RESEARCH

EXPLORING DEMOGRAPHIC AND SOCIOECONOMIC DRIVERS OF FOOD INSECURITY IN COLOMBIAN HOUSEHOLDS

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PONTIFICIA UNIVERSIDAD JAVERIANA

FACULTY OF ECONOMIC AND ADMINISTRATIVE SCIENCES

MASTER IN SOCIAL POLICY

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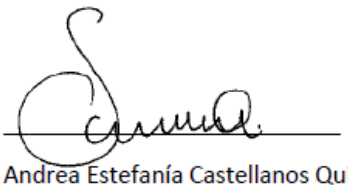
Por medio de la presente entrego a usted el Trabajo de Grado cuyo título es "Exploring Demographic and Socioeconomic Drivers of Food Insecurity in Colombian Households".

Espero que este Trabajo cumpla con los requisitos académicos exigidos y que alcance el propósito para el cual fue elaborado.

Atentamente



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Por medio de la presente me permito comunicarle, que en mi calidad de director de trabajo de grado he leído detenidamente el informe final del estudio titulado "Exploring Demographic and Socioeconomic Drivers of Food Insecurity in Colombian Households", realizado por la estudiante de la Facultad de Ciencias Económicas y Administrativas de la Universidad Javeriana, Andrea Estefanía Castellanos Quintero con cédula 1144061025, y considero que cumple con todos los requisitos requeridos para ser presentada a evaluación.

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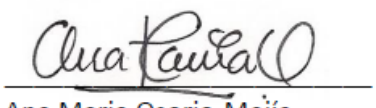

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"EXPLORING DEMOGRAPHIC AND SOCIOECONOMIC DRIVERS OF FOOD INSECURITY IN COLOMBIAN HOUSEHOLDS" Aprobado por el Comité de Trabajos de Grado en cumplimiento de los requisitos exigidos por la Pontificia Universidad Javeriana para optar por el título de Magíster en Política Social.

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Abstract

Attaining the Sustainable Development Goal of eradicating hunger and reducing moderate to severe food insecurity by 2030 is imperative. According to FAO, global moderate or severe food insecurity have risen over six years, affecting over 30% of the world's population. In 2020, Latin America experienced a substantial increase, with a nine-point rise in food insecurity. In Colombia, data from the latest National Nutritional Situation Survey (ENSIN) of 2015 revealed that 54.2 out of 100 households faced food insecurity. This study investigated the demographic and socio-economic factors contributing to food insecurity in Colombian households, utilizing ENSIN 2015 microdata and the Latin American and Caribbean Household Food Security Measurement Scale (ELCSA). Employing Binary Logistic Model (BLM) and Ordered Logistic Model (OLM), age was identified as a protective factor, decreasing the likelihood of food insecurity. Female-headed households, indigenous or Afro-Colombian identities, urban locations, regional disparities, wealth inequalities, unemployment, and lower educational attainment consistently correlated with a higher likelihood of food insecurity. This research, relevant for evidence-based policy formulation underscores the urgent need to understand household-level food insecurity for the effective design of targeted interventions.

Keywords: Food insecurity, Colombia, demographic factors, socioeconomic factors, Sustainable Development Goals, ENSIN 2015, ELCSA, Binary Logistic Model (BLM), Ordered Logistic Model (OLM).

Introduction

One of the pivotal Sustainable Development Goals for 2030 is the eradication of hunger. A critical component in achieving this goal involves diminishing the incidence of moderate or severe food insecurity within the population, as measured by the Food Insecurity Experience Scale (FIES). The Food and Agriculture Organization of the United Nations (FAO, 2008) defines food insecurity as arising when there is an insufficient intake of food, a condition that may manifest as transient during specific crisis periods, seasonal during resource-scarce times, or chronic when persisting continuously over an extended period.

According to the FIES, an individual is in a state of moderate food insecurity when the quality and variety of food are compromised, and/or the quantities consumed are reduced, or meals are skipped. Regarding severe food insecurity, the FIES indicates that this occurs when one experiences hunger, referring to the absence of food consumption during the day or for an extended period (Ballard, Kepple & Cafiero, 2013).

A recent report on the state of food security and nutrition in the world (FAO, 2021) asserts that moderate or severe food insecurity has been increasing for six years and affects more than 30% of the global population. By 2020, Latin America emerged as the world's most affected region by moderate or severe food insecurity, with the food insecurity index in the region rising by nine (9) percentage points from one year to another. In Colombia, the latest National Survey of Nutritional Status (ENSIN) in 2015 revealed a concerning reality: 54.2% of households in the country faced food insecurity. These households, predominantly led by women are concentrated in specific regions such as the *Atlántico*, the *Amazonía & Orinoquía*, and the *Pacífica*.

Various studies have delved into the different factors influencing food insecurity by assessing demographic and socioeconomic characteristics. In New Zealand, Carter et al. (2010) found a higher prevalence of food insecurity among females, associated with factors such as sole parenthood, unmarried

status, younger age, Māori and Pacific ethnicity, poor self-rated health, renting, unemployment, and lower socioeconomic status. Similarly, Magaña-Lemus et al. (2016) identified vulnerable households in Mexico facing food insecurity, including those with younger, less-educated heads, led by single, widowed, or divorced women, with disabled members, native language speakers, and residing in rural or lower-income settings. Grimaccia and Naccarato's (2018) in a global analysis underscored the impact of education, household composition, and location on food insecurity risk.

