



Food Security and Its Determinants among Women Informal Workers in Khulna City Corporation, Bangladesh

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Received: 8 June 2026; Revised: 7 August 2026; Accepted: 31 August 2026

Abstract

Background: Food insecurity among women in informal employment represents a critical yet underexplored public health concern in urban Bangladesh. **Objective:** This study examined the food security status and its determinants among women informal workers in Khulna City Corporation (KCC), Bangladesh. **Methods:** A cross-sectional study design was employed, with data collected from 385 women through purposive sampling using structured questionnaires. Food security status was assessed using the Household Dietary Diversity Score (HDDS), with households consuming fewer than five food groups classified as food insecure. Binary logistic regression was employed to identify factors associated with food security status. **Results:** Findings revealed that 56.36% of respondents were food insecure. Higher educational attainment and greater monthly income were identified as significant positive predictors of food security, while larger family size and the presence of a chronically ill household member significantly reduced the likelihood of food security. Occupational type and daily working hours were additionally significant, with street vendors more likely to be food secure than domestic workers, and women working more than eight hours per day significantly less likely to achieve food security. Age and alternate source of income were not

statistically significant predictors. Economic barriers, particularly low and unstable income, high food prices, and irregular employment, were the most frequently reported challenges to food access.

Conclusion: These findings highlight the structural vulnerabilities driving food insecurity among women informal workers and underscore the need for targeted interventions, including vocational and literacy-focused education programs, wage protection and income-support schemes for low-earning occupations such as domestic work, and expansion of social safety nets tailored to informal-sector households with dependents or chronically ill members.

Keywords: Food security, Women informal workers, Dietary diversity, Determinants, Khulna, Bangladesh

What was Known

- Women in the informal sector face high risks of food insecurity.
- Food security research in Bangladesh has mostly focused on rural agricultural areas.
- Data on dietary diversity challenges of urban women workers remained scarce.

What's New and Next

- Most women informal workers in Khulna lack food security and dietary diversity.
- Income and education strongly determine their daily food access.
- Future policies must stabilize urban income to protect the informal sector.

Introduction

Food security remains one of the most pressing developmental challenges facing low and middle-income countries. The Food and Agriculture Organization (FAO) defines food security as a condition in which all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs for an active and healthy life ⁽¹⁾. Despite significant progress in global food production, access to adequate and nutritious food remains deeply unequal, particularly among marginalized populations in rapidly urbanizing developing economies ^(2,3). In Bangladesh, food insecurity is shaped by a complex interplay of poverty, gender inequality, climate vulnerability, and dependence on informal livelihoods, making it a multidimensional challenge that cannot be addressed through production-side interventions alone ⁽⁴⁾.

Women bear a disproportionate burden of food insecurity in developing countries, as their roles as primary caregivers and household food managers coexist with structural barriers limiting

their own access to food, income, and productive resources ⁽⁵⁾. Socio-cultural norms that restrict women's participation in economic decision-making further compound these vulnerabilities, often resulting in women prioritizing household members' food needs over their own ^(6,7). Research consistently demonstrates that improving women's economic empowerment and food access generates significant multiplier effects for household and community-level food security outcomes ^(8,9). Informal sector employment compounds these vulnerabilities further, as informal workers are characterized by low and unstable wages, absence of legal protections, limited access to social safety nets, and high exposure to economic shocks ⁽¹⁰⁾. These conditions directly constrain their purchasing power and dietary diversity. The COVID-19 pandemic further exposed and intensified these vulnerabilities, as women in the informal sector experienced disproportionate job losses, severe income instability, and disrupted access to food markets ⁽¹¹⁾. In Bangladesh, where women constitute a substantial portion of the urban informal workforce, these dynamics translate into heightened household food insecurity with long-term consequences for maternal and child nutrition ⁽¹²⁾.

