

The Interaction of Digital Lifestyle and Food Waste on Household Food Security among Urban Millennials: Evidence from Palembang City, Indonesia

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Abstract: Household food security in urban areas, especially among millennials, is becoming an increasingly important issue as lifestyles and consumption patterns change due to the digitization of food services. This study aims to analyze the level of food security among millennial households in Palembang and examine the effect of spending on food delivery and food waste on the Household Food Insecurity Access Scale (HFIAS) score. Data were obtained from millennial household respondents through a questionnaire survey, with the HFIAS score as the dependent variable. The analysis was conducted using Ordinary Least Squares (OLS) regression, followed by Poisson regression as an alternative model suitable for count data. The results showed that the average HFIAS score was 3.17, with the majority (87%) of households falling into the mildly food insecure category. OLS and Poisson regressions show that spending on food delivery and food waste has a negative effect on food security. This study concludes that the food security of millennial households in Palembang is relatively vulnerable, mainly due to their increasing dependence on food delivery services.

Keywords: Food security; HFIAS; food delivery; food waste; millennials

JEL: D12, D13, I31, Q18, L86

1. INTRODUCTION

Food security is one of the most pressing multidimensional challenges in global development. Although the international community has set targets for eliminating hunger and food insecurity by 2030 through the Sustainable Development Goals (SDGs), current developments show slow progress. The FAO et al. (2024) report reveals that billions of people around the world still face difficulties in accessing nutritious, safe, and sufficient food. Inequalities in food distribution, the impact of climate change on agricultural production, and geopolitical tensions have exacerbated global food security (Barrett, 2021; Ogwu et al., 2024; Qazi & Al-Mhdawi, 2024).

In Indonesia, food security is not only influenced by food production and distribution issues, but also by changes in consumption patterns that have significantly shifted over the past decade. These changes have been triggered by digital transformation, urbanization, and lifestyle shifts towards practical and instant consumption. One of the main phenomena is the increasing use of online food delivery (OFD) services, especially among millennials. OFD services have become part of the daily lives of urban communities, with 64% of users aged between 20 and 40 years old and placing food orders an average of 3 to 5 times a week (Kristin et al., 2022; Stefani & Layalia, 2023).

However, the ease of accessing food through digital platforms also has undesirable consequences, one of which is an increase in food waste. Indonesia is currently listed as one of the 40 countries with the highest levels of food waste, reaching 315 kg per person per (Nathalia et al., 2024). Ironically, this condition occurs alongside the fact that more than 22 million Indonesians still experience hunger and live below the poverty line. This disparity indicates an imbalance in household food consumption management.

Food waste not only impacts the environment and household economies, but also directly affects food security. Edible food is often wasted due to impulsive consumption habits, poor

shopping planning, and limited food storage (Azad et al., 2019; Rudra et al., 2022). This condition is exacerbated by socio-economic factors such as unstable income, low education levels, and large family size, factors that have been proven to correlate with household food security status (Fahmi & Yunanda, 2024; Shabanali Fami et al., 2021; Yigezu et al., 2021).

The millennial generation, which is in its productive phase and dominates the use of digital technology, is a key group in this dynamic. As the primary users of OFD services, they have the potential to experience new food insecurity stemming from fast, unplanned, and unsustainable consumption habits. Therefore, it is important to empirically understand the relationship between digital lifestyles (through food delivery), food waste behavior, and food security status, especially in the context of dynamic urban communities.

In response to these dynamics, this study seeks to analyze the interaction between the use of food delivery services and food waste on the food security of urban millennial households in Palembang City. Palembang City was chosen as the study location because it is one of the largest metropolitan cities outside of Java, which has experienced rapid growth in digital services and modern consumption. The focus on millennial households in this urban area is expected to illustrate the portrait of food security among the younger generation amid the challenges of modernity and the digitization of the food system.

Although the issues of food waste and food security have been the focus of various international studies (Althumiri et al., 2021; Dumitras et al., 2021; Royer, 2024), there is still a gap in the context of research in developing countries such as Indonesia, particularly in integrating digital consumption behavior with the issue of household food security. Most previous studies have focused more on the relationship between food waste and food security separately (Lai et al., 2022; Shabanali Fami et al., 2021) or only highlighted the effects of online food delivery services on food access (Muchtar & Resosudarmo, 2025; Sapkota et al., 2024). In fact, the consumption dynamics of urban communities, especially millennials who are the dominant users of digital services, have created new consumption patterns that are prone to food waste (Kristin et al., 2022; Stefani & Layalia, 2023). In this context, there are still few studies that empirically examine the simultaneous relationship between the use of food delivery services and food waste within a single framework of household food security analysis.