Examining the Sierra Tarahumara in Mexico, Cordero-Ahiman et al. (2017) found that 59.35% of households experienced severe food insecurity, attributing it to income, maize production, seed consumption in scarcity, and casual employment. Akinboade and Adeyefa's (2017) study on South African urban poor households highlighted the influence of income sources, social grants, and educational attainment on food security, emphasizing the importance of timely income receipt and unimpeded access to social grants for improved outcomes. Furthermore, Cordero-Ahiman et al. (2020), focus their analysis on the Paute River Basin in Ecuador, emphasizing housing size and access to food security information as critical determinants of food insecurity.

Although numerous studies have examined the factors influencing food insecurity from regional, national, and local perspectives, there is a lack of evidence on similar research for Colombia. The studies carried out in Colombia on the topic of food insecurity have mainly evaluated its link with nutritional factors and were designed for specific populations (Machado-Duque et al., 2014; Prada-López, 2021), which are not representative samples of the state of food insecurity at the national level. In this context, understanding the associated factors of food insecurity in Colombian households is of major importance. This comprehension serves as the foundation for crafting evidence-based initiatives and public policies to address the issue effectively.

This study aimed to analyze demographic, social, and economic factors that underpin food insecurity at the household level in Colombia, centering on the question: "What are the primary demographic, social, and economic drivers behind food insecurity in Colombian households?" This analysis sought to explore the intricacies of the national situation, emphasizing how interconnected factors are associated with household food insecurity. This research strived to shed light on critical dimensions defining this challenge in Colombia, offering valuable insights to inform comprehensive and transformative strategies and policies for addressing food insecurity.

Data and methods

A secondary analysis of cross-sectional data was conducted using the most recent Colombian National Nutritional Survey (ENSIN 2015). The survey, a collaborative initiative led by the Colombian Institute of Family Welfare (ICBF in Spanish), the National Institute of Health (INS in Spanish), the Ministry of Social Protection (MPS in Spanish), and the Colombian Family Welfare Association (PROFAMILIA in Spanish), employed a comprehensive, population-based approach.

ENSIN utilized a descriptive methodology, employing a probabilistic, clustered, stratified, and multistage sampling technique. Random selection procedures were applied within households listed in the national demographic census of 2005. The survey aimed to capture a representative sample of households nationwide, encompassing individuals under the age of 64. It covered both rural and urban areas across all 32 departments of the country, except for scattered rural populations in the *Amazonía* & *Orinoquía* regions. In 2015, the survey's sample size comprised 44,200 households. From this pool, a specific subset of households participated in the food security module, resulting in a sub-sample of 44,135 households, each represented by the head or primary member of the household.

The term "household" is used in the ENSIN to refer to all individuals living in the same residence, regardless of their familial relationship, whether by blood or marriage. The "household" is the basic unit

of analysis in the survey, providing information on the living conditions, health, and nutrition of the Colombian population.

Outcome and explanatory variables

Household food security.

The Latin American and Caribbean Food Security Scale (ELCSA, acronym in Spanish) served as the dependent variable in this study. To evaluate the food security status of households, the ENSIN utilized the ELCSA (FAO, 2012), a rigorously validated scale across multiple countries in the region, including Colombia. The ELCSA is recognized for its reliability in measuring the level of food security within households, providing valuable insights into their access to nutritious and ample food resources.

The calculation of the Food Security Index through ELCSA involves a meticulous process. First, households are assessed based on predetermined indicators related to their food access, utilization, and stability. These indicators encompass aspects such as the availability of food, the adequacy of dietary intake, and the resilience of food access over time.

Each indicator is assigned a specific score, reflecting the level of food security. For instance, households with consistent and adequate access to nutritious food receive higher scores, indicating a more secure food situation. Conversely, households facing limitations in food access or experiencing disruptions in their food supply receive lower scores, indicating a higher degree of food insecurity. By aggregating the scores from individual indicators, the Food Security Index is calculated. Results can be categorized into different levels of food security based on their scores. These categories include:

- Food Secure: Households with consistent access to enough food. Food intake is regular, nutritious, and reliable.

- Mild Food Insecurity: Households experiencing uncertainty about their ability to obtain food but do not necessarily reduce their food intake or alter their eating patterns. The overall quantity and quality of meals are not significantly compromised.
- Moderate Food Insecurity: Households that already reduce the quality and quantity of their food intake. Households may reduce meal sizes, skip meals, or substitute nutritious foods for cheaper and less nutritious options.
- Severe Food Insecurity: Represents the most critical level, indicating households with disrupted eating patterns and reduced food intake. People in these households may frequently go hungry, sometimes for entire days, and may face substantial challenges in obtaining enough food.

Using ELCSA as a standardized tool ensures the consistency and reliability of the food security assessments conducted within the survey, facilitating meaningful comparisons both within the country and across the broader Latin American and Caribbean region.

Household demographic and socioeconomic variables.