Khulna City Corporation (KCC), located in the southwestern coastal region of Bangladesh, presents a particularly relevant and underexplored context for studying food security among women informal workers. Unlike Dhaka or Chattogram, where informal settlement growth is driven primarily by general rural to urban economic migration, Khulna's informal labor market reflects a distinct convergence of climate induced displacement and urban poverty, making it a uniquely instructive setting for examining how environmental and economic vulnerabilities jointly shape food security outcomes. The city faces compounding environmental pressures, including climate-induced displacement from surrounding coastal areas, increasing salinity intrusion, and rapid growth of informal settlements within the urban core ^(13,14,15). These conditions have contributed to a large and growing informal labor market in which women are heavily represented in precarious occupations such as domestic work and street vending. Despite this, empirical evidence on the food security status of this specific population remains scarce.

Existing studies on food security in Bangladesh have largely focused on rural households and agricultural communities, with relatively limited attention to urban informal workers ⁽¹⁶⁾. Where urban food insecurity has been examined, gender-disaggregated analyses that specifically address the experiences of women in informal employment are largely absent from the literature ⁽⁷⁾. This gap is significant, as the determinants of food insecurity among urban informal women workers may differ substantially from those observed in rural or general urban populations, necessitating targeted

empirical investigation. This distinction is particularly important because urban informal workers depend almost entirely on the cash economy and market food purchases for household consumption, leaving them acutely exposed to price volatility and income shocks. In contrast, many rural households can partially buffer such shocks through subsistence farming, kitchen gardens, or livestock rearing, mechanisms that are largely unavailable to women working in Khulna's urban informal sector.

This study addresses these gaps by examining food security status and its determinants among women engaged in informal sector employment in Khulna City Corporation. Specifically, the study aims to: (i) assess the prevalence of food insecurity among this population using the Household Dietary Diversity Score (HDDS); and (ii) identify the socio-economic and household-level factors associated with food security status through binary logistic regression analysis. The findings are intended to generate evidence that can inform targeted policy interventions and social protection programs aimed at improving food security among this vulnerable and underserved population in Bangladesh.

Materials and Methods

Study Area and Population

This study was conducted in Khulna City Corporation (KCC), located in the southwestern region of Bangladesh (Figure 1). Khulna is one of the country's major urban centers and is characterized by a substantial informal economy with notable female labor force participation. The city faces heightened environmental vulnerability, including increasing salinity intrusion and climate-induced displacement from surrounding coastal areas, which have contributed to the growth of informal settlements and precarious livelihoods within the urban core^(13,14,15). These conditions make KCC a particularly relevant setting for examining food security among women in the informal sector.

Study Design and Sampling

A cross-sectional study design was employed to identify the determinants of food security among women engaged in informal sector employment in KCC. A purposive sampling technique was applied to recruit participants who met the eligibility criteria, specifically adult women aged 18 years and above who were actively engaged in informal sector work within KCC for a minimum of six months prior to data collection, and who provided informed consent to participate. Women who were formally employed, unable to communicate due to severe illness or cognitive impairment, or unwilling to provide consent were excluded from the study. Probability sampling methods, such as simple

