The Effect of Mexican Household Food Security Status and Income Distribution on Food Access

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Abstract: We studied how income distribution and food security status are related to the quality and quantity of foods consumed by Mexican households. Methods: First, we analyzed current expenditure on eleven food groups across food security levels stratified by income quintiles and food security status, based on 2010 National Income and Expenditure Surveys. Second, we designed and budgeted two 2,000-calorie-per-day diets which cover the daily nutritional requirements of the Mexican population to observe, based on the current income data from the surveys, which households could purchase such diets. Results: Those households that spent the most on food are also those that invest the smallest percentage of their income on food. Monthly per capita expenditure was greater on most food groups in food secure (FS) households and decreased as food insecurity worsened. Statistical analyses of current expenditure on food groups revealed statistically significant differences across income quintiles and food security levels (p<0.05). The standard diet's weekly cost was US$44.89 per person. Households with an average weekly income per capita (US$71.17) and those in the fourth (US$65.25) and fifth (US$181.27) quintiles could afford it, but those in the first (US$14.0), second (US$27.59), and third (US$42.75) quintiles could not. We designed a special diet for low-income groups, with a weekly cost of US$17.79 per person, which could not be afforded by households in the first quintile, even when all their income went to food. Discussion: Based on a descriptive analysis we found that income barriers and food insecurity are related to limited access to nutritious foods and diets among Mexican households.

Keywords: Food Security, Poverty, Barriers to Food Access, Barriers to Nutritious Diets

Introduction

The Mexican population has experienced considerable improvements in its nutritional and health status, to a certain extent due to government programs designed to tackle nutritional deficiencies. For instance, the prevalence of wasting (weight-for-height of 2 standard deviations (SD) or more below the corresponding median of the reference population) in under-five children decreased from 6.2% to 1.6% between 1988 and 2012 (Gutierrez et al. 2012; Rivera-Dommarco et al. 2013). Nonetheless, Mexico has an unfinished agenda addressing anemia and underweight in vulnerable groups, together with a striking increase in the prevalence of overweight and obesity across all income groups that has lead Mexico to rank among the top five most overweight countries in the world (WHO 2008). The double burden of disease in Mexico is associated with income barriers that limit people's ability to access and purchase healthful foods.

Undernutrition in Mexico has followed a downward trend in the last decades. In 1988 the prevalence of stunting (height-for-age of 2 SD or more below the corresponding median of the reference population) in under-five children was 22.5% in urban and 43.1% in rural areas, while in 2012 it has decreased to 11.1% and 20.9%, correspondingly (Gutierrez et al. 2012; Rivera-Dommarco et al. 2013). The prevalence of anemia in under-five children has also decreased from 31.6% in 1999 to 23.3% in 2012 (de la Cruz-Góngora et al. 2013). The percentage of anemic women aged 12 to 49 decreased from 21.2% in 2006 to 15.6% in 2012 (Shamah-Levy et al. 2013). The improvements in the health status of women and children can be in some way attributed to the Mexican government's public health interventions such as universal immunization, vitamin A supplementation, school breakfast programs, *Liconsa* milk distribution, and the *Oportunidades* Human Development Program (CONEVAL 2010).

COMMON
GROUND

Despite such improvements in nutritional status, overweight and obesity have become one of the principal concerns of the Mexican health system. Almost 10% of under-five children (Rivera-Dommarco et al. 2013), 34.4% of children aged 5 to 11 and 34.9% of adolescents aged 12 to 19 are either overweight or obese (Gutierrez et al. 2012). A striking 73.0% of women and 69.4% of men over 19 years are either overweight or obese (Barquera et al. 2013).