This study employed a comprehensive set of explanatory variables to investigate and quantify the potential relation of demographic and socioeconomic factors on food insecurity in Colombia. The variables of the study were selected based on the empirical literature (Ahiman et al., 2017; Carter et al., 2010; Cordero- Akinboade and Adeyefa's, 2017; Cordero-Ahiman et al., 2020; Grimaccia and Naccarato's, 2018; Magaña-Lemus et al., 2016), the FAO's conceptual framework of determinants of food insecurity (FAO 2012) and the information available in the survey. The variables encompassed various dimensions, including demographic characteristics such as age and gender of the head of the household, as well as household size. Marital status, geographic location, availability of space for growing food or raising animals, and the extent of self-consumption of food or animal products were also considered. Additionally, socio-demographic aspects were considered, including the self-reported ethnicity of the

head of the household, educational level, and economic activity. Geographical diversity was addressed by including the Colombian regions as a variable, and the economic status of households was assessed using the Harmonized Wealth Index by quartiles. This Index is a measure that combines several components of household wealth, such as the value of housing, financial assets, debts, and other factors, into a single measure (ENSIN, 2015). The Index has four quartiles, the fourth represents the highest level of wealth and the first the lowest. Particularly in the ENSIN 2015, this index was created to have a standardized measure of household wealth that would be comparable with surveys conducted in previous years. By incorporating this extensive list of variables, the study aimed to discern and model the intricate interplay between these socioeconomic factors and the prevalence of food insecurity in Colombia.

Statistical analysis

The statistical analysis in this study was conducted with a holistic approach to thoroughly comprehend the relationships among key variables. Initial emphasis was placed on an extensive descriptive statistical analysis, encompassing both the outcome variable—the food insecurity index—and the explanatory variables. This method provided a detailed overview of data distribution and fundamental characteristics, establishing a solid foundation for interpreting the results. All statistical analyses, performed using STATA 15, incorporated the sample weights calculated in the 2015 Colombian National Nutritional Survey (ENSIN). The inclusion of these weights ensured the national representativeness of the results, thereby enhancing the external validity of the findings. Pearson's Chi-squared tests were conducted to evaluate the associations between all explanatory variables and the food insecurity index.

To deepen our understanding of the influence of social and economic variables on food insecurity, two statistical models were estimated. First, a Binomial Logistic Model (BLM) was employed, specifically designed for analyzing binary variables such as the presence or absence of food insecurity. For this model, a dichotomous variable was constructed where a value of 1 represents mild, moderate, or severe food

insecurity, while a value of 0 indicates food security. Additionally, an Ordered Logistic Model (OLM) was utilized, well-suited for variables with ordered levels, such as the categories of food insecurity.

Results

This section delves into descriptive and econometric analysis of the continuous and descriptive variables applied in the research. The initial sample to estimate logistic regression models comprised 44,135 households, however exclusions were made for those with incomplete information. Consequently, considering available data on demographic, social, and economic variables, the ultimate sample utilized for analysis encompassed 27,042 households, constituting 61% of the original sample. Inferential statistics were applied to understand the links between dependent and independent variables, offering insights into the factors influencing food insecurity in Colombian households. The Chi-squared test revealed significant associations ($P < 0{\cdot}05$) between the Food Security Index and all explanatory variables.

Descriptive analysis

The results indicated that 45.77% of Colombian households experience food security, while 54.23% are in a state of food insecurity. Upon disaggregating the data on levels of food insecurity, it can be observed that 31.88% of households are in a state of mild food insecurity, followed by 13.83% in a state of moderate food insecurity, and 8.52% in a state of severe food insecurity (Table 1).

Table 1. Descriptive analysis of household food security status

Outcome variable	Description	n	%
Food Insecurity Index:	**Household food insecurity indicator (BLM)**	44,135	
Food security	0 = Secure		45.77
Food insecurity	1 = Mild, moderate, and severe insecurity		54.23
Food Insecurity levels:	**Household food insecurity level (OLM)**	44,135	
Secure	0		45.77
Mild insecurity	1		31.88
Moderate insecurity	2		13.83
Severe insecurity	3		8.52

Source: Prepared by the author with data from the National Nutritional Status Survey of Colombia, ENSIN, 2015.

Table 2 presents summary statistics for demographic and socioeconomic variables across the entire sample, as well as a breakdown based on levels of food security and food insecurity. The study's findings showed that most households are concentrated in Colombia's *Central* and *Atlántico* regions, each representing 24.5% of the total. The *Oriental* region followed closely behind, comprising 15.4% of households. Additionally, both the *Pacífica* region and the *Amazonía* & *Orinoquía* regions were notable, accounting for 15.1% and 14.5% of households, respectively. Finally, *Bogotá* contributed 6% of the total households. After examining the data stratified by food security status, it was evident that the *Atlántico* region had the highest proportion of households facing food insecurity, comprising approximately 70%. Following closely were the *Pacífica* and *Amazonía* & *Orinoquía* regions at 66% and 62% respectively. The *Oriental* region stood at 56%, and finally, *Bogotá* and the *Central* region had 54% each.

