consumers of processed foods and SSB.^{20,21} The consumption of these foods has been associated with the development of obesity, hypertension or type 2 diabetes, which are comorbidities associated with COVID-19.²² Given these complexities, the objective of this study was to estimate changes in food and beverage purchases at the onset of the COVID-19 pandemic in Mexico.

MATERIALS AND METHODS

Data Source

Data from the National Household Income and Expenditure Survey (ENIGH for its acronym in Spanish) in its 2014-2020 rounds was used. The ENIGH is a cross-sectional survey carried out every 2 years, between August and November in the 31 states of Mexico. The survey has a probabilistic, two-stage stratification design and is representative at the national level and by strata (urban and rural).²³ The ENIGH collects information on household purchases for food and beverages using a daily recording instrument for a consecutive week. On the first day of the interview, the ENIGH personnel train the member of the household responsible for buying food and beverages on how to use the recording instrument. In addition to the purchases made, information on food and beverages obtained from gifts, through subsidies, or from domestic production is also requested and recorded as nonmonetary

RESEARCH SNAPSHOT

Research Question: Were there changes in household food and beverage purchases and proportion spent on food consumed away from home during the coronavirus disease pandemic in Mexico? And if so, was it different by income level and place of residence?

Key Findings: Results show an increase in purchases of basic foods, water, and prepared foods, along with a decrease in purchases of nonbasic energy-dense foods and milk in 2020 compared with 2018. The proportion spent on food consumed away from home also decreased. In rural areas purchases of sugar-sweetened beverages increased.

expenses. In addition to household purchases, the ENIGH includes sociodemographic information.²³ All information collected in the ENIGH is in person and self-reported.

The analysis includes 234,631 households with information of food and beverages purchases (8% from 2014, 28% from 2016, 29% from 2018, and 34% from 2020).

Identification of Food Groups

Food and beverage categories in ENIGH are composed of 242 items, that could be: disaggregated foods, for the most frequently consumed items (eg, tortillas) or grouped foods, for less-frequently consumed (eg, the white bread category is composed by the combination of bolillo, telera, and baguette). Food and beverages groups were classified into 6 major categories: basic foods, nonbasic energy-dense foods (NBEDF), prepared food, water, milk, and SSB.

The basic food category includes fresh vegetables, fresh fruits, cereals, tortillas, legumes, animal-based food, and other basic ingredients that are canned chiles, seeds, sugars, oils, and fats. The other basic foods groups ingredients are purchased in small quantities (<100 g/capita/day).

The NBEDF category includes processed foods and taxed foods (in 2014 the Mexican government implemented a tax to NBEDF with at least 275 kcal/100 g)²⁴: processed meat, refined flours, sweet bread and other NBEDF (eg, salty snacks, confectionery and puddings, chocolate, fruit and vegetable-based sweets, peanut and hazelnut butter, milk-based sweets, ice cream, and popsicles). Other NBEDF groups products that are purchased in small quantities (<100 g/capita/day).

The prepared food category is composed mostly of Mexican traditional dishes (eg, atole, flautas, stews, soups, tacos, tamales, tortas, sopes, menudo, pozole and prepared corn) and 15% by other prepared foods (eg, barbecue and birria, carnitas, roasted chicken, and pizza).

Beverages include SSB (prepared water—usually home-made water mixed with fruits and sugar-, juices, 100% fruit juices, soft drinks, energy drinks, or any other beverage with added sugar), bottled water, and milk. Coffee and alcoholic beverages were excluded. Coffee was excluded because the quantity consumed is not registered in liters as the other beverages. Because purchases of alcoholic beverages are reported for 1 week only, same as the rest of the food and

beverages, the quantity consumed is underestimated because households may purchase alcohol with less frequency.

The ENIGH does not collect specific information on expenditures on food and beverages consumed away from home, therefore only the proportion spent was included.

Variables

The quantity of food and beverage purchased was divided by the total number of household members. Quantity of food and beverages purchases were expressed in grams (g) per capita per day for food and milliliters (mL) per capita per day for beverages. We also included the proportion spent on food consumed away from home as an outcome variable.

The models were adjusted by several covariates that could be associated with food and beverage purchases. Household composition was classified into four mutually exclusive categories: adults only (household members older than age 19 years); adults and children younger than age 12 years; adults and adolescents between ages 12 and 19 years; and adults, children, and adolescents. Education of the head of the household was divided into three categories: low (0 to 6 years of schooling), medium (between 7 and 12 years), and high (13 or more years of study). Age of the head of household was expressed in tertiles. A binary variable was added in the models that takes 1 if the sex of the head of the household is a male, 0 if female. Quarterly household income was included as quintiles and converted to US dollars.

Place of residence was included as urban or rural area. The models were also adjusted for previous ENIGH rounds (2014 and 2016) and per capita gross domestic product.²⁵

Statistical Analysis

A 2-part model was used to estimate changes in food and beverage purchases before and during the COVID-19 pandemic. Two-part models are designed to deal with censored dependent variables in 2 parts (some of the food and beverage categories have more than 50% nonconsumers, as shown in Figure 1). The first part models the probability of purchasing a specific food group, expressed as a binary dependent variable, and modeled by a probit regression. The second part is the change in the amount of food and beverages purchased, expressed as a continuous variable, and modeled with generalized linear models because the dependent variables do not have a normal distribution. The predicted values integrate both parts of the model and allow that zeros and values greater than zero to be modeled with different densities.²⁶ Coefficients from the models are expressed as marginal effects. Food and beverage purchases in 2020 were compared with 2018. Variables included in the two-part model were household composition, household head education, household head age, income level in quintiles, strata (urban or rural), gross domestic product, and previous rounds (2014 and 2016). Analyses were conducted for the main food and beverage groups and for all subgroups. *P* values < 0.05 were considered as statically