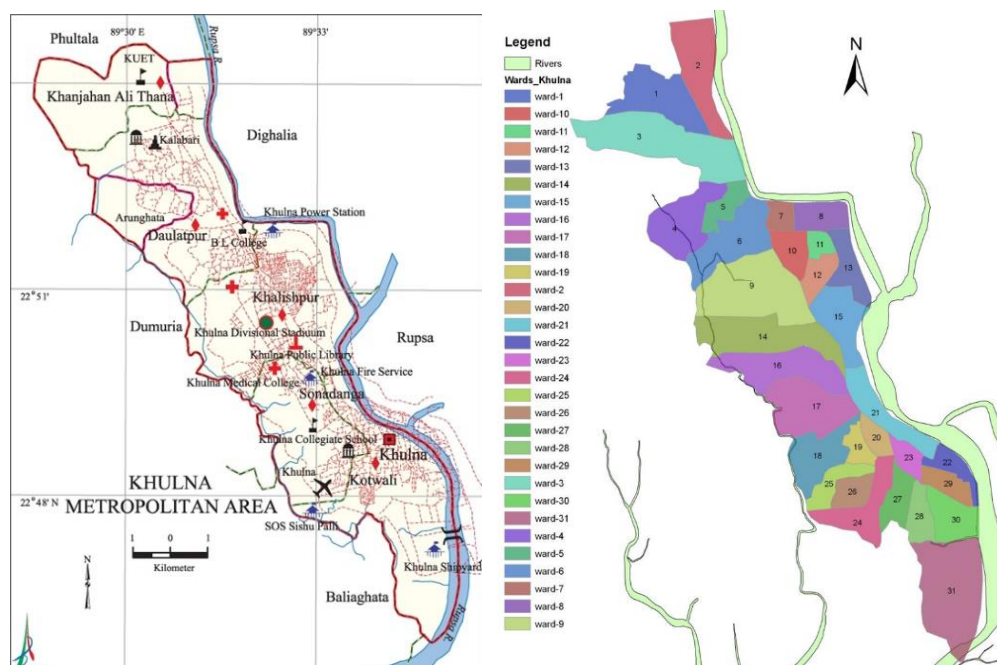


Figure 1: Geographic location of Khulna City Corporation, Bangladesh

random or stratified sampling, were not feasible in this context due to the absence of a formal administrative registry or sampling frame for women engaged in informal sector work in KCC. Purposive sampling was therefore adopted to ensure inclusion of eligible participants across the major informal occupational categories relevant to this study. Enumerators identified and approached potential respondents directly at common informal work sites, including local markets, roadside vending points, and residential neighborhoods where domestic workers were engaged, until the required sample size was reached. The sample size was determined using Cochran's formula for unknown population proportions:

$$n = \frac{Z^2 pq}{e^2}$$

where n is the required sample size, Z is the standard normal value corresponding to a 95% confidence level (1.96), p is the estimated proportion of the population possessing the characteristic of interest (assumed at 0.5 to maximize variance), $q = (1 - p)$, and e is the margin of error (5%). This yielded a minimum required sample size of 384, rounded to 385 participants⁽¹⁷⁾. A total of 412 women were approached for participation, of whom 385 agreed to take part and completed

the survey, yielding a response rate of 93.4%. The remaining individuals declined participation at the time of data collection. All 385 collected questionnaires were fully completed, with no cases requiring exclusion due to missing or incomplete data.

Data Collection and Measurement of Food Security

Data were collected through a structured questionnaire administered via face-to-face interviews. The questionnaire was developed by adapting items from previously validated instruments used in Bangladesh-based food security and dietary diversity studies^(16,20), with modifications made to reflect the specific socio-economic and occupational context of women informal workers in KCC. It captured socio-demographic characteristics, household composition, income levels, occupational details, and dietary information. Prior to full deployment, a pilot study was conducted with 30 informal sector women (approximately 5% of the target sample), who were subsequently excluded from the final sample, in order to assess the clarity, cultural appropriateness, and relevance of the instrument^(18,19).

Food security status was assessed using the Household Dietary Diversity Score (HDDS), a validated proxy indicator of household-level food access. The HDDS was calculated by summing the number of distinct food groups (12 items) consumed by a household within a 24-hour recall period across twelve pre-defined food groups (Supplementary Table S1). Households consuming five or more food groups (≥ 5) were classified as food secure, while those consuming fewer than five food groups (< 5) were classified as food insecure, following the threshold applied in prior Bangladesh-based research⁽²⁰⁾. To ensure the recall period reflected typical dietary patterns, data collection was scheduled to avoid atypical days such as religious festivals, fasting days, and the day immediately following salary or wage disbursement, so that reported food consumption would represent respondents' usual daily food access rather than exceptional circumstances.

The dependent variable was food security status, operationalized as a binary outcome (food secure=1; food insecure=0) based on the HDDS threshold described above. Independent variables were examined, as defined in Table 1.