Most households in the study, constituting 75%, were situated in urban areas, while the remaining 25% were in rural regions. Notably, households in rural areas exhibited a higher prevalence of food insecurity (70%) compared to the 58% observed in urban settlements. On average, a household consisted of 3.3 individuals, including 0.24 children under the age of five and 0.31 adults over the age of 64. When the data was analyzed based on the food security status of households, it was revealed that households with food security have a lower average number of inhabitants, which stands at 3.12 persons. Conversely, households experiencing food insecurity have an average of 3.4 individuals per household. Additionally, households experiencing food insecurity have a higher proportion of children under 5 years of age, i.e., 0.27 compared to 0.21 in food-secure households. Households with food security have a higher proportion of adults over 64 years of age, i.e., 0.37 compared to 0.31 in food-insecure households.

Analysis of the harmonized wealth index revealed that 46% of households belong to the first quartile, 24% to the second quartile, 19% to the third quartile, and 11% to the fourth quartile based on their wealth status. Regarding food insecurity, the highest proportion of food-insecure households was found in the first quartile, while most food-secure households were in the fourth quartile. This trend was

reflected in the distribution of quartiles within the Harmonized Wealth Index: 71% of households in the first quartile experienced food insecurity, compared to 29% that are food secure; in the second quartile, 62% were food insecure and 38% were food secure; the third quartile consisted of 50% food insecure and 50% food secure households, while the fourth quartile exhibited 38% food insecurity and 62% food security.

Concerning household heads, the mean age was 44.05 years, with 62% being male and 38% female. Among households grappling with food insecurity, the average age of heads was slightly lower, at 43.75 years. Notably, 65% of households led by women experienced food insecurity, compared to 59% headed by men, indicating a higher incidence of food insecurity in female-headed households. On average, 61% of household heads were married or in a relationship, while 39% were single, divorced, or widowed. A closer look at food insecurity showed that households led by single, divorced, or widowed individuals have a higher prevalence of food insecurity compared to those led by individuals who were married or in a relationship.

Ten percent (10%) of household heads identified as Afro-Colombian, 8% as indigenous, and 82% did not align with either of the mentioned ethnicities. Analyzing the distribution of food insecurity across ethnicities highlighted the indigenous ethnicity with the highest propensity (78%), followed by the Afro-Colombian ethnicity at 73%. In contrast, among those not identifying with the mentioned ethnicities, only 59% experienced food insecurity.

Concerning the educational background of household heads, the majority have between secondary complete and incomplete higher studies, accumulating approximately 11 to 15 years of education. This group comprises about 37% of the sample. Following closely were individuals who have completed primary school but not secondary, with educational durations ranging from 5 to 10 years, making up 32% of the sample. Subsequently, there is a cohort of individuals who have completed less

than primary school, having studied only 0 to 4 years (23%). Lastly, 8% of the sample consisted of individuals who have completed higher education (16-24 years). Regarding food-insecure households, those led by individuals with less than primary education (74%) exhibited a higher prevalence of food insecurity. In opposition, households headed by individuals who have completed higher education or above showed a lower incidence of food insecurity, standing at 34%.

According to the data, most household heads were informally employed (54%), followed by formally employed heads (43%), and lastly, only 3% of heads were unemployed. When compared to the data on food insecurity, it was found that households led by unemployed heads had a higher prevalence (82%) of food insecurity, followed by those led by informally employed heads (69%) and formally employed heads.

In terms of strategies to address food insecurity, households without spaces for cultivating food or raising animals predominated, constituting 72%, compared to the 28% with such resources. Among households equipped with spaces for cultivating food or raising animals 68% faced food insecurity, while 58% of those without such spaces experienced insecurity. The households consuming self-cultivated or raised food or animals accounted for only 27%, contrasting sharply with the 73% who do not engage in such practices. Of those households consuming self-cultivated or raised items 68% encountered around food insecurity, whereas 59% of those who did not engage in this practice experienced food insecurity.

Table 2. Disaggregated descriptive analysis of household food security status.

Quantitative	Total			Food Insecurity			Food Security			P-Value
	n	Mean	SD	n	Mean	SD	n	Mean	SD	
Age	35,773	44.05	12.02	22,000	43.75	11.92	13,726	44.44	12.14	0.825
Household size	44,202	3.30	1.73	27,035	3.45	1.83	17,100	3.12	1.59	0.000***
Children under 5 years old	44,202	0.24	0.51	27,035	0.27	0.54	17,100	0.21	0.47	0.000***
Adults over 64 years old	44,202	0.34	0.62	27,035	0.31	0.59	17,100	0.37	0.64	0.559

Qualitative	Total		Food Insecurity		Food Security		P-Value
	n	%	n	%	n	%	
Head of household gender							<0.000***
Male	27,498	62%	16,249	59%	11,249	41%	
Female	16,637	38%	10,786	65%	5,851	35%	
Marital status							<0.000 ***
Married or partnered	26,213	61%	15,871	61%	10,342	39%	
Single, divorced or widowed	16,839	39%	10,529	63%	6,310	37%	
Geographic location of the household							<0.000 ***
Urban	32,982	75%	19,272	58%	13,710	42%	
Rural	11,153	25%	7,763	70%	3,390	30%	
Place for growing food or raising animals							<0.000 ***
Yes	12,313	28%	8,429	68%	3,884	32%	
No	31,821	72%	18,605	58%	13,216	42%	
Food or animal self-consumption							<0.000 ***
Yes	12,085	27%	8,276	68%	3,809	32%	
No	32,049	73%	18,758	59%	13,291	41%	
Self-reported ethnicity head of household							<0.000 ***
Afro-Colombian	3,583	10%	2,610	73%	973	27%	
Indigenous	2,692	8%	2,091	78%	601	22%	
None of the above	29,092	82%	17,111	59%	11,981	41%	