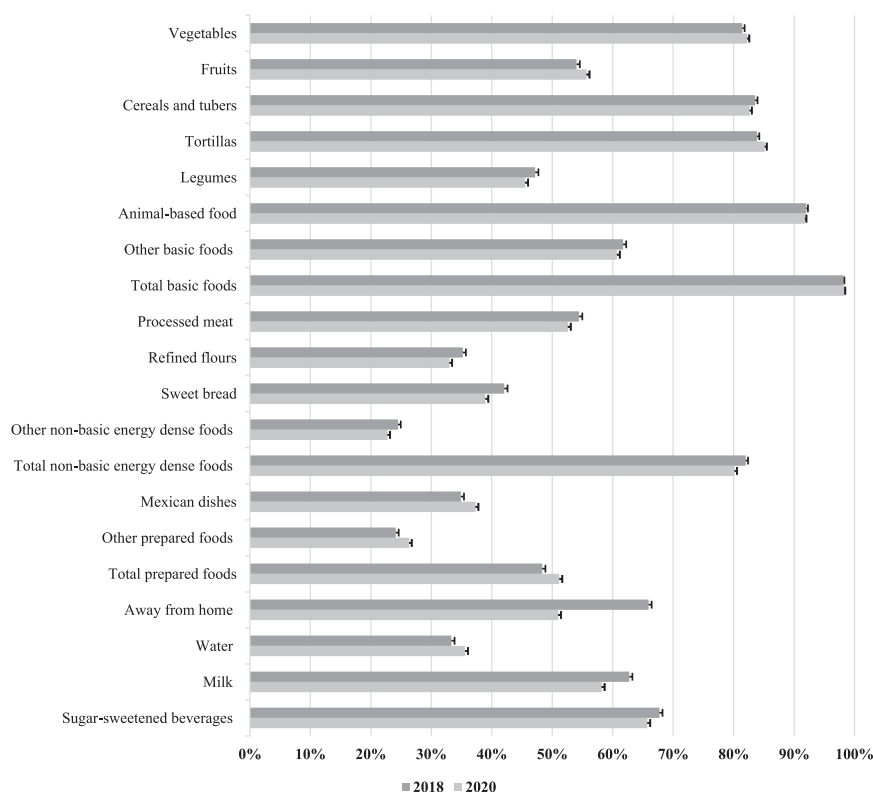


Figure 1. Proportion of households that purchase each group of food and beverages by food/beverage group and survey year, The Mexican National Household Income and Expenditure Survey 2018 and 2020. Whiskers in bars represent 95% CI.

significant. All analyses were performed applying the complex sample design of the ENIGH using Stata software version 15.0.²⁷

Falsification Test

Changes in food and beverage purchases may be associated with previous trends rather than the COVID-19 pandemic. Because we only have one round of exposure to COVID-19 (2020), we were unable to adapt models to test whether observed results are beyond previous trends, such as interrupted time series analyses. To address this potential limitation, a falsification test was conducted moving the year of exposure to COVID-19 to 2018 and 2016, where no significant changes in purchases are expected because no other policy or external shock happened in those years.

The study is a secondary analysis using publicly available deidentified data and is therefore exempt from institutional review board approval. The authors of the study did not collect any data.

RESULTS

Sociodemographic Characteristics and Percent Purchasers

Table 1 shows the sociodemographic characteristics of the population for 2018 and 2020. A total of 150,239 households with information of food and beverages purchases were included (46% from 2018 and 53% from 2020). The proportion of households with a male head of household was around 70% in both rounds. The average number of members per household decreased from 3.6 to 3.5. The proportion of households with adults only increased from 41% to 44%. The share of households whose head of household reported low education decreased from 38% to 36%. Average quarterly income increased from 442.4 to 529.2 US dollars in the lowest income quintile, and from 5,902.8 to 6,243.8 US dollars in the highest income quintile.

The proportion of households purchasing each food/beverage group in the 2018 and 2020 ENIGH rounds is shown in Figure 1. There was a 1.8 percentage point (pp) increase for fruits, 3.2 pp for prepared food, and 2.2 pp for water. In contrast, there was a decrease in the percentage of households purchasing legumes, NBEDF, and proportion spent on food consumed away from home, with values of -1.7 pp, -1.6 pp, and -14.4 pp, respectively.

Distribution of Household Food and Beverage Expenditures

Figure 2 shows the distribution of household expenditures by food group, nationally, by urban/rural areas and income quintile. Nationally, there was a significant increase in the proportion of food spent for basic foods from 49.5% to 55.6%, prepared foods from 8.2% to 10.7%, SSB from 4.8% to 5.2%, and water from 1.2% to 1.4%. In urban areas, purchases of basic and prepared food increased from 47.1% to 53.9%, and 8.8% to 11.6%, respectively. In rural areas, basic foods purchases increased from 61.6% to 64.7% and prepared food increased from 5.2% to 6.1%.

By income level, for the lowest quintile the proportion of food spent on basic foods increased from 63.6% to 65.6%, whereas prepared food increased from 5.6% to 6.9%. For the highest income quintile, the proportion of basic

Table 1. Socioeconomic and demographic characteristics of households in 2018 and 2020, Mexican National Household Income and Expenditure Survey 2018 and 2020^a

Variable	2018	2020	P value ^b
	N = 69,373	N = 80,866	
Sex of the head of the household (% male)	71	70	0.001
Mean age of the head of the household by tertile (years)			
Low	32.8	34.3	< 0.001
Middle	48.7	50.8	< 0.001
High	68.4	69.9	< 0.001
Household size (mean)	3.6	3.5	< 0.001
Household composition (%)			
Adults only	41	44	< 0.001
Adults and children only	26	24	
Adults and adolescents only	15	15	
Adults, children, and adolescents	18	16	
Education of the head of the household (%)			
Low, 0-6 y	38	36	0.002
Medium, 7- 12 y	45	46	
High, 13 or more y	17	17	
Mean quarterly income by quintiles^c			
Lowest	\$442.4	\$529.2	< 0.001
Low	\$937.2	\$1,095.2	< 0.001
Medium	\$1,521.9	\$1,700.3	< 0.001
High	\$2,354.7	\$2,630.4	< 0.001
Highest	\$5,902.8	\$6,243.8	0.013
Place of residence			
% Rural	23	21	< 0.001
Gross domestic product per capita^d	\$10,076.7	\$9,673.5	

^aThe complex sample design was considered to calculate means and proportions.