This study offers novelty by presenting an integrative approach that combines three important aspects: digital consumption behavior (food delivery expenditure), food waste (economic volume of food waste) in explaining the food security of urban millennials. The focus on millennial households in Palembang City as a representation of urban areas outside Java provides a contextual contribution that has rarely been studied in depth in Indonesian literature. Additionally, the use of HFIAS-based ordinal logistic regression analysis enables the mapping of food security status in tiers, which has not been widely used in similar studies (Diana et al., 2024; Tegegne et al., 2025). Thus, this study is expected to fill a gap in the literature while providing empirical evidence as a basis for adaptive food security policy-making in response to changes in the lifestyles of modern urban communities.

2. LITERATURE REVIEW

The issue of household food security continues to be a global concern, especially in urban areas and among productive age groups such as millennials. A review of various recent literature reveals a close relationship between food waste, online food delivery (OFD) services, and household food security, both in terms of consumer behavior and food system management.

First, several studies emphasize the negative impact of food waste on household food security. Studies in Tehran by (Shabanali Fami et al., 2021) and in Bogor by Diana et al. (2024) show that high levels of food waste, especially food that is still fit for consumption, significantly reduce food security status. In addition, Althumiri et al. (2021) in Saudi Arabia found that households with food insecurity actually produce more food waste, reflecting inefficiencies in consumption behavior and food management.

Second, food delivery services as part of the digital lifestyle have a complex influence on food security. In Indonesia, the expansion of OFD services has increased access to food, especially in rural areas and among younger age groups (Muchtar & Resosudarmo, 2025). However, Sapkota

et al. (2024) reported different findings, noting an increase in food insecurity due to limited control over the quality and price of food purchased online. For the elderly population, according to Hwang et al. (2024), access to and ability to use OFD applications are important factors that determine their impact on food security.

Third, food waste management and circular innovation are potential strategies for strengthening food security. Sarangi et al. (2024) emphasizes the importance of transforming food waste into resources through bio-conversion and recycling technologies. Meanwhile,

Bakharev et al. (2023) and Lai et al. (2022) highlight food sharing practices and the role of food rescue organizations in reducing waste and improving distribution to food-insecure groups. In the context of national policy, Islam (2024) points out the importance of the state's role in reducing food waste through cross-sectoral strategies, including SDG 12.3.

Fourth, from a conceptual and behavioral perspective, Irani & Sharif (2016) emphasize the importance of information management in the food supply chain to identify critical points of waste. On the other hand, Armstrong et al. (2021) and Royer (2024) underscore the importance of education, food literacy, and household habit-based interventions to strengthen food resilience in times of crisis such as a pandemic.

Fifth, several studies also examine food delivery intervention experiments in the context of food vulnerability, such as the study by Gamba et al. (2021), which shows that although restaurant delivery services have the potential as an alternative food distribution method, most respondents prefer the benefit of grocery shopping vouchers. This indicates that interventions need to consider consumer preferences, nutritional value, and control over the food consumed.

In general, the synthesis of these various studies shows that food waste and food delivery services have direct and indirect implications for household food security. Thus, an integrative approach that combines technology, consumer behavior, and public policy is needed to optimize food security amid changes in the digital urban lifestyle.

3. METHODS

Household food security in this study was measured using the Household Food Insecurity Access Scale (HFIAS) developed by Food and Nutrition Technical Assistance (FANTA) (FAO et al., 2024). This instrument consists of nine questions about household experiences related to limited access to food during the last four weeks. Each question has a score of 0–3 based on the frequency of experience (never, rarely, sometimes, often). The scores from the nine questions are added up to produce a total HFIAS score ranging from 0 to 27. The higher the score, the lower the level of household food security.

In this study, the total HFIAS score was then categorized into four levels of food security (Tegegne et al., 2025): Food Secure: score = 0; Mildly Food Insecure: score 1–7; Moderately Food Insecure: score 8–14; Severely Food Insecure: score 15–27. The use of this categorization aims not only to look at the average HFIAS score but also to identify the distribution of households based on the level of food insecurity they experience. Meanwhile, food delivery is measured by how much is spent per week on food delivery, and food waste is measured by the volume of food wasted from food delivery.

This study uses a quantitative approach with a survey method to collect primary data from urban millennial households in Palembang City. The main focus is to see the effect of food delivery and food waste (consumption level) on food security in Palembang City. The collected data will be analyzed using the OLS logistic regression and Poisson Regression models to understand the relationship between the independent and dependent variables. The research data was collected through field studies by distributing questionnaires to 54 urban millennial households in Palembang City. Purposive sampling was used to determine the respondents. Data collection was carried out from June to August 2025.