Qualitative	Total		Food Insecurity		Food Security		P-Value
	n	%	n	%	n	%	
Educational level head of household							<0.000 ***
Less than complete primary school (0-4 years)	8,284	23%	6,168	74%	2,116	26%	
Between complete primary and incomplete secondary (5-10 years)	11,476	32%	7,537	66%	3,939	34%	
Between secondary complete and higher incomplete (11-15 years)	13,058	37%	7,268	56%	5,790	44%	
Higher complete and above (16-24 years)	2,731	8%	920	34%	1,811	66%	
Head of household economic activity							<0.000 ***
Unemployed	782	3%	644	82%	138	18%	
Formally employed	12,302	43%	5,827	47%	6,475	53%	
Informally employed	15,280	54%	10,559	69%	4,721	31%	
Region							<0.000 ***
Atlantico	10,812	24.5%	7,571	70%	3,241	30%	
Oriental	6,786	15.4%	3,793	56%	2,993	44%	
Amazonía & Orinoquía	6,416	14.5%	3,989	62%	2,427	38%	
Bogota	2,658	6.0%	1,432	54%	1,226	46%	
Central	10,802	24.5%	5,868	54%	4,934	46%	
Pacífica	6,661	15.1%	4,382	66%	2,279	34%	
Harmonized wealth quartile							<0.000 ***
First	20,095	46%	14,338	71%	5,757	29%	
Second	10,701	24%	6,639	62%	4,062	38%	
Third	8,272	19%	4,152	50%	4,120	50%	
Fourth	5,067	11%	1,906	38%	3,161	62%	

Source: Prepared by the author with data from the National Nutritional Status Survey of Colombia, ENSIN, 2015.

SD: Standard deviation

Econometric Estimation Analysis

Table 3 shows the coefficients of the different determinants of food insecurity at the household level, odds ratios (OR), standard errors, and cut-off thresholds. The results of both the Binary Logistic Model (BLM) and the Ordered Logistic Model (OLM) showed that food insecurity is associated with the following variables: age, household size, households with children under 5 years old, head of household gender (female), self-reported ethnicity head of household (Afro-Colombian and indigenous), marital status (single, divorced or widowed), geographic location of the household (rural), *Atlántico*, *Bogotá* and *Pacífica* regions, the harmonized wealth quartile (first, second and third), head of household employability (unemployed and informally employed), educational level of the head of household (0 to 15 years of education). However, households with adults over 64 years old, *Oriental*, *Amazonía* & *Orinoquía* regions, having places for growing food or raising animals, and self-consumption of food or animals were not statistically significant in the estimation of the model.

The combined results from the BLM and the OLM offered a comprehensive understanding of the intricate determinants of food security in Colombian households. Common findings across both models underscored the association between increasing age, with each additional year decreasing the likelihood of food insecurity (BLM: OR 0.993, OLM: OR 0.994). Female-headed households, as well as those identifying as indigenous or Afro-Colombian, consistently exhibited a higher likelihood of food insecurity (Female: BLM OR 1.447, OLM OR 1.399; Indigenous: BLM OR 1.824, OLM OR 1.950; Afro-Colombian: BLM OR 1.490, OLM OR 1.668). Marital status, rural/urban location, regional disparities, wealth index, employment status, and educational attainment emerged as influential factors shaping food security outcomes. While rural location generally lowered the likelihood of food insecurity (BLM OR 0.744, OLM OR 0.652), regional differences persist, particularly in the *Atlántico* (BLM: OR 1.626, OLM: OR 1.706) *Pacífica* (BLM: OR 1.251, OLM: OR1.153), and *Bogotá* (BLM: OR 1.338, OLM: OR1.258) regions compared with the *Central* region. Wealth disparities contributed to higher odds in the first three quartiles (1st: BLM

OR 2.606, OLM OR 3.163; 2nd: BLM OR 1.940, OLM OR 2.082; 3rd: BLM OR 1.371, OLM OR 1.481), and employment status, especially unemployment or informal employment, was associated with increased likelihood of food insecurity compared with the formally employed category (Unemployed: BLM OR 2.933, OLM OR 3.060; Informally employed: BLM OR 1.531, OLM OR 1.580). Educational attainment demonstrated a significant influence, with higher likelihood for those with less than 16 years of education, particularly at the lower education levels (0-4 years: BLM OR 3.541, OLM OR 3.877; 5-10 years: BLM OR 2.641, OLM OR 2.799; 11-15 years: BLM OR 2.151, OLM OR 2.151).

