Household Food Insecurity in Somalia: Extent, Determinants, and Policy Implications[1]

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Keywords: Household food insecurity; Somalia; ordinal logistic regression; Proportional Odds Model; Rasch model; household survey.

Abstract

Food insecurity remains a significant challenge for Somali households, with 44.3 percent of the population experiencing moderate or severe food insecurity. This study aims to identify the determinants of household food insecurity in Somalia using ordinal logistic regression model to data from the Somalia Integrated Household Budget Survey (SIHBS) 2022. The response variable is derived from the Food Insecurity Experience Scale (FIES), which uses an underlying Rasch logistic measurement model to derive internationally comparable food insecurity severity estimates. The study applied the proportional odds model for ordered logistic regression after confirming that the proportional odds parallel assumption was not violated. The results from the model revealed that education of the household head and household access to electricity were significantly associated with the severity of the household food insecurity level in Somalia.

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1. Introduction

According to the Food and Agricultural Organization (FAO) of the United Nations, food insecurity is defined as a "situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" [1]. The global prevalence of moderate or severe food insecurity is estimated to be around 2.33 billion people in 2023, with the underlying structural factors of food insecurity including lack of access to and unaffordability of nutritious foods, unhealthy food environments, and high and persistent inequality [2].

Food insecurity in Somalia is even more severe than that of the global estimates. In 2022, 44.3 percent of the population suffered from either moderate or severe food insecurity with persistent shocks, including large rises in food prices (53.3%), drought or severe water shortage (47.3%), and the death of livestock (14.6%) [3].

Our purpose in this study is to identify the demographic, human capital, and infrastructure that inform variations in food security. The abstract is structured as follows: we begin with a brief discussion of the literature review pertaining to food security in Somalia. Second, we highlight the methodology, including food insecurity measurement. Third, we present multivariate analyses that explore the specific ways in which demographic, human capital, and infrastructure variables inform the nature of food insecurity in Somalia. We conclude with a discussion of the nature and dynamics of food security in Somalia, address methodological limitations, and provide suggestions for policy and future research.

2. Brief Literature Review

According to the High-Level Panel of Experts on Food Security and Nutrition [4], food security is recognized as having four main dimensions: availability, access, utilization, and stability, along with the four other dimensions of availability, access, utilization, and stability. These six dimensions of food security are reinforced in conceptual and legal understandings of the right to food. Food insecurity is influenced by several socioeconomic and environmental factors. Acute food insecurity, characterized by severe conditions threatening lives and livelihoods, can arise from rapid changes or shocks, while chronic food insecurity reflects a long-term inability to meet nutritional needs, often resulting in malnutrition.

Previous studies in Somalia investigated the demographic and socioeconomic determinants of food insecurity in Somalia. Research on spatial variation and determinants of household food insecurity in Somalia using spatial and multilevel analysis and variance components for multilevel models of household food insecurity in Somalia using the Somali Demographic and Health Survey (SHDS 2020) found wealth status, sex of the household head, age of the household head, household size, household head school attendance, and place of residence were significantly associated with household food insecurity [5]. Another study on social determinants of household food security among rural families in Kismayo District, Somalia, using a probit model using primary data with a sample size of 380, revealed that family income, age of the household head, gender, and family asset diversification have a significant influence on household food security [6]. However, the authors avoided the ordinal nature of the dependent variable (household food insecurity), which could result in a biased estimate of the parameters, which may lead to a biased conclusion.

A recent study highlighted factors associated with household food security in Somalia using an ordered probit model using SHDS 2020 data and concluded that the level of education of the household head, access to electricity, agricultural practices, livestock, and having a bank account influence the household food insecurity [7]. The study used Household Hunger Scale as a response variable, which is based on the frequency of food insecurity experiences. However, our study used the Food Insecurity Experience Scale (FIES), which is based on the severity of those experiences and uses an underlying Rasch logistic measurement model to derive internationally comparable food insecurity severity estimates.

Other studies have identified key determinants of food insecurity at the household level, influencing several factors, including age of the household [8] and [9], educational level of the household head, source of income of the household, household size, geographical location of the household head [8], access to electricity, agricultural practices, having a bank account [7], land ownership, non-farm activities, improved seed use, and soil fertility status [9]

Our purpose in this study is to build on the recent empirical developments to further provide a more comprehensive examination of the determinants of food insecurity in Somalia. We specifically explore the demographic, human capital, and infrastructure determinants of food insecurity. As far as we are aware, this is the first multivariate study of food insecurity using the most recent nationally representative survey, the Somalia Integrated Household Budget Survey (SIHBS, 2022).

