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Food insecurity and health behaviors in a disaster-affected population: A case study of Tacloban, Philippines

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ABSTRACT

Background: Food insecurity is a widespread issue that poses a major global challenge with far-reaching impacts.
Objective: Investigate the relationship between food insecurity and health behaviors among the population of Tacloban, Philippines, affected by Typhoon Haiyan in 2013.
Methods: This study employed a cross-sectional design, surveying 226 households between April 2022 and June 2023. Households were selected using a systematic random sampling technique to ensure representative coverage. To evaluate food insecurity, we utilized the Food Insecurity Experience Scale-a robust tool that captures the degree to which individuals or households face challenges in accessing sufficient and nutritious food due to economic and social constraints. In addition, we explored a variety of health-related behaviors among participants, including the use of traditional healing practices, engagement in physical activity, sleep patterns and duration, dietary habits, medication adherence, as well as alcohol and tobacco use. The relationships between food insecurity and these health behaviors were rigorously examined using multiple logistic regression analysis, providing valuable insights into the interplay between access to food and lifestyle choices within the community.
Results: The results showed that 94 % of households experienced food insecurity, with 27 % severely, 52 % moderately, and 15 % mildly food insecure. The analysis revealed significant associations between food insecurity and several health behaviors. Food insecurity was found to be significantly associated with lower medication adherence, greater use of traditional healers, poorer dietary habits, and sleeping problems. However, no significant associations were found between food insecurity and smoking behavior, physical activities, or alcohol consumption.
Conclusion: Based on these findings, the study concluded that food insecurity negatively impacts health behaviors. Therefore, the authors suggested that improving food security in households could potentially lead to improvements in health behaviors.

1. Introduction

Access to adequate food is a fundamental human need, recognized as a basic right at the 1996 World Food Summit in Rome [1,2]. The Food and Agriculture Organization (FAO) has made a significant commitment to eradicating hunger by 2030, as outlined in Sustainable Development Goal Target 2.1 [3]. This goal aims to eliminate hunger and ensure that all individuals, particularly those who are poor or in vulnerable situations, including infants, have year-round access to safe, nutritious, and sufficient food [4].

Food insecurity is a pervasive problem across low-, middle-, and high-income countries. It remains an important and relevant issue due to

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its prevalence and its association with adverse health and nutrition outcomes [5]. It remains an important and relevant issue due to its prevalence and its association with adverse health and nutrition outcomes, such as increased risk of chronic diseases, poor mental health, and higher rates of hospitalizations [6]. For example, in 2023, an estimated 2.33 billion people globally-almost 29 % of the world's population-experienced moderate or severe food insecurity, highlighting the widespread and persistent nature of this challenge [7]. According to FAO, in 2018, 9.2 % of the global population, which means over 700 million people experienced severe food insecurity, while 17.2 % (around 1.3 billion people) faced moderate food insecurity [8].

Africa exhibits the highest levels of total food insecurity (moderate or severe) compared to any other region, affecting over half of its population [9]. Latin America has a food insecurity prevalence exceeding 30 %, Asia stands at 23 %, while Northern America and Europe have rates around 8 % [10]. FAO's data from 2014 to 2016, collected using the food insecurity experience scale (FIES), revealed that 14.3 million adults in the Europe and Central Asia (ECA) region experienced severe food insecurity [11].

Drought and conflict are the primary factors exacerbating issues related to food production, distribution, and access [12]. According to FAO FAO's 2018 global food security eport, new or intensified conflict and insecurity in regions such as Myanmar, north-east Nigeria, the Democratic Republic of Congo, South Sudan, and Yemen, along with prolonged drought conditions in eastern and southern Africa, have significantly increased the number of people facing acute food insecurity [13]. Additionally, high rates of population growth and poverty, within fragile ecosystems, contribute to the challenge. For those facing poverty or food insecurity, maintaining good health, adhering to a nutritious diet, managing chronic diseases, or a combination of these tasks can be particularly difficult due to limited financial resources, competing priorities, and stress [14]. Gregory and Coleman-Jensen's study highlighted that, in some cases, food insecurity is a stronger predictor of chronic illness than income, with food insecurity status being significantly associated with a greater number and range of chronic diseases compared to income alone [15]. Exposures to health risks like food insecurity can have a profound impact on health outcomes, and the onset and progression of diseases in later life [16,17].

The Philippines, located in Southeast Asia, has a population of about 108 million [18]. The Philippines is highly susceptible to natural disasters, including typhoons, earthquakes, and volcanic eruptions, making it one of the most disaster-prone countries globally [19]. In the first half of 2018, the estimated poverty prevalence among Filipino individuals was 21.0 %, affecting approximately 22 million people [20, 21]. The prevalence of household poverty during the same period was recorded at 16.1 %. These figures represent a slight decrease from the rates reported in 2015, which were 27.6 % for poverty prevalence among individuals and 22.2 % for household poverty.

On November 8, 2013, the Visayas region of the Philippines—home to some of the country's most impoverished provinces—was struck by a powerful typhoon called Yolanda (internationally known as Haiyan) [22]. According to the National Risk Reduction and Management Council, the aftermath of Typhoon Haiyan resulted in the loss of 6300 lives, with 1062 individuals reported as missing and 28,688 sustaining injuries [23]. The report also revealed extensive destruction of agricultural land and infrastructure, amounting to an estimated total damage cost of approximately US$1890 million. Additionally, around 1.1 million houses were partially or completely damaged, and the overall impact on people's livelihoods, environment, and food security affected roughly 16 million individuals [24]. Similarly, Atienza et al. [25] documented that the typhoon had a significant impact on the livelihoods of those living both above and below the poverty threshold, affecting 86.7 % and 92.4 %, respectively.

High poverty and low-income levels, particularly among agricultural households, contribute to difficulties in obtaining sufficient food [26]. This underscores/highlights the relevance of examining how food insecurity affects health behaviours in vulnerable communities. The resulting food insecurity poses long-term health risks, including negative health behaviors. While previous studies have shown a link between food insecurity and adverse health outcomes, further research is needed to explore this association in northern Tacloban city specifically. Therefore, the objective of this study was to examine the association between food insecurity and health behaviors in a population that was affected by Typhoon Haiyan.

2. Study design and methods

2.1. Study design and sample

This cross-sectional study was conducted in Tacloban City, Philippines, between April 2022 and June 2023. Due to logistical and resource constraints, data collection activities were carried out on selected days within this timeframe rather than continuously. Upon our arrival, the research team was welcomed by the Department of Health (DOH) and we held meetings with their administration. During these meetings, we provided an overview of our study, and they shared information about the general food insecurity and health situation in the city. Based on these discussions, we determined the specific study site to be in the northern part of Tacloban. Throughout the research, DOH assigned their staff members, such as nurses, village captains, and ambulance drivers, who worked in the villages, to accompany us during interviews. Their presence facilitated our interactions with community members to gather relevant information.

