



Exploring the Determinants of Food Insecurity in Pakistan

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ABSTRACT

This research investigates the impact of various socioeconomic, demographic, and contextual factors on household food insecurity in Pakistan, utilizing data from the Pakistan Social and Living Standards Measurements (PSLM) 2019-20. The aftermaths of the Logistic regression analysis emphasize the vulnerability of households to food insecurity, influenced by factors such as literacy levels, income status, gender, marital status and age of the household head, as well as household size and migration status. Households headed by illiterate, lower-income, larger families, and migrants are particularly at risk. Conversely, households headed by older individuals, married couples, females, or those in higher income brackets are likely to experience higher food security due to more stable incomes and better resource management. These results point to the need for specific interventions that target educational and economic enhancements and address demographic vulnerabilities to improve food access and security for diverse groups.

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1. Introduction

Food security means having consistent access to sufficient, nutritious food necessary for a healthy life, while food insecurity involves the lack of reliable access to affordable, healthy food in the significant quantities. Food insecurity, stemming from social, economic, or other barriers, can lead to malnutrition and broader negative impacts such as reduced productivity, higher healthcare costs, and poor educational outcomes (Van Woerden, Hruschka, & Bruening, 2019). Stability in food security refers to the ability to consistently acquire food, challenged by factors like droughts, conflicts, and economic fluctuations (Anwar, Shair, & Hussain, 2024). At the household level, food insecurity occurs due to inadequate physical, social, or economic access to food, affecting individuals' nutrition and capacity for productive work (Ogundari & Aromolaran, 2017). Addressing food insecurity requires systemic solutions to ensure sustainable access to nutritious food and tackle its underlying causes. The Food Security Information Network (FSIN) (2020) report on global food crises indicates that acute food insecurity has resulted in 96,000 Pakistanis being categorized as internally disabled. According to the (Government of Pakistan. National Nutrition Survey, 2018), while 63% of households are deemed "food secure," approximately 36% are classified as "food insecure." Furthermore, the (Global Hunger Index, 2020) placed the country 88th among 107 nations experiencing severe level of hunger. Food and nutritional security emerge as critical issues, with nearly half of all children under five suffering from stunting, wasting, or both. Additionally, at least 18% of women of reproductive age are underweight. The overall rate of undernourishment affects about 18% of the population, highlighting significant nutritional challenges within the country (Government of Pakistan. National Nutrition Survey, 2018).

Considering the significant impact of food security on individual health and productivity outcomes. The literature at macro level study found key determinants including cereal

production per capita, yield per hectare, governance, logistics performance, and employment levels (Allee, Lynd, & Vaze, 2021). At household level, household food insecurity is strong associated with low education, poor social networks, limited social capital, lower income, and unemployment (Hernández-Vásquez, Visconti-Lopez, & Vargas-Fernández, 2022). Additionally, low education, restricted social capital, and residing in countries with low per capita income are linked to severe food insecurity (Acheampong et al., 2022). Research such as Rose (1999) establishes a clear link between lower income levels and increased food insecurity. This association is further supported by Che and Chen (2001), who found that lower-income groups exhibit higher rates of food insecurity. Importantly, middle-income households are not immune to food insecurity, with a Canadian study reporting that 14% of such households face food insecurity, in contrast to 34% among low-income households. Additionally, food insecurity is influenced by a range of socioeconomic factors, including neighborhood deprivation (Russell et al., 1999), dependence on government income subsidies (Kaiser, Baumrind, & Dumbauld, 2007), and rental tenancy, alongside income volatility.