To account for such unfinished nutritional agenda and to address obesity issues, the Mexican Government has implemented diverse strategies to promote healthy eating, emphasizing the importance of consuming fresh fruits and vegetables, while moderating the intake of fats, cereals, etc. However, there seems to be little recognition that a nutritious diet is out of reach for many Mexican households. Although we found no studies with empirical evidence on the effect of income barriers to nutritious foods in Mexico, studies carried out in other countries suggest that limited money hinders individuals' ability to consume a varied and nutritious diet (Darko, Eggett, and Richards 2013; Giskes et al. 2002). As highlighted by Mejan et al. (Mejean et al. 2010), diet is influenced by sociodemographic, economic and cultural factors; therefore, low socioeconomic status is associated with unhealthier diets with low consumption of food groups such as fruits, vegetables and meats. The higher calorie cost of healthful choices limits its access among individuals with low socioeconomic status (Rehm, Monsivais, and Drewnowski 2011). Not surprisingly, other studies have found that those belonging to a higher socioeconomic status were more likely to meet dietary requirements of fruits and vegetables than those belonging to a lower socioeconomic status (Giskes et al. 2002). Similarly, others have associated higher diet costs with higher quality diets (Rehm, Monsivais, and Drewnowski 2011)

In addition to household and individual level associations between income and diet, neighborhood income has been found to affect diets, through supply factors such as having fewer supermarkets and stores with healthful choices and more convenience stores (Booth, Pinkston, and Poston 2005; Horowitz et al. 2004) and fast-food restaurants (Booth, Pinkston, and Poston 2005).

Considering that 40% of Mexican households had some degree of food insecurity (18.05% low, 11.49% moderate and 9.92% severe) (ENIGH 2010) defined as the "limited or uncertain availability of nutritionally adequate and safe foods, or the limited or uncertain ability to acquire acceptable foods in socially acceptable ways"(Anderson 1990; Wolfe, Frongillo, and Valois 2003), and taking into account that 45.5% of the Mexican population suffers from poverty (CONEVAL 2013), it is relevant to assess whether low-income consumers can afford nutritious diets.

Our objective was to carry out a descriptive analysis exploring households' ability to purchase a nutritious diet, according to their income and food security status. To our knowledge, no other study has analyzed this relationship empirically in Mexico. The patterns of high income inequality in the country further underscore the relevance of research in this area.

Methods

Data and Variables

Income and Food Expenditure

We obtained data on households' income, expenditure on food items, and food security status from the 2008 and 2010 National Income and Expenditure Survey (ENIGH 2008 and ENIGH 2010). The ENIGH is a nationally representative survey that collects data at the household level every three non-consecutive months. Food expenditure information for 228 food items was used to construct 11 food groups (fresh fruit, fresh vegetables, fats, dairy, fresh animal protein, legumes, cereals, sweetened drinks, ready to eat foods, foods eaten outside home, and processed animal protein). These food groups were created to reflect diet quality and Mexican food consumption patterns

Food Security

To measure household food security status we used the Mexican Food Security Scale (EMSA), which is contained within the ENIGH 2008 and 2010. The EMSA was derived from the USDA Household Food Security Scale and was modified and validated for the Mexican population. It is composed of 12 items that measure households' perceptions regarding having and obtaining enough food to meet dietary needs (Shamah-Levy et al. 2008). Households are classified as having food security (FS), low food insecurity (LI), moderate food insecurity (MI), and severe food insecurity (SI).

Cost of Diets

To assess the market costs of two healthy diets, we obtained data of food prices in February 2013 from a lower-end supermarket chain which is found in all of the 32 states of Mexico. The cost of food items was converted into US dollars using the exchange rate published by the Central Bank of Mexico on May 14, 2013 (1 USD= 12.14 MXN).

Analyses

We conducted two analyses. For our first analysis we computed descriptive statistics to portray the average monthly per capita expenditure and the average monthly expenditure as a share of total income on the 11 food groups, across food security levels (FS, LI, MI, and SI). We then assessed the significance of the monthly expenditure as a share of total income on different food groups across food security levels, using t-tests (due to survey corrections using the SVY command in STATA, analysis of variance – ANOVA tests – could not be performed). The t-tests were used to determine if there were significant differences in average share of total income spent on food groups between food security levels (FS, LI, MI, and SI). We only assessed monthly expenditure as a share of total income as this measure reveals the clearest pattern of income inequality and quality of foods consumed. Prior studies suggest the groups that are most vulnerable to experiment problems in their nutritional status are those who spend a large proportion of their income on food (de Pee et al. 2010). Statistical analysis was conducted using STATA 12, accounting for survey corrections for complex sampling survey designs.