The population affected by the 2013 Typhoon Haiyan, who were displaced, resides in northern Tacloban City. This area encompasses eight villages, of which six were included in our study: Village 97, 101, 105, 106, 107, and Village 108. According to the City Health Office in Tacloban City, there were an estimated 7545 households in these six villages as of 2018. However, many accommodations often remained empty because households frequently returned to their previous disaster-prone sites to sustain their livelihoods. We used a purposive sampling method to select the study sites. These villages were purposively selected because they hosted a significant number of displaced Typhoon Haiyan victims. In total, we sampled 226 households, determining the sample size based on the duration of data collection and recommendations for interview research.

We employed a systematic sampling technique at the household level, using specific house numbers assigned by the city administration. Samples were proportionately collected from each of the six villages. The total number of households in each village was divided by the total number of households in all six villages and then multiplied by the sample size ($n = 226$). The head of the household or any other member with well-informed about the household's day-to-day activities served as the respondent for our semi-structured interviews. In cases where the head of the household was unavailable or unable to respond, another adult member—typically the primary caregiver or a person responsible for managing food and health matters—was selected to ensure accurate and reliable responses. Alongside interviews, we also conducted direct observations and walked through the communities with local residents (a method known as participatory transect walks) to better understand conditions related to farming, livestock, water access, sanitation, education, healthcare services, and overall community well-being.

To guide the interviews, we utilized an interview guideline consisting of four sections: demographic characteristics, food security, livelihood conditions and strategies, and health behaviours [27]. We collaborated with the assigned nurses, explaining the study and the interview guidelines to them. They are nurses, proficient in English and the local language (Tagalog or Waray), assisted in translating the interviews and explaining the responses to us. We ensured the accuracy and relevance of the responses to the questions asked.

2.2. Socio-economic and demographic variables

This study analyzed various socio-economic and demographic factors, including age, gender, marital status, occupation, and household size, respondent's education, and household income. The education level of the household was determined based on the highest level attained by the household head, categorized as elementary, secondary, higher education or Technical and Vocational Education and Training (TVET) level. Household income was assessed by considering the number of individuals with income and calculating the average daily household income. In households without regular or non-salaried jobs, income tended to be unstable, leading to periods without any income. The study also examined the occupation of household members, categorising them into employed (civil service, private sector, self-employed) or unemployed.

2.3. Livelihood condition of the households

The livelihood conditions of the households were assessed to determine their abilities to cope with challenges and the strategies they employed for survival. Various factors were considered, including the number of household members with income, sources of household income, social networks, social protection instruments, access to land for farming, infrastructural problems, and sources of food. The sources of household income were classified as "earnings," "relatives," and "own production." Social networks were categorized as "relatives," "none," and "neighbors." Social protection instruments were divided into "microfinance," "MCCT (Modified Conditional Cash Transfer) and CCT (Conditional Cash Transfer)" (government support provided to certain households with conditions), and "saving".

The study also investigated infrastructural problems, such as transportation, water, and electricity issues. Sources of food were classified as "purchasing," "own production," and "relatives." The question of access to land required a simple "yes" or "no" response. In terms of health, the study assessed whether the household head had a health condition that that affected their ability to earn income or perform daily activities. This referred to long-term health problems that affect productivity, and respondents were asked to answer with either "yes" or "no." Additionally, the study inquired about the presence of any health insurance (private or public) within the household.

2.4. Food insecurity assessment

The severity of food insecurity status was assessed using the Food Insecurity Experience Scale (FIES). The FIES is a scale that was developed by FAO Voices of the Hungry project [26]. Food insecurity as measured by FIES refers to limited access to food, at the level of individuals or households, due to a lack of money or other resources [5]. It is an experience-based metric of the severity of food insecurity that relies on people's direct responses to a series of questions concerning their access to adequate food. FIES, an experienced-based scale, puts people's experiences and behavioral responses at the core of the definition of what food insecurity means [26].

According to FAO [5], FIES has been proven to be effective in measuring the food insecurity status of respondents with diverse cultural, linguistic, and development contexts. With the ease of processing FIES data, the results are timely, providing picture of the food insecurity situation. Another important aspect of FIES is that it enables the measurement of food insecurity. This data can then be analyzed together with indicators of its determinants such as livelihoods. It can also be examined alongside indicators of its consequences like health outcomes, to contribute to a more comprehensive understanding and inform more effective policies and interventions [26].

FIES is composed of eight questions that explore individual or household experiences with regard to food. This principle follows the sequence of events associated with food insecurity [28]. The lived experience of food insecurity was characterized initially by anxiety, associated with worry about being able to get enough food. As conditions worsened, it resulted in a decreased amount of stored food in the home, followed by worsening quality and diversity of the diet, a decreased quantity of food eaten per meal, and, finally, being forced to skip meals and feel hungry for an extended period [29]. In this study, the households' experience of food was explored in the past twelve months. The questions given to the households are described in Table 1, adapted from FAO [30]. The responses are either "yes" or "no". We asked further questions to know the reasons for the lack of money or other resources to get food.

The results of the FIES scale according to Ballard et al. [26] can be presented as mild, moderate, or severe food insecurity. Table 2 shows the severity of food insecurity classification.

2.5. Health behaviors

In this study, various health behaviors were assessed, including the use of traditional healers, physical activities, sleep behavior, dietary habits, medication adherence, alcohol consumption, smoking, drug use, and risky sexual behavior. The use of traditional healers was examined as a measure of health-seeking behavior when individuals lacked the financial means to seek conventional medical treatment. The participants were asked if they visited traditional healers for healthcare, and if the response was affirmative, the reasons behind their choice were further explored. To investigate physical activities, participants were asked about their engagement in exercises such as running, jogging, basketball, gym workouts, or walking, excluding excluding physical activity related to occupational duties. If they answered positively, details such as the type of exercise, frequency per week, and average duration per session were obtained. The responses were categorized as either "yes" or "no" during analysis. Sleep behavior was assessed by inquiring about the average duration of sleep per night.

Participants were also asked if inadequate access to food (due to lack of resources or money) affected their sleep quality, causing them to

Table 1
Food insecurity experience scale.