Social safety nets are inescapable in softening the severity of food insecurity (Shair, Hussain, & Idrees, 2023; Shair et al., 2023). Food insecurity tend to be higher amid the global economic crisis which can be soften by implanting various coping strategies (Shair, Hussain, & Idrees, 2023). Remittance-receiving household is likelihood of being food insecure than non-receiving, and likelihood of food insecurity tend to be lower among the recipient households if remittances increases (Ahmad et al., 2024) Particularly vulnerable demographics include households with children, single-parent households, as well as Hispanic, black, and other marginalized ethnic groups (Alaimo, 2005). In light of Sustainable Development Goal 2, which aims to achieve 'Zero Hunger,' the issue of food insecurity is increasingly prioritized, particularly in developing countries such as Pakistan where high levels of food insecurity persist. The introduction of the Food Insecurity Experience Scale Survey-Module (FIES-SM) into the Pakistan Social and Living Standards Measurement (PSLM) survey marks a significant development. However, there is limited literature exploring this aspect within the Pakistani context. Existing studies such as those by (Cheema & Abbas, 2016; Ejaz Ali Khan, Azid, & Usama Toseef, 2012), and Shair, Hussain and Idrees (2023); Shair et al. (2023) do not provide a comprehensive examination of food insecurity using the new, nationally representative data set and modern indicators of food insecurity recently integrated into the PSLM survey. The primary objective of this study is to examine the impact of various demographic and socio-economic factors on the food insecurity among households in Pakistan. The study empirically designed to analyze the likelihood of food insecurity associated with factors such as province, urban versus rural location, household head's literacy, income level, gender, age, marital status, household size, and migrant status using logistic regression models. This research is significant as it provides a detailed understanding of the underlying causes of food insecurity across diverse household contexts. By identifying the key factors influencing food security, such as income disparities, educational attainment, and demographic characteristics, the findings can guide policymakers and social service organizations in designing targeted interventions to alleviate food insecurity. The study's insights are crucial for developing tailored strategies that address specific needs and vulnerabilities, thereby enhancing the effectiveness of food security programs.

2. Methodology

This research aims to investigate the factors influencing household food insecurity in Pakistan. The study uses a dichotomous dependent variable categorized as 'food insecure' and 'food secure.' Given the binary nature of the responses, the economic literature frequently suggests using the Logit model to estimate the probability of occurrence of specific covariates (Greene, 2003; Gujarati, 1995). The model is specified as follows:

$$\text{Logit}(p_i) = \log\left(\frac{p_i}{1-p_i}\right) = \alpha_0 + \alpha_1 X_{1i} + \alpha_2 X_{2i} + \dots + \alpha_k X_{ki} \quad (1)$$

Where p_i is the probability of the event of interest (e.g., being 'food insecure'), α_s are the coefficient of the model, and X_s are the explanatory variables (covariates). The description of the outcome variable and covariates are presented in the Table 1. We will convert the coefficients of the equation 1 into odds ratio by taking exponents (such as e^{β_j}). This expression will give coefficients greater than, equal to, or less than one. The coefficient greater than one

will provide the increase in likelihood food insecurity, and less than one coefficient will give decrease in likelihood of food insecurity, while equal to one will suggest no effect on the probability of food insecurity.

Table 1: Definition of the variables

Variables	Description
Outcome variable	
Food insecurity	A binary variable coded 1 if the household experience moderate or severe food insecurity, zero otherwise. Food insecurity status is defined as if household responded yes to any question 4 to question 8 of the Food Insecurity Experience Scale Survey Module (FIES-SM). These are 8 questions developed by the Food and Agriculture Organization (FAO).
Explanatory variables:	
Province	A multinomial categorical variable which consist of four province of Pakistan such as Punjab, KPK, Balochistan and Sindh.
Urban	A binary variable coded 1 if household from the urban area, zero otherwise.
Illiterate	A binary variable coded 1 if household's head is illiterate, zero otherwise.
Income level	A ordinal categorical variable which consist of five categories such as low income, lower middle income, middle income, upper middle income, and upper income. This variable constructed by adding all source of household income and then converted into per capita income. Then sort the household into 5 quantiles on the basis of per capita income.
Female head	A binary variable coded 1 if household head is female, zero otherwise.
Age of head	Age is a continuous variable in year old.
Marital Status of head	A nominal categorical variable which consist of three categories such as married, unmarried and widow/widower. It is also relevant to mention that widow category also included separated and divorced individuals.
Household size	A discrete variable which is sum of family member in household.
Migrant	A binary variable coded 1 if household head is migrant in the district in which currently living, zero otherwise.

