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Household food security: Perceptions, behavior and nutritional quality of food purchases

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ABSTRACT

Food security is an encompassing concept that includes several dimensions: sufficiency, acceptability, safety, stability and nutritional quality. Lately, diverse studies discuss how much objective and subjective indicators are able to characterize some of the above-mentioned dimensions. This has opened the door to some apparent contradictions between different food security measurements that reflect perception (through specific surveys) and behavior (expenditure data).

This article aims to extend the food security debate, focusing on the dimension of nutritional quality and classifying food products as healthy or unhealthy, in addition to computing their calorie value. Using a nationally representative database of nearly 6700 households in Mexico, we found that food-secure households (55% of the total sample) purchase an overall food basket that is 0.7 items less diverse, spend $85 Mexican pesos per week more, and show no significant difference in terms of purchased kcals compared to food-insecure households. After controlling for confounding factors, we found that food-secure households purchase a wider variety of healthy food items (and a smaller variety of unhealthy food items), spend more money on food, and purchase more calories in healthy food items compared to food-insecure households. Therefore, with this article, we enhance the relevance of the nutritional quality of food purchases in the food security debate.

1. Introduction

The term *food security* is currently defined by the Food and Agriculture Organization (FAO) as the *physical, economic and social access, at all times, to sufficient, safe, and nutritious food to meet people's dietary needs and food preferences for a healthy and active life* (FAO, 1996). As noted by several authors, the definition of food security involves five dimensions: sufficiency, nutritional quality, acceptability, safety and stability (Coates, 2013). Given the complexity of the concept of food security, objective indicators have proven to be insufficient to capture all pathways to food insecurity (Maxwell, Vaitla, & Coates, 2014). Recent evidence suggests that subjective measurements such as experiential (psychological) and behavioral questionnaires capture important aspects of food insecurity, such as the stability of access to food (Maxwell, Watkins, Wheeler, & Collins, 2003). However, several studies have shown that subjective food safety measurements cannot fully characterize changes in food expenditure behavior – such as coping strategies – because some households continue to report their status

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as secure regardless of their consumption patterns. This has raised concerns with regard to the external validity of the instruments (Barrett, 2010; Gundersen, Engelhard, & Waxman, 2014; Gundersen & Ribar, 2011; Kirkland, Kemp, Hunter, & Twine, 2011; Nord & Brent, 2002; Warr, 2014). This discussion has revealed the importance of properly interpreting subjective food security data, which also extends to the relationship between food insecurity indicators and objective household data, such as the nutritional quality and the quantity of food consumption.

There are few studies that explore the nutritional quality dimension of food insecurity (measured either by calorie content or dietary diversity), mainly because it requires a comprehensive set of data. However, some efforts have been made so far. Kendall, Olson, and Frongillo (1996) found, using U.S. household data, a decrease in the quantity and nutritional quality of diet as households become more insecure, particularly in fruits and vegetables. Similar studies report a positive relationship between dietary diversity and the consumption of certain food groups and higher food security, using different subjective measurements (Melgar-Quinonez et al., 2006; Thorne-Lyman et al., 2010). Also Coates, Wilde, Webb, Rogers, and Houser (2006) and Hackett, Zubieta, Hernandez, and Melgar-Quinonez (2007) found similar results using a similar approach in Bangladesh and Ecuador, respectively. Although these studies report consistencies between dietary diversity, quantity of food consumption and food security, they fail to account for the nutritional quality of food products, which is a major factor in developed countries (Inamura et al., 2015). Our article aims to explore the relationship between the perception of food security status and the nutritional quality (objective measures) at a household level. We aim to contribute to the debate on the divergences and complementarities between objective (behavior, food purchases) and subjective (perceptions) food security measurements, and, in this way, inform policymakers on the instruments to monitor food security while taking into account unintended food purchases consequences.

We found that, after controlling for confounding factors, food-secure households purchase a wider variety of healthy food items (and a smaller variety of unhealthy food items), spend more money on food, and purchase more calories in healthy food items compared to food-insecure households. Enhancing the relevance of the nutritional quality of food purchases in the food security debate, food-secure and food-insecure households differ in healthy and unhealthy food items. Unexpectedly, food-secure households do not purchase more overall calories than food-insecure households. This finding shows the relevance of taking the nutritional quality of food purchases into account in order to improve food security.