^bEstimated with *t* test or χ^2 .

^cMean quarterly income expressed in 2018 US dollars.

^dGross domestic product expressed in current US dollars.

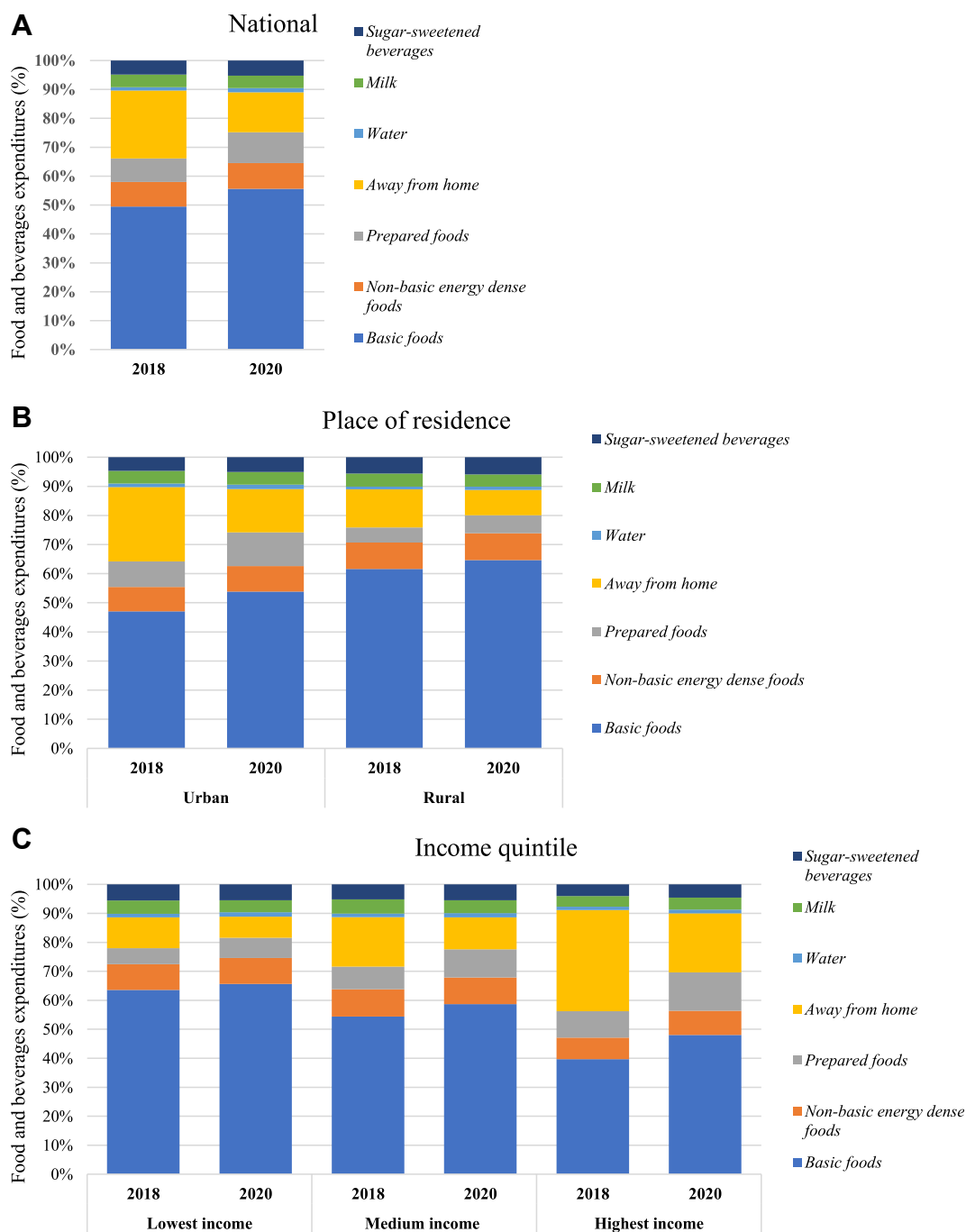


Figure 2. Distribution of household expenditures on food and beverages in 2018 and 2020. Panel a) National. Panel b) By place of residence. Panel c) By income quintile. Mexican National Household Income and Expenditure Survey 2018 and 2020.

foods purchased increased from 39.7% to 48% and purchases on prepared foods increased from 9.1% to 13.3%. Table 2 (available at www.jandonline.org) shows tests for statistical differences for distribution of expenditures between 2018 and 2020 at the national level, place of residence and income quintile. Nationally, by place of residence and income quintile, there was a significant increase in basic foods, prepared food, water, and SBB (except for the lowest income quintile). There was a

decrease of expenditures on food consumed away from home for all stratified categories.