3. Data and Descriptive analysis

3.1. Data Source

The research employs data from the Pakistan Social and Living Standards Measurements (PSLM) 2019-20, obtained from the Pakistan Bureau of Statistics' official website. The PSLM district-level survey encompassed 176,790 households, but due to adjustments for missing observations, the effective sample was reduced to 160,272 households.

3.2. Descriptive analysis

The descriptive analysis of the variables used in the study is provided in the Table 2. It includes summary statistics for several variables, including a measure of insecurity and various demographic and socioeconomic factors. The average (mean) level of insecurity is 0.219, with a standard deviation of 0.414. This variable ranges from 0 (not insecure) to 1 (insecure). The mean value of the variable insecurity indicates that almost 22% households in the study are food insecure. In the sample 17.8% of the households are from the KPK province. The province Punjab has a higher mean insecurity which indicates that 49.6% households are from Punjab, 23.1% from Sindh 9.5% from the Balochistan. In the sample 3 out of 10 households are from the urban area. 4 out of 10 household's head are illiterate. The variable socioeconomic status indicates almost equivalent to 20% representation of lower income group to upper income group. A mean of 0.085 suggests that approximately 8.5% of the household heads in your sample are female. The average age of household heads is approximately 44.3 years, with a standard deviation of 13.444, indicating variability in the age distribution. The age ranges from 14 to 99 years. Regarding the marital status of household's head, a mean of 0.019 means that about 1.9% of the household heads are unmarried. A high mean of 0.914 indicates that 91.4% of the household heads are married, highlighting that marriage is the predominant marital status in this population. The mean of 0.067 shows that 6.7% of the household heads are widowed. The average household size is about 5.4 members, with a standard deviation of 2.602, reflecting a range in household sizes from 1 to 42 members. This indicates that household sizes vary considerably within the population. A mean of 0.078 indicates that approximately 7.8% of the households include migrants.