2. Material and methods

In our analysis, we used the National Income and Expenditure Household Survey (ENIGH, Spanish acronym), which is a nationally representative income and expenditure survey conducted by the Mexican Statistical Institute (INEGI). This database contains information on food expenditure (at home and away from home) and the monetary value of food purchased during one week. The data set also contains the socioeconomic characteristics of the households, including geographical location, housing characteristics, number and age of the family members, income, gender, and the education level of the head of the household, among other variables. Moreover, the survey contains information used to officially measure poverty, as well as self-reported food security indicators. Therefore, the ENIGH is the only official, nationally representative, data set in Mexico that contains variables to measure both objective and subjective food security indicators at a household level.

The Mexican Food Security Scale (EMSA, Spanish acronym) is a survey designed to address access to food and hunger experiences at a household level, and it is based on both the Latin American and Caribbean Food Security Scale (ECLSA, Spanish acronym) and the USDA Household Food Security Survey (HFSS). EMSA distinguishes between households with only adult members and those with members under 18. In the first group, there are six questions related to food shortages and hunger experiences, whereas households with children answer six additional questions. In the Appendix B, we provide the food security questionnaire and basic response statistics. The EMSA has been proven to be internally consistent using the Rasch model, as well as Cronbach' s alpha analysis (Villagómez-Ornelas et al., 2014), with similar results with regard to internal validity as the ECLSA (FAO, 2012).

As established in the EMSA, food security status is determined by the number of positive responses. It considers that a household is food secure when none of the questions in the food security questionnaire is responded affirmatively. In contrast, a household is classified as food insecure if at least one of the answers is responded affirmatively. In this article, we follow the EMSA criterion, which is the one officially accepted in Mexico. We believe this is reasonable, since an affirmative answer shows a serious food constraint.

To assess the nutritional quality of food purchases, as have other authors (Inamura et al., 2015), we used the food variety score (number of food items purchased in a representative week), calorie content per food item and *healthiness* of each food product, which required additional information. We used the weight-to-calorie or volume-to-calorie conversion factors presented by Pérez-Lizaur, Palacios-González, Castro-Becerra, and Flores-Galicia (2014); previous works by these authors have been used to conduct research (Medina, Villanueva-Borbolla, & Barquera, 2012). We also classified food products as healthy or unhealthy. However, we note that there is no unified criterion to make such a distinction, and a deep discussion of this issue is beyond the scope of this article. The complete list of food products classified as healthy or unhealthy is included in the Appendix B. In our criterion, healthy food products have more than one of the following attributes: fresh (or with a low level of processing), rich in water, rich in fiber, low in energy density, low in fat and low in sugar (especially with no sugar added). In contrast, unhealthy foods have the opposite attributes as healthy foods, particularly processed and ready-to-eat foods.

In Table 1, we present the basic statistics for food-insecure and food-secure households using representative weights. We used the data available for all households that provided food expenditure data and answered the food security questionnaire.

We expanded the sample from 6680 households to slightly more than 24 million households, equivalent to nearly 96 million inhabitants in Mexico as on 2012. Therefore, the basic statistics are estimated using weights to reflect the sample design, and are representative at a national level.

Regarding household head characteristics, not being a native speaker of an indigenous language and a higher education level are related to food security, as are households with a lower average number of minors (household members younger than 18 years old). With regard to housing, urban households with a sewage system, a car and a refrigerator are more likely to be food secure, given that these attributes allow better access to and storage of food. As for water supply, results suggest that households that drink water from the faucet tend to be less food secure, which at first may seem counter-intuitive. In Mexico, the quality of the water from the pipe/faucet is perceived as dubious. Therefore, most people drink bottled water or boil the water from the faucet before using it. In this context, people that drink water directly from the faucet are people who might not have access to safe water sources, which explains why drinking water directly from the faucet is associated with food insecurity.

Food-secure households, on average, have a significantly higher income than food-insecure households. A higher income allows economic access to a higher quantity and better quality of food. Therefore, it is not surprising that food-secure households also spend more on food. However, as presented in Fig. 1, the income distribution of food-secure and food-insecure households is fairly similar, confirming that a large portion of food-insecure households are classified as thus due to their own perception rather than due to objective measurement.

In Table 1, regarding the amount and nutritional quality of purchased food, food-secure households spend more on food (both healthy and unhealthy), and they purchase significantly fewer calories and a smaller variety of unhealthy food. Today, some foods have a high caloric content but low nutritional value, also known as 'empty calories', meaning that the use of unconditional indicators, such as calories, may be misleading in countries such as Mexico, that have high levels of both obesity and food insecurity.

