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How do context variables affect food insecurity in Mexico? Implications for policy and governance

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Abstract
Objective: To assess, from a systems perspective, how climate vulnerability and socio-economic and political differences at the municipal and state levels explain food insecurity in Mexico.
Design: Using a cross-sectional design with official secondary data, we estimated three-level multinomial hierarchical linear models.
Setting: The study setting is Mexico's states and municipalities in 2014.
Participants: Heads of households in a representative sample of the general population.
Results: At the municipal level, vulnerability to climate disasters and a poverty index were significant predictors of food insecurity after adjusting for household-level variables. At the state level, gross domestic product and the number of nutrition programmes helped explain different levels of food insecurity but change in political party did not. Predictors varied in strength and significance according to the level of food insecurity.
Conclusions: Findings evidence that, beyond food assistance programmes and household characteristics, multiple variables operating at different levels – like climate vulnerability and poverty – contribute to explain the degree of food insecurity. Food security governance is a well-suited multisectoral approach to address the complex challenge of hunger and access to a nutritious diet.

Keywords
Food insecurity
Food security governance
Climate vulnerability
Poverty

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Food insecurity is 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'[1,2]. It has been associated with negative impacts on human development such as increased poverty and inequality[3,4], and has been correlated with poor economic growth[5]. Empirical studies suggest an association between food insecurity and adverse health outcomes such as increased risk of obesity[6,7], type 2 diabetes[8,9] and other chronic conditions[10,11].

Food insecurity is a pressing global problem, as close to 800 million people experience it around the world[12]. The Sustainable Development Goals emphasize that ending hunger, achieving food security and improving nutrition through sustainable agriculture are key factors to ensure that people are well nourished, which in turn allows them to live, learn and work longer, and contribute to societies' aspirations in terms of economic growth and human development[12,13]. However, food insecurity needs to be recognized as a complex construct with a wide range of determinants that go beyond hunger. Food security thus encompasses important issues linked to food production, access to healthful foods, utilization and conservation of natural resources, climate vulnerability, health needs, social inequities and economic development. The challenges of achieving food security are more complex and need a more integrative and transdisciplinary focus. Such complexity requires coherent polices at the local, national and international levels, as well as breaking down the sectoral silos of traditional food insecurity policies[13].

Mexico is a good example of the limitations of common approaches to food insecurity. Despite the government's efforts to combat poverty and malnutrition, in Mexico food insecurity is a persistent problem. As portrayed in Fig. 1, the Mexican government increased the per capita expenditure on food assistance substantially, from about $US 20 in 2008 to approximately $US 35 in 2010. While expenditure almost doubled, food insecurity from 2010 to 2014 remained

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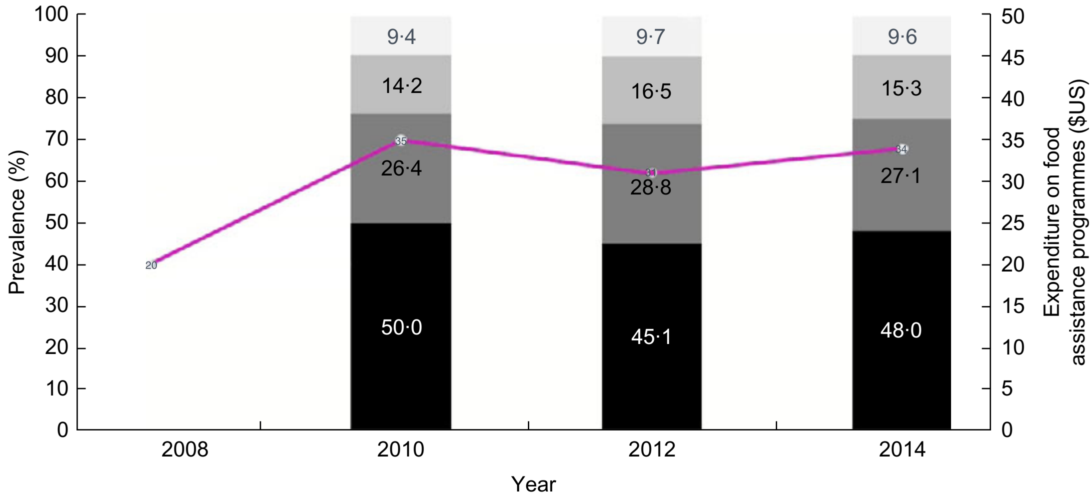