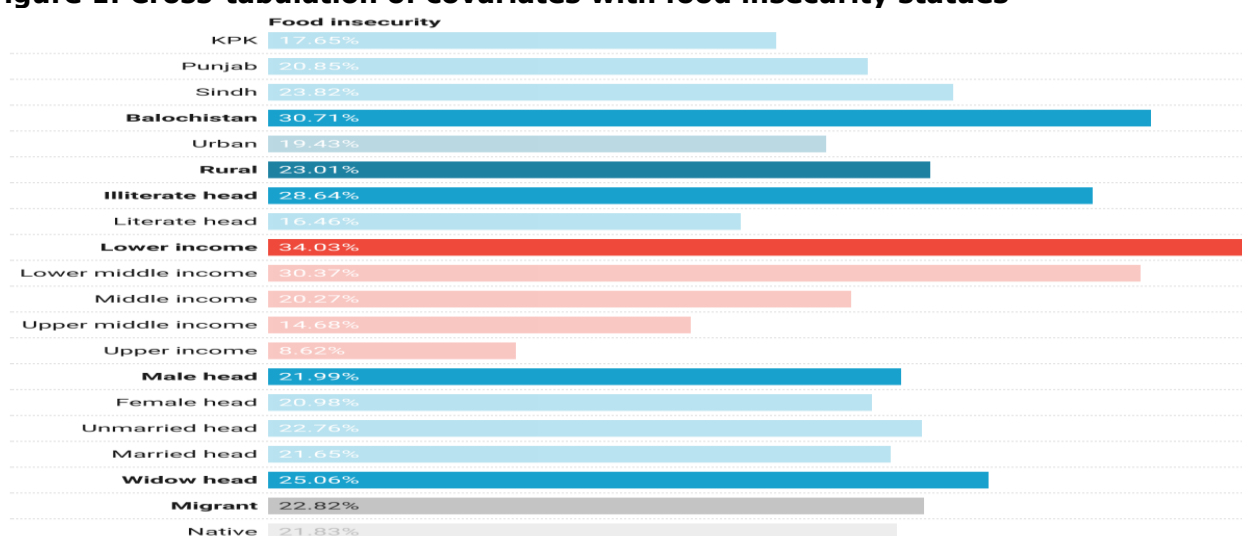
Table 2: Descriptive statistics

Variables	Mean	Std. dev.	Min	Max
Insecure	0.219	0.414	0	1
Province:				
KPK	0.178	0.383	0	1
Punjab	0.496	0.5	0	1
Sindh	0.231	0.421	0	1
Balochistan	0.095	0.293	0	1
Urban	0.311	0.463	0	1
Illiterate	0.447	0.497	0	1
Lower income	0.203	0.402	0	1
Lower middle income	0.21	0.407	0	1
Middle income	0.215	0.411	0	1
Upper middle income	0.173	0.378	0	1
Upper income	0.199	0.399	0	1
Female	0.085	0.278	0	1
Age	44.254	13.444	14	99
Marital Status:				
Unmarried	0.019	0.137	0	1
Married	0.914	0.281	0	1
Widow	0.067	0.25	0	1
Household size	5.416	2.602	1	42
Migrant	0.078	0.267	0	1

3.3. Cross-tabulation

We presented cross-tabulation of various covariates with food insecurity in Figure 1. It indicates the proportion of each category that experiences food insecurity. It displays percentages of food insecurity across different demographic and socio-economic categories such as province, income level, literacy of the household head, and gender of the household head. Each bar represents a different category, with colors distinguishing the types of categories (e.g., provinces, income levels). The province Balochistan shows the highest rate of food insecurity at 30.71%. Sindh follows with 23.82%, Punjab has a food insecurity rate of 20.85%, while KPK has the lowest among provinces at 17.65%. Rural areas have a higher food insecurity rate at 23.01% compared to urban areas at 19.43%.

Figure 1: Cross-tabulation of covariates with food insecurity statuses



Regarding the education of head, illiterate heads of households show a higher rate of food insecurity at 28.64% compared to literate heads at 16.46%. The prevalence of food insecurity across the income levels show that lower income groups face the highest food insecurity at 34.03%. Food insecurity rates decrease progressively with higher income levels, with the upper income group having the lowest at 8.62%. Slightly higher food insecurity is observed in households led by males (21.99%) compared to those led by females (20.98%). Marital status of head shows that widows/widowers face a higher rate of food insecurity at 25.06%. Unmarried heads have food insecurity at 22.76%, and married heads show slightly

lower food insecurity at 21.65%. Migrants have a food insecurity rate of 22.82%, which is comparable to natives at 21.83%. In summary, the Figure 1, effectively illustrates the variations in food insecurity across different demographic and socio-economic groups, emphasizing the higher prevalence in rural areas, Balochistan province, households with illiterate heads, and lower income categories. Notably, widows also experience a relatively higher level of food insecurity. These insights can guide targeted interventions to address the factors contributing to food insecurity in these vulnerable segments.