Now, the question becomes whether the differences in purchased variety, food expenditure and purchase calories remain after controlling for confounding factors. Given that food security perception is expected to be non-random; a matching propensity score technique was implemented to estimate the likelihood of being a secure household based on the variables available in the survey, in order to balance the sample for both groups. Mathematically, the following expression was estimated:

$$p(X_i) = Pr(D = 1|X_i) = E(D|X_i)$$

where D represents the food security perception dummy variable, and X is a group of household-level variables related to the food security condition. For the latter to be a valid technique for estimating the likelihood of participation, two conditions need to be satisfied: first, the sample should be balanced across the mentioned variables, given the propensity score; second, the unconfoundedness of participation given the propensity score, meaning that once a sample is balanced, the expected probability of being food secure for all households should be the same. The first condition could verified in the sample, but the second cannot be tested directly.

Afterwards, the average difference of the objective food security indicators between matched households was computed for the mentioned outcomes as the Average Treatment Effect of the Treated (ATT), given that we desire to explore the differences in behavior between food-secure households and similar insecure households. Thus, the food security differential is computed as follows:

$$\tau = E[E(Y_{1i}|D_i = 1, p(X_i)) - E(Y_{0i}|D_i = 0, p(X_i))|D_i = 1]$$

where Y_1 and Y_0 are the potential outcomes for behavior variables in food-secure and food-insecure households, respectively (Food Variety Score, food expenditure and kcal). There are many possible matching criteria. We implemented nearest neighbor matching using one, three and five closest neighbors for robustness purposes. Data management and estimations were conducted using Stata SE version 13.

3. Results and discussion

First, we computed a Probit specification for the dependent variable 'food security status' (0 = food insecure, 1 = food secure) in order to estimate the likelihood of being food secure using independent variables, also known as confounding factors, related to the head of the household (gender, age, native speaker of an indigenous language, and level of education), household composition (number of adults, number of children and number of workers) and household characteristics (region, faucet water, sewage, car, refrigerator, rural and income). We also controlled for additional variables depending the model specification: the Food Variety Score model controls for food expenditure and calorie content, the Food Expenditure model controls for calorie content and food variety. Finally, the kcal model controls for food expenditure and food variety. The results of the Probit models are presented in Table 3 of the Appendix A.

Secondly, we used three alternative specifications of the nearest neighborhood matching to calculate the ATT between food-secure households and food-insecure households in terms of three objective food security indicators. We also differentiated household food baskets as containing healthy or unhealthy food items. The results are presented in Table 2. Unlike the unconditional results in Table 1, we were able to distinguish between healthy and unhealthy food items. Food-secure households spend more on food (both healthy and unhealthy), have a greater variety of healthy food items (in contrast to

Table 1
Basic statistics food insecure and food secure households.