3. Methodology

3.1.Data

The study was based on the 2022 Somalia Integrated Household Budget Survey (SIHBS) conducted by the Somalia National Bureau of Statistics. The SIHBS survey collected detailed information on household consumption and expenditures incurred on goods and services and other socioeconomic information relevant for monitoring the living conditions of Somali households, such as access to basic assets, food security, facilities, and services. The survey also captured information about household head characteristics such as place of residence, household size, age, land ownership, and education. The survey covered 17 out of 18 regions in Somalia using a sample of 7,212 households from 601 Enumeration Areas (EAs), with 12 households interviewed per EA [3]. The data in the model included 6,808 households after excluding cases with missing values in key variables.

3.2.Food insecurity measurement

The procedures used to construct the categorical food insecurity outcome variable used in the Somalia household food insecurity analysis. The measure is based on the Food Insecurity Experience Scale (FIES), which uses an underlying Rasch logistic measurement model to derive internationally comparable food insecurity severity estimates. Probabilities of experiencing moderate-or-severe and severe food insecurity were generated through the official FAO Rasch modelling workflow and subsequently applied to the survey data using Stata.

A raw score (RS) was computed for each household by summing the eight binary FIES items:

$$RS_i = \sum_{k=1}^{8} X_{ik}$$

This score ranges from **0 to 8** and reflects the total number of food insecurity conditions experienced. The raw score is *not* directly interpreted as food insecurity level; instead, it serves as an input to the Rasch model, which places both households and items onto a common severity scale. The Rasch conditional maximum likelihood estimation model produces item severity parameters, household ability/severity parameters, and thresholds for moderate and severe food insecurity.

Probability curves mapping raw scores to probability of moderate-or-severe food insecurity and probability of severe food insecurity. These results reflect the probabilistic interpretation of FIES scores and ensure global comparability. Under equating (see Fig. 1), skipped and healthy were considered unique, giving a 99.4% correlation of the common items.

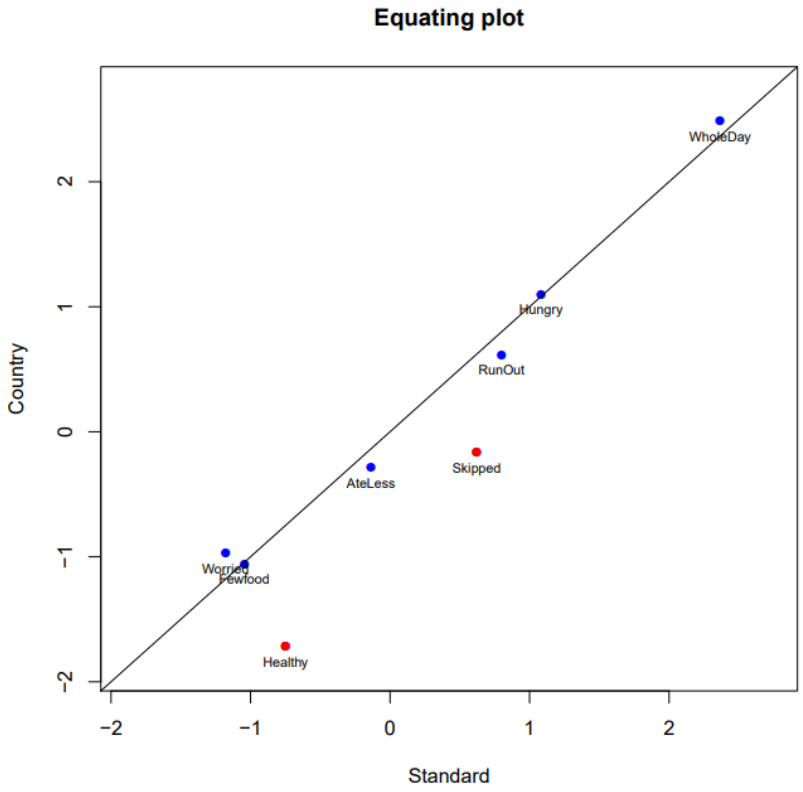

Fig.1: Equating plot

Based on FAO global classification guidelines, three food insecurity classes were constructed:

1. Mild or Food Secure: $Pr(\text{Moderate-or-Severe}) < 0.5$

2. Moderate Food Insecurity: $Pr(\text{Moderate-or-Severe}) \geq 0.5 \text{and} Pr(\text{Severe}) < 0.5$

3. Severe Food Insecurity: $Pr(\text{Severe}) \geq 0.5$

This methodology ensures full compliance with FAO's FIES standards and produces internationally comparable food insecurity estimates.