For our second analysis we designed two, culturally and sociologically appropriate, 2,000-calorie- per-day diets (See Tables 1 and 2). These diets cover 90 to 100% of the nutritional and energy requirements of the Mexican population (Bourges, Casanueva, and Rosado 2009). Neither of the diets includes typical oil-fried Mexican dishes, nor soda and processed sweetened beverages which are frequently consumed in Mexican households. Table 1 shows a standard with moderate cost (Diet 1) while Table 2 displays a special diet formulated for low-income groups in Mexico (Diet 2). Using income data from ENIGH 2008 and 2010 and the direct costs of each diet (i.e. the costing exercise did not consider indirect costs linked to food preparation such as gas, water, and electricity) we analyzed which households could afford daily consumption of Diet 1 and Diet 2 during a week's time using average weekly per capita income across quintiles (where the first quintile has the lowest income and the fifth quintile has the highest income).

Results

Figure 1 displays the monthly per capita expenditure (left axis) and the monthly expenditure as a percentage of total income (right axis) on food groups across food security status levels, for 2008 and 2010. For all food groups, except for legumes and fats, per capita expenditure (on left axis and expressed in bars) on food was highest in FS households. Per capita expenditure decreased on food groups as food insecurity level worsened; although this does not hold true for sweetened drinks and foods eaten outside home. Per capita expenditure on sweetened drinks is greater for SI

than MI households in 2010. Also, average per capita expenditure on foods eaten outside home for the SI households is greater than MI and about equal to the LI households. Regarding monthly expenditure as a share of total monthly income (on right axis and expressed in symbols), the food insecure groups, when compared to the FS group, spent a higher percentage of their income on most food groups. The higher difference is exemplified by the share of income spent on cereals. Although the FS spends a slightly higher amount (per capita) than SI on cereals ($US 8.4 vs. $US 7.7), this is 4.6% of their monthly income, while it is twice as much, about 8.0%, of the monthly income of the SI group. Likewise, the difference in the share of income spent on fresh vegetables follows a similar pattern, while the per capita expenditure on fresh vegetables is greater for the FS than for SI households ($US 4.8 vs. $US 3.7), this represents a smaller percentage of the income of FS than SI households on this food group (2.6% vs. 3.8%). Therefore, there is a pattern suggesting that although FS households on average spend more per capita on food groups such as fresh fruits and vegetables, it represents a lower share of their income spent on foods compared to households with some level of food insecurity.

The results of the t-tests assessing the monthly expenditure on food as a share of total income stratified by food security levels is statistically significant in all cases at $p<0.05$ (Table 3). It is relevant to underline that the share is small because it represents the percentage of the household's total income spent on a particular food group. For example, while FS households spent on average 0.7% of their income on fats, severe food insecure households spent 1.2% of their total income on fats.

The results from the second analysis are displayed in Figures 2 and 3. The weekly per capita cost of the standard diet (see Table 1, Diet 1) was US$ 44.89. Figure 2 shows that the standard (moderate cost) diet could be afforded by those households with an average weekly income per capita (US$ 71.17), as well as by households in the fourth (US$ 68.29) and fifth (US$ 189.70) income quintiles. Nonetheless, households in the first (US$ 14.0), second (US$ 27.59), and third (US$ 42.75) income quintiles could not follow this standard diet, even when all their income went towards food. The weekly per capita cost of the special diet formulated for low income groups (see Table 2) was US$ 17.79. Figure 3 displays that the diet for low-income groups (Diet 2) could not be afforded by those in the first income quintile (US$ 14.0), even when all their income went towards food. However, households in the second, third, fourth, and fifth income quintiles, as well as those with average income, could afford this diet.