Variable	Description	Food insecure households					Food secure households					*t*-test
		N	Mean	SD	Min	Max	*N*	Mean	SD	Min	Max	*p*-value
gender	gender of the hh head, 0 = male, 1 = female	10,390,910	0.25	0.43	0.00	1.00	14,360,352	0.26	0.44	0.00	1.00	0.45
age	age in years hh head	10,390,910	49.11	16.15	17.00	97.00	14,360,352	48.63	15.67	17.00	97.00	0.05
native	household head speaks native language, 0 = no, 1 = yes	10,390,910	0.14	0.35	0.00	1.00	14,360,352	0.06	0.23	0.00	1.00	0.00
edu0	no formal education, 0 = no, 1 = yes	10,390,910	0.15	0.36	0.00	1.00	14,360,352	0.06	0.23	0.00	1.00	0.00
edu1	elementary or less (complete or incomplete), 0 = no, 1 = yes	10,390,910	0.46	0.50	0.00	1.00	14,360,352	0.31	0.46	0.00	1.00	0.00
edu2	secondary (complete or incomplete), 0 = no, 1 = yes	10,390,910	0.26	0.44	0.00	1.00	14,360,352	0.29	0.45	0.00	1.00	0.00
edu3	more than secondary, 0 = no, 1 = yes	10,390,910	0.13	0.34	0.00	1.00	14,360,352	0.35	0.48	0.00	1.00	0.00
adults	number of people with 18 years or more	10,390,910	2.51	1.17	1.00	11.00	14,360,352	2.43	1.11	0.00	10.00	0.00
minors	number of people with 17 years or less	10,390,910	1.57	1.45	0.00	11.00	14,360,352	1.07	1.22	0.00	11.00	0.00
workers	number of people working with 14 years or more	10,390,910	1.78	1.11	0.00	9.00	14,360,352	1.63	1.05	0.00	8.00	0.00
water	hh drinks water from faucet, 0 = no, 1 = yes	10,386,846	0.19	0.39	0.00	1.00	14,360,352	0.16	0.37	0.00	1.00	0.01
refri	refrigerator at the hh, 0 = no, 1 = yes	10,390,910	0.80	0.40	0.00	1.00	14,360,352	0.84	0.36	0.00	1.00	0.00
car	car at the hh, 0 = no, 1 = yes	10,390,910	0.24	0.43	0.00	1.00	14,360,352	0.29	0.45	0.00	1.00	0.00
rural	hh in a village of less than 2,500 inhabitants, 0 = no, 1 = yes	10,390,910	0.30	0.46	0.00	1.00	14,360,352	0.17	0.38	0.00	1.00	0.00
sewer	sewer to a public pipe, 0 = no, 1 = yes	10,386,846	0.71	0.45	0.00	1.00	14,360,352	0.76	0.43	0.00	1.00	0.00
fvs1	food var score, number of healthy items at home/week	10,390,910	9.07	6.28	0.00	42.00	14,360,352	8.41	6.21	0.00	43.00	0.10
fvs2	food var score, number of unhealthy food items at home/week	10,390,910	20.23	10.23	0.00	68.00	14,360,352	17.86	9.05	0.00	68.00	0.00
fvs3	food var score, number of all food items at home/week	10,390,910	29.30	14.31	1.00	96.00	14,360,352	26.27	13.04	1.00	111.00	0.00
fexp1	healthy food expenditure, in Mexican pesos	9,968,309	140.12	108.83	0.00	1,143.00	13,316,562	158.80	129.79	0.00	916.00	0.00
fexp2	unhealthy food expenditure, in Mexican pesos	10,389,987	343.81	238.52	0.00	3,404.20	14,336,465	385.81	255.08	0.00	3,069.10	0.00
fexp3	total food expenditure, in Mexican pesos	10,390,910	478.20	305.31	0.00	4,265.50	14,360,352	532.42	335.42	0.00	3,263.90	0.00
kcal1	healthy food kcal	9,968,309	8,372.59	8,509.98	4.17	130,910.40	13,316,562	7,421.66	8,471.99	0.00	199,304.70	0.00
kcal2	unhealthy food kcal	10,389,987	39,020.59	35,607.72	0.21	506,924.70	14,336,465	29,995.05	25,798.83	2.82	796,964.40	0.00
kcal3	total food kcal	10,390,910	47,049.20	39,020.92	1.69	535,042.40	14,360,352	36,827.37	29,857.41	2.82	802,987.10	0.00
texp	total expenditure per hh/week, thousands Mexican pesos	10,390,910	1.97	1.51	0.17	20.35	14,360,352	2.93	2.25	0.20	28.34	0.00
tinc	total income per hh/week, thousands Mexican pesos	10,390,910	1.95	1.45	0.11	9.51	14,360,352	3.00	1.99	0.15	9.51	0.00