3.3.Variables in the Study

3.3.1. *Dependent Variable*

The outcome variable of this study is the household food insecurity level, which is based on FAO global classification guidelines and derived from the eight FIES questions about their experiences in the SIHBS data with food insecurity. The three food insecurity classes were constructed with three categories, namely mild, moderate, and severe food insecurity.

3.3.2. Independent Variables

The independent variables used in the study are presented in Table 1 below.

Table 1: Operational definitions of the variables

Dependent variable	**Categories**
Food insecurity levels	1 "Mild or food secure"
	2 "Moderately food insecure"
	3 "Severely food insecure"
Independent variables	**Categories**
Place of residence of the household	1" Rural" *
	2" Urban"
	3" Nomadic"
Age of the household head	Continues "16-100"
Highest level of formal education of the household head completed	0" No Formal Education" *
	1" Primary"
	2" Secondary"
	3" Higher Education"
Household access to electricity	0" No" *
	1" Yes"
Household head sex	0" Female" *
	1" Male"
Household ownership of land	0" Does not own land" *
	1" Own land"
Household size	Continues "1-23"
Household access to internet	0" No access" *
	1" Have access"

*Reference category

3.4.Ordinal Logistic Regression Model

Ordinal logistic regression is a statistical model used for modeling the relationship between an ordinal dependent variable with more than two categories and one or more independent variables, which can be categorical or continuous. The food insecurity variable is categorical with three ordered categories that take a value of one if a household is classified as being mild or food secure, two if a household is classified as moderately food insecure, and three if a household is classified as severely food insecure. In this study, the proportional odds model (POM) for ordinal logistic regression is used since the proportional odds assumption is not violated.

Let $\boldsymbol{Y_k}$ be the household food insecurity for $\boldsymbol{k^{th}}$ household with $\boldsymbol{j}$ categories and let $\boldsymbol{x}$ be the explanatory variables associated with household food insecurity. Then, the cumulative probability of $\boldsymbol{Y_k}$ being in a specific category $j = 1, \ldots, J-1$ or lower is $P(Y_k \leq j \mid \boldsymbol{x})$ and the odds of being in lower or equal to a particular category are defined as:

$$\frac{P(Y_k \leq j|\mathbf{x})}{P(Y_k \leq j|\mathbf{x})} \tag{1}$$

The proportional-odds model for ordinal logistic regression can be written as:

$$\text{logit}\,[P(Y \leq j \mid \mathbf{x})] = \alpha_j + \beta_1 X_1 + \beta_2 x_2 + \cdots + \beta_k X_k \tag{2}$$

where $\boldsymbol{Y}$ represents the ordinal response variable. The parameter $\boldsymbol{j}$ is the category threshold, serving as a point at which the cumulative probability is evaluated. The intercept for threshold $\boldsymbol{j}$ is expressed as $\boldsymbol{\alpha_j}$, and it adjusts the model for each category threshold. The coefficient $\boldsymbol{\beta_k}$ corresponds to the variable $\boldsymbol{X_k}$, indicating the effect of each independent variable on the odds of the response variable being at or below a particular category threshold.

The cumulative probability in equation (2) can be expressed as

$$P(Y \leq j \mid x)] = \frac{\exp(\alpha_j+\beta_1 X_1+\beta_2 x_2+\cdots+\beta_k X_k}{1+\exp(\alpha_j+\beta_1 X_1+\beta_2 X_2+\cdots+\beta_k X_k)} \tag{3}$$

We can also define the probability of each j_{th} category as

$$\pi_j(x) = \frac{\exp(\alpha_j+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_k x_k)}{1+\exp(\alpha_j+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_k x_k)} - \frac{\exp(\alpha_j+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_k x_k)}{1+\exp(\alpha_j+\beta_1 x_1+\beta_2 x_2+\cdots+\beta_k x_k)} \tag{4}$$

4. Analyses and Results

4.1. Descriptive Statistics

Figure 1 demonstrates the distribution of household food insecurity levels within a sampled population. It classifies food security into three distinct categories based on severity. Over half of the households (56.7%) fall into the mild or food-secure category, and nearly half of the households (43.3%) suffer from either moderate or severe food insecurity, suggesting a substantial number of the population facing critical food insecurity.