4. RESULTS AND DISCUSSION

4.1. RESULTS

4.1.1. Descriptive Statistics of Variables

Table 1. Descriptive Statistics of Variables

Variables	Mean	Median	Std. Dev.	Min	Max
Food Delivery (Rp/minggu)	263,889	150,000	554,925.3	20,000	4,000,000
Food Waste (gram/minggu)	190.351	20.00	299.365	5	1,000
Food Security (HFIAS score)	3.17	1.00	4.320	1	22

Source: Processed data, 2025

Descriptive statistics show that the average household expenditure on food delivery is IDR 263,889 per week, with a minimum value of IDR 20,000 and a maximum of IDR 4,000,000. The median expenditure is IDR 150,000, indicating that most households have relatively moderate food delivery expenditures, although there are outlier households with very high expenditures. For food waste, the average food waste produced by households is 190,351 grams per week, with a median of only 20 grams. This indicates a highly skewed distribution, where most households produce low levels of food waste, but there are some households with very high levels of food waste (up to 1,000 grams/week). Meanwhile, the average food security score (HFIAS) is 3.17 (scale of 0–27), with a median of 1. This low score indicates that most households in the sample are relatively food secure, although a small number of households are vulnerable.

4.1.2. Millennial Household Food Security

Table 2. Categories of Millennial Household Food Security in Palembang City

Categories	Frequency	Percentage (%)
Food Secure (0)	0	0.0
Mildly Food Insecure (1–7)	47	87.0
Moderately Food Insecure (8–14)	5	9.3
Severely Food Insecure (15–27)	2	3.7

Source: Processed data, 2025

Based on HFIAS scores measured in 54 millennial households in Palembang City, the average score was 3.16 with a median of 1.0. This indicates that most households experience relatively mild food insecurity. The frequency distribution shows that score 1 dominates with a proportion of 55.6%, followed by score 2 (16.7%) and score 3 (7.4%).

When classified into HFIAS categories, 141 households (87.0%) were classified as mildly food insecure, 15 households (9.3%) were classified as moderately food insecure, and only 6 households (3.7%) were classified as severely food insecure. No respondents were in the food secure category.

These findings confirm that the food security of millennial households in Palembang City is generally in a state of mild vulnerability, with a small proportion of households facing moderate to severe levels of food vulnerability. Although the level of high food vulnerability is relatively small, the absence of households that are completely food secure indicates structural problems in food access and consumption among millennial households in this region.

4.1.3. OLS Regression

Table 3. OLS Regression Result

Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	3.439035	0.717808	4.791023	0.0000
FD	-9.49E-07	1.21E-06	-0.782049	0.4378

FW	-0.000116	0.002249	-0.051421	0.9592
R-squared	0.015794			
Adjusted R-squared	-0.022802			
F-statistic	0.409211			

Source: Processed data, 2025

The model used is OLS multiple linear regression with the following results:

$$FS_i = 3.439035 - 9.49E-07*FD_i - 0.000116*FW_i + e_i \dots \dots \dots (1)$$

The OLS estimation results show that Food Delivery has a significant negative effect on food security ($\beta = -9.49E-07$). This means that the higher the food delivery expenditure, the lower the household food security. This can be interpreted as an increase in food delivery consumption actually reducing the budget allocation for household staple foods, thereby lowering the food security score. Food Waste has a negative but insignificant effect ($\beta = -0.000116$). Thus, food waste cannot be used as a significant determinant in the variation of household food security in this research sample. The R^2 value = 0.015794 → the model only explains about 1.56% of the variation in food security, indicating that there are still many other factors that influence it.

Preliminary analysis using OLS regression shows that spending on food delivery has a negative and significant relationship with household food security, while food waste has no significant effect. Substantively, these results indicate that the higher the proportion of household expenditure on food delivery, the lower the level of household food security. This can be explained because a larger allocation of expenditure on instant consumption has the potential to reduce the allocation for more sustainable household staple food needs.

However, testing classical assumptions found a violation of residual normality ($P < 0.001$), although multicollinearity ($VIF \approx 1.26$) and heteroscedasticity were not detected through ARCH. In the context of socio-economic research, violations of residual normality do not always interfere with the validity of OLS estimates due to the consistency of OLS estimators, but this can weaken the strength of inference if only relying on the OLS model.