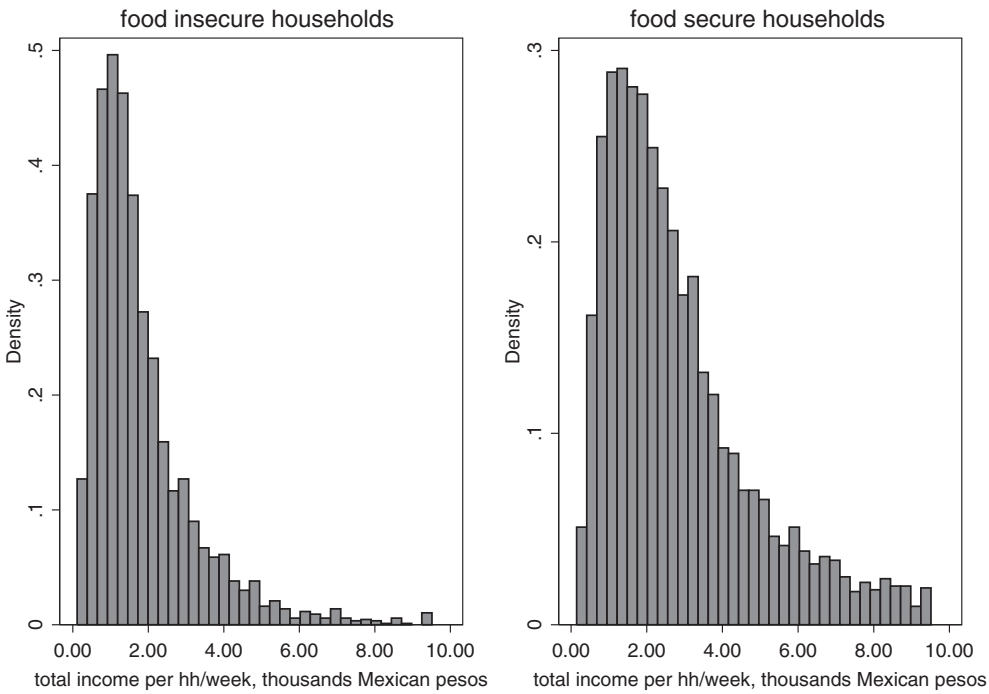

Fig. 1. Income histogram per type of household.

unhealthy food items) and purchase more healthy-food calories compared with food-insecure households. This suggests that food classification in terms of healthiness (healthy vs. unhealthy food items), after controlling for confounding factors, would play a significant role in the food security perception status.

The behavioral change (in term of food purchases) is not always statistically significant or relevant in terms of amount. Taking into account the actual magnitude, food-secure households spend around $85 Mexican pesos more per week (around 3% of the weekly budget), purchase 0.7 less food items per week (over an average purchase of 26 food items per week), and have no significant differences with regard to overall calorie food expenditure than food-insecure households.

The fact that food-secure households spend more on food is somehow expected, and in some cases, well documented by previous studies. It was unexpected that, consistently across matching specifications, food-secure households purchase a lesser overall food variety than food-insecure households. Moreover, in terms of calories purchased, there is no statistical difference between both types of households. This suggests that some earlier food security measurements, such as kcal *per capita*, may be misleading with regard to actual food security perception.

The main contribution of our article is to break down food purchases into healthy and unhealthy foods and, from this, enhance the relevance of the nutritional quality of food purchases in the food security debate. The fact is, a large portion of the behavioral change was revealed only after food healthiness classifications became a challenge to developing food security measurements. This suggests to refine food security measurements by adding the nutritional dimension. This way, we would be able find more consistency between objective (behavior) and subjective (perception) measurements on food security.

Table 2
Matching results using three matching specifications.

Variables	1–1 Matching			3–3 Matching			5–5 Matching		
	Healthy	Unhealthy	All food	Healthy	Unhealthy	All food	Healthy	Unhealthy	All food
Food variety score	0.386**	−1.120***	−0.734*	0.309**	−1.042***	−0.733**	0.304**	−1.016***	−0.712**
	(0.167)	(0.272)	(0.380)	(0.150)	(0.240)	(0.335)	(0.144)	(0.229)	(0.320)
Food expenditure	26.59***	55.07***	81.66***	28.33***	56.83***	85.16***	28.50***	59.63***	88.14***
	(2.817)	(6.562)	(8.203)	(2.483)	(5.722)	(7.150)	(2.393)	(5.492)	(6.867)
kcal	420.6*	−810.8	−390.1	371.7	−788.7	−417.0	372.6*	−1,045	−672.2
	(248.2)	(860.5)	(955.1)	(228.8)	(749.7)	(841.9)	(218.0)	(728.9)	(812.4)
Observations	6680	6680	6680	6680	6680	6680	6680	6680	6680

Standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

4. Conclusions

As noted by Gundersen and Ribar (2011), among others, objective (using food expenditure data) and subjective (using perception surveys) food security measurements often differ. At first, this apparent inconsistency could be interpreted as problematic. Building upon this finding, we argue that the most commonly used objective and measurements fail to account for the nutritional quality dimension of food security. This is a major concern, considering the nutritional transition to diets abundant in calorie-dense and highly processed food items observed in many developed and developing countries, such as Mexico.

We found that the distinction between healthy and unhealthy food is relevant to understanding the change in food purchasing behaviors in food-secure and food-insecure households. There is no statistical difference between the calories purchased in both groups. However, food-secure households purchase more healthy calories. Moreover, food-secure households purchase a lower overall food variety, which is the combined effect of an increase in the variety of healthy food and a decrease in the variety of unhealthy food. Finally, food-secure households spend more on food, mainly due to an increase in unhealthy food items compared with food-insecure households.