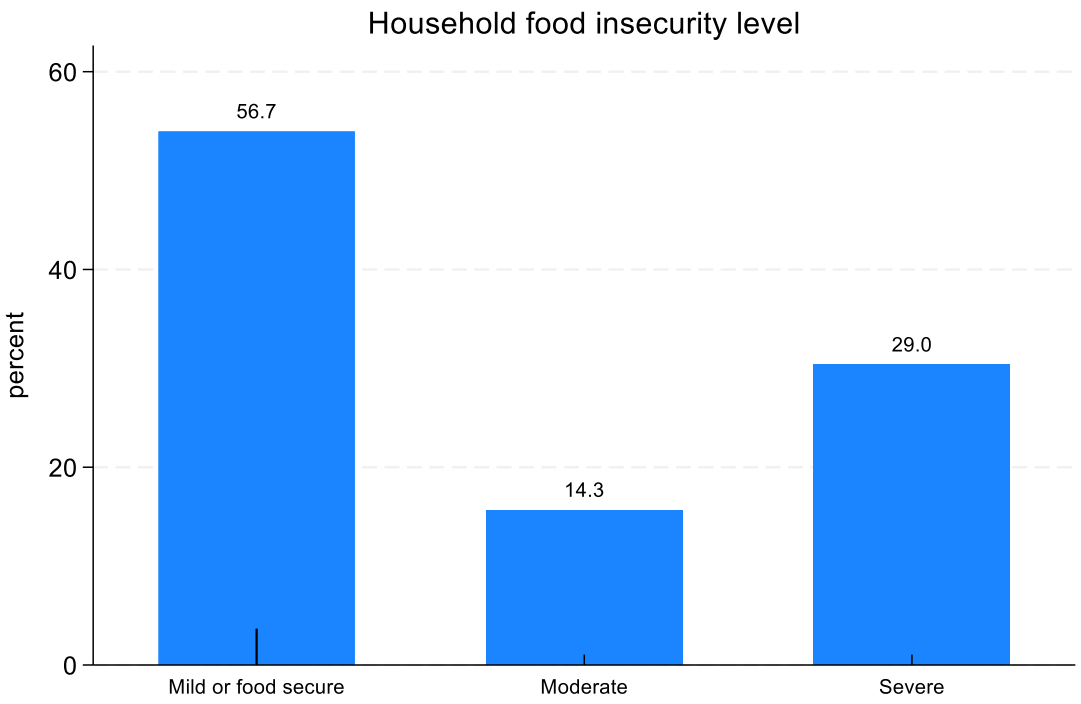

Fig.2: Household food insecurity level

4.2.Multi-variate Analysis

Table 2 presents a descriptive of food security status across several socioeconomic variables: place of residence, level of formal education, electricity access, sex, land ownership, and internet access. Comparing the total percentages for each category, urban residents make up the largest proportion at 61.5%, followed by rural at 26%, and nomadic at 12.6%. This indicates that food security or insecurity is most prevalent among urban populations. Regarding education, household heads with no formal education account for the majority at 75.6%, while those with primary, secondary, and higher education constitute 12.6%, 7.1%, and 4.8%, respectively, highlighting a strong association between lower education levels and increased food insecurity.

In terms of electricity access, those with access represent 58.9% of the total, compared to 41.1% without access, suggesting that electricity availability is linked to better food security outcomes. When considering sex, females comprise a slightly larger share at 52.6% versus males at 47.4%, indicating a marginal gender difference in food security status.

For land ownership, individuals who do not own land dominate at 74.8%, with landowners making up only 25.2%, underscoring the importance of land ownership in mitigating food insecurity. Finally, internet access shows a striking disparity: 73.1% of those without internet access fall into the total category, compared to only 26.9% with access. This pattern, consistent across all variables, demonstrates that urban residency, higher education, electricity access, female sex, land ownership, and internet access are associated with lower overall percentages of food

insecurity, while rural residency, lack of education, no electricity, not owning land, and digital exclusion correspond to higher vulnerability.

Table 2: Proportion of household food insecurity and the categorical variables.

	Household Food Security Status			
Variables	**Mild or food secure**	**Moderate food insecure**	**Severely food insecure**	**Total N (%)**
Place residence				
Rural	1015 (27.5)	293 (24.7)	583 (23.8)	1891 (26.0)
Urban	2345 (60.9)	669 (64.0)	1268 (61.3)	4282 (61.5)
Nomadic	470 (11.7)	141 (11.3)	311 (14.9)	922 (12.6)
Level of formal education				
No education	2683 (74.4)	800 (74.3)	1623 (78.4)	5106 (75.6)
Primary	510 (12.8)	159 (14.6)	251 (11.1)	920 (12.6)
Secondary	275 (7.5)	77 (7.1)	130 (6.2)	482 (7.1)
Higher education	184 (5.3)	77 (4.0)	77 (4.2)	300 (4.8)
Electricity access				
No access	1569 (37.8)	560 (45.2)	1045 (45.4)	3174 (41.1)
Have access	2261 (62.2)	543 (54.9)	1117 (54.6)	3921 (58.9)
Sex				
Female	1994 (51.7)	574 (54.2)	1151 (53.6)	3719 (52.6)
Male	1836 (48.3)	529 (45.8)	1011 (46.4)	3376 (47.4)
Land ownership				
Not own	2801 (74.2)	774 (72.2)	1596 (77.1)	5171 (74.8)
Own land	1029 (25.8)	329 (27.7)	566 (22.9)	1924 (25.2)
Internet access				
No internet access	2630 (72.8)	810 (74.2)	1552 (73.2)	4992 (73.1)
Have access	1022 (27.2)	265 (25.8)	529 (26.8)	1816 (26.9)