Data Analysis

Descriptive statistics including frequencies, percentages, means, and standard deviations were used to summarize participant characteristics and food security status. Binary logistic regression was employed to identify factors associated with food security status, given the dichotomous nature

Table 1 Variable definitions used in this study

Variable	Definition / Measurement	Scale
Dependent Variable		
Food Security Status	Classified based on HDDS over 24-hour recall; ≥ 5 food groups = food secure (1), < 5 = food insecure (0)	Binary
Independent Variables		
Age (Years)	Respondent's age in years	Continuous
Education Level	No Formal Education (0), Primary (1), Secondary (2), Higher Secondary+ (3)	Ordinal
Monthly Income (BDT)	$< 5,000$ (1), 5,000-9,999 (2), 10,000-14,999 (3), $\geq 15,000$ (4)	Ordinal
Family Size	Total number of members residing in the respondent's household	Continuous
Incurable Person in Family	Yes (1), No (0)	Binary
Alternate Source of Income	Yes (1), No (0)	Binary
Type of Informal Work	Domestic Worker (0), Street Vendor (1)	Binary
Working Hours Per Day	< 6 hours (1), 6-8 hours (2), > 8 hours (3)	Ordinal

of the dependent variable ⁽²¹⁾. The model estimated odds ratios (OR) and 95% confidence intervals (CI) for each independent variable. Model fit was assessed using the Hosmer-Lemeshow test, and explanatory power was reported using Cox & Snell and Nagelkerke R-squared values. The marginal effect of each predictor on the probability of food security was calculated as:

$$\partial P / \partial x_{ij} = P_i(1 - P_i)\beta_j$$

where P_i is the predicted probability of food security for the i -th household and β_j is the coefficient for the j -th predictor. All analyses were performed using IBM SPSS Statistics.

Results

Socio-Demographic and Economic Profile of Respondents

A total of 385 women engaged in informal sector employment participated in this study. Table 2 presents their socio-demographic and economic characteristics. The majority of respondents (41.30%) were aged between 30 and 44 years, followed by those aged 45-59 years (28.57%) and 18-29 years (25.97%). Only 4.16% of participants were aged 60 years or above. Regarding educational attainment, more than one-third of respondents (36.10%) had no formal education, while 30.91% had completed primary schooling. Secondary and higher secondary education or above were reported by 20.52% and 12.47% of respondents, respectively.

In terms of monthly income, nearly half of the respondents (46.49%) earned between 5,000 and 9,999 BDT, while 30.91% earned below 5,000 BDT. Only 4.16% reported monthly earnings of 15,000 BDT or above. Regarding household composition, more than half of the respondents (51.43%) resided in families of 4-6 members, while 27.79% belonged to larger households of seven or more members. The presence of a chronically ill family member was reported by 15.58% of respondents. The majority (77.40%) had no alternate source of household income, indicating heavy dependence on informal sector earnings as their primary means of livelihood.

Regarding occupational categories, the majority of respondents (56.62%) were domestic workers, while the remaining 43.38% were street vendors. In terms of daily working hours, approximately half of the respondents (50.91%) worked between 6 and 8 hours per day, while 25.97% worked more than 8 hours and 23.12% worked fewer than 6 hours per day.

Food Security Status of Surveyed Households

The assessment of food security among surveyed households, based on the Household Dietary Diversity Score (HDDS), is presented in Table 3. The results indicate that 56.36% of households were classified as food insecure, having consumed fewer than five distinct food groups during the 24-hour recall period. In contrast, 43.64% consumed five or more food groups, reflecting sufficient dietary diversity to be classified as food secure. These findings highlight a notable prevalence of food insecurity among women in the informal sector of Khulna City Corporation, with more than half of the surveyed households failing to meet the minimum dietary diversity threshold.