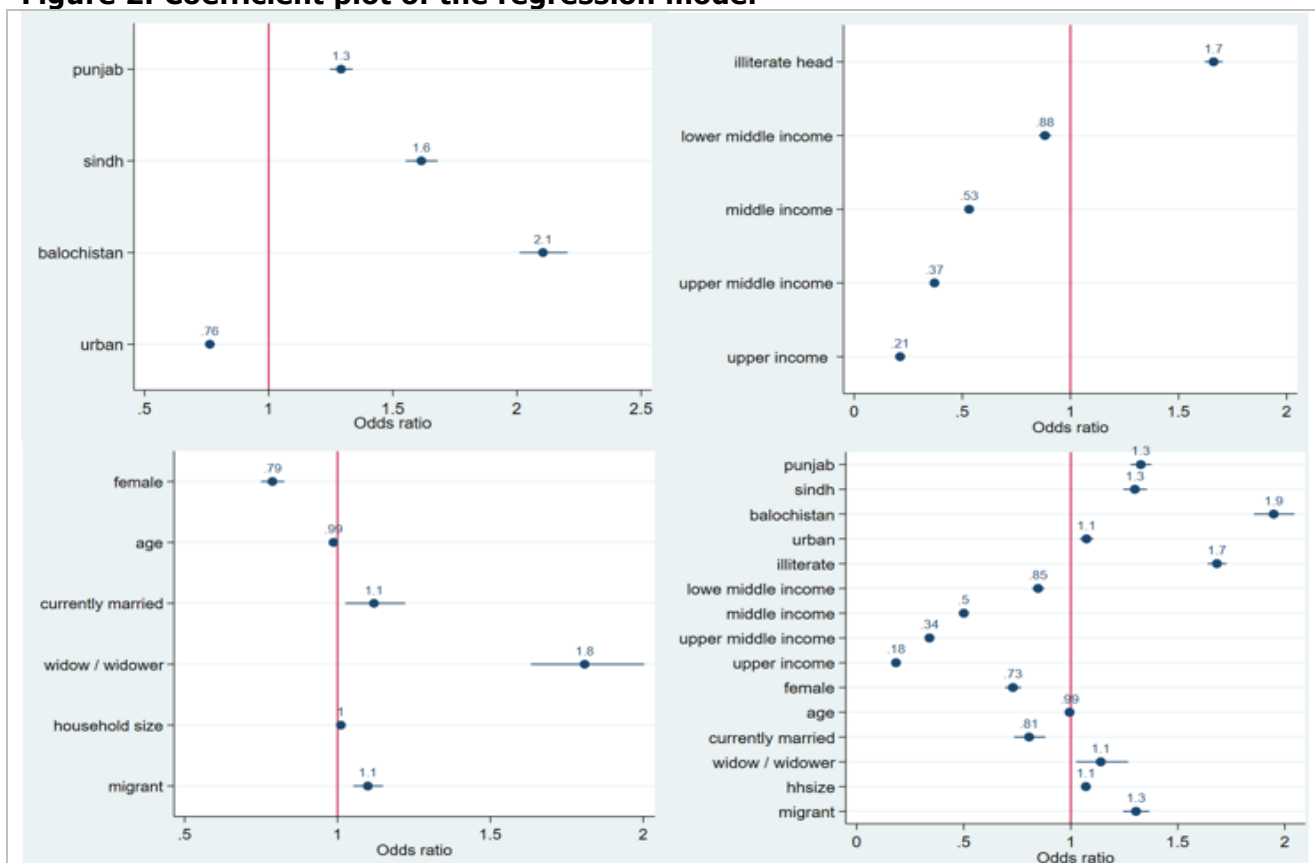
4. Results and Discussion

We presented the coefficients Logit model in the form of odds ratio in Table 3 and coefficient plot in the Figure 2. The coefficient of 1.292 suggests that the odds of the outcome in Punjab are 1.292 times the odds in KPK, holding all other variables constant. This is statistically significant at a high level ($p < 0.1$). It suggests that individual from the Punjab is 29 per cent more likelihood of being food insecure than a person from the KPK. The coefficient of 1.615 indicates that the odds of the outcome in Sindh are approximately 61.5% higher than in KPK, which is also highly significant. The odds of the outcome in Balochistan are 2.105 times the odds in KPK, indicating the highest relative odds among the provinces. The odds of the outcome in urban areas are 1.071 times the odds in rural areas (assuming the reference category is rural), suggesting a 7% more likelihood of the food insecurity in households of urban areas than the households of rural areas. Khyber Pakhtunkhwa (KPK) experiences lower food insecurity than provinces like Punjab, Sindh, and Balochistan due to several factors. Its fertile valleys support robust agriculture, producing essential cereals that reduce reliance on external food sources. Substantial remittances from abroad boost household incomes, enhancing food access. Additionally, greater political stability has fostered better infrastructure development, aiding agricultural and food distribution efforts. While geographical isolation challenges other provinces, KPK's improved connectivity allows better market access, further mitigating food insecurity despite existing challenges.