"Now I would like to ask you some questions about food consumption in your household in the last 12 months. During the last 12 months, was there a time when:

Question number	Standard label	Question
1	Worried	During the last 12 months, was there a time when you or any other member of your household was worried that s/he would not have enough food to eat because of a lack of money or other resources?
2	Healthy	Still thinking about the last 12 months, was there a time when you or any other member of your household was unable to eat healthy and nutritious food because of a lack of money or other resources?
3	Few foods	Was there a time when you or any other member of your household ate only a few kinds of foods because of a lack of money or other resources?
4	Skipped	Was there a time when you or any other member of your household had to skip a meal because there was not enough money or other resources to get food?
5	Ateless	Still thinking about the last 12 months, was there a time when you or any other member of your household ate less than s/he thought s/he should because of a lack of money or other resources?
6	Ranout	Was there a time when your household ran out of food because of a lack of money or other resources?
7	Hungry	Was there a time when you or any other member of your household was hungry but did not eat because there was not enough money or other resources for food?
8	Whole day	During the last 12 months, was there a time when you or any other member of your household went without eating for a whole day because of a lack of money or other resources?

Table 2
Severity of food insecurity classification.

FIES Questions	Domains of the food insecurity construct	Assumed severity of food insecurity
1, 2, and 3	Uncertainty and Worry about food/ Inadequate food quality	Mild
4, 5, and 6	Insufficient food quantity	Moderate
7 and 8	Insufficient food quantity	Severe (Hunger)

worry about acquiring food and impacting their ability to rest well. For alcohol consumption, participants were asked if they consumed alcohol, and if so, further details were gathered regarding the frequency of consumption (frequent or occasional, defined as at least two times per week or at most once weekly, respectively). Dietary behavior was evaluated by asking participants about the average number of major meals consumed per day (breakfast, lunch, and dinner) in their household. The responses were categorized as one time per day, two times per day, or three times per day. Medication adherence was assessed by asking participants if they or any member of their household sometimes skipped taking medication. If affirmative, the reasons for skipping medication, such as lack of food or resources to acquire food, were explored. Cigarette smoking and drug use were examined by directly asking participants if they engaged in these behaviors.

2.6. Statistical analysis

Statistical data analyses were performed by using MS Excel and R Studio software. The variables were both qualitative and quantitative. Qualitative variables included gender, education, marital status, occupation, food security status, activities before disaster, source of income, source of food, social network, social protection instrument, general health problem, health care coverage, physical activities, medication adherence, use of traditional healers, smoking, sleeping behavior, alcohol consumption, and dietary habit. The quantitative variable includes age, household size, household income per day, and the number of households members (s) with income. After categorising qualitative data, the description of the demographic, socio-economic characteristics, livelihood condition, and health behaviours was performed according to food security status. Descriptive analyses were used to examine the distribution of key variables. A pairwise chi-square test was used to examine the associations of household food insecurity with demographic and socio-economic characteristics. Multiple logistic regressions were performed to examine the association between food insecurity and health behaviors. The factors that were significant at an alpha level of 0.1 or less during univariate logistic regression were included in the multivariate logistic regression model. The result of multivariate logistic regression was presented as an odds ratio with a 95 % confidence interval. A p-value <0.05 was considered a level of statistical significance.

3. Results

3.1. Socio-economics and demographic characteristics

The results of the study revealed that a total of 226 households were successfully interviewed. Among the respondents, 144 (63.7 %) were females, and 82 (36.3 %) were males. The median age of the respondents was 39 years, ranging from 18 to 76 years. In terms of marital status, the majority of households (54.4 %) were married, followed by those who were cohabitating (29.2 %), separated (2.2 %), single parents (7.5 %), and widowed (6.6 %). The mean household size was 5, with a range of 1–14 members.

Regarding income generation, 72.5 % of households relied on a single member to generate income. The median daily household income was 300 pesos (approximately 5.3 euros), ranging from 0 to 1450 pesos (approximately 25 euros). The occupations of the households were primarily self-employment (80.4 %), followed by civil servants (8.2 %) and those in the private sector (6 %). A small percentage (4.9 %) of households did not engage in income-generating activities and received support from relatives.

The educational levels of the household heads varied, with 24.9 % having completed primary education, 25.1 % having completed secondary education, 24.6 % having completing TVET, and 24.7 % having attained higher education. In addition, Table 3 provides a detailed breakdown of the distribution of occupations according to educational levels.

The study found significant variations in the occupation of households before and after Typhoon Haiyan. Before the typhoon, the majority of households were engaged in agricultural production, indicating a high level of self-employment. These agricultural activities primarily involved fishing, coconut cultivation, and rice production. This suggests that agriculture played a vital role in the livelihoods of these households. However, the devastating impact of Typhoon Haiyan led to the widespread destruction of agricultural infrastructure and crops. As a consequence, many households were forced to modify their occupations and seek alternative income-generating activities. The aftermath of the typhoon resulted in a significant shift in the types of jobs and livelihood strategies pursued by these households.

Fig. 1 provides a visual representation of the comparison between income-generating activities before and after Typhoon Haiyan. This comparison highlights the changes that occurred in the livelihoods of the affected households. The figure likely illustrates a decrease in agricultural activities and an increase in other forms of employment or income sources, as households sought to recover from the impact of the typhoon. The transformation of livelihood strategies in response to the typhoon underscores the resilience and adaptability of the affected households. It also indicates the challenges they faced in rebuilding their lives and finding alternative means of income generation after the loss of their agricultural activities.

3.2. Livelihood condition

The study identified a range of major activities and sources of income for the households in the studied population. These activities encompassed various sectors and occupations. The most prevalent occupations included driving, which involved operating different types of vehicles such as bikes, multicabs, and jeepneys. Construction-related work, such as laborers and carpentry, was also a significant source of income for some households. Fishing and being a fish vendor were important occupations, highlighting the significance of the local aquatic resources for livelihoods in the community. Additionally, store ownership emerged as another common occupation, indicating the presence of small businesses within the community.

Fig. 2 provides a visual representation of the percentage distribution of occupations within the studied population. It showcases the diversity of occupations and the varying levels of involvement in each category. It is important to note that while some occupations had a higher percentage of households involved, others had lower representation. Among the less common occupations were security guards, glass

Table 3
Distribution of occupation with the educational level of household heads, n = 226.