Table 2 Sample Summary Statistics of Women in the Informal Sector

Variable	Category	Frequency (n)	Percentage (%)
Age (Years)	18-29	100	25.97
	30-44	159	41.30
	45-59	110	28.57
	60+	16	4.16
Education Level	No Formal Education	139	36.10
	Primary (1-5 Years)	119	30.91
	Secondary (6-10 Years)	79	20.52
	Higher Secondary+	48	12.47
Monthly Income (BDT)	<5,000	119	30.91
	5,000-9,999	179	46.49
	10,000-14,999	71	18.44
	≥15,000	16	4.16
Family Size	1-3 members	80	20.78
	4-6 members	198	51.43
	≥7 members	107	27.79
Incurable Person in Family	Yes	60	15.58
	No	325	84.42
Alternate Source of Income	Yes	87	22.60
	No	298	77.40
Type of Informal Work	Domestic Worker	218	56.62
	Street Vendor	167	43.38
Working Hours Per Day	<6 hours	89	23.12
	6-8 hours	196	50.91
	>8 hours	100	25.97

Table 3 Household Dietary Diversity Score (HDDS) and Food Security Status

HDDS Category	Food Security Status	Frequency (n)	Percentage (%)
Consumed <5 food groups	Food Insecure	217	56.36
Consumed ≥ 5 food groups	Food Secure	168	43.64

Factors Affecting Food Security Status

Table 4 presents the results of the binary logistic regression analysis examining factors associated with food security status among women in the informal sector. The model demonstrated a good fit, as indicated by a non-significant Hosmer-Lemeshow test ($\chi^2 = 8.12$, $df = 8$, $p = 0.422$), with a Nagelkerke R^2 of 0.698, indicating that the model accounts for a substantial proportion of the variability in food security status, though Nagelkerke R^2 is a pseudo- R^2 and should not be interpreted identically to R^2 in linear regression.

Education level emerged as a significant positive predictor of food security. Compared to women with no formal education, those with primary education were more than twice as likely to be food secure ($OR = 2.225$, $p = 0.030$). This likelihood increased progressively with higher educational attainment, with women having secondary education approximately 3.5 times more likely ($OR = 3.492$, $p = 0.005$) and those with higher secondary education or above approximately 6.7 times more likely ($OR = 6.686$, $p = 0.002$) to achieve food security.

Monthly income was similarly a strong positive predictor. Women earning 5,000-9,999 BDT were 3.67 times more likely to be food secure compared to those earning below 5,000 BDT ($OR = 3.669$, $p = 0.002$). This association strengthened considerably with higher income levels, with women in the highest income category ($\geq 15,000$ BDT) being approximately 18 times more likely to be food secure ($OR = 18.174$, $p < 0.001$). It should be noted, however, that the wide confidence interval observed for this group (95% CI: 3.791-87.126) reflects the small sample size in this category ($n = 16$) and should be interpreted with caution.

Family size was identified as a significant negative predictor, with each additional household member reducing the odds of food security by approximately 25.9% ($OR = 0.741$, $p = 0.032$). Similarly, the presence of a chronically ill family member significantly reduced the likelihood of food security by approximately 66.7% ($OR = 0.333$, $p = 0.028$). Age and alternate source of income were not found to be statistically significant predictors of food security status in this model.

Regarding occupational type, street vendors were approximately 1.86 times more likely to be food secure compared to domestic workers (OR = 1.859, $p = 0.045$), suggesting that street vending, despite its informality, may offer relatively greater income flexibility and food access compared to domestic work. With respect to working hours, women working more than 8 hours per day were approximately half as likely to be food secure compared to those working fewer than 6 hours (OR = 0.507, $p = 0.023$), indicating that excessive working hours may constrain time available for food procurement and preparation, thereby reducing dietary diversity. Women working 6-8 hours per day did not show a statistically significant difference in food security status compared to those working fewer than 6 hours (OR = 1.405, $p = 0.224$).