Table 3 (available at www.jandonline.org) shows difference in unadjusted quantity of food and beverage purchased between 2018 and 2020 at national level and by place of residence. There were increases in purchases for basic and prepared food at the national level and in rural areas, and increases in water for all. There were reductions in purchases for food away from home and milk for all. Table 4

Table 5. Changes in food and beverage purchases in Mexico during the corona virus disease 2019 pandemic, nationally and by place or residence^a

Food group	National ^b		Urban ^c		Rural ^c	
	Coefficient	Percent change	Coefficient	Percent change	Coefficient	Percent change
Vegetables (g/capita/d)	7.4***	5.3	8.5***	6.1	4.5*	3.2
Fruits (g/capita/d)	7.3***	8.1	7.5***	7.8	5.1***	8.3
Cereals and tubers (g/capita/d)	-2.7*	-2.5	-0.5	-0.5	-12.7*	-5.1
Tortillas (g/capita/d)	4.9***	3.0	5.4***	3.3	6.8**	4.3
Legumes (g/capita/d)	-0.9**	-3.2	-0.2	-0.8	-3.1***	-7.3
Animal-based food (g/capita/d)	2.6**	1.8	2.4	1.6	2.5	2.1
Other basic foods (g/capita/d)	-0.47	-1.0	0.0	0.0	-2.2*	-3.7
Basic foods (g/capita/d)	17.0***	2.4	22.4***	3.2	2.5	0.3
Processed meat (g/capita/d)	-0.4	-2.1	-0.5	-2.4	-0.3	-1.9
Refined flours (g/capita/d)	-1.3***	-10.8	-1.7***	-14.2	-0.1	-1.3
Sweet bread (g/capita/d)	-1.5***	-10.1	-1.7***	-12.3	-0.3	-1.8
Other NBEDF ^d (g/capita/d)	-1.1***	-13.2	-1.0*	-10.2	-1.8***	-27.5
NBEDF^d (g/capita/d)	-4.2***	-7.9	-4.8***	-8.4	-2.5**	-5.2
Mexican traditional dishes (g/capita/d)	14.2***	17.3	14.0***	17.2	14.9***	21.0
Other prepared food (g/capita/d)	1.9***	12.9	2.1***	12.8	0.8*	10.3
Prepared food (g/capita/d)	16.0***	16.5	16.1***	16.5	15.7***	19.8
Water (mL/capita/d)	82.9***	18.9	84.0***	17.5	83.1***	29.7
Milk (mL/capita/d)	-12.3***	-11.7	-13.4***	-11.4	-8.6***	-10.5
SSB ^e (mL/capita/d)	1.6	0.9	-0.8	-0.6	7.2***	5.6
Food consumed away from home (%)^f	-6.4***	-44.9	-7.5***	-41.3	-3.4***	-37.8

^aThe complex sample design was considered. This analysis was performed using the Mexican National Household Income and Expenditure Survey 2014-2020.

^bCoefficients estimated with marginal effects of two-part model adjusted for household head age, household composition, household head schooling, sex of the household head, household income (in quintiles), residence area (urban/rural), per capita gross domestic product, and previous purchases of food and beverages (2014 and 2016). Percent change was estimated based on each food group's average amount purchased in 2018.

^cCoefficients estimated with marginal effects of two-part model adjusted for household head age, household composition, household head schooling, sex of the household head, household income (in quintiles), per capita gross domestic product, and previous purchases of food and beverages (2014 and 2016). Percent change was estimated based on each food group's average amount purchased in 2018.

^dNBEDF = nonbasic energy-dense foods.

^eSSB = sugar-sweetened beverages.

^fPercent of total food and beverages spent.

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

(available at www.jandonline.org) shows the same difference by income quintile. Significant increases were seen for prepared food and water and reductions in the proportion spent on food consumed away from home for all income quintiles.

Changes in Food and Beverage Purchases

Table 5 shows changes in food and beverage purchased in 2020 compared with 2018 from the 2-part models. Overall, purchases of basic foods increased 17 g/capita/day at the national level and 22.4 g/capita/day in urban areas ($P < 0.001$) in 2020 compared with 2018. Results show a significant increase in purchases of vegetables (national = 7.4, urban = 8.5, rural = 4.5 g/capita/day), fruits (national = 7.3, urban = 7.5, rural = 5.1 g/capita/day) and animal-based food

(national = 2.6 g/capita/day). Purchases of NBEDF decreased both at the national level (-4.2 g/capita/day) and by stratum (urban -4.8 and rural -2.5 g/capita/day). At the national level, purchases of prepared food increased by 16 g/capita/day ($P < 0.001$). The amount of water purchased increased by an average of 83 mL/capita/day, the proportion spent on food consumed away from home decreased by -44.9%, -41.3%, and -37.8%, and purchases of milk decreased by -12.3, -13.4, and -8.6 mL/capita/day, respectively, at the national level and in the urban and rural strata. Purchases of SSB increased only in rural areas by 7.2 mL/capita/day ($P < 0.001$).

Table 6 shows results by income quintile. For the lowest income quintile there was a significant increase in purchases of tortillas and processed meats of 7.2 and 2.4 g/capita/day, respectively. The highest income quintile increased purchases

Table 6. Changes in food and beverage purchases in Mexico during the coronavirus disease 2019 pandemic by income quintile^a