Both models (Model 2 & 3) show an odds ratio greater than 1 for households headed by an illiterate person, suggesting these households are more likely to experience food insecurity. Specifically, the odds are 1.670 times higher in the first model and 1.683 times higher in the second model compared to households headed by a literate person. It suggests that a household headed by illiterate person is 67% more likelihood of food insecurity than a household headed by literate person. Households headed by literate individuals are less likely to face food insecurity due to several reasons. Literacy improves employment prospects, often leading to better-paying jobs which enhance food affordability. Educated individuals also access and utilize information on nutrition and health more effectively, making healthier food choices. Literacy enhances problem-solving and critical thinking skills, aiding in efficient budget management and food planning. Additionally, literate heads of households typically have wider social networks and better access to government and financial services, supporting stronger food security. Overall, literacy equips individuals with essential tools to ensure stable food access for their families. Low Income category serves as the reference group against which other income categories are compared. The odds of experiencing food insecurity are 0.882 times that of the low income group, indicating a decrease in the likelihood of food insecurity as income increases to lower middle. It also suggests that a household from the lower middle income group has 12% less likelihood of food insecurity than a household from the low income category. It also suggests that a household from the middle income group has 47% less likelihood of food insecurity compared to a household from the lower income group. A household from the upper middle income group has 63% less likelihood of food insecurity than a household from the lower income group. The highest income group has the lowest odds of experiencing food insecurity, with 79% less likelihood of food insecurity compared to the low income group.

Households from upper and upper-middle income groups are more likely to achieve food security due to several factors. Higher incomes allow for the purchase of adequate, nutritious food and a more diverse diet. These households often have better access to quality food sources, like supermarkets and health food stores. Higher educational levels lead to better awareness about nutrition and stable employment, further supporting food security. Additionally, such households usually have better healthcare access, stable housing, and reliable infrastructure, all crucial for consistent food supply. Extensive social networks and financial safety nets also buffer against economic downturns that could impact food security.

Figure 2: Coefficient plot of the regression model



An odds ratio of 0.730 indicates that households headed by females are about 27% less likely to experience food insecurity compared to those headed by males, given everything else constant. Female-headed households may experience lower food insecurity than male-headed ones due to several factors. Women often allocate a higher portion of their income to food, healthcare, and education, directly improving family well-being and food security. They typically prioritize nutritional value in food purchases, enhancing dietary quality. Strong community and social networks provide additional support, sharing resources and knowledge about food programs. Additionally, government assistance programs are frequently more accessible to female-headed households. Women's tendency towards risk-averse financial decisions prioritizes essentials like food, contributing to greater stability and food security, although outcomes can vary based on specific circumstances. The odds ratio of 0.994 per year increase in age suggests that each additional year in the age of the household head reduces the likelihood of food insecurity by approximately 0.6%. This is calculated as $(1 - 0.994 = 0.006)$ or 0.6% when converted to percentage points. As household heads age, they often experience less food insecurity due to several factors. Older individuals typically have more life and work experience, leading to greater financial stability and resource management skills. They tend to have established social networks and access to community resources that provide support. Additionally, they usually possess accumulated assets like savings and home ownership, which buffer against economic downturns. Older adults often qualify for government benefits, have fewer dependents, and hold valuable knowledge about budgeting and nutrition, all of which contribute to a more secure food situation.