Table 4 Factors Affecting Food Security Status Among Women in the Informal Sector

Independent Variable	B	S.E.	p-value	OR	95% CI
Constant	-1.240	0.95	0.191	0.289	
Age (Years)					
30-44 (Ref: 18-29)	0.35	0.30	0.243	1.419	0.788-2.553
45-59 (Ref: 18-29)	0.48	0.38	0.206	1.616	0.772-3.385
60+ (Ref: 18-29)	-0.10	0.75	0.893	0.905	0.207-3.961
Education Level					
Primary (Ref: No Formal Education)	0.800	0.37	0.030*	2.225	1.077-4.595
Secondary (Ref: No Formal Education)	1.250	0.45	0.005**	3.492	1.450-8.411
Higher Secondary+ (Ref: No Formal Education)	1.900	0.60	0.002**	6.686	2.073-21.570
Monthly Income (BDT)					
5,000-9,999 (Ref: <5,000)	1.300	0.42	0.002**	3.669	1.603-8.401
10,000-14,999 (Ref: <5,000)	2.100	0.55	<0.001***	8.166	2.784-23.971
≥15,000 (Ref: <5,000)	2.900	0.80	<0.001***	18.174	3.791-87.126
Family Size (per additional member)	-0.300	0.14	0.032*	0.741	0.563-0.975

Table 4 Factors Affecting Food Security Status Among Women in the Informal Sector (Cont.)

Independent Variable	B	S.E.	p-value	OR	95% CI
Incurable Person in Family (Yes vs. No)	-1.100	0.50	0.028*	0.333	0.125-0.887
Alternate Source of Income (Yes vs. No)	0.400	0.55	0.466	1.492	0.509-4.379
Type of Informal Work					
Street Vendor (Ref: Domestic Worker)	0.620	0.31	0.045*	1.859	1.012-3.414
Working Hours Per Day					
6-8 hrs (Ref: <6 hrs)	0.340	0.28	0.224	1.405	0.812-2.431
>8 hrs (Ref: <6 hrs)	-0.680	0.30	0.023*	0.507	0.281-0.914

Model fit statistics: -2 Log Likelihood = 96.30; Cox & Snell R^2 = 0.338; Nagelkerke R^2 = 0.698; Hosmer-Lemeshow Test: χ^2 = 8.12 (df = 8), p = 0.422; Note: OR = Odds Ratio; CI = Confidence Interval; *p<0.05, **p<0.01, ***p<0.001

Major Challenges Faced in Accessing Food

Figure 2 presents the major challenges reported by respondents regarding food access. Economic barriers were overwhelmingly predominant. Low and unstable income was the most frequently cited challenge, reported by 87.79% of respondents. High food prices and inflation were identified by 80.26% of participants, indicating that even when income is available, purchasing power remains severely constrained by market conditions. Irregular employment and lack of steady work affected 61.82% of respondents, directly contributing to income instability and reduced food access.

Beyond immediate income constraints, inadequate savings was reported by 56.62% of respondents, reflecting a lack of financial resilience during periods of reduced earnings or unexpected expenditure. The burden of family dependents was cited by 49.35% of participants, suggesting that larger household sizes and a greater number of non-earning members further exacerbate food insecurity. Debt and loan repayments were identified as a challenge by 36.10% of respondents, while limited access to credit affected 28.83%, further restricting households' capacity to manage consumption during lean periods.

Health-related barriers were also notable, with 22.60% of respondents citing illness within the family as a significant obstacle to food access due to increased healthcare expenditure and reduced earning capacity. Long working hours and time constraints were reported by 18.44% of participants, potentially limiting their ability to purchase and prepare food efficiently. Finally, lack of awareness about nutritious food was identified by 10.39% of respondents, suggesting a need for nutritional education alongside economic interventions.