Discussion

Eating a healthy and diverse diet in Mexico appears to be available only to higher income groups. Analyses of monthly per capita expenditure and monthly expenditure as a share of total income spent on the 11 food groups shed light on how regressive food expenditure patterns are in Mexico: those households that spend the most on food are also the households that invest the smallest percentage of their income on food. Monthly per capita expenditure was greater on most food groups in the FS households and decreased as food insecurity worsened. An exception to this was per capita expenditure on legumes being greatest for the SI group for both 2008 and 2010. This could be explained by a high consumption of black beans, which are a staple of the Mexican population, and are a very affordable food item. Per capita expenditure on fats being fairly equal across household food security status could reveal that greater satiety is obtained by this food group as well as cultural factors associated to the consumption of fats. Furthermore, from an economic point of view, fats could be viewed as an income neutral good, where the quantity demanded remains equal even when income increases or decreases. The fact that per capita expenditure on sweetened drinks appears to be equal for MI and SI households in 2008 and greater for SI than MI households in 2010 can be due to limited access to clean purified water, as well as to cultural factors. Mexico has been recently ranked the biggest consumer of soft drinks in the word, which exposes how the consumption of soda has become imbedded in the

food customs of the country. Diabetes is the number one cause of death in Mexico (SINAIS 2008). Several authors have found an independent association between consumption of sweetened beverages and type-two diabetes, as well one mediated by overweight and obesity (Basu et al. 2013). On the other hand, a higher per capita expenditure on food eaten outside home in the SI group in 2010, when compared to the LI and MI groups, could be attributed to a lack of kitchens in poor dwellings, and to the substitution of home cooked meals for cheaper fast foods (Rivera-Dommarco et al. 2012).

Expenditure on different food groups as a percentage of income revealed how households allocate a greater amount of their income on fats, legumes, cereals, and sweetened drinks as they become more food insecure. With the exception of legumes, LI, MI and SI households are spending more money in calorie-dense foods that offer them the greatest satiety for their money. This finding supports the relationship between food insecurity and increased body mass index (BMI) found in other studies (Townsend et al. 2001). They also support the findings from other suggesting that households that spend a larger share of their income on foods are more vulnerable and have less nutritious diets (de Pee et al. 2010; Mejean et al. 2010).

Our second analysis showed that the lower three income quintiles could not afford a diet that is considered standard for the Mexican population, and that the lowest quintile could not even afford a diet that was especially formulated for low income groups. This is especially troubling as this means that approximately 67 million Mexicans could not afford following the Standard Diet on a daily basis, and of these, approximately 22 million could not even afford the Special Diet on a daily basis. The result of households' inability to follow a nutritious diet, as is described in the above mentioned analysis of food expenditure per capita and as a percentage of total income, is a high intake of calorie-dense foods. High calorie, low nutrient diets are associated with malnutrition (undernutrition on one side, and overweight and obesity on the other).

A limitation of our analysis is that we considered that all of the household per capita income was allocated towards food, and did not take into account other household expenses, such as electricity, gas, water, and transportation, that would further hinder household's ability to purchase food.

Conclusion

Mexico is facing soaring rates of overweight and obesity that have affected its population across income groups, although poorest groups have been affected the most. Additionally, Mexico still faces the challenges of developing nations regarding undernutrition and anemia, especially in children and bearing age women. Policies to address both overweight and underweight should consider the food insecurity that a large part of the Mexican population faces due to limited financial and physical access to safe and nutritious foods. The associations that previous studies have found between food insecurity and negative health outcomes, specifically overweight and obesity, call for immediate government action to address this issue. Long-term policy should be oriented towards increasing the wages of the poorest households, because, as this study showed, they cannot even afford a nutritious diet that has been especially designed for low-income Mexican households. On the other hand, physicians, nurses, and dieticians who care for overweight and obese patients should be aware of the strong financial limitations Mexican households face when recommending weight loss dietary plans. Health professionals could switch from recommending traditional weight loss diets to asking patients what food items they can afford.