Fig. 1 (Colour online) Comparison of the prevalence of food security/food insecurity (▬, food security; ▬, mild food insecurity; ▬, moderate food insecurity; ▭, severe food insecurity) and the Mexican government's expenditure on food assistance programmes (--), 2010–2014. The graph suggests that additional expenditures in food assistance programmes do not yield considerable reductions in food insecurity. In 2008, the total per capita expenditure in food assistance programmes was $US 20 (constant pesos 2010, $US 1 = $MX 18·64). By 2010, the government expenditure in these programmes increased up to $US 35, then it decreased to $US 31 in 2012, and then recovered to $US 34 in 2014. However, the prevalence of moderate food security at the household level, using the Latin American and Caribbean Food Security Scale (ELCSA), increased in 2012 by 2 points and severe food insecurity remained stable at 9 %. The ELCSA was not gathered in 2008. Nevertheless, similar results were obtained when food insecurity was estimated with the Mexican Food Security Scale (EMSA), the scale used by the official multidimensional poverty measure; whereas food security increased from 57·0 % in 2008 to 60·5 % in 2010, moderate food insecurity remained stable and severe food insecurity increased during the same period from 8·4 to 9·9 %. (Source: our own estimates using the National Household Income and Expenditure Survey (ENIGH) 2010, 2012 and 2014, and the National Council for the Evaluation of Social Policy (CONEVAL) inventory[25,28])

constant at nearly 58 % of households when using the Mexican Food Security Scale (EMSA) and about 48 % when using the Latin American and Caribbean Food Security Scale (ELCSA),* suggesting that the programmes addressing food insecurity have been insufficient. There are important variations in the prevalence of food insecurity among states in Mexico. Figure 2 shows that, in 2014, while northern states like Baja California and Nuevo Leon had a food insecurity prevalence of 30 %, states in the southern part of the country, like Chiapas and Guerrero, showed a prevalence of 80 %. Furthermore, such differences are reproduced at the municipal level. Food assistance public expenditure has been allocated to a huge diversity of federal and state-level programmes, heterogeneous in design (i.e. cash transfers, in-kind, vouchers), implementation (i.e. size, periodicity, etc.) and target population. The existence of these disparities requires an assessment with systemic models to capture structural and environmental determinants of food insecurity beyond household-level characteristics. Recently, systemic theoretical proposals have emerged to understand food insecurity. For example, Ericksen proposes a framework for studying food security as an outcome of food systems interacting with environmental and socio-political factors at multiple levels[14]. Considering this systematic perspective, we assess how food insecurity at the household level in Mexico is explained by climate vulnerability and socio-economic and political differences at the municipal and state levels.

Food security is embedded in the Sustainable Development Goals. However, while it is recognized as a societal aspiration, it is much less known how to achieve it. Policies centred in food assistance – at least for the Mexican case – have not been effective in halting the levels of food insecurity, despite the increases in per capita public expenditure. The present research intends to shed light in terms of other factors that could be addressed to achieve food security.

*It is worth noting that the ELCSA is the gold standard in Latin America. However, the official measure in Mexico is the EMSA, a shorter version of the ELCSA. A key consequence of using EMSA is that it yields a lower prevalence of food insecurity than ELCSA. Moreover, the National Household Income and Expenditure Survey (ENIGH), collected every 2 years, considers all the questions of the ELCSA and the EMSA, except for the year 2008, when it only inquired for the twelve items of the EMSA scale. The National Health and Nutrition survey (ENSANUT) also measures food insecurity using the ELCSA but it is collected every 6 years. A disadvantage of the ENIGH is that it includes skip patterns after the first six questions, and this probably underestimates the prevalence of food insecurity. Therefore, estimates of the prevalence of food insecurity in Mexico differ depending on the scale and survey used. We use the ENIGH because it is widely used in Mexico and offers more recent data.