Educational level	Civil servant (%)	Occupation (%)	Private-sector workers (%)	Self-employment (%)
Higher education	4.4	1.8	2.6	15.9
TVET	0.8	0.8	1.8	21.2
Secondary	2.2	1.3	0.8	20.8
Elementary	0.8	0.8	0.8	22.5

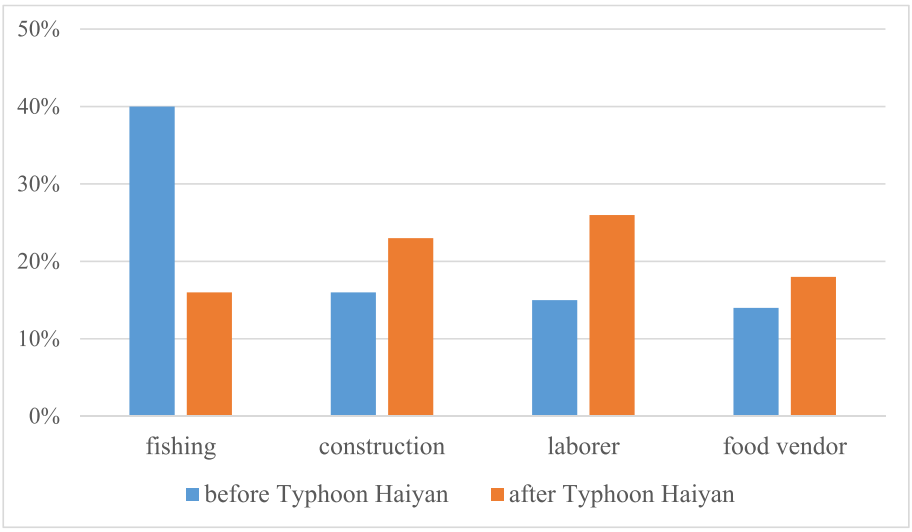

Fig. 1. Comparison of some income-generating activities before and after Typhoon Haiyan.

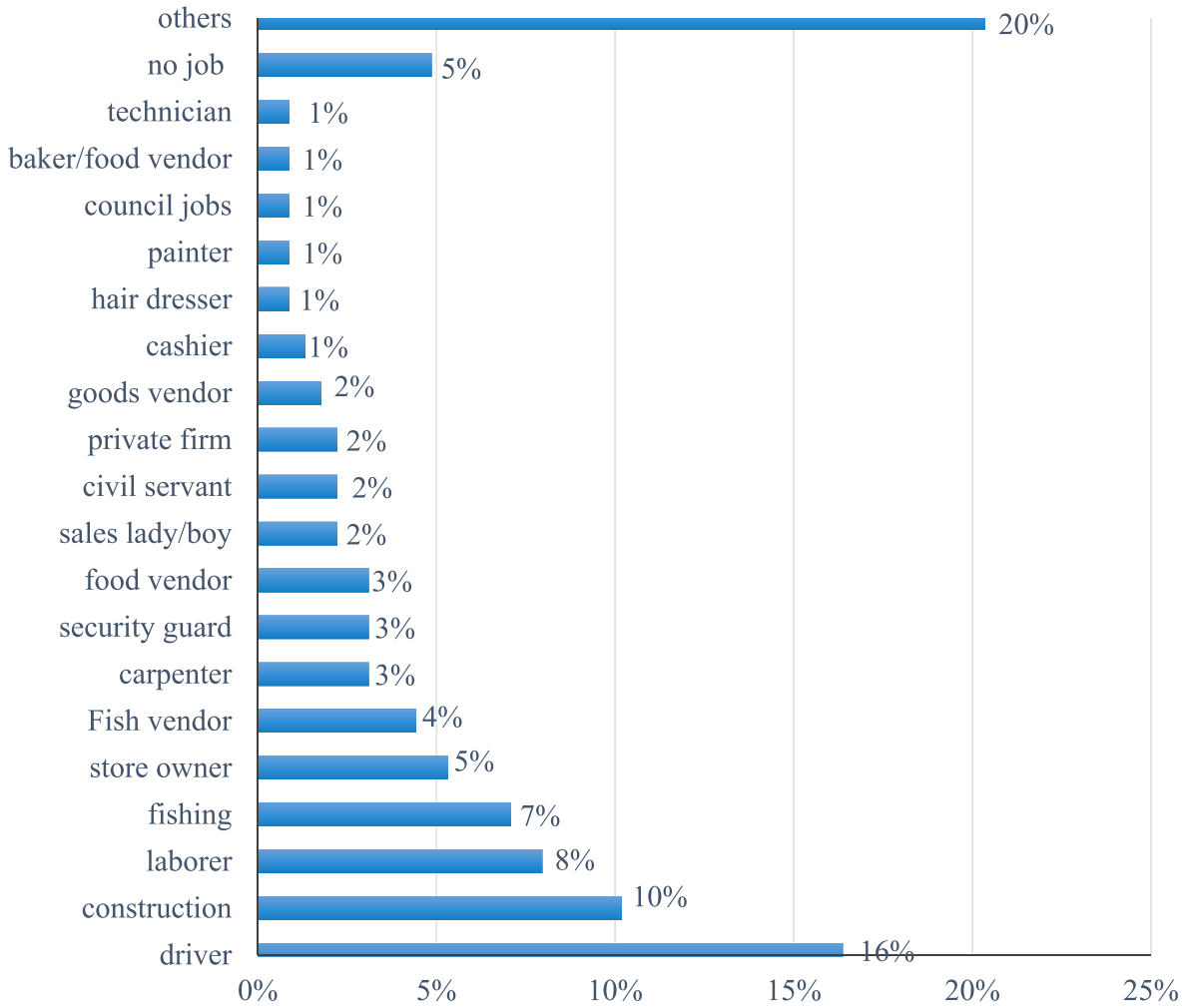

Fig. 2. Illustrates the percentage distribution of occupations within the studied population of 226 households. The "others'' category represents occupations in which only one household is involved.

installers, painters, laundry workers, rice mill workers, technicians, peddlers, police officers, seamstresses, waste plastic sellers, woodcutters, wood sellers, cooks, waiters, hairdressers, cashiers, and coconut vendors. These occupations represent a wide range of skills and services provided by members of the community.

Among the households included in the study, a significant

proportion, 54.2 % (123 households), relied on social protection instruments such as MCCT or CCT. These instruments provide financial support and assistance to vulnerable households. However, the number of households with microfinance support was relatively low, accounting for only 4.87 % (11 households). Similarly, only a negligible percentage, 1.33 % (3 households), reported having savings as a social protection mechanism. The presence of pension funds within households was also quite limited, with only 0.89 % (2 households) indicating such financial support.

Regarding social networks, the majority of households, 186 (83.6 %) reported having some form of social network. These networks were primarily comprised of relatives, emphasising the importance of familial connections in the community. Other sources of social networks included workplaces and neighbors. Notably, none of the households were affiliated with community groups or meetings, suggesting a potential area for community engagement and collaboration.