Acknowledgement

Tables and Figures

Table 1: Daily direct cost of standard diet (Diet 1)

Breakfast	
2 guavas	US $ 1.46
1 cup skim milk	
1 turkey ham and cheese sandwich	
Snack	
½ cup melon with 3 Tbs. granola	US $ 0.50
Lunch	
1 bowl kale soup	US $ 3.46
½ cup mashed potatoes	
1 medium sized fish filet with tomato sauce	
2 tortillas	
Dinner	
1 apple	US $ 0.99
2 corn *sopes* (corn dough discs) with black beans and chicken	
Total cost per day, per person	US $ 6.41

Table 2: Daily cost of low cost diet formulated for low-income groups (Diet 2)

| Breakfast	
1 mandarin	US $ 0.52
2 lima bean *tlacoyos (*lima bean and corn dough discs*)* with tomato sauce	
1 cup *atole* (hot maize drink)	
Lunch	
1 bowl carrot and noodle soup	US $ 1.16
4 tortillas	
2 sardines with half a zucchini	
1 glass lemonade	
Dinner	
2 *enfrijoladas* (fried tortillas in black bean sauce) with cheese	US $ 0.86
½ cup *nopal* cactus	
1 cup milk	
Total cost per day, per person	US $ 2.54
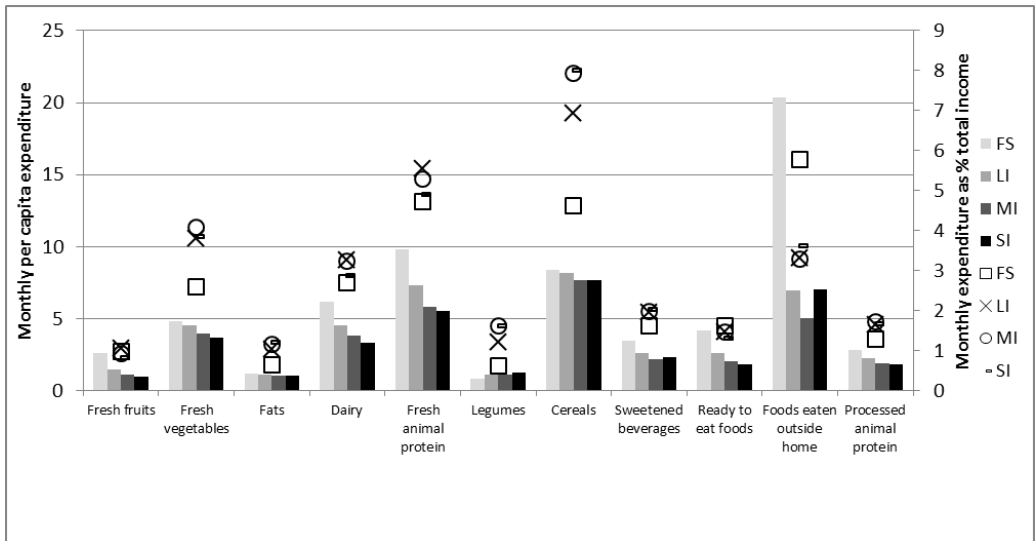
Figure 1: Monthly expenditure on food groups by household food security status, ENIGH 2010.

Table 3: Share of total income spent of food groups by household food security status, ENIGH 2010