Methods

Data

The data used for the current analysis come from different sources that allowed us to identify political, economic and sociodemographic characteristics at the state, municipal and household levels. These sources include the

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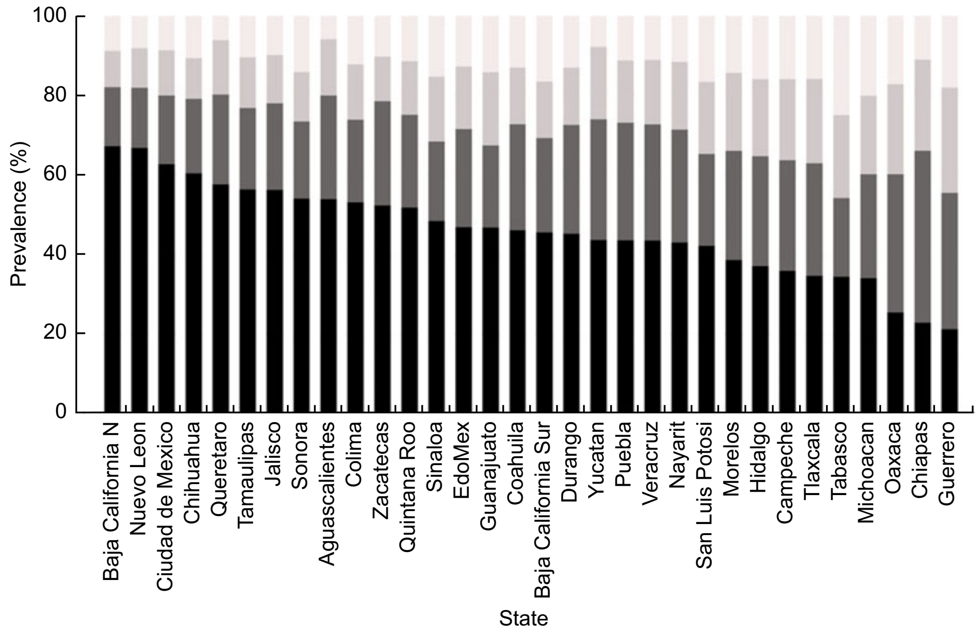

Fig. 2 Prevalence of food security/food insecurity (▬, food security; ▬, mild food insecurity; ▬, moderate food insecurity; ▬, severe food insecurity) by state in Mexico, 2014. The figure shows the variation in the prevalence of food insecurity by state measured with the Latin American and Caribbean Food Security Scale (ELCSA) during 2014. The plot evidences the important gaps between states: while northern states like Baja California Norte and Nuevo León have a prevalence of food security of 70 %, southern states like Guerrero and Chiapas have a prevalence of food security of 20 %. These differences suggest great heterogeneity in the expenditure, design and implementation of food assistance programmes in Mexico. (Source: National Household Income and Expenditure Survey (ENIGH) 2014[18])

National Household Income and Expenditure Survey 2014 (ENIGH 2014), the Population Census of 2015, the National Population Council (CONAPO) and inventories of social programmes for the National Council for the Evaluation of Social Policy (CONEVAL). The analysis considers three levels: household, municipality and state. The household-level variables come from the ENIGH 2014 and the municipal- and state-level variables come from the other sources. Data sets were merged by the geographical standard codes provided by the National Institute of Statistics and Geography (INEGI).

The analytical sample is comprised of 19 124 nationally representative households, nested in 506 municipalities, which are in turn nested in thirty-two states.

Dependent variable

Food insecurity is a complex construct ranging from food production to dietary quality and access to nutritious foods. To date, no single indicator can account for such multiple dimensions, but there is an international confluence in measuring food insecurity through experience-based scales[15]. Such scales are reliable indicators that can be measured through representative samples and they estimate the access dimension of food insecurity, allowing the severity of the phenomenon to be captured[16]. We operationalized food insecurity through the ELCSA; a scale that has shown excellent psychometric properties for the general population[17]. The ELCSA is collected in the ENIGH and is a fifteen-item experience-based scale that measures the level of food insecurity at the household level[18]. The scale has two versions differentiating between households with minors and households without them. The first eight items are asked in every household. When a person younger than 18 years of age lives in the household, the full scale is administered. According to prior cut-off points defined in the literature[19], households were classified as being food secure, mildly food insecure, moderately food insecure and severely food insecure.

Household-level variables

At the household level, the models were adjusted for several sociodemographic variables obtained from ENIGH 2014[18]. Gender of the head of household was operationalized as a dichotomous variable (1 = female; 0 = male). Education level of the head of household was constructed as an ordinal variable with five categories (1 = none; 2 = primary; 3 = secondary; 4 = technical education or high school; 5 = university or more). Household size was computed as a continuous variable, while dummy variables were included to indicate if there were members with age-related vulnerabilities in the household (i.e. older adults aged 70 years or above; children under 5 years of age).