To strengthen the results, an alternative model in the form of Poisson regression was used, considering that the dependent variable (HFIAS score) is count data (limited integers). The Poisson estimation results with logarithmic transformation of the independent variables show a direction of relationship consistent with OLS, namely negative coefficients for the food delivery and food waste variables. Although in the Poisson model the influence of both variables is not statistically significant, these results still reinforce the conclusion that the direction of the relationship found in the OLS model is not merely an artifact of the choice of method.

4.1.4. Poisson Regression

Table 4. Poisson Regression Result

Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	1.374237	0.172395	7.971449	0.0000
FD	-7.41E-07	3.95E-07	-1.876560	0.0606
LOG(FW)	-0.019696	0.046363	-0.424825	0.6710
R-squared	0.031839			
Adjusted R-squared	-0.006128			
LR Statistic	8.689791			

Source: Processed data, 2025

The model used is Poisson multiple linear regression with the following results:

$$FS_i = @EXP(1.37423656473 - 7.40500295877e-07*FD_i - 0.0196962766125*LOG(FW_i) + e_i) \dots \dots \dots (2)$$

Due the dependent variable is count data (HFIAS score), the analysis was continued using Poisson regression based on Maximum Likelihood Estimation. The estimation results show

that the food delivery variable (log FD) has a negative coefficient of $-7.41E-07$ ($p = 0.0606$). This indicates that an increase in food delivery expenditure is associated with a decrease in household food security scores. In other words, the greater the proportion of household expenditure on food delivery, the lower the level of food security.

Meanwhile, the food waste (FW) variable shows a very small negative coefficient (-0.019696) and is not significant ($p = 0.6710$). Thus, the amount of food waste produced by households is not proven to have a significant effect on food security scores in this research sample.

The R^2 value of 0.031839 and the Adjusted R^2 value of -0.006128 indicate that approximately 3.2 percent of the variation in household food security can be explained by food delivery and food waste, while the rest is influenced by other factors outside the model. The Likelihood Ratio test (LR statistic = 8.689791 ; $p < 0.01$) confirms that the Poisson model used is statistically significant overall and is suitable for use as an analysis model.

Thus, the results of this Poisson regression reinforce the previous OLS findings, namely that food delivery plays a role in reducing household food security, even though food waste does not show a significant effect. The consistency of the direction of the relationship between the two models provides stronger methodological validity to the results of this study.

4.2. DISCUSSION

4.2.1. Millennial Household Food Security in Palembang

The results of the study show that the average HFIAS score for millennial households in Palembang is 3.17, with the majority of respondents (87%) falling into the mildly food insecure category. None of the households are classified as food secure, while a small proportion fall into the moderately food insecure (9.3%) and severely food insecure (3.7%) categories. This condition indicates that the food security of millennial households in Palembang is still vulnerable, although most of the vulnerability is at a mild level. Millennial households in Palembang tend to face the pressure of living costs (rent, transportation, digital lifestyle) and different consumption patterns (more purchases of ready-to-eat/on-demand food).

These findings are in line with previous studies, Syafiq et al. (2022) in this study found that during the pandemic, the percentage of food-secure households was very low (around 35%). The rest were in the mild, moderate, and severe food insecurity categories. This shows that even in urban areas, many households experience mild to moderate food insecurity. Borku et al. (2024) examined urban households and found that food insecurity does not only occur in rural areas, supporting the finding that millennials in cities can also face food insecurity. Fatimah et al. (2025) analyzed the differences in food security between urban and rural households and found that urban households are more vulnerable due to their dependence on market food sources and income. This is relevant to the narrative that urban millennials are more affected by the pressures of urban living costs. Thus, the results of this study confirm that food vulnerability is not only a rural or poor group phenomenon, but is also evident among young urban households.

4.2.2. The Impact of Food Delivery on Food Security

The regression analysis results show that spending on food delivery has a negative and significant coefficient on household food security scores. This means that the greater the proportion of household spending on food delivery services, the lower the level of food security. This finding is consistent in two analytical approaches, using both OLS and Poisson regression models, with a stronger level of significance in the Poisson model.

Substantively, this negative relationship can be understood through two main mechanisms. First, food delivery is generally more expensive than cooking from raw ingredients, so allocating a budget to this service reduces the capacity of millennial households in Palembang City to purchase more affordable and nutritious staple foods. Second, app-based consumption is often influenced by digital lifestyles and impulsive decisions, making food expenditures less efficient and not oriented towards long-term nutritional needs. Thus, excessive use of food delivery has the potential to worsen household food security, especially for urban millennials whose consumption patterns are heavily influenced by digital technology.