3.3. Food insecurity status

The analysis of food insecurity is described using the Food Insecurity Experience Scale (FIES). According to this analysis, a negligible majority of the households in the study, 93.8 % (212 households), experienced food insecurity, while only a small proportion, 6.2 % (14 households), were classified as food secure. In addition, further examination of the food insecurity status showed that 27 % (61 households) were severely food insecure, 51.8 % (118 households) were moderately food insecure, and 15 % (33 households) were mildly food insecure (Fig. 3). This breakdown provides insights into the varying degrees of food insecurity experienced by the households.

Among the reasons cited for the inability to acquire food, financial constraints emerged as the primary factor, with almost all households, 92 % (208 households), attributing their food insecurity to this issue. Additionally, all households identified water as a significant infrastructural problem they faced. Other infrastructural issues that were mentioned to a lesser extent included electricity, transportation, and accessibility to main markets. These findings highlight the multifaceted nature of food insecurity, where financial limitations and inadequate infrastructure play crucial roles in the households' access to food.

3.4. Food insecurity, livelihoods, and health behaviors association

The associations between food security status and education, occupation, and sources of food were examined, and the results are presented in Table 4. The statistical analysis revealed significant associations between these variables and food security status. Education ($p = 0.0053$), occupation ($p = 0.0014$), and sources of food ($p < 0.001$) all demonstrated significant relationships with food security status. Among the respondents who had no occupation, 45.4 % of their households experienced severe food insecurity. On the other hand, among self-employed respondents, 47 (26 %) households experienced severe food insecurity, 102 (56 %) households experienced moderate food insecurity, and 22 (12.1 %) households experienced mild food insecurity.

In terms of food sources, 68.1 % of food-insecure households relied solely on purchasing food. However, 29.6 % of food-insecure households obtained their food through a combination of purchasing and own production. A small percentage, 2.2 %, relied on purchasing and other relatives' gifts for their food. Additionally, it was found that 52.4 % of food-insecure households had social protection instruments such as MCCT, CCT, microfinance, social pension funds, or savings. This suggests that these households had some form of support system in place to mitigate food insecurity. Furthermore, 73.4 % of food-insecure households had health care coverage, primarily through the Philippine Health Insurance Corporation.

Among the studied households, 26.5 % (60) of the respondents reported health problems that affected their productivity. Surprisingly, despite the high percentage of households with health problems, there was no significant association between health problems and food insecurity status ($p = 0.932$). This suggests that while health issues may impact productivity, they do not directly influence food security status in this population. However, the analysis revealed a significant association between food security status and dietary habits of the households ($p < 0.001$), as shown in Table 5. The dietary habits were categorized into two groups: twice daily food intake and thrice daily food intake. Among the food-insecure households, 42.0 % (89) reported a dietary habit of consuming food twice daily, while the remaining 58.0 % (123) reported a dietary habit of consuming food thrice daily. The odds ratios (OR) of severe food insecurity and moderate food insecurity are presented in Table 5. The odds ratio for severe food insecurity was 0.087 (95 % CL: 0.026–0.24), indicating a significantly lower likelihood of severe food insecurity among households with a thrice daily food intake compared to those with a twice daily food intake. Similarly, the odds ratio for moderate food insecurity was 0.31 (95 % CL: 0.10–0.80), indicating a lower likelihood of moderate food insecurity among households with a thrice daily food intake. Regarding alcohol consumption, the majority of the respondents (81.4 %) consumed alcohol occasionally, while a smaller percentage (16.4 %) did not consume

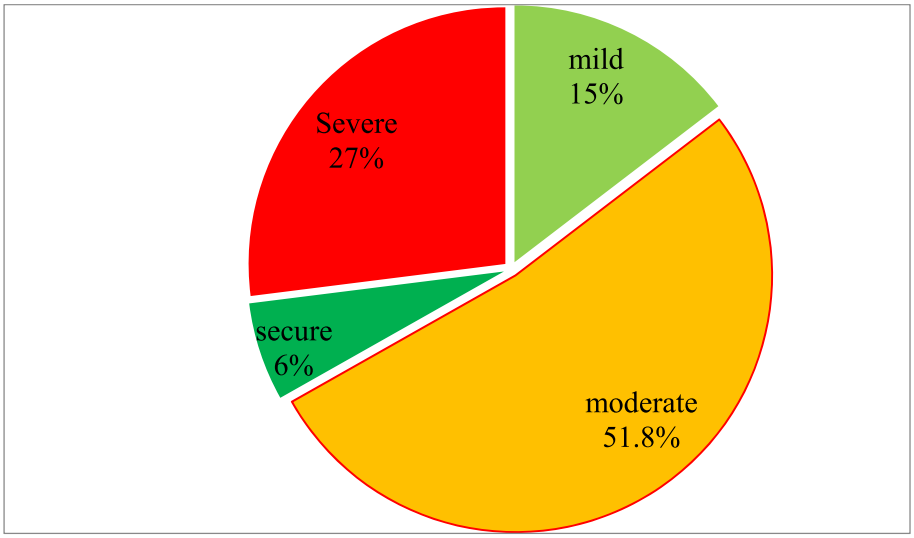

Fig. 3. Proportion of food insecurity status in the sampled households, n = 226.

Table 4
Association of education, occupation, and food source with food security status.

Variables	Total (%)	Food security status				
		Food secure (%)	Food-insecure (%)			
			Mild	Moderate	Severe	p-value
Education						0.0053
Higher education	56 (24.8)	8 (14.3)	14 (25)	26 (46.4)	8 (14.3)	
TVET	56 (24.8)	5 (8.9)	2 (3.6)	38 (67.8)	11 (19.6)	
Elementary school	57 (25.2)	0 (0.0)	8 (14)	23 (40.4)	26 (45.6)	
Secondary school	57 (25.2)	1 (1.7)	9 (15.6)	31 (54.4)	16 (28)	
Occupation						0.0014
Civil servant	19 (8.4)	1 (5.3)	4 (21)	7 (36.8)	7 (36.8)	
Private sector	14 (6.2)	1 (7)	2 (14.3)	6 (42.8)	5 (35.7)	
Self-employment	182 (80.5)	10 (5.5)	22 (12.1)	102 (56)	47 (26.0)	
No occupation	11 (4.9)	2 (18.2)	5 (45.4)	3 (27.7)	5 (45.4)	
Food source						0.00017
Purchase and own production	67 (29.6)	7 (10.4)	11 (16.4)	28 (41.8)	21 (31.3)	
Purchase	154 (68.1)	6 (3.9)	22 (14.3)	88 (57.1)	38 (24.7)	
Purchase and relatives	5 (2.2)	1 (20)	0 (0.0)	2 (40)	2 (40)	

Table 5
Association of food insecurity and health behaviours.