Using the unconditional means shown in Table 1, we found that food expenditure can be a weak instrument to predict food security status. Food-secure household purchase a smaller variety of unhealthy foods and spend more on food, but purchase less overall calories. After controlling for confounding factors, in Table 3, we found a different result. Food-secure households increase the variety of healthy food while decreasing the variety of unhealthy food and only purchase more healthy calories. Therefore, our results suggest that controlling for confounding factors is key to analyzing food security, while unconditional statistics as a predictor of food security need to be used with some caution.

We took into account the nutritional quality of food purchases in two ways. First, we measured food variety using the food variety score. Gundersen and Ribar (2011) found that food-secure households purchase more food items per week than food-insecure households. However, we found that food-secure households only purchase more healthy food items. Our results can inform future interventions to increase food security and reward variety. For instance, an intervention that offers many coupons for different food groups may be more efficient than an intervention that gives a single coupon to be exchanged for food (with no concern for variety).

Secondly, we computed the purchased calorie content according to the *healthiness* of food items. We found that food-secure households purchase more healthy food calories, with no statistical difference on overall purchased calories or unhealthy calories compared with food-insecure households. Considering the growing problem of malnutrition in the world, this result shows a relevant challenge for policy makers: households that spend more on healthy calories perceive themselves as food secure. In sum, we found that aggregated food security indicators such as food security surveys, food expenditure or food variety scores can be misleading to measure the level and trend of a country's food security status if the nutritional content of purchased foods is not taken into account, thus misinforming policy makers.

We chose a dataset from Mexico because it is a country that holds a relatively high prevalence of both obesity and food insecurity. On average, it is recommended that a person consume 2000 kcal/day. Using the ENIGH (2012) and correcting for consumption units, we estimate that people in Mexico consume, on average, 2771 kcal/day. This is in line with the 33% adult obesity prevalence reported by the National Institute of Public Health. At the same time, also using the ENIGH (2012), we found that close to 45% of Mexican households experience some degree of food insecurity. We argue that the nutritional quality dimension of food security can explain why Mexico holds high rates of obesity and food insecurity. To some degree, food security may show a direct relationship with nutritional quality, meaning that households declare themselves to be food secure, tend to purchase more (variety and kcal) healthy food. We argue that if we really want to help improve food security, we also need to take obesity into account (and vice versa).

The main limitation of our research is relying on food expenditure as a means to approximate consumption, thus considering that the calories counted in food items are a proper proxy for calories available for consumption, given that households could use several different cooking techniques at home, some of them healthier than others. Also, we were not able to account for the foods consumed away from home, which could be an important part of a household's diet. The latter is expected to increase the difference between food-secure and food-insecure households, because food away from home is, in general, less healthy than food prepared at home.

It can be tempting to quickly extrapolate our findings to other countries. Given cultural and other environmental factors, our findings are not directly applicable to other apparently similar countries. For example, Mexico and the United States may differ, among other things, in cultural practices, such as home cooking times, that are likely to affect their food security status. Moreover, in Mexico, most households do not drink water from the faucet. As noted above, we cannot predict how these differences may impact a country's food security status. However, we do consider that the 'nutritional quality purchased food' dimension in food security deserves more attention and measurement, and that extending some of the analysis in our article using a U.S. database is an area of fruitful future research.

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Appendix A

Table 3
Probit estimation results.