To analyze the determinants of household food insecurity in Somalia, we implement ordinal logistic regression modelling with proportional odds, subsequently checking the parallel regression assumption or proportional odds assumption (see Table 3). The p-value of the five tests (Brant test, Wolfe Gould, Score, Likelihood ratio, and Wald) is greater than the significance level (α=0.05). The result of the assumptions shows that we fail to reject the null hypothesis, and the

proportional odds assumption is not violated; therefore, we have enough evidence to suggest that the coefficients for our independent variables are consistent across all categories of the dependent variable. Since the POM meets the parallel assumption [10], we reject more complex models like the Partial Proportional Odds or Generalized Ordered Logit.

Table 3: Results of the parallel regression assumption tests

Tests	**Chi-Square**	**Df**	***p-value***
Wolfe Gould	14.73	8	0.065
Brant	14.68	8	0.066
Score	14.75	8	0.064
likelihood ratio	14.73	8	0.065
Wald	14.78	8	0.064

4.3.Ordered Logistic Regression Model Result

A proportional odds model for ordinal logistic regression was conducted to examine the determinants of household food insecurity in Somalia. The overall model was statistically significant ($x^2(8) = 43.63, p < 0.001$), and the parallel test for the proportional odds assumption (Brant test: $x^2 = 14.68, p = 0.066$) showed the assumption was not violated (see Table 3).

Table 4 shows odds ratio estimates of household food insecurity. Household access to electricity was identified as a significant factor, with electrified households having 23.6% lower odds of more severe food insecurity (OR = 0.764, 95% CI: 0.691-0.846, $p < 0.001$).

Educational attainment of the household also showed a significant effect, with each incremental level of education reducing the odds of more severe food insecurity by 7.0% (OR = 0.930, 95% CI: 0.869-0.995, $p = 0.036$).

However, the variables (place of residence, age of the household head, household head sex, land ownership, household size, and internet access) did not show statistically significant associations with food insecurity levels in this model.

Table 4: Determinants of Household Food Insecurity in Somalia (Ordered Logistic Regression).

Variable	Odds ratio (OR)	Std. err.	z	P>z	95% confidence interval (CI)	
					Lower	Upper
Land ownership (ref: No)						
Own land	1.021	0.054	0.380	0.701	0.919	1.133
Internet access (ref: No)						
Have access	1.039	0.066	0.610	0.544	0.918	1.176
Household head sex (ref: Female)						
Male	0.986	0.049	-0.290	0.774	0.895	1.086
Household size (continuous)	1.001	0.009	0.160	0.870	0.984	1.019
Electricity access (ref: No)						
Have access	**0.740**	**0.043**	**-5.170**	**0.000**	**0.660**	**0.830**
Education level[1]	**0.928**	**0.032**	**-2.150**	**0.032**	**0.868**	**0.994**
Household head age	1.000	0.002	0.150	0.884	0.997	1.004
Place of residence (ref: Rural)						
Urban	1.091	0.066	1.440	0.149	0.969	1.228
Nomadic	1.029	0.083	0.360	0.717	0.880	1.205
/cut1	*0.039*	*0.096*			*-1492219*	*0.227*
/cut2	*0.717*	*0.096*			*0.528*	*0.906*

N = 6,808 | LR χ^2 (9) = 45.12 ($p < 0.001$) | Pseudo R^2 = 0.0034 | Log likelihood = -6702.71

[1]Education: 0=No formal, 1=Primary, 2=Secondary,3=Higher

4.4. Discussion and Conclusion

The objective of the study was to identify demographic, human capital, and infrastructure factors that influenced household food insecurity in Somalia using ordered logistic regression. The proportional odds model (POM) for ordinal logistic regression was used since the proportional odds assumption was not violated. The result for the POM shows that the level of education of the household head and household access to electricity are significantly associated with the severity of the household food insecurity level in Somalia. However, the predictors—place of residence, age of the household head, household head sex, land ownership, household size, and internet access—did not significantly influence the food insecurity level in this model.

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