Health behavior	Total (%)	Food security status				
		Food secure (%)	Food insecure (%)			
			Mild	Moderate	Severe	p-value
Sleeping problem						0.002
No	208 (92.0)	14 (6.2)	29 (12.8)	115 (50.9)	50 (22.1)	
Yes	18 (8.0)	0 (0.0)	4 (1.8)	3 (1.3)	11 (4.9)	
Alcohol consumption						0.251
Frequently	5 (2.2)	0 (0.0)	1 (20.0)	1 (20.0)	3 (60.0)	
No	37 (16.4)	1 (2.7)	9 (24.3)	17 (45.9)	10 (27.0)	
Occasional	184 (81.4)	13 (7)	23 (12.5)	100 (54.3)	48 (26.1)	
Dietary habit						<0.001
2/day	92 (40.7)	3 (3.3)	5 (5.4)	43 (46.7)	41 (44.6)	
3/day	134 (59.3)	11 (8.2)	28 (20.9)	75 (56)	20 (14.9)	
Medication adherence problem						<0.001
No	149 (66)	13 (8.7)	26 (17.4)	89 (59.7)	21 (14.9)	
Yes	77 (34)	1 (1.3)	7 (9.1)	29 (37.6)	40 (51.9)	
Smoking status						0.132
No	140 (62)	9 (6.4)	22 (15.7)	76 (54.3)	33 (23.6)	
Yes	86 (38)	5 (5.8)	11 (12.8)	40 (46.5)	30 (34.9)	
Physical activities						0.1032
No	167 (73.9)	7 (4.2)	27 (16.2)	85 (50.9)	48 (28.7)	
Yes	59 (26.1)	7 (11.8)	6 (10.2)	33 (55.9)	13 (22.0)	
Use of traditional healers						<0.001
No	126 (55.7)	8 (6.3)	26 (20.6)	76 (60.3)	16 (12.7)	
Yes	100 (44.2)	6 (6.0)	7 (7.0)	42 (42.0)	45 (45.0)	

*The Chi-square test was used to check the association between food insecurity and sleep problems, dietary habits, physical activities, alcohol consumption, and smoking.

alcohol, and only 2.2 % consumed alcohol frequently. However, the analysis did not find a significant association between alcohol consumption and food insecurity. Sleeping problems were also significantly associated with food insecurity ($p = 0.002$). The average duration of sleep at night among the households was 7 h, with a standard deviation of 1.4.

Among the 212 food-insecure households, 136 (64.1 %) respondents reported non-adherence to medication, with a significant association ($p < 0.001$). Regarding smoking, 131 (61.8 %) respondents were non-smokers, and 81 (38.2 %) were smokers. However, there was no significant association between smoking and food security status ($p = 0.132$). In terms of physical activities, the majority of respondents (74.0 %) did not engage in physical activities beyond their normal jobs. However, the analysis did not find a significant association between physical activities and food insecurity status ($p = 0.1032$). A significant association was observed between household food insecurity and the use of traditional healers ($p < 0.001$).

The analysis revealed several associations between health-related factors and food security status among the households. Medication adherence was found to be significantly associated with food security status ($p < 0.001$). The odds ratio for severe food insecurity households (OR = 7.36, 95 % CL: 2.7–22.2) who had non-adherence to medication was significantly higher compared to moderate food insecurity households (OR = 1.33, 95 % CL: 0.52–3.74). As given details in Table 6, the binomial logistic analysis showed a higher odds ratio for severe food insecurity (OR = 10.44, 95 % CL: 3.98–30.6) and moderate food insecurity (OR = 2.05, 95 % CL: 0.86–5.5) among households that used traditional healers.

Table 6
Unadjusted and adjusted odd ratio of food security status in terms of negative health behaviors.

Variables	Non-adjusted odd ratio (95 % confidence interval)	Adjusted odd ratio (95 % confidence interval)
Poor dietary habits		
Mild food insecure	Ref.	Ref.
Moderate food insecure	0.29 (0.086–0.82)[a]	0.31 (0.10–0.80)[a]
Severe food insecure	0.082 (0.022–0.24)[a]	0.087 (0.026–0.24)[a]
Food secure	0.65 (0.13–3.6)	0.67 (0.13–3.6)
Non-medication adherence		
Mild food insecure	Ref.	Ref.
Moderate food insecure	1.21 (0.49–3.28)[a]	1.33 (0.52–3.74)[a]
Severe food insecure	7.07 (2.75–20.23)[a]	7.36 (2.7–22.2)[a]
Food secure	0.28 (0.14–1.85)	0.39 (0.02–2.7)
Use of traditional healers		
Mild food insecure	Ref.	Ref.
Moderate food insecure	1.88 (0.75–5.21)[a]	2.05 (0.86–5.5)[a]
Severe food insecure	8.72 (3.21–26.3)[a]	10.44 (3.98–30.6)[a]
Food secure	3.2 (0.78–13.3)	2.78 (0.72–11.02)

[a] Significance difference from the reference ($p < 0.05$). Note: Adjusted for household education, occupation, and household size.

3.5. Results of transect walk and direct observation participatory approaches

The transect walking and direct observation participatory approaches utilized in this study involved direct observation and interaction with the people of the communities. Researchers, along with health workers and village captains, walked through the villages to gain insights into the living conditions and way of life of the residents. Based on these observations, it was noted that the shelters in the resettlement sites had a similar structure and were constructed using solid rods and concrete materials. Each household was allocated one room, which typically measured around 20 square meters and included an internal bathroom. Depending on the financial status of the household, they might partition the room into different sections, such as a living area and a bedroom. The interviews revealed that some respondents became emotional and shed tears, likely due to the food insecurity issues they were facing.

The resettlement sites were located in confined areas with limited access to markets. However, basic public services, such as schools and health centers, were available in the camps. Schools were easily accessible, and new structures were being built in other camps, indicating efforts to improve educational facilities. The health centers operated daily throughout the week and sometimes provided services directly to households. However, there were challenges with the water supply, and people had to queue for hours to fetch water. In some areas, boreholes were present, requiring physical effort to pump water. It was also observed that there were limited or no farmlands available for agriculture in the villages.

On a positive note, common playgrounds were present in the communities, providing spaces for recreational activities. Among the youth, basketball, and volleyball were the most popular games, fostering community engagement and bringing them together. Overall, the transect walking and direct observation participatory approaches provided valuable firsthand information about the physical environment, living conditions, access to services, and recreational activities in the communities. These observations help to paint a comprehensive picture of the challenges and opportunities faced by the population under study.