Food group	Lowest ^b		Low ^b		Medium ^b		High ^b		Highest ^b	
	Coefficient	Percent change	Coefficient	Percent change	Coefficient	Percent change	Coefficient	Percent change	Coefficient	Percent change
Vegetables (g/capita/d)	7.6*	4.6	10.0***	7.1	-0.8	-0.5	2.6	1.9	18.2***	13.6
Fruits (g/capita/d)	9.9**	12.7	4.6*	6.3	2.9	3.6	6.9**	87.6	13.2***	11.2
Cereals and tubers (g/capita/d)	-3.6	-1.5	-4.7	-3.6	-3.4	-3.3	-2.5	-2.9	2.2	3.0
Tortillas (g/capita/d)	7.2*	3.9	-3.7	-2.0	0.8	0.3	6.9**	4.5	8.3***	7.2
Legumes (g/capita/d)	-1.3	-2.8	-1.0	-3.2	-0.9	-3.4	-2.0***	-8.4	0.7	4.3
Animal-based food (g/capita/d)	0.8	0.5	1.7	1.3	0.5	0.4	0.3	0.2	9.3***	6.1
Other basic foods (g/capita/d)	-2.7*	-4.7	0.3	0.6	-0.8	-1.9	-0.2	-0.6	1.1	3.2
Basic foods (g/capita/d)	17.1	1.8	8.5	1.2	-3.6	-0.5	11.5	1.7	53.4***	8.3
Processed meat (g/capita/d)	2.4***	18.0	-0.9	-4.6	-1.5*	-6.7	-0.9	-4.1	-1.2	-5.5
Refined flours (g/capita/d)	-2.4 **	-18.1	-0.4	-4.0	-0.8	-7.4	-1.3**	-11.9	-1.5*	-10.4
Sweet bread (g/capita/d)	-0.8	-4.3	-1.0*	-6.6	-2.3***	-15.3	-1.8***	-13.5	-1.0**	-9.0
Other NBEDF ^c (g/capita/d)	-1.6*	-22.9	-1.7**	-22.5	-0.9	-10.3	-0.4	-6.2	-0.6	-4.6
NBEDF^c (g/capita/d)	-2.3	-4.8	-3.8***	-7.3	-5.4***	-9.7	-4.3***	-8.2	-4.2**	-7.2
Mexican dishes (g/capita/d)	12.2**	12.5	7.6*	9.9	21.5***	32.0	7.7*	10.2	19.0***	23.6
Other prepared food (g/capita/d)	1.8***	20.3	1.2	9.2	1.2*	8.4	1.0	6.2	4.0***	22.1
Prepared foods (g/capita/d)	13.9***	13.2	8.7*	9.6	22.6***	28.4	8.9*	9.7	23.1***	23.4
Water (mL/capita/d)	76.6***	17.0	66.5***	15.5	74.5***	17.8	91.6***	21.7	99.5***	22.4
Milk (mL/capita/d)	-10.2***	-11.3	-12.7***	-12.3	-16.7***	-14.8	-14.5***	-12.5	-6.3*	-5.5
SSB ^d (mL/capita/d)	2.9	2.3	-7.0*	-4.7	0.2	0.0	8.5	5.0	3.0	1.7
Food consumed away from home (%)^e	-3.0***	-38.2	-4.9***	-41.7	-5.4***	-38.4	-7.4***	-41.6	-11.9***	-43.5

^aThe complex sample design was considered. This analysis was performed using the Mexican National Household Income and Expenditure Survey 2014-2020.

^bCoefficients estimated with marginal effects of two-part model adjusted for household head age, household composition, household head schooling, sex of the household head, residence area (urban or rural), per capita gross domestic product, and previous purchases of food and beverages (2014 and 2016). Percent change was estimated based on each food group's mean values of quantity purchased in 2018.

^cNBEDF = nonbasic energy-dense foods.

^dSSB = sugar-sweetened beverages.

^ePercent of total food and beverages spent.

*P < 0.05.

**P < 0.01.

***P < 0.001.

RESEARCH

of basic foods by 53.4 g/capita/day. Except for the lowest income quintile, all income groups showed a decrease in purchases of NBEDF with values ranging from -7.2% to -9.7% . Purchases of prepared food and water increased significantly in all income quintiles. The amount of milk purchased and the proportion spent on food consumed away from home significantly decreased ($P < 0.05$) in all income quintiles.

Falsification Test

Table 7 (available at www.jandonline.org) shows the falsification tests for changes in food and beverage purchases in previous rounds where we would not expect similar patterns as in 2020. The estimated increase in purchases of basic food in 2020 compared with 2018 of 2.4% contrasts with the nonsignificant change observed in 2016 vs 2018, and a reduction of -3.1% in 2016 vs 2014. The -7.9% reduction in purchases of NBEDF in 2020 compared with 2018 are different to the nonsignificant changes observed in 2016 compared with 2018, and in 2016 compared with 2014. Although in 2018 compared with 2016 there was an increase in purchases of prepared food of 12.1% and nonsignificant changes in 2016 compared with 2014, the increase in 2020 was higher (16.5%). The 18.9% increase in water in 2020 contrasts with nonsignificant change in 2018 and smaller reduction 2016 (-5%). Although there was a downward trend for milk in 2018 (-6.2%) and 2016 (-8.5%), the reduction was higher in 2020 (-11.7%). The large reduction in the proportion spent on food consumed away from home in 2020 (-44.9%) contrasts with an increase in 2016 (13.6%).

DISCUSSION

Changes in food and beverages purchases during the COVID-19 epidemic were estimated in a nationally representative sample of households. Changes in quantity purchased by food group and proportion spent on food consumed away from home in 2020 compared with 2018 were estimated using a 2-part model adjusted for household-level sociodemographic variables, per capita gross domestic product, and previous rounds (2014 and 2016).

Compared with 2018, results show a 2.4% increase in purchases of basic foods (mainly from increases in fruits, vegetables, and tortillas) in 2020, 18.9% for water, and 16.5% for prepared food. In contrast, a significant decrease in the proportion spent on food consumed away from home of -44.9% , NBEDF -7.9% , and reduction of -11.7% for milk was found. Among the rural population, there was an increase in SSB purchases and a decrease in legumes. The lowest income quintile significantly increased purchases of processed meat, fruits, vegetables, and tortillas.