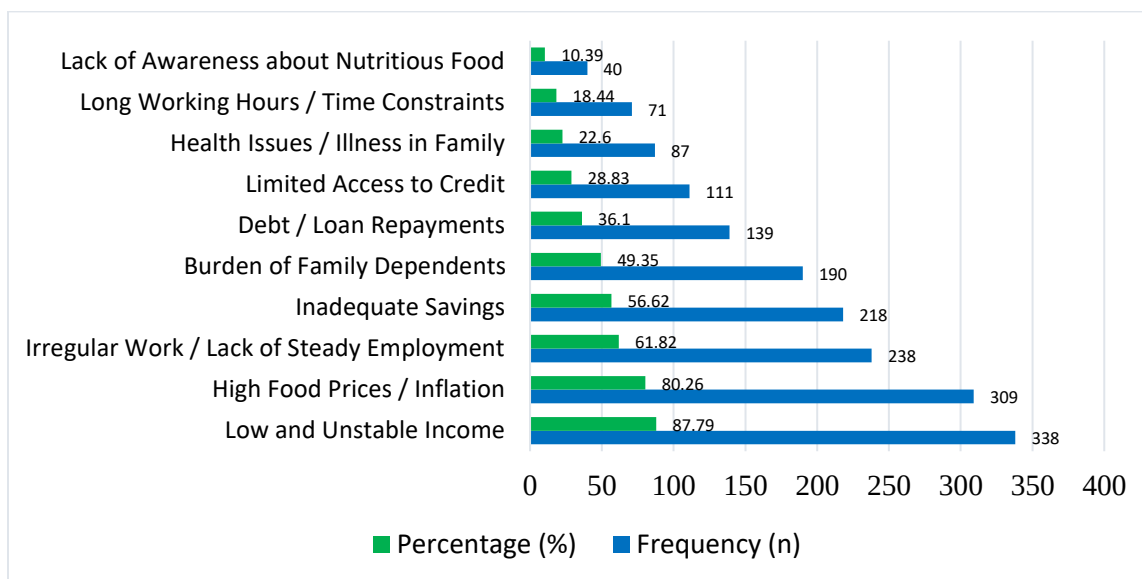


Figure 2 Major Challenges Faced by Women in the Informal Sector to Access Food

Discussion

This study examined food security status and its determinants among 385 women informal workers in Khulna City Corporation, Bangladesh. More than half of the households (56.36%) were classified as food insecure based on the HDDS threshold, a finding consistent with broader evidence of high food insecurity prevalence among urban informal workers in developing economies ^(2,3). A similarly high prevalence has been reported in recent studies from other parts of Bangladesh, including slum households in Khulna Division ⁽²⁸⁾ and urban informal settlements affected by climate-induced migration ⁽²⁹⁾, reinforcing the pattern of acute food insecurity among the country's urban informal population.

Education emerged as a strong positive predictor of food security, with odds of food security increasing progressively with higher educational attainment. This aligns with findings from Nepal,

where women's education beyond the secondary level was associated with significantly lower rates of food insecurity ⁽²²⁾, and with evidence from Ghana linking educational attainment to improved dietary diversity among household heads ⁽²³⁾.

Monthly income was the most powerful predictor in the model, with women in the highest income bracket approximately 18 times more likely to be food secure than those earning below 5,000 BDT. This is consistent with established literature demonstrating that income is a primary determinant of household food access and nutritional adequacy ^(4,24). The wide confidence interval observed for the highest income group, however, reflects the small sample size in that category (n=16) and warrants cautious interpretation.

Family size was a significant negative predictor, with each additional household member reducing the odds of food security by approximately 26%. This inverse relationship is well-documented, as larger households face increased per capita resource strain ^(24,25). The presence of a chronically ill family member further reduced food security odds by approximately 67%, corroborating evidence that chronic illness imposes substantial economic burdens that diminish household food access ⁽²⁶⁾.

Age and alternate source of income were not significant predictors in this model. The non-significance of alternate income sources may reflect the irregular and low-value nature of secondary income streams available to this population, which may be insufficient to meaningfully improve dietary diversity ⁽¹⁰⁾. The economic challenges reported by respondents, particularly low and unstable income, high food prices, and irregular employment, further underscore the structural vulnerabilities that drive food insecurity among this demographic ^(7,11).