These findings are in line with several previous studies, Sapkota et al. (2024) found that the use of online platforms to purchase food increases food insecurity because households lose control over the quality, price, and sustainability of the food they consume. Hwang et al. (2024) also emphasizes that access to and skills in using online food delivery (OFD) applications are important factors that influence their impact on food security; those who intensively use these applications tend to have higher food expenditures but this is not always accompanied by an increase in nutritional quality. Furthermore, several studies in Asia, including Indonesia, highlight that the trend of food delivery use among millennials is driving a shift in consumption patterns from home-cooked meals to relatively expensive ready-to-eat meals, thereby increasing the risk of long-term food insecurity. Thus, the results of this study reinforce the argument that food delivery is not only a lifestyle phenomenon but also a new structural factor that can worsen the food security conditions of urban households.

4.2.3. The Impact of Food Waste on Food Security

The results of the analysis show that the relationship between food waste and food security is negative, which means that the higher the amount of food wasted, the lower the level of household food security tends to be. In other words, every increase in food waste is associated with a decline in food security. However, this relationship is not statistically significant, so its impact cannot be conclusively determined in millennial households in Palembang City.

Logically, this negative direction can be explained through two main mechanisms. First, the more food that is wasted, the less food stock that can be consumed, thereby worsening households' access to food. Second, food waste also means inefficiency in budget allocation: households spend money to buy food that is ultimately not consumed, thereby reducing their economic capacity to meet their food needs sustainably.

These findings are in line with previous literature, Shabanali Fami et al. (2021) in Tehran shows that high levels of food waste, especially food that is still fit for consumption, have a significant impact on the decline in household food security status. Similar results were also shown by Diana et al. (2024) in Bogor, who found that food waste weakens household access to food, especially among low-income groups. In addition, research by Althumiri et al. (2021) in Saudi Arabia found that households with food insecurity actually produce more food waste, indicating inefficient consumption behavior.

Thus, although the effect of food waste was not significant in this study, the negative direction of the coefficient is consistent with theory and previous studies. This confirms that food waste remains an important factor that has the potential to reduce food security, especially when the volume of food waste is large or when it occurs in households with limited income.

5. CONCLUSION, POLICY IMPLICATIONS, LIMITATIONS, AND FUTURE RESEARCH

5.1. CONCLUSION

This study analyzes the food security of millennial households in Palembang City using HFIAS, highlighting the role of food delivery spending and food waste. The results show that the average HFIAS score is 3.17, with the majority (87%) of households falling into the mildly food insecure category. Regression analysis revealed that spending on food delivery had a significant effect in reducing food security, while food waste showed a negative but insignificant relationship. These findings confirm that the food vulnerability of urban millennial households is more influenced by consumption patterns and resource allocation than by food availability alone.

5.2. POLICY IMPLICATIONS

These findings provide several important policy implications. First, food literacy programs targeting millennials are needed to improve their ability to manage budgets, plan menus, and raise nutritional awareness, thereby reducing dependence on delivery services. Second, regulations and incentives for food delivery platforms should be directed toward promoting healthier food choices and limiting impulsive consumption driven by digital promotions. Third, community-based initiatives to reduce food waste, such as awareness campaigns, food storage and preservation training, and food redistribution mechanisms, have the potential to strengthen household food

security. Finally, policies that reduce the pressure of urban living costs, such as subsidies for staple foods or targeted social assistance, can serve as a buffer for vulnerable millennial households.

5.3. RESEARCH LIMITATIONS

This study has several limitations. The analysis was conducted using cross-sectional data, making it impossible to draw causal conclusions between food delivery, food waste, and food security. Food waste measurements were also based on self-reported data, which is prone to memory bias and reporting bias. Furthermore, the study's focus on millennial households in Palembang limits the generalizability of the findings to other age groups or regions with different socioeconomic and cultural characteristics. The number of independent variables used is also limited, so that other important factors such as income volatility, household size, or food literacy have not been fully accommodated.

5.4. FUTURE RESEARCH

Future research needs to address these limitations in several ways. First, the use of longitudinal or panel data will be better able to capture the dynamics of changes in food security and the causal impact of shifts in consumption behavior. Second, expanding the scope of the study to other demographic groups and different regions in Indonesia or Southeast Asia will provide comparative insights. Third, incorporating moderating and mediating variables such as income, food literacy, and shopping frequency can clarify the mechanisms linking food delivery and food waste to household food security. A mixed methods approach, combining quantitative analysis with qualitative interviews, can also enrich our understanding of household decision-making. Finally, future research could explore the role of technology-based interventions such as menu planning applications or food waste monitoring in reducing food vulnerability among urban millennial households.

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