The results of this study suggest that during COVID-19 pandemic, Mexican households increased purchases of more nutritious foods such as fruits and vegetables. Other studies have shown that the lockdown has positively changed dietary behavior.^{7,28,29} At the national level, the amount of water purchased for drinking or cooking increased by 83 mL/capita/day. This finding is consistent with that of Bakhsh and colleagues²⁹ in Arabia, where they observed that 57% of respondents increased their water consumption during the lockdown. The observed changes in purchases or eating patterns could be associated with several factors such as income reductions, food price increases, lower mobility, lower

access to food stores along with having more time for cooking.^{5,30} For instance, as part of the COVID-19 mitigation measures, access to food stores was restricted to one adult per family and children were not allowed to attend. On the other hand, between February and October 2020, the cost of the food basket—that is used to monitor inflation—increased 2.2% but the cost decreased for fruits and vegetables,³¹ which could partly explain the observed increase in purchases of these items in the current study.

In the United States, between 2016 and 2020, the proportion of expenditures for food consumption away from home decreased from 36.5% to 29.3% and from 40.4% to 32.2% among high-income households.³² These results are similar to this study showing an overall reduction in proportion spent on food consumed away from home from 23% to 14% and from 35% to 20% among high-income households. Reductions in the proportion spent on food consumed away from home were associated with large decreases in the use of restaurants during the first months of the COVID-19 pandemic where mobility restrictions were implemented.³³ Because high-income households spent more on food consumed away from home,³⁴ larger reductions were expected.

Other studies have shown that the lockdown was associated with negative dietary habits.^{18,35} However, lockdown measures vary across countries and demographic differences in populations pose a challenge to the comparability of results. An average increase of 16 g/capita/day was observed in purchases of prepared food. This result is consistent with findings from Ellison and colleagues³⁶ in the United States, and could be related to a decreased mobility, an increase in time working from home, and increases in digital platforms for food sales.

There was a decrease in purchases of milk of -11.7% . Studies on the influence of the COVID-19 pandemic highlight that reductions in purchases of dairy food were associated with operating costs, transportation, and price increases.³⁷ However, according to ENIGH data,²³ milk purchases in Mexico had been decreasing since the 1990s.

The present study showed that some population groups increased purchases of unhealthier options. In particular, the rural population increased the amount of SSB purchases by 5.6% and in the lowest income quintile there was an increase in purchases of processed meat by 18%. These findings are in line with those published by Gaytan-Rossi and colleagues³⁸ in 2020, which suggest that the COVID-19 pandemic in Mexico had a negative influence on food security, particularly among the most vulnerable households. The increase in SSB purchases is consistent with results previously observed in countries such as Colombia, Argentina, and France.^{15,18,39}

The proportion of income used to buy food did not change significantly between 2018 and 2020 (values of 31.4% and 32.3%, respectively).²³ However, the proportion of income assigned to clothing and footwear, or education and recreation, suffered significant reductions,²³ which means that during the COVID-19 pandemic households reallocated their resources without sacrificing the proportion of income spent on food and beverages.

An article from Cummings and colleagues⁴⁰ in the United States shows that individuals with higher stress during the COVID-19 pandemic had higher intake of sugars and of alcoholic beverages. Although the current study did not measure stress, the increase in SSB purchases in rural areas

may have been associated with emotional stress to cope with the scarcity of health services for COVID-19 cases.

The study has some limitations. The ENIGH are cross-sectional surveys so causality cannot be claimed. We could not adapt interrupted time series analyses to adjust for previous trends and test for differences in post-COVID-19 trends because there is only one round of exposure to the pandemic. Given that the COVID-19 was an external shock, we compared 2020 with 2018 (previous ENIGH round) and adjusted the models for previous rounds (2016 and 2014). However, the falsification tests showed that the estimated changes in 2020 compared with 2018 were not driven by a previous trend for basic food, water, and the proportion spent on food consumed away from home. Also, the largest changes in purchases of NBEDF, prepared food, and milk were observed.

CONCLUSIONS

Results of this study show that during the COVID-19 lockdown there was an increase in basic food and prepared food purchases, whereas purchases of NBEDF and the proportion spent on food consumed away from home decreased. However, findings showed an increase in SSB purchases among rural dwellers and an increase in purchases of processed meat among the lowest income quintile. Various factors such as income reductions, unemployment, mobility restrictions, or increases in prices may have led the observed changes. Future research should be conducted to analyze these potential pathways.

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STATEMENT OF POTENTIAL CONFLICT OF INTEREST

No potential conflict of interest was reported by the authors.

FUNDING/SUPPORT

There is no funding to disclose.

AUTHOR CONTRIBUTIONS

M. A. Colchero was responsible for the conception of the project. N. A. Sánchez-Ortiz and M. A. Colchero developed general research plan. N. A. Sánchez-Ortiz wrote the statistical program and prepared the initial draft document. Successive drafts were developed by N. A. Sánchez-Ortiz and M. A. Colchero. Both authors have reviewed and approved the final version.

Table 2. Distribution of household expenditures for food and beverages nationally, by place of residence, and income quintile in 2018 and 2020, Mexican National Household Income and Expenditure Survey 2018 and 2020^a

	National			Urban			Rural		
	2018	2020	<i>P</i> value ^b	2018	2020	<i>P</i> value ^b	2018	2020	<i>P</i> value ^b
Basic foods (%)	49.5	55.6	< 0.001	47.1	53.9	< 0.001	61.6	64.7	< 0.001
NBEDF ^c (%)	8.5	8.8	0.253	8.4	8.8	0.287	9.0	9.2	0.476
Prepared foods (%)	8.2	10.7	< 0.001	8.8	11.6	< 0.001	5.2	6.1	< 0.001
Away from home (%)	23.5	13.9	< 0.001	25.5	14.9	< 0.001	13.1	8.7	< 0.001
Water (%)	1.2	1.4	< 0.001	1.2	1.5	< 0.001	0.9	1.1	< 0.001
Milk (%)	4.4	4.3	< 0.001	4.3	4.4	< 0.001	4.5	4.2	< 0.001
SSB ^d (%)	4.8	5.2	< 0.001	4.7	5.1	< 0.001	5.6	5.9	0.002