|	FS		LI		MS		SI		
	%	S.D.	%	S.D.	%	S.D.	%	S.D.	P-value
Fresh fruits	1.0	0.000	1.0	0.000	0.9	0.000	0.8	0.001	0.001
Fresh vegetables	2.6	0.001	3.8	0.001	4.1	0.002	3.8	0.001	<0.001
Fats	0.7	0.000	1.0	0.000	1.2	0.001	1.2	0.001	<0.001
Dairy	2.7	0.001	3.3	0.001	3.2	0.001	2.9	0.001	<0.001
Fresh animal protein	4.7	0.001	5.6	0.001	5.3	0.002	4.9	0.002	<0.001
Legumes	0.6	0.000	1.2	0.001	1.6	0.001	1.6	0.001	<0.001
Cereals	4.6	0.001	6.9	0.002	7.9	0.002	8.0	0.003	<0.001
Sweetened beverages	1.6	0.000	2.0	0.001	2.0	0.001	2.0	0.001	<0.001
Ready to eat foods	1.6	0.000	1.5	0.001	1.5	0.001	1.3	0.001	0.014
Foods eaten outside	5.8	0.001	3.3	0.001	3.3	0.002	3.6	0.003	<0.001
Processed animal protein	1.3	0.000	1.6	0.000	1.7	0.001	1.7	0.001	<0.001
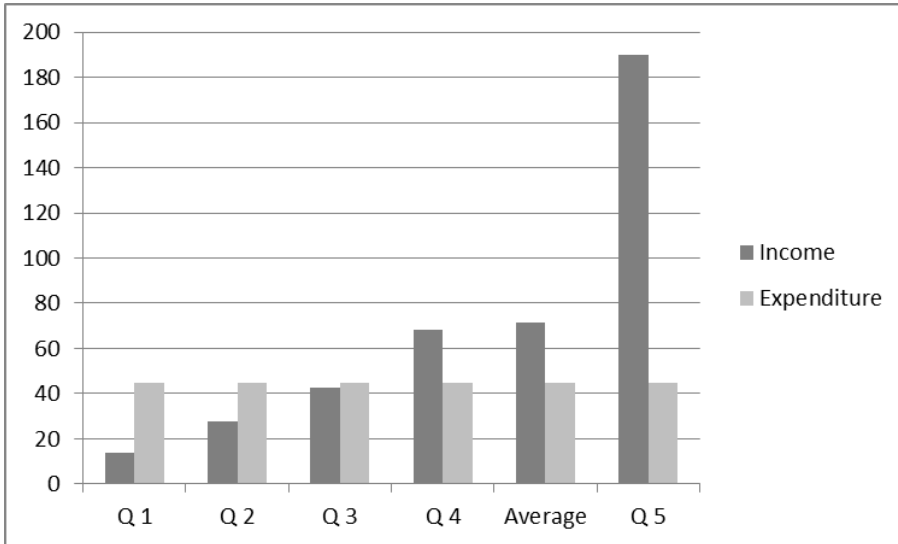
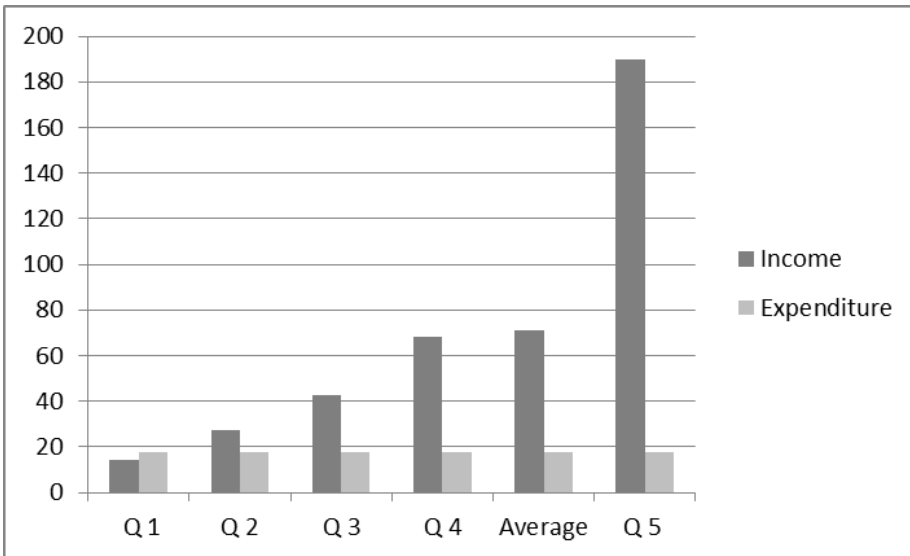Figure 2: Weekly household per capita income and per capita expenditure on Standard Diet

Figure 3: Weekly household per capita income and per capita expenditure on Special Diet for low-income groups

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