Variables	Food variety score eq	Food expenditure eq	kcal eq
gender	−0.04	−0.05	−0.03
	(0.04)	(0.04)	(0.04)
age	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
native	−0.19***	−0.20***	−0.21***
	(0.05)	(0.05)	(0.05)
adults	−0.064***	−0.051**	−0.067***
	(0.02)	(0.02)	(0.02)
minors	−0.13***	−0.12***	−0.13***
	(0.01)	(0.01)	(0.01)
workers	−0.042**	−0.041**	−0.036*
	(0.02)	(0.02)	(0.02)
edu0	−0.66***	−0.70***	−0.69***
	(0.07)	(0.07)	(0.07)
edu1	−0.36***	−0.38***	−0.36***
	(0.05)	(0.05)	(0.05)
edu2	−0.19***	−0.18***	−0.17***
	(0.05)	(0.05)	(0.05)
2.region	−0.16**	−0.13**	−0.14**
	(0.06)	(0.06)	(0.06)
3.region	−0.09	−0.05	−0.04
	(0.07)	(0.07)	(0.07)
4.region	−0.03	0.03	0.02
	(0.06)	(0.06)	(0.06)
5.region	0.11	0.14*	0.11
	(0.07)	(0.07)	(0.07)
6.region	−0.05	0.01	−0.01
	(0.08)	(0.08)	(0.08)
7.region	0.10	0.15	0.12
	(0.11)	(0.11)	(0.11)
water	−0.098**	−0.098**	−0.093**
	(0.04)	(0.04)	(0.04)
sewer	0.05	0.03	0.03
	(0.04)	(0.04)	(0.04)
car	0.03	0.03	0.03
	(0.04)	(0.04)	(0.04)
refri	0.00	0.01	0.01
	(0.05)	(0.05)	(0.05)
rural	0.05	0.00	0.00
	(0.04)	(0.04)	(0.04)
tinc	0.184***	0.198***	0.174***
	(0.01)	(0.01)	(0.01)
fexp1	0.00052**		0.00050*
	(0.00)		(0.00)
fexp2	0.00023***		0.00051***
	(0.00)		(0.00)
kcal1	−3.88e−06*	0.00	
	(0.00)	(0.00)	
kcal2	−2.60e−06***	−1.06e−06*	
	(0.00)	(0.00)	
fvs1		0.00	0.00
		(0.00)	(0.00)
fvs2		−0.0078***	−0.017***
		(0.00)	(0.00)
Constant	0.34***	0.46***	0.52***
	(0.10)	(0.11)	(0.11)
Observations	6680	6680	6680

Standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

Appendix B. Food security questionnaire

1. In the last three months, due to lack of money or resources, have you or has any adult in your household eaten too narrow a variety of food?
2. In the last three months, due to lack of money or resources, have you or has any adult in your household had to skip a meal (breakfast, lunch or dinner)?
3. In the last three months, due to lack of money or resources, have you or has any adult in your household eaten less than you believe should have been eaten?
4. In the last three months, due to lack of money or resources, have you or has any adult in your household been left with no food?
5. In the last three months, due to lack of money or resources, have you or has any adult in your household felt hungry and did not eat?
6. In the last three months, due to lack of money or resources, have you or has any adult in your household eaten a single meal in a day or has not eaten in the whole day?
   Only for households including people under 18 years old:
7. In the last three months, due to lack of money or resources, has any person under 18 years old in your household eaten too narrow a variety of food?
8. In the last three months, due to lack of money or resources, have you or has any adult in your household eaten less than s/he should have eaten?
9. In the last three months, due to lack of money or resources, have you or has any adult in your household had to reduce the amount of food served in a meal to a person under 18 years old?
10. In the last three months, due to lack of money or resources, has any person under 18 years felt hungry and did not eat?
11. In the last three months, due to lack of money or resources, has any person under 18 years gone to bed feeling hungry?
12. In the last three months, due to lack of money or resources, has any person under 18 years eaten a single meal in a day or has not eaten in the whole day?

Table 4
Summary statistics.

Variable	Mean	Std. dev.	Min.	Max.	*N*
Q1. adults, not enough food variety in last 3 months, 0 = no, 1 = yes	0.36	0.48	0	1	7110
Q2. adults, skipped meal in last 3 months, 0 = no, 1 = yes	0.16	0.36	0	1	7110
Q3. adults, eat less in last 3 months, 0 = no, 1 = yes	0.26	0.44	0	1	7110
Q4. adults, no food in last 3 months, 0 = no, 1 = yes	0.13	0.34	0	1	7110
Q5. adults, hungry in last 3 months, 0 = no, 1 = yes	0.17	0.37	0	1	7110
Q6. adults, no food whole day in last 3 months, 0 = no, 1 = yes	0.11	0.32	0	1	7110
Q7. child, no food variety in last 3 months, 0 = no, 1 = yes	0.35	0.48	0	1	4024
Q8. child, eat less in last 3 months, 0 = no, 1 = yes	0.23	0.42	0	1	4024
Q9. child was served less in last 3 months, 0 = no, 1 = yes	0.22	0.41	0	1	4024
Q10. child hungry but did not eat in last 3 months, 0 = no, 1 = yes	0.11	0.31	0	1	4024
Q11. child, went to bed hungry in last 3 months, 0 = no, 1 = yes	0.1	0.29	0	1	4024
Q12. child, did not eat whole day in last 3 months, 0 = no, 1 = yes	0.07	0.25	0	1	4024

Table 5
List of Healthy Food.