The findings also highlight the importance of occupational type and working hours as determinants of food security. Street vendors were significantly more likely to be food secure than domestic workers, potentially reflecting greater income variability and proximity to food markets that characterize street vending occupations ⁽²⁷⁾. This aligns with evidence suggesting that the nature of informal work, beyond income alone, shapes dietary access through time availability and market proximity ⁽¹⁰⁾. Women working more than 8 hours per day were significantly less likely to be food secure, a finding consistent with literature demonstrating that excessive working hours reduce time available for food procurement and preparation, thereby compromising dietary diversity among working women ⁽⁷⁾.

This study has strengths, including its focus on an understudied population and use of a validated food security measure with robust regression analysis. However, several limitations warrant consideration. The cross-sectional design precludes causal inference, the purposive sampling approach, necessitated by the absence of a formal registry for informal workers, may limit representativeness, and reliance on a single 24-hour dietary recall may not fully capture usual or seasonal dietary patterns. Additionally, the study's focus on a single urban center limits generalizability to other settings in Bangladesh. Future research using longitudinal designs, probability sampling, and multi-day recall across multiple urban centers would strengthen this evidence base.

Conclusion

This study provides empirical evidence on the food security status and its determinants among women informal workers in Khulna City Corporation, Bangladesh. More than half of the surveyed households were classified as food insecure, reflecting the profound dietary vulnerability of this population. Binary logistic regression analysis identified higher educational attainment and greater monthly income as significant positive predictors of food security, while larger family size and the presence of a chronically ill household member were significant negative predictors. Occupational type and daily working hours were additionally identified as significant determinants, with street vendors more likely to be food secure than domestic workers, and women working more than eight hours per day significantly less likely to achieve food security. Age and alternate source of income did not demonstrate statistically significant associations with food security status.

The findings underscore that food insecurity among women in the informal sector is associated with a confluence of structural and household-level factors, with economic instability emerging as the most consistently reported challenge. While the cross-sectional design of this study precludes causal inference, these associations point to plausible areas for targeted policy attention, including expansion of access to education and vocational training, strengthening social protection programs for households with chronically ill dependents, and mechanisms to stabilize income and food prices for urban informal workers.

Ethical Approval Statement

Ethical approval was obtained from the Institutional Review Board of German University Bangladesh (IRB Approval No: IRB/2026/04). All participants were informed of the study objectives,

the voluntary nature of participation, and their right to withdraw at any time without consequence. Written informed consent was obtained from each participant prior to data collection. Confidentiality of participant information was maintained throughout the study, and no personally identifiable data were disclosed.

Author Contributions

SAU: Conceptualization, Investigation, Project Administration, Writing Original Draft Preparation. AAZ: Supervision, Methodology, Formal Analysis, Writing, Review & Editing. SHMR: Software, Formal Analysis, Writing Original Draft Preparation. SSCA: Investigation, Resources, Data Curation. SH: Validation, Visualization, Writing, Review & Editing. All authors have critically reviewed the findings, read, and approved the final manuscript for publication.

Acknowledgements

Not Applicable

Source of Funding

The work presented in this article was self-funded.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary Table S1. Food Groups Used in the Household Dietary Diversity Score (HDDS)

No.	Food Group	Examples
1	Eggs	Chicken/duck eggs
2	Vegetables	Leafy greens, gourds, other vegetables
3	Legumes, nuts, and beans	Peas, lentils, beans, nuts
4	Cereals and grains	Wheat, maize, millet, sorghum, rice, noodles, biscuits, bread
5	Meat	Goat, lamb, beef, pork, poultry, organ meats
6	Tubers and roots	Cassava, yam, potato
7	Fruits	Banana, mango, seasonal fruits
8	Fish and shellfish	Fresh, dried, or preserved fish
9	Condiments and beverages	Coffee, tea, other condiments
10	Fats and oils	Cooking oil, butter, ghee
11	Milk and dairy products	Yoghurt, cheese, milk
12	Sugar and honey	Sugar, honey, sweets