The OLM results in Table 3 also present essential insights into the cutoff values, specifically cut1, cut2, and cut3, which delineate distinct levels of food insecurity. These thresholds represent the anticipated cumulative likelihoods under the condition of independent variables being zero. Importantly, none of the confidence intervals for these three cutoff thresholds exhibit overlap, meaning significant distinctions among the four food security levels. This statistical evidence underscores the meaningful separation between the different levels of food insecurity, enhancing the reliability and precision of the model's predictive capacity.

Table 3. Binary Logistic Model (BLM) and the Ordered Logistic Model (OLM) regression coefficient estimates.

Independent Variable		BLM			OLM		
		Food Insecurity			Food Insecurity		
Variables	**Categories**	**Coefficients**	**Odds Ratio**	**95% C.I. for O.R.**	**Coefficients**	**Odds Ratio**	**95% C.I. for O.R.**
Head of Household Age		-0.00740***	0.993***	0.991 - 0.994	-0.00560***	0.994***	0.993 - 0.996
Household size		0.147***	1.158***	1.143 - 1.173	0.130***	1.139***	1.126 - 1.153
Children under 5 years old		-0.167***	0.846***	0.816 - 0.878	-0.235***	0.791***	0.767 - 0.815
Adults over 64 years old		0.0166	1.017	0.957 - 1.080	-0.0187	0.981	0.934 - 1.031
Head of household gender	Male	1	1		1	1	
	Female	0.390***	1.477***	1.419 - 1.538	0.336***	1.399***	1.351 - 1.449
Self-reported ethnicity head of household	None of the above	1	1		1	1	
	Afro-Colombian	0.399***	1.490***	1.422 - 1.561	0.512***	1.668***	1.584 - 1.756
	Indigenous	0.601***	1.824***	1.453 - 2.289	0.668***	1.950***	1.425 - 2.669
Marital status	Married or partnered	1	1		1	1	
	Single, divorced, or widowed	0.134***	1.144***	1.094 - 1.196	0.186***	1.205***	1.158 - 1.254
Geographic location of the household	Urban	1	1		1	1	
	Rural	-0.296***	0.744***	0.659 - 0.840	-0.428***	0.652***	0.578 - 0.735
Region	Central	1	1		1	1	
	Atlántico	0.486***	1.626***	1.527 - 1.732	0.534***	1.706***	1.569 - 1.855

Independent Variable		BLM			OLM		
		Food Insecurity			Food Insecurity		
Variables	**Categories**	**Coefficients**	**Odds Ratio**	**95% C.I. for O.R.**	**Coefficients**	**Odds Ratio**	**95% C.I. for O.R.**
	Oriental	0.0760	1.079	0.992 - 1.174	0.0126	1.013	0.929 - 1.104
	Amazonía & Orinoquía	0.0672	1.070	0.995 - 1.149	-0.0347	0.966	0.891 - 1.048
	Bogotá	0.291***	1.338***	1.295 - 1.382	0.229***	1.258***	1.214 - 1.304
	Pacífica	0.224***	1.251***	1.171 - 1.336	0.142***	1.153***	1.069 - 1.243
Harmonized wealth quartile	Fourth	1	1		1	1	
	First	0.958***	2.606***	2.412 - 2.816	1.151***	3.163***	2.957 - 3.383
	Second	0.662***	1.940***	1.855 - 2.028	0.733***	2.082***	2.007 - 2.160
	Third	0.316***	1.371***	1.330 - 1.414	0.337***	1.401***	1.364 - 1.439
Head of household employability	Formally employed	1	1		1	1	
	Unemployed	1.076***	2.933***	2.731 - 3.150	1.119***	3.060***	2.858 - 3.277
	Informally employed	0.426***	1.531***	1.475 - 1.589	0.457***	1.580***	1.526 - 1.636
Educational level head of household	High school complete and above (16-24 years)	1	1		1	1	
	Less than complete primary school (0-4 years)	1.264***	3.541***	3.243 - 3.867	1.355***	3.877***	3.576 - 4.204
	Between complete primary and incomplete secondary (5-10 years)	0.971***	2.641***	2.508 - 2.781	1.029***	2.799***	2.665 - 2.941

Independent Variable		BLM			OLM		
		Food Insecurity			Food Insecurity		
Variables	**Categories**	**Coefficients**	**Odds Ratio**	**95% C.I. for O.R.**	**Coefficients**	**Odds Ratio**	**95% C.I. for O.R.**
	Between secondary complete and higher incomplete (11-15 years)	0.766***	2.151***	2.045 - 2.263	0.766***	2.151***	2.048 - 2.260
Place for growing food or raising animals	Yes	1	1		1	1	
	No	-0.166	0.847	0.611 - 1.174	-0.21	0.808	0.546 - 1.196
Food or animal self-consumption	Yes	1	1		1	1	
	No	0.231	1.260	0.929 - 1.710	0.313	1.367	0.972 - 1.924
Constant					-1.900***	0.150***	0.131 - 0.170
cut1					1.944***	6.985***	6.157 - 7.925
cut2					3.658***	38.78***	34.34 - 43.79
cut3					4.897***	133.9***	117.1 - 153.1
Observations					27042	27,042	

Note: Significance levels: * p < 0.10, ** p < 0.05, ***p < 0.01.