Municipal-level variables

Municipal-level variables allow capture of aggregated contextual variables in terms of environmental and sociodemographic characteristics, which define the places where the households are embedded. Measures of climate vulnerability at the municipal level in Mexico were constructed with the definition of vulnerability from the Intergovernmental Panel on Climate Change (IPCC), which is calculated with an index composed of three variables: exposure, sensitivity and adaptive capacities[20]. Based on these concepts, the National Institute of Ecology and Climate Change (INECC) normalized the distinct categories considered in the different studies[21] to identify the municipalities under high or very high vulnerability in Mexico. For purposes of our analysis, a dummy variable was generated which identified municipalities with high or very high vulnerability to hydro-meteorological climate-related disasters.

To account for different sociodemographic municipal contexts, the 2010 municipal poverty index of the CONAPO was considered. This index considers aspects such as access to education, households' conditions, monetary income and population density[22]. The index ranges from 0 to 100, with higher values indicating more poverty. Quintiles of the poverty index were generated to facilitate the interpretation of the analytical models. Lastly, as a proxy for urbanization, population density was a continuous variable calculated with INEGI's Population Census by dividing the total population in the municipality by its geographical extension in square kilometres. Quintiles for population density were also generated.

State-level variables

State-level variables account for macro characteristics of the political and economic environment where municipalities are aggregated. To adjust for economic aspects, we obtained the state gross domestic product (GDP) from INEGI's National Accounts 2014[23] and then transformed it to per capita GDP using INEGI's Population Census of 2015[24]. To facilitate interpretation of the statistical models, the per capita GDP was transformed into quintiles. In terms of political variables, it should be stressed that, in the analysed period, Mexico's states were governed by three political parties: (i) the PRI (*Partido Revolucionario Institucional*), which ruled the country for decades and, in 2012, regained the Federal Presidency after 12 years of acting as opposition; (ii) the PAN (*Partido Acción Nacional*), a right-wing party that governed the Federal Presidency between 2000 and 2012; and (iii) the PRD (*Partido de la Revolución Democrática*), a left-wing party facing internal conflicts that eventually led to a division. We retrieved information for each state to assess if, in the nearest state election (i.e. not all states have elections in the same year), there had been a change in the ruling political party, as this is a gross portrayal of the political environment in the state that could affect formal and informal institutions. Hence, a dummy variable was generated to tag states where a change in the party governing had occurred (change of party in power = 1). Finally, a continuous variable of the number of state-level food assistance programmes was estimated from CONEVAL's inventory of state-level social programmes[26], as this shows the heterogeneity between states and also indicates how food assistance programmes contribute to reduce food insecurity prevalence.

Analysis

Three-level multinomial hierarchical linear models were estimated. The first level corresponds to the household, the second level to the municipality and the third level to the state. For a dependent variable with four response options, the multinomial model creates three dummy variables, all with food security as the reference category (score = 0). Details on the model specification are provided in the online supplementary material.

The modelling strategy started with municipal-level variables in the first two models and then added state-level variables in the last two models, all while adjusting for household-level covariates. Model 1 estimated the effects of urbanization and vulnerability to disasters at the municipality level on the prevalence of the three types of food insecurity. Model 2 substituted population density by a more complex composite index of poverty (that includes population density). Model 3 incorporated into Model 1 the three state-level variables: the number of food assistance programmes, change in political party and per capita GDP. Likewise, Model 4 added to Model 2 the same state-level variables. The complete output for the null model and Models 1 to 4 is presented in the online supplementary material, Supplemental Tables S1 to S5.

Results

Table 1 summarizes the descriptive statistics at the household, municipal and state levels. At the household level, on average, the head of household had an education attainment below middle school. The mean household size was 4 people and 26 % of the households were headed by a woman with an average education equivalent to 8 years. There was at least one older adult in 9 % of the households and a child under 5 years of age was living in 30 % of the households. For the dependent variable, 48·0 % of the sample were food secure, 27·1 % reported mild, 15·3 % moderate and 9·6 % severe food insecurity. At municipality level, one in five municipalities were identified to have high or very high vulnerability to climate disasters. The poverty index ranged from 1·2 to 61·5 with a mean of 19·5. Population density was, on average, 941 persons per square kilometre. At the state level, almost half changed the party in power during past elections (47 %). States had, on average, four different food assistance

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Table 1 Descriptive statistics at the household, municipal and state levels, Mexico, 2014