	Lowest income			Medium income			Highest income		
	2018	2020	<i>P</i> value ^b	2018	2020	<i>P</i> value ^b	2018	2020	<i>P</i> value ^b
Basic foods (%)	63.6	65.6	0.004	54.4	58.7	< 0.001	39.7	48.0	< 0.001
NBEDF ^c (%)	8.8	9.0	0.765	9.4	9.2	0.033	7.5	8.3	0.010
Prepared foods (%)	5.6	6.9	< 0.001	7.8	9.7	< 0.001	9.1	13.3	< 0.001
Away from home (%)	10.6	7.3	< 0.001	17.0	11.0	< 0.001	34.9	20.3	< 0.001
Water (%)	1.3	1.5	< 0.001	1.2	1.4	< 0.001	1.1	1.4	< 0.001
Milk (%)	4.6	4.1	< 0.001	4.9	4.5	< 0.001	3.7	4.1	0.954
SSB ^d (%)	5.5	5.5	0.778	5.2	5.5	0.001	4.0	4.6	< 0.001

^aThe complex sample design was considered to calculate proportions.^bEstimated with *t* test.^cNBEDF = nonbasic energy-dense foods.^dSSB = sugar-sweetened beverages.

Table 3. Quantity purchased by food and beverage group, nationally and by place of residence in 2018 and 2020, Mexican National Household Income and Expenditure Survey 2018 and 2020^a

Food group	National			Urban			Rural		
	2018	2020	<i>P</i> value ^b	2018	2020	<i>P</i> value ^b	2018	2020	<i>P</i> value ^b
Vegetables (g/capita/d)	141.5	151.1	< 0.001	141.8	152.3	0.004	140.6	146.5	< 0.001
Fruits (g/capita/d)	89.5	98.3	< 0.001	97.4	106.0	< 0.001	63.0	69.4	< 0.001
Cereals and tubers (g/capita/d)	122.9	117.6	0.001	85.7	86.3	0.018	248.9	234.8	0.575
Tortillas (g/capita/d)	158.2	164.2	< 0.001	158.2	163.6	< 0.001	158.1	166.8	< 0.001
Legumes (g/capita/d)	29.0	28.2	0.026	24.9	25.1	< 0.001	43.0	40.0	0.629
Animal-based food (g/capita/d)	147.2	152.8	< 0.001	152.3	157.4	< 0.001	129.7	135.3	0.001
Other basic foods (g/capita/d)	43.4	43.1	0.583	38.6	39.4	0.014	59.6	57.1	0.207
Basic foods (g/capita/d)	731.7	755.3	< 0.001	698.8	730.1	0.399	842.9	849.8	< 0.001
Processed meat (g/capita/d)	19.2	19.2	0.894	20.9	20.6	0.622	13.6	13.8	0.456
Refined flours (g/capita/d)	11.9	10.9	0.002	12.2	10.9	0.913	10.8	10.9	0.001
Sweet bread (g/capita/d)	14.8	13.6	< 0.001	14.2	12.8	0.853	16.6	16.5	< 0.001
Other NBEDF ^d (g/capita/d)	8.4	7.7	0.010	8.9	8.3	< 0.001	6.8	5.3	0.102
NBEDF^c (g/capita/d)	54.2	51.3	< 0.001	56.2	52.5	0.088	47.8	46.4	< 0.001
Mexican dishes (g/capita/d)	79.6	99.3	< 0.001	82.4	101.5	< 0.001	70.4	90.9	< 0.001
Other prepared foods (g/capita/d)	14.6	17.4	< 0.001	16.5	19.5	0.008	8.1	9.4	< 0.001
Prepared foods (g/capita/d)	94.2	116.7	< 0.001	98.8	121.0	< 0.001	78.5	100.3	< 0.001
Water (mL/capita/d)	433.3	536.1	< 0.001	478.6	578.9	< 0.001	280.2	375.3	< 0.001
Milk (mL/capita/d)	107.7	97.9	< 0.001	115.4	104.2	< 0.001	81.5	74.3	< 0.001
SSB ^d (mL/capita/d)	154.6	160.6	0.011	161.9	166.1	< 0.001	129.8	139.9	0.155
Food consumed away from home (%)^e	16.2	9.8	< 0.001	18.3	10.8	< 0.001	9.1	5.9	< 0.001

^aThe complex sample design was considered to calculate means.

^bEstimated with *t* test.

^cNBEDF = nonbasic energy-dense foods.

^dSSB = sugar-sweetened beverages.

^ePercent of total food and beverages spent.

Table 4. Quantity purchased of food and beverage group by income quintile in 2018 and 2020, Mexican National Household Income and Expenditure Survey 2018 and 2020^a