Source: Prepared by the author with data from the National Nutritional Status Survey of Colombia, ENSIN, 2015.

Discussion

Demographic factors

The findings revealed an inverse relationship between the age of household heads and the likelihood of food insecurity. These results find support in previous research, such as that of Magaña-Lemus (2016), which suggested that an increase in the age of the household head may be associated with greater expertise in managing household resources. Furthermore, accumulated work experience could translate into a more substantial income, thereby reducing the likelihood of the household experiencing food insecurity.

The presence of a significant proportion of working-age adults in the household also played an important role. This dynamic, supported by the observations of Maitra and Prasada (2015), implies a lower burden of dependents in the household, resulting in a higher income capacity for the family unit. In this sense, the coexistence of more experienced household heads and a higher proportion of working-age adults can strengthen the economic resilience of the household and ultimately reduce vulnerability to food insecurity.

Female-headed households exhibited a higher likelihood of food insecurity. A notable gender disparity in food insecurity has been reported in previous studies, with women more vulnerable to sacrificing their food intake to ensure their family's nourishment (McIntyre et al., 2003; Carter, 2010). This vulnerability is embedded in entrenched gender roles and traditional family responsibilities, underscoring the complexity women face in balancing family nutrition. It emphasizes the importance of considering gender factors in designing strategies to address food insecurity and promote equitable food resource distribution.

Another major determinant of food insecurity found in Colombia was ethnicity. Households led by individuals from indigenous or Afro-Colombian ethnicities exhibited a higher likelihood of food

insecurity. These findings mirror those of Carter (2010), who identified a similar pattern among ethnicities in New Zealand, attributing it to challenges related to historical inequalities affecting these vulnerable groups. In the Colombian context, the United Nations High Commissioner for Refugees (UNHCR) situational profiles on indigenous (UNHCR, 2011a) and Afro-Colombian (UNHCR, 2011b) ethnicities highlighted the direct impact of violence on these communities in their territories. This has forced them to migrate within the country, further intensifying their vulnerability. These insights underscore the imperative of addressing ethnic dimensions in the formulation of strategies and policies aimed at enhancing food security, acknowledging the historical experiences and contemporary realities shaping the circumstances of these specific groups.

Drawing parallels with the studies conducted by Carter et al. (2010), Magaña-Lemus et al. (2016), and Grimaccia and Naccarato (2018), it was found that marital status affects the likelihood of food insecurity. Specifically, households headed by single, divorced, or widowed parents consistently demonstrated a heightened vulnerability to food insecurity. These research findings highlighted the significance of considering the structure and dynamics of household composition, shedding light on the unique challenges faced by sole-parenthood households. The absence of a partner may contribute to a reduced pool of resources and support networks, amplifying the risk of food insecurity. To address this challenge, policymakers could promote community-based initiatives and partnerships that foster social cohesion and bolster local resilience by enhancing and expanding household support networks.

Food insecurity was closely linked to the geographical location of households, with households in the *Atlántico*, *Pacífica*, and *Bogotá* regions showing a higher likelihood. These results aligned with the 2015 Multidimensional Poverty Index (DANE, 2016), which indicated that the *Atlántico* and *Pacífica* regions had the highest levels of poverty. Regarding Bogotá, the capital of the country, this result stands out, as it generally boasts better indicators compared to other regions. However, this outcome may be

associated with significant inequalities within the city. For instance, it is one of the regions with the highest prevalence of chronic malnutrition.

In contrast to the findings of Magaña-Lemus et al. (2016), which revealed a correlation between food insecurity and households situated in rural regions of Mexico, the present study suggests a lower prevalence of food insecurity among rural households in Colombia. Although statistically significant in both models, this result warrants closer examination, particularly in light of initial descriptive analyses indicating a higher proportion of rural households experiencing food insecurity. Sensitivity tests were subsequently conducted on the model to discern the underlying factors contributing to this outcome. Various iterations were executed by eliminating distinct variables and observing the behavior of the Urban/Rural variable. In all instances, the outcomes closely resembled those presented in the study, except when the Wealth variable was omitted. Under this condition, the model's outcomes converged with those observed in descriptive statistics. The examination of the findings suggests an inference that the increased vulnerability of rural households to food insecurity may not exclusively be attributed to their rural location but, rather, may emanate from their underlying socioeconomic conditions.

Socio-economic Factors

The findings of our study revealed that households located in the first quartile of the Harmonized Wealth Index exhibit a higher likelihood of food insecurity compared to others. This result demonstrates how, as one progresses through the quartiles, the likelihood of experiencing food insecurity decreases. These results are consistent with prior research from other authors who have also emphasized the influence of income on household food security. Carter et al. (2010) noted a relationship with lower socioeconomic status, Magaña-Lemus et al. (2016) indicated the presence of food insecurity in lower-income settings, Cordero-Ahiman et al. (2017) referred to income, and Akinboade and Adeyefa (2017) mentioned income sources as a key factor.

As expected according to the literature, the household's wealth plays a relevant role in determining the likelihood of households experiencing food insecurity. Although this finding has been widely studied, it is important to highlight that its consistent presence in research calls attention to policymakers and invites an analysis of historically implemented policies to address inequity. It is imperative to pay attention to conventional models and redirect them to improve the livelihoods of families, thereby contributing to improvements in other important areas such as food security.