	Mean/ proportion	SD	Min.	Max.
Household-level variables (*n* 19 124)				
Education	2·7	0·9	1	5
Household size	3·8	1·9	1	17
Woman as head of household	0·26	–	0	1
Older adults (>70 years of age)	0·09	–	0	1
Infant (<5 years of age)	0·30	–	0	1
Food insecurity (%)			0	3
Food security	48·0	–	–	–
Mild food insecurity	27·1	–	–	–
Moderate food insecurity	15·3	–	–	–
Severe food insecurity	9·6	–	–	–
Municipal-level variables (*n* 506)				
Vulnerability to climate disasters	0·20	–	0	1
Poverty index	19·5	10·5	1·2	61·5
Poverty index (quintiles)	3·5	1·32	1	5
Population density	941	2425	1	17 423
Population density (quintiles)	–0·6	1·31	–2	2
State-level variables (*n* 32)				
Change of party in power	0·47	–	0	1
Number of nutrition programmes	4	2·5	0	10
Per capita annual state GDP	128·7	104·5	45	679
Per capita annual state GDP (quintiles)	3	1·48	1	5

GDP, gross domestic product (thousands of $MX, base 2008).
Descriptive statistics of all the variables included in the models. The unadjusted prevalence of food insecurity, the dependent variable, was estimated using the Latin American and Caribbean Food Security Scale (ELCSA) from the National Household Income and Expenditure Survey (ENIGH) 2014.

programmes – although there was an important heterogeneity as one state did not offer food assistance programs, while another had ten. Average state per capita GDP was $MX 128·73 (in thousands, base 2008).

Table 2 summarizes the hierarchical linear models, all adjusted by household-level sociodemographic variables. Model 1 introduced variables at the second level (i.e. municipality). Results indicated that for each additional quintile in population density there was a significant decrease in the three levels of food insecurity; each one-quintile increase in population density was associated with a 25 % (OR = 0·744; 95 % CI 0·693, 0·799), 23 % (OR = 0·772; 95 % CI 0·725, 0·823) and 24 % (OR = 0·760; 95 % CI 0·722, 0·801) decrease in the odds of severe, moderate and mild food insecurity, respectively. Conversely, municipalities tagged with high or very high vulnerability to climate disasters had higher odds ratios of severe food insecurity by 58 % (OR = 1·581; 95 % CI 1·284, 1·945), by 38 % for moderate food insecurity (OR = 1·382; 95 % CI 1·144, 1·671) and by 22 % for mild food insecurity (OR = 1·220; 95 % CI 1·050, 1·417), when compared with municipalities without the risk of climate disasters.

Model 2 substituted population density by a composite index of poverty at the municipality level. It showed that an additional quintile in the poverty index was significant in the three levels of food insecurity; each one-quintile increase in the poverty index was associated with a 42 % increase in the odds of mild food insecurity (OR = 1·425; 95 % CI 1·362, 1·490), a 47 % increase in the odds of moderate food insecurity (OR = 1·474; 95 % CI 1·398, 1·555) and a 51 % increase in the odds of severe insecurity (OR = 1·507; 95 % CI 1·419, 1·600). Moreover, municipalities with high or very high vulnerability to climate disasters had a nearly 30 % higher odds of reporting severe food insecurity (OR = 1·287; 95 % CI 1·066, 1·555) than those with low or moderate vulnerability to natural disasters. When the poverty index was in the model, vulnerability to climate disasters ceased to be significant for moderate and mild food insecurity.

In Model 3, in addition to the municipal- and household-level covariates of Model 1, state-level variables were introduced. As expected, population density and vulnerability to disasters remained similar as in Model 1. Food assistance programmes and change in political party were not statistically significant. However, per capita GDP at the state level had a significant negative association with the three levels of food insecurity; an additional quintile in per capita GDP was associated with a decrease in the odds by 24 % for severe food insecurity (OR = 0·758; 95 % CI 0·692, 0·831), 24 % for moderate food insecurity (OR = 0·758; 95 % CI 0·677, 0·850) and 22 % for mild food insecurity (OR = 0·780; 95 % CI 0·697, 0·873).