Food	Lowest			Low			Medium			High			Highest		
	2018	2020	P value ^b	2018	2020	P value ^b	2018	2020	P value ^b	2018	2020	P value ^b	2018	2020	P value ^b
Vegetables (g/capita/d)	150.4	156.4	0.079	141.9	155.2	< 0.001	143.6	144.7	0.718	139.0	144.6	0.077	134.2	154.7	< 0.001
Fruits (g/capita/d)	75.0	85.5	0.001	77.3	86.9	0.001	82.9	87.6	0.099	90.8	98.7	0.019	117.1	130.2	< 0.001
Cereals and tubers (g/capita/d)	235.1	209.0	< 0.001	130.2	122.8	0.033	103.2	99.8	0.208	86.8	85.0	0.427	74.9	78.8	0.060
Tortillas (g/capita/d)	179.5	189.1	0.003	184.5	182.9	0.549	169.8	172.6	0.251	149.9	157.3	< 0.001	114.7	123.4	< 0.001
Legumes (g/capita/d)	47.6	44.5	0.010	33.1	32.3	0.298	26.9	26.3	0.348	23.7	21.8	0.002	16.9	18.0	0.053
Animal-based food (g/capita/d)	142.2	146.0	0.339	144.1	149.9	0.012	146.3	151.2	0.038	148.2	150.8	0.235	153.8	164.5	< 0.001
Other basic foods (g/capita/d)	59.4	53.8	< 0.001	44.9	45.5	0.561	41.8	41.1	0.486	37.2	38.0	0.452	35.9	38.0	0.085
Basic foods (g/capita/d)	889.2	884.2	0.682	755.9	775.6	0.032	714.5	723.2	0.314	675.6	696.3	0.016	647.5	707.5	< 0.001
Processed meat (g/capita/d)	12.8	16.6	< 0.001	18.8	18.4	0.431	21.4	19.9	0.035	20.8	20.3	0.340	21.4	20.4	0.184
Refined flours (g/capita/d)	13.8	11.1	0.028	9.9	10.2	0.548	10.4	9.9	0.384	10.7	9.8	0.027	14.4	13.3	0.11
Sweet bread (g/capita/d)	19.3	18.0	0.042	15.3	14.7	0.191	15.2	13.2	< 0.001	13.5	12.0	< 0.001	11.3	10.4	0.024
Other NBEDF ^c (g/capita/d)	7.1	5.9	0.127	7.2	5.9	0.006	8.0	7.4	0.001	7.7	7.5	0.583	11.6	11.3	0.703
NBEDF^c (g/capita/d)	52.9	51.5	0.414	51.3	49.2	0.059	55.0	50.5	0.001	52.7	49.5	0.001	58.6	55.4	0.029
Mexican dishes (g/capita/d)	99.5	119.2	< 0.001	77.0	91.8	< 0.001	65.5	93.9	< 0.001	76.9	87.8	0.008	80.8	104.6	< 0.001
Other prepared foods (g/capita/d)	9.2	12.5	< 0.001	12.9	15.0	0.007	14.8	16.7	0.004	16.6	18.2	0.010	18.3	23.7	< 0.001
Prepared foods (g/capita/d)	108.7	131.7	< 0.001	89.8	106.8	< 0.001	80.3	110.6	< 0.001	93.5	106.1	0.003	99.2	128.3	< 0.001
Water (mL/capita/d)	426.6	525.6	< 0.001	436.9	535.8	< 0.001	431.8	532.1	< 0.001	424.0	528.8	< 0.001	446.2	556.4	< 0.001
Milk (mL/capita/d)	92.7	85.4	0.008	102.3	92.9	< 0.001	111.2	96.6	< 0.001	113.1	101.1	< 0.001	116.6	112.0	0.106
SSB ^d (mL/capita/d)	131.4	138.8	0.045	150.0	147.5	0.478	153.1	156.9	0.29	166.5	181.6	0.077	168.2	175.7	0.104
Food consumed away from home (%)^e	7.7	5.6	< 0.001	11.8	7.4	< 0.001	14.1	9.2	< 0.001	17.8	10.6%	< 0.001	27.4	15.%	< 0.001

^aThe complex sample design was considered to calculate means.

^bEstimated with *t* test.

^cNBEDF = nonbasic energy-dense foods.

^dSSB = sugar-sweetened beverages.

^ePercent of total food and beverages spent.

Table 7. Changes in quantity of food and beverage purchased in 2020, 2018, and 2016 in Mexico (falsification test)^a

Food group	2020 ^b		2018 ^c		2016 ^d	
	Coefficient	Percent change	Coefficient	Percent change	Coefficient	Percent change
Basic foods (g/capita/d)	17.0***	2.4	−2.5	−0.3	−23.***	−3.1
NBEDF ^e (g/capita/d)	−4.2***	−7.9	−0.9	−1.6	−1.0	−1.7
Prepared foods (g/capita/d)	16.0***	16.5	10.3***	12.1	0.2	0.2
Water (mL/capita/d)	82.9***	18.9	−11.8	−2.8	−26.2*	−5.0
Milk (mL/capita/d)	−12.3***	−11.7	−6.7***	−6.2	−10.3***	−8.5
SSB ^f (mL/capita/d)	1.6	0.9	−4.8**	−2.7	−0.3	−0.3
Food consumed away from home (%) ^g	−6.4***	−44.9	0.1	1.0	1.8***	13.6

^aThe complex sample design was considered. This analysis was performed using the Mexican National Household Income and Expenditure Survey 2014–2020.

^bCoefficients estimated with marginal effects of two-part model adjusted for household head age, household composition, household head schooling, sex of the household head, household income (in quintiles), place of residence (urban/rural), per capita gross domestic product, and previous purchases of food and beverages (2014 and 2016). Percent change was estimated based on each food group's average amount purchased in 2018.

^cCoefficients estimated with marginal effects of two-part model adjusted for household head age, household composition, household head schooling, sex of the household head, household income (in quintiles), place of residence (urban/rural), per capita gross domestic product, and previous purchases of food and beverages (2014). Percent change was estimated based on each food group's average amount purchased in 2016.

^dCoefficients estimated with marginal effects of two-part model adjusted for household head age, household composition, household head schooling, sex of the household head, household income (in quintiles), place of residence (urban/rural) and per capita gross domestic product. Percent change was estimated based on each food group's average amount purchased in 2014.

^eNBEDF = non-basic with high energy density or added sugar.

^fSSB = sugar-sweetened beverages.

^gPercent of total food and beverages spent.

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.