In terms of the household head's employability level, our results aligned with those of Magaña-Lemus et al. (2016) and Cordero-Ahiman et al. (2017), who suggested that working conditions, whether formal employment, unemployment, or informal employment, are determinants of household food security. In the Colombian context, unemployed or informally employed household heads exhibit a higher prevalence of food insecurity. Strengthening social safety net programs is key to assisting unemployed and informally employed individuals and families grappling with food insecurity. This may include expanding access to unemployment assistance, cash transfers, and food assistance programs (Schmidt, Shore-Sheppard & Watson, 2015).

The results highlighted the fundamental importance of education in the reduction of the likelihood of food insecurity in Colombian households. A trend was observed whereas the number of years of education of the head of the household increases, the likelihood of households experiencing food insecurity decreases. These findings align with previous research, such as the results from Magaña-Lemus et al. (2016), who identified a higher prevalence of food insecurity among less educated household heads. Similarly, there are parallels in the findings of Grimaccia and Naccarato (2018) and Akinboade and Adeyefa (2017), supporting the significance of education in food security and emphasizing the substantial role of the educational level of the household head in mitigating food insecurity.

In addition to its fundamental role in reducing the likelihood of food insecurity in Colombian households, education is closely linked to better job opportunities and increased income. Moreover, higher levels of education provide individuals with essential knowledge about nutrition and healthy eating habits, enabling them to make informed food choices. This knowledge equips individuals with the skills to optimize their food budgets and access diverse sources of nutritional information. By understanding and navigating food assistance programs more effectively, educated individuals enhance their resilience to food insecurity challenges. Therefore, education not only improves economic opportunities but also empowers individuals to make informed decisions that positively influence their nutritional well-being and household food security status.

Policy implications

In formulating policies to address food insecurity in Colombian households, policymakers should consider a holistic and nuanced approach that goes beyond the singular focus on income outlined in the CONPES 113 of 2008, which represents the latest policy on food security in Colombia. While income is undeniably a vital socio-economic factor, as evidenced by the study's results indicating that wealthier households are less prone to food insecurity, it is crucial to acknowledge and integrate other significant demographic and social factors highlighted in this research. These factors include the age, gender, marital status, ethnicity, and the educational attainment of the household head. Recognizing the multifaceted nature of food insecurity, policymakers are encouraged to update and expand existing policies to encompass these diverse determinants, ensuring a more comprehensive and effective approach to promoting food security throughout the country.

At this point, it is important to highlight the advantages of employing the Ordered Logistic Model (OLM). The use of OLM in the study presents notable benefits pertinent to both research and social policy aspects. Firstly, OLM allows for a nuanced exploration of the hierarchical structure inherent in categorical variables, facilitating the analysis of ordered outcomes with multiple levels. This capability enables

researchers and policymakers to discern subtle gradations within complex phenomena, such as food insecurity levels, thereby enhancing the precision of targeted interventions. Moreover, OLM's accommodation of ordinal data enhances the interpretability of results, providing insights into the factors influencing outcomes across distinct categories of interest. By leveraging OLM, researchers can uncover not only the presence or absence of associations but also their magnitude and direction within different strata of the outcome variable. From a social policy perspective, this methodological approach is valuable for informing tailored interventions and resource allocation strategies aligned with the specific needs of vulnerable populations. Embracing the analytical power of OLM empowers policymakers to design more effective programs aimed at mitigating food insecurity, thus advancing broader goals of inclusive development and well-being.

Some of the study's limitations encompass various aspects. Firstly, it was not possible to establish causal relationships between the study variables due to the observational nature of the analysis. Moreover, the absence of important variables, such as cultural factors, could significantly influence the results; unfortunately, these variables were not considered within the data analysis scope. Although the quality of the analyzed database is acknowledged, there is a recognized lack of more updated information since the last survey was conducted in 2015. Currently, there is no available information on when the next survey edition will be released, which was delayed due to the Covid-19 pandemic. This limitation hampers the ability to obtain more recent data for intertemporal analysis and comparisons.

Conclusions

The econometric estimation analysis, employing Binary Logistic Model (BLM) and Ordered Logistic Model (OLM), provided valuable insights into the determinants of food insecurity in Colombian households. This study revealed that various demographic and socio-economic factors significantly influenced the likelihood of food insecurity. Age proveed to be a protective factor, demonstrating an inverse relationship with the likelihood of food insecurity. Female-headed households, indigenous or Afro-

Colombian ethnicity, single, divorced, or widowed marital status, rural location, and specific regional disparities (particularly in the *Atlántica*, *Pacífica*, and *Bogotá* regions) were consistently associated with higher likelihood of food insecurity. Wealth disparities, employment status (especially unemployment or informal employment), and lower educational attainment of the household head also contributed to increased odds of food insecurity. Notably, the study's findings challenge the association between food insecurity and rural locations, highlighting the importance of nuanced analysis beyond conventional assumptions. These insights emphasize the need for policymakers to adopt a comprehensive approach in formulating strategies, addressing not only income disparities but also demographic and socio-economic factors to effectively enhance food security in Colombia.

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