Households headed by married individuals have an odds of being food insecure that are 19.5% lower than those headed by unmarried individuals (base category). Households headed by widow/widower are 14% more likely to be food insecure compared to those headed by unmarried individuals. Households headed by married individuals generally experience lower food insecurity due to several advantages. These include dual incomes, which increase financial stability and resources for essentials. Married couples often share responsibilities like food purchasing and preparation, achieving economies of scale that reduce costs. They also enjoy emotional and social support, enhancing their ability to cope with stress and maintain employment. Access to benefits such as health insurance and better opportunities for financial

planning further contribute to their food security compared to unmarried or widowed households. Each additional member in the household increases the odds of experiencing food insecurity by 7%, considering the odds ratio of 1.070. An increase in household size often leads to higher food insecurity due to various factors. A household with larger family size often face greater food demands because household income does not observe proportional increase. Larger families also face higher non-food cost like healthcare and education which divert funds from food which increases the food insufficiency. The aftermaths in the Table 3 also suggest that a household headed by a person who is migrant and did not native in the district in which currently residing has 30.5% more likelihood of experiencing the food insecurity vis-à-vis household headed by a native. A household headed by migrant is more inclined to food insecurity due to limited social network, employment barriers due to language difficulty which strain financial resources, thereby leading to more inclined to food insecurity.

Table 3: Odds ratio of the Logistic regression model

Variable	Model 1	Model 2	Model 3
KPK (base)			
Punjab	1.292*** (0.0232)	1.284*** (0.0238)	1.327*** (0.0251)
Sindh	1.615*** (0.0330)	1.265*** (0.0268)	1.299*** (0.0283)
Balochistan	2.105*** (0.0494)	1.942*** (0.0471)	1.948*** (0.0483)
Urban	0.763*** (0.0107)	1.071*** (0.0158)	1.073*** (0.0162)
Illiterate head		1.670*** (0.0217)	1.683*** (0.0224)
Low income (base)			
Lower middle income		0.882*** (0.0150)	0.847*** (0.0145)
Middle income		0.529*** (0.00967)	0.500*** (0.00928)
Upper middle income		0.369*** (0.00783)	0.340*** (0.00741)
Upper income		0.212*** (0.00506)	0.184*** (0.00466)
Female head			0.730*** (0.0192)
Age of head			0.994*** (0.000525)
Marital status of head:			
Unmarried (base)			
Married			0.805*** (0.0373)
Widow			1.140** (0.0620)
Household size			1.070*** (0.00284)
Migrant			1.305*** (0.0312)
Constant	0.221*** (0.00344)	0.287*** (0.00615)	0.318*** (0.0164)
Pseudo R2	0.0087	0.0666	0.0725
Observations	160,272	160,272	160,272

Standard error eform in the parenthesis, * 10%, **5%, ***10% level of significance

5. Conclusion

This study analyze the factors influencing food insecurity across various demographics using a Logit model. Key findings suggest significant inter-province regional disparities, with Punjab, Sindh, and Balochistan showing higher likelihood of food insecurity compared to KPK, attributed to less robust agricultural outputs and socio-economic challenges. The analysis also highlights the vulnerability of households based on literacy, income level, and gender of the head, marital status of head, age of head, household size, and migrant status. Notably, households headed by illiterate individuals, lower income categories, larger family sizes, and migrants are particularly prone to food insecurity. Conversely, older household heads, those led by married couples or females, and higher income groups tend to exhibit greater food security,

benefiting from accumulated resources, stable incomes, and effective resource management. These findings underscore the need for targeted interventions to address food insecurity, focusing on education, economic support, and specific demographic vulnerabilities to enhance food access and stability across diverse populations. Research suggests that policy interventions aimed at mitigating food insecurity should concentrate on narrowing inter-provincial disparities through technological support and training initiatives. Enhancing educational and literacy programs is vital for empowering residents, especially those from lower-income households, by bolstering their employment prospects. Furthermore, it is essential to broaden social safety nets, adapting food assistance programs to accommodate the specific requirements of large families and migrant populations. Additionally, policies must be implemented to ensure income stability for households led by widows, potentially through subsidies or stipends.

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