Coriander	Packaged vegetables and legumes
Canned tuna	Guava
Apple and Wild apple	Whole chicken
Chard, spinach and purslane	Grapes
Green tomato	Avocado
Other chilies	Corn, soy and wheat sprouts
Tea flowers and leaves	Lettuce
Prickly pear	Mexican tea
Smoked fish	Poblano chilli
Natural bottled water	Fresh mushrooms
Mineral water	Broccoli
Fresh seafood	Pumpkin
Other poultry	Salmon and processed cod
Parsley	Grain beans
Fresh shrimp	Other grain legumes
Processed seeds	Serrano chilli
Onion	Grain chickpeas
Prepared water and natural juices	Mirliton

Table 5 (*continued*)

Pinapple	Coconut, olive, soy oil
Eels, roe	Crystallized, dried and chilli fruit
Tomato	Garlic
Grain lentils	Plantain and dwarf Cavendish banana
Other vegetables	Watermelon
Frozen vegetables and legumes	Oranges
Apricot, peaches	Peas
Mango	Grain fava or lima beans
Plantain and wild banana	Other fruits (pomegranates, figs, kiwi)
Packaged chilies	Jalapeño chilli
Papaya	Corn
Limes	Green beans
Packaged seeds	Cauliflower and cabbage
Pear	Plum and hog plum
Carrot	Pitahaya and prickly pear
Melon	Other bananas
Processed seafood	Boneless leg, thigh, breast
Grapefruit	
Mandarin, nectarine, tangerine	
Lemon	
Sugar apples, custard apples, soursop	
Soluble tea (any flavor)	
Seed in bulk	
Sapodilla and mammey	
Cucumber	
Fish fillet	

Table 6
List of unhealthy food.

Sweet breads, loaves	Goat and kid	Jellies, jam, peanut butter
Chihuahua cheese	Margarine	Other dressings, spices and sauces
Manchego cheese	Chicken and tomato concentrates	Milk caramels and sweets
Other meats: horse, rabbit, iguana	Concentrates and powders for drinks	Aged and Cotija cheese
Other cheeses and pork viscera	Sausage	Summer sausage
Butter	Mortadella, salami	Chili meat
Other milk derivatives	Honey from bees	Fermented milk beverages
Other wheat products	Cinnamon	Mayonnaise
Wheat flour	Vegetable shortening	Oaxaca or asadero cheese
Processed beans	Smoked pork chop	Aromatic herbs
Fresh cheese	Cloves	Soup pasta
Other cereals	Pork knuckles	Other cuts of beef
Cola and soft drinks	Other cuts of pork	Machaca and dried meats
Potato	Pork steak	Carnitas
Cookies	Evaporated milk	Diced pork shank
Beef hamburgers for barbecuing	Salt	Other corn products
Snacks, fried foods, etc.	Vinegar	Condensed milk
Other milks: donkey, soy, goat	Flan, gelatine, puddings	Rib of beef
Other sweets	Pork ham	Packaged cakes and pastries
Flank steak, steak	Rice cereal, oats, banana	Pasteurized cow milk
Other chocolates	Barbecue and birria	Cream
Packaged juices and nectars	Potato chips/crisps	Other prepared foods
Other processed meats	Beef steak	Energy drinks
Soluble toasted coffee	Beef stew	Corn flour
Other rice products	Insects	Crackers
Corn dough	Special cuts of beef	Packaged sweet breads
Corn, wheat, rice or oat cereal	Pureed baby food	Corn grain
Mole paste or powder	Ground pork	Sandwich bread
Piece of beef pulp	Toasted ground grain coffee	Modified milk
Grain rice	Viscera	Viscera and other parts
Mashed potato flour	White chicken egg	Fruits in syrup and preserves
Pork cracklings	Fermented corn beverages	
White bread	Chocolate in bars	
Prepared pizzas	Mustard	
Other sugars and honeys	Lamb: mutton and lamb	
Other processed legumes	Powdered whole milk	
Pepper	Roast chicken	
Fruit and vegetable juices	Chamorro beef	

(*continued on next page*)

Table 6 (*continued*)

Beet and sweet potato	Corn tortilla
Processed lard (bacon)	Flank steak, chuck, etc
Cakes and pastries in pieces	Yellow cheese
Pork ribs and chops	Hunk of pork pulp
Powdered chocolate	Other tubers
Ice creams, slushies and popsicles	Ground beef
Pork shoulder	White and brown sugar
Beef steak	Flour tortilla
Non-pasteurized milk	Chorizo and sausage
Other oils: codfish	Toast
Pork lard	Instant soups
Sweet and spicy sauces	Poultry sausages, mortadella, nuggets

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