Model 4 is equivalent to Model 3 in the focus on state-level predictors, but it substituted population density by the poverty index at the municipality level. The poverty index had slightly higher coefficients than in Model 2. Vulnerability to disasters remained statistically significant only for severe food insecurity; these municipalities showed 33 % (OR = 1·333; 95 % CI 1·105, 1·608) higher odds than non-vulnerable municipalities. At the state level, change in political party was not statistically significant. Moreover, per capita GDP decreased the size of its coefficients; each one additional quintile was associated with a decrease of 13 % in the odds of the three levels of food insecurity (OR = 0·87; 95 % CI 0·80, 0·95). The reason is that these coefficients now reflect the effect of state-level GDP on a municipality in the third quintile of the poverty index rather than on the third quintile of population density. For the same reason, food assistance programmes proved significant only on severe food insecurity; each one additional programme was significantly associated with a decrease of 5 % (OR = 0·951; 95 % CI 0·909, 0·994) in the odds of severe food insecurity. The effect was discernible in municipalities located in states with an average per capita GDP and on municipalities in the third quintile of the poverty index.

Table 2 Household food insecurity explained by three-level multinomial hierarchical linear models, Mexico, 2014

	Severe food insecurity			Moderate food insecurity			Mild food insecurity		
Model	Coefficient	OR	95 % CI	Coefficient	OR	95 % CI	Coefficient	OR	95 % CI
Model 1									
Intercept	−4·041	0·018	0·014, 0·022	−3·165	0·042	0·033, 0·054	−2·035	0·131	0·103, 0·166
Municipality level									
Disasters	0·458	1·581	1·284, 1·945	0·323	1·382	1·144, 1·671	0·198	1·220	1·050, 1·417
Density	−0·295	0·744	0·693, 0·799	−0·258	0·772	0·725, 0·823	−0·274	0·760	0·722, 0·801
Model 2									
Intercept	−3·926	0·019	0·017, 0·023	−3·038	0·048	0·042, 0·055	−1·9277	0·145	0·127, 0·167
Municipality level									
Disasters	0·253	1·287	1·066, 1·555	0·109	1·115	0·941, 1·323	0·015	1·015	0·883, 1·168
Poverty quintiles	0·410	1·507	1·419, 1 ·600	0·388	1·474	1·398, 1·555	0·354	1·425	1·362, 1·490
Model 3									
Intercept	−4·087	0·017	0·014, 0·020	−3·224	0·040	0·032, 0·049	−2·131	0·119	0·097, 0·145
Municipality level									
Disasters	0·453	1·573	1·281, 1·932	0·318	1·374	1·138, 1·661	0·197	1·218	1·051, 1·412
Density	−0·264	0·768	0·719, 0·820	−0·235	0·791	0·744, 0·841	−0·263	0·768	0·732, 0·807
State level									
Food programmes	−0·034	0·967	0·918, 1·018	−0·020	0·980	0·918, 1·046	0·006	1·006	0·943, 1·073
Change in power	0·022	1·022	0·789, 1·325	0·039	1·039	0·755, 1·430	0·091	1·095	0·800, 1·498
Per capita GDP quintiles	−0·277	0·758	0·692, 0·831	−0·276	0·758	0·677, 0·850	−0·248	0·780	0·697, 0·873
Model 4									
Intercept	−3·911	0·020	0·017, 0·023	−3·036	0·048	0·041, 0·056	−1·971	0·139	0·120, 0·161
Municipality level									
Disasters	0·287	1·333	1·105, 1·608	0·139	1·149	0·969, 1·362	0·047	1·048	0·913, 1·203
Poverty quintiles	0·374	1·453	1·366, 1·546	0·358	1·430	1·354, 1·512	0·324	1·383	1·323, 1·446
State level									
Food programmes	−0·051	0·951	0·909, 0·994	−0·037	0·963	0·922, 1·006	−0·019	0·981	0·938, 1·027
Change in power	−0·059	0·942	0·752, 1·180	−0·057	0·945	0·759, 1·177	0·019	1·019	0·814, 1·275
Per capita GDP quintiles	−0·138	0·871	0·800, 0·948	−0·143	0·867	0·799, 0·941	−0·135	0·874	0·804, 0·950

GDP, gross domestic product.
All models were estimated with household-level covariates: woman as head of household, education of head of household, household size, presence of older adults (70 years or older = 1) and presence of children (5 years or younger = 1); estimates not shown, but available in the online supplementary material. The dependent variable was always food insecurity, estimated using the Latin American and Caribbean Food Security Scale (ELCSA) from the National Household Income and Expenditure Survey (ENIGH) 2014, and the reference category was 'food security'. Models 1 and 2 focused on the municipality level and Models 3 and 4 on the state level, all adjusting for household-level covariates. Model 1 estimated the effects of population density and vulnerability to disasters. Model 2 substituted population density by a more complex composite index of poverty. Model 3 added to Model 1 the three state-level variables: the number of nutrition programmes, change in political party and per capita GDP. Likewise, Model 4 added the same variables to Model 2.