4. Discussion

The purpose of this study was to examine how food insecurity is related to health behaviors in a disaster-affected population. As indicated in the results, the proportion of food insecurity is higher than those of previous studies. This can be explained by the fact that the study was done in a relocation site in which all of the households lost their properties during the 2013 Typhoon Haiyan. In 2011, an estimated 71 % of households in Eastern Visayas (regional level) were classified as food insecure according to a national survey based on Radimer-Cornell food insecurity items; this was before the disaster [31].

As shown in the analysis of the present study, the type of occupation of the household affected the food security status. Those with non-salary jobs reported that they sometimes go for days without income. An example of such a non-salary job was construction. If there are no construction opportunities, these workers will have to stay without income. This will therefore affect the food security of the households. This finding aligns with previous research in various settings. For example, a study by Ref. [32] in rural Ethiopia demonstrated that households relying on daily wage labor were more likely to experience food insecurity compared to those with stable, salaried employment. In the Philippines, a report by the Food and Nutrition Research Institute (FNRI, 2020) also highlighted that families dependent on seasonal or informal work were at greater risk of food insecurity, especially during periods of economic downturn or natural disasters [33]. The high level of self-employment, 80.5 % showed that most of the households rely on non-salary income. This was in line with the study of Atienza et al. [25], which stated that livelihood schemes and entrepreneurial training are extremely important for poor households to have a high level of non-salary income.

Our findings highlighted the respondents' insights into social protection measures, social networks, and sources of food available to their households. The reliance on social protection instruments such as the Modified Conditional Cash Transfer (MCCT) or Conditional Cash Transfer (CCT) programs underscores the critical role of external support in addressing economic vulnerabilities and mitigating food insecurity. This observation is consistent with studies from other contexts, which have demonstrated the positive impact of social protection programs on household food security. For example, in a multi-country analysis, Study found that cash transfer programs significantly improved food security and dietary diversity among beneficiary households [34]. Similarly, in the Philippines, the Pantawid Pamilyang Pilipino Program (4Ps), a national CCT initiative, has been shown to reduce hunger and improve nutritional outcomes among children in recipient families [35]. The reliance on purchasing food suggests potential challenges in achieving food self-sufficiency, although some households engage in their own production through backyard gardens. Limited access to agricultural land may further impede the expansion of food production. Understanding the dynamics of social protection, social networks, and food sources provides valuable insights for policymakers, organizations, and community leaders in designing targeted interventions and support systems to enhance the livelihoods and well-being of the households in the studied population.

Our study showed that the major source of households' income before Typhoon Haiyan was self-employment. Households were involved in fishing, coconut and rice farming, fish vending, and other labor work. ACAPS [36] stated that an estimated 74 % of fishing communities reported that their main income sources were severely affected by the typhoon. Agriculture, a primary source of livelihood declined by 23 %, followed by poultry and livestock, as well as fishing which fell by 18 % and 26 % respectively. Because there were fewer livelihood options in the relocation sites, some households prefer to stay in their original coastal habitats where they can easily carry out income-generating activities like fishing. These findings corroborate those of Atienza et al. [25], who found that although the original coastal habitats have been designated by the government as "no-build zones",

some households had no choice but to remain in these areas to access their livelihood activities.

The relocation sites also face the problem of water and transportation. Water remains a major infrastructural problem in these resettlement areas as reported by all the households. Some households also reported electricity to be another infrastructural issue in the resettlement sites. The high prevalence of food insecurity underscores the urgent need for interventions and support mechanisms to address the financial constraints faced by these households. Efforts should also be directed towards improving infrastructural facilities, particularly in relation to water availability, electricity, transportation, and market access, to alleviate the challenges faced by the households. By addressing these underlying factors, it is possible to enhance the food security and overall well-being of the households in the study population.

Understanding the distribution of occupations within the studied population offers insights into the local economy, employment opportunities, and the diversity of skills present in the community. It also sheds light on the potential sources of income and the occupations that contribute significantly to the households' livelihoods. Such information can be valuable for policymakers, researchers, and organizations seeking to support and improve the economic well-being of the community. The study of Atienza et al. [25] in Eastern Vasayas showed that the practice of helping one another is an important social interaction of the people in the villages. This is not different from our findings, where 83.62 % of the households receive help mostly from relatives, and sometimes neighbors and workplaces. This is a form of social cohesion.

The presence of social protection instruments and health care coverage indicates potential avenues for addressing food insecurity and improving the overall well-being of these households. Efforts to enhance education opportunities, promote stable and diverse employment, expand social protection programs, and improve access to affordable and nutritious food are crucial in addressing the underlying factors contributing to food insecurity in this population. Moreover, frequent skipping of breakfast can result in nutritional imbalance, and people who skip breakfast also have more unhealthy habits such as smoking, drinking alcohol, and exercising less [37,38]. For these reasons, it would be reasonable to select regular breakfast intake as an important parameter of healthy habits. Other studies also had similar findings in which the food security status of the household had an association with health behaviors [39,40]. Household dietary habits, such as the frequency of meals, play a significant role in determining the level of food insecurity experienced. However, health problems and alcohol consumption were not identified as direct factors influencing food insecurity in this study. Further research and analysis may be needed to explore the complex relationship between health, alcohol consumption, and food security in this population.

As shown in the results, food insecurity was associated with dietary habits. Some households generally take two to three major meals per day. However, the quality and the quantity of the meals were not taken into consideration when assessing this dietary habit. Some households went whole days without meals. The emotional stress triggered by food insecurity may negatively affect individuals' eating habits [41,42]. These findings highlight the interplay between socioeconomic factors, access to resources, and food security status. Education, occupation, and sources of food all play significant roles in determining the food security status of households.

According to Willows et al. [39] rates of non-smoking, participation in physical activities, and regular breakfast intake declined in food-insecure individuals. The rate of non-smoking, in particular, significantly declined in food-insecure respondents, and meal patterns, perceptions of healthy eating, physical activity, and mental health, were related to food insecurity [40,43]. However, the present study showed that smoking has no significant association with food insecurity. Poorer families, and especially women, are engaging in negative coping strategies and limiting food intake. If these strategies continue for an extended period, they may negatively affect the health and physical well-being of the affected population [44].

Our study demonstrated the link between food insecurity and the use of traditional healers. Households find a compromise between visiting a medical center and use of traditional healers with scarce resources to get food. According to Nonhlanhla et al. [45], the main reason for the use of traditional healers was the perception of the effectiveness of treatment, proximity, and low economic status (relating to food security status). Other factors may influence this decision, such as education, rural or urban. The study of Bishwajita and Yaya in Bangladesh also showed that severe food insecurity was significantly associated with the under and non-utilisation of maternal health services [46]. This supports our findings on the use of traditional healers.

This study also demonstrated that there was no significant association between food insecurity and lack of physical exercise, alcohol consumption, and smoking. However, other studies showed that alcohol consumption and moderate-vigorous physical activities were related to food insecurity [47]. Engaging in regular physical activity is indicative of good self-care, as it is known to increase fitness, prevent obesity, reduce prevalence rates of chronic diseases, and boost mental health [48]. Furthermore, we assessed the association between household food insecurity sleep duration, and sleep complaints. The data analysis showed that food insecurity had an association with sleep complaints, however, no significant relation was observed with sleep duration. Food insecure respondents worried about food and they became stressed and they did not sleep well. This result is supported by the findings of Ding et al. [49] which reported that food insecurity participants were more likely to report sleep complaints than food security participants and poor sleep quantity and quality may predispose food insecure adults to adverse health outcomes. Because of longer working hours, more shift work, and the 24/7 availability of food and recreational activities, the average number of hours of sleep has declined over the past century [50]. Buysse et al. [51] suggested that complaints about sleep quality had become common and that a considerable proportion of adult's experience sleep quality disturbances, such as difficulty initiating sleep. Researchers found that more frequent sleep complaints and short sleep duration were linked to low income [52]. Higher-income households or individuals had better sleep quality, shorter sleep latency, and greater sleep efficiency [53].

In this study, because of a lack of food in the households, members of the households do not adhere to prescribed medications. In moderate and severe food insecure households, they sometimes did not have food to eat and may abandon their medications during that time. According to the findings of Silverman et al. [54], food insecurity had an association with medication adherence and this study also explained that low-income patients had lower medication adherence than high-income patients. Food-insecure households are less likely to have correct medication adherence and are more likely to forgo needed medical care due to cost compared to food-secure households [55]. For example, severe food insecurity has been shown to dramatically increase the likelihood of missed medication doses, with odds ratios indicating a strong and consistent association across various populations and health conditions [56]. People with food insecurity have limited control over what they eat; this sense of powerlessness leads to distress and affects their medication adherence, for instance, HIV and diabetes patients [57]. Non-adherence to medication has been shown to be linked to poor health outcomes in conditions such as HIV/AIDS, tuberculosis, and other chronic diseases [58–60]. Poor health reduces productivity and this further worsens food insecurity. Individuals with food insecurity report taking medication less often than prescribed due to costs and deferring paying for the medication in order to have money for food [61,62]. In the face of limited resources, demands for food may compete with resources needed to procure medicines. Even when clinic consultations are "free," clinical care is not without costs as patients have to incur costs in other ways such as travelling to distant clinics or waiting in long lines for care, purchasing food.

Understanding changes in occupation and income sources is vital for assessing the long-term impact of the typhoon on community stability and well-being. This study highlights the link between food insecurity, negative health behaviors, and financial constraints, underscoring the need for targeted interventions. Expanding cash transfer programs like MCCT and 4Ps, providing food assistance, and implementing community-based nutrition education can help address these challenges. Additionally, promoting backyard gardening and livelihood training can improve self-sufficiency. These strategies are essential for enhancing food security and resilience in disaster-affected communities.

5. Limitation

This study has several limitations that should be considered when interpreting the findings. First, its cross-sectional design restricts the ability to establish causal relationships between food insecurity, health behaviors, and socio-economic factors. The purposive selection of six villages in northern Tacloban City, which primarily included populations displaced by Typhoon Haiyan, may limit the generalizability of the results to other regions or non-displaced populations. If a larger or more diverse sample had been included, it is possible that the results would have captured a broader range of experiences and potentially revealed different patterns of food insecurity and health behaviors across various socio-economic or geographic contexts. Additionally, the use of systematic sampling based on house numbers could have introduced selection bias, particularly given the frequent movement of households between villages and disaster-prone areas. Data collection relied heavily on self-reported information through interviews, which may be subject to recall bias and social desirability bias. The study assessed experiences over the past twelve months, which may not capture seasonal variations or longer-term trends in food insecurity and health behaviors. In our analysis, a certain potential confounding variables, such as mental health status and detailed socio-economic indicators, were not included in the regression model, which may have introduced bias and affected the observed associations between the main variables of interest and the outcomeLastly, while efforts were made to adjust for potential confounders in the statistical analysis, unmeasured variables such as mental health status or access to external social support may have influenced the results.

6. Conclusion and recommendation

The study highlights the prevalence of household food insecurity in the study area, primarily caused by financial constraints and worsened by the impact of Typhoon Haiyan. The research reveals a negative relationship between food insecurity and various health factors, including dietary habits, medication adherence, sleeping problems, and the use of traditional healers. It emphasizes the need to address food insecurity as a determinant of overall health and well-being, not just from a nutritional standpoint. The study suggests implementing a monitoring and evaluation system to assess the effectiveness of existing policies and interventions, with a focus on education to improve knowledge and empower households to make healthier choices. Further research is recommended to explore the links between food insecurity and other risky behaviors. Overall, addressing food insecurity requires comprehensive approaches to improve health behaviors and outcomes in the study area. Future studies should consider employing larger and more diverse samples across multiple locations to strengthen the external validity and broader applicability of the results.

CRediT authorship contribution statement

Gashaw Enbiyale Kasse: Writing – review & editing, Visualization, Validation, Investigation, Formal analysis, Data curation. **Abdo Megra Geda:** Writing – review & editing, Visualization, Validation, Investigation, Formal analysis, Data curation. **Aregash Wendimu Tumebo:** Writing – review & editing, Visualization, Validation, Investigation, Formal analysis, Data curation. **Elvis Akem Tambe:** Writing – original draft, Methodology, Conceptualization. **Abraham Belete Temesgen:** Writing – review & editing, Visualization, Validation, Investigation, Formal analysis, Data curation. **Mulusew Tesfaye Yitie:** Writing – review & editing, Visualization, Validation, Investigation, Formal analysis, Data curation. **Tadesse Mihiret Yimam:** Writing – original draft, Visualization, Validation, Investigation, Formal analysis, Data curation. **Samuel Atalay Shiferaw:** Writing – review & editing, Visualization, Validation, Investigation, Formal analysis, Data curation.

Availability of the data and material

The data used to support the findings of this study have been included in the body. Further inquiries can be directed to the corresponding author.

Consent for publication

Not applicable.

Ethical approval

This study has received approval from the Institutional Review Board Committee of the University of Gondar (UoG), College of Veterinary Medicine and Animal Sciences (CVMAS) (Ref. No CVMAS/05/2022), following a review for ethical standards and confirmation of its moral integrity.

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Declaration of competing interest

The authors declare that they have some known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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