ORIGINAL RESEARCH

# Self-Reported Food Safety Practices and Associated Factors Among Health Extension Model and Non-Model Households in Northeastern Ethiopia: A Comparative Cross-Sectional Study

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**Purpose:** Eating contaminated food continues to cause numerous food-borne diseases globally. Understanding the causes of poor food safety practices is key to preventing food-borne diseases. Therefore, this study aimed to assess the prevalence of food safety practices and associated factors among health extension model and non-model households in Kombolcha, Ethiopia.

**Methods:** A comparative cross-sectional study was conducted among 327 model households and 329 non-model households in Kombolcha. Four kebeles were selected randomly from a total of 12 kebeles, followed by a systematic random sampling method to select a total of 656 households. The data were collected through face-to-face interviews with household heads and observations from April 15 to May 15, 2021. Data were entered into EpiData version 3.1 and analyzed using SPSS version 25.0. Determinants of food safety practices were determined by using multivariable logistic regression model at a *p*-value <0.05.

**Results:** The overall prevalence of food safety practices was 44.7% (95% CI: 40.5–48.4%), of which 57.8% (95% CI: 53.0–63.1%) were model and 31.6% (95% CI: 26.5–36.7%) were non-model households, with significant variation among household types. Being a model household (AOR=2.99; 95% CI: 1.98–4.52), having a female household head (AOR=3.13; 95% CI: 2.13–4.59), proper solid waste management (AOR=2.32; 95% CI: 1.54–3.48), good knowledge of food safety (AOR=2.05; 95% CI: 1.43–3.03), and good attitude (AOR=1.74; 95% CI: 1.22, 2.49) were significant predictors of good food safety practices.

**Conclusion:** The prevalence of good food safety practices was not satisfactory. Being a model household, having a female household head, proper solid waste management, good knowledge, and good attitude were significantly associated with good food safety practices. Therefore, the identified modifiable factors are potential areas of intervention to enhance good food safety practices.

**Keywords:** food safety practices, health extension model, non-model

## Introduction

Food infection and poisoning occur as a result of people eating food contaminated by microorganisms such as bacteria, viruses, and other food-borne pathogens,[1] or their toxins, which can pose a threat to the health of consumers.[2] Contamination is caused by improper preservation methods, unsanitary handling and storage, cross-contamination of food contact surfaces, or unhealthy practices during preparation.[3,4] This can lead to large-scale outbreaks of food-borne illness and poisoning, often accompanied by high mortality.[5]

Food-borne diseases (FBDs) are responsible for significant morbidity and mortality. It is well known that food-borne hazards can cause more than 200 acute and