Discussion

Prior research highlights that food security is central to individual dignity and foundational to the satisfaction of human rights. Access to healthful foods, however, is heavily determined by structural and social conditions[26]. The present study suggests that spending in food assistance programmes is insufficient to modify the prevalence of food insecurity by highlighting the simultaneous effects of broader contextual determinants like the vulnerability to climate disasters. Food assistance programmes are not designed to modify some of these meso and macro determinants of food insecurity. Food security cuts across key issues such as reduction in poverty and inequalities, climate vulnerability and institutional capacities. This poses important public policy challenges, as it underlines the need for systemic or holistic approaches for such phenomena. This has actually been recognized in the Sustainable Development Goals, as the end of hunger is seen beyond the provision of foods to include more general notions of biophysical conditions and how food is actually produced. The multilevel factors affecting food security suggest the need for complex interventions involving a wide range of actors including governments, civil society, human rights ombudspersons, academia and international organizations, among others[26], that may help strengthen a modern and systemic approach to food security governance[27].

In the present research, in addition to the vulnerability to climate disasters, we also documented a strong association of food insecurity with variables such as poverty (i.e. municipal level) and per capita GDP (i.e. state level); these variables underscore how structural inequalities affect the access of households to healthful food choices. Hence, ending hunger – as posed by Sustainable Development Goal 2 – goes beyond food production, and it implies addressing social inequalities that in countries like Mexico have been replicated for decades and have hardly been modified by current policies. It is also worth stressing that climate vulnerability can further aggravate such inequalities, as the models suggest that susceptibility to climate-related disasters has a disproportionate effect among the severely food insecure, which in turn has a stronger association with the poverty index.

Another relevant finding of the present study is that the levels of food insecurity do not show monotonic steps, namely in terms of indicators such as the poverty index;

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it is not the same moving from mild food insecurity to moderate as moving from moderate to severe. This has methodological implications and policy lessons. Changes in predictors of food insecurity will not have equal effects on every level of food insecurity and some solutions might work better for severe food insecurity while others are more sensitive to milder levels. For example, food assistance programmes were only effective for severe food insecurity and in municipalities with average poverty. Therefore, it is key to keep measuring food insecurity with the best available scale – the ELCSA – differentiating the three levels of insecurity: mild, moderate and severe.

The presented findings should inform food security governance not only in Mexico, but in other countries facing similar inequalities, as well as in areas confronted with high climate vulnerability. Food security governance should be increasingly seen as a multisectoral, multidisciplinary and global challenge to meet the goals of reducing hunger and getting access to a nutritious diet.

Besides the fact that cross-sectional designs are not well suited to establish causality, our study has other limitations. It intended to account for political factors that modify how food assistance, poverty and agricultural programmes are operated. However, we did not find a significant association using an indicator for change of ruling party. This may be because we could not measure other relevant institutional dimensions, such as corruption and governmental management efficacy, which are likely to affect such programmes' implementation. Data on these dimensions are not fully available in Mexico. Similarly, the agricultural system is likely to influence food insecurity. Despite the vast amount of data reported by INEGI on agriculture production, transforming such data into significant variables for purposes of the current analysis was unfeasible. Experts on this area of knowledge should be producing usable indicators for the vulnerability to climate-related hydro-meteorological events – such as frosts, floods and droughts – that affect agricultural productivity and food security. Therefore, a more nuanced model that reflects the systems perspective is warranted.

Conclusions

Food insecurity is certainly not uniquely a nutrition or food production issue. Modern policies need to acknowledge that ending hunger and providing access to nutritious foods depends on characteristics of state and local ecosystems like climate vulnerability, the socio-economic context and its institutional capacities. Our research highlights that narrowly defined food assistance programmes may not produce long-lasting effects in reducing food insecurity. The food system needs to be acknowledged as a complex and integrated system, which implies accounting for the natural, political, economic or social processes related to food production, access, availability and stability. Stagnant food insecurity indicators in Mexico suggest the need for a more nuanced and holistic approach to policy making. Failure to do so puts at risk the results of policies and the people they seek to benefit. Systemic approaches offer the possibility of advancing global justice for food security.

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Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/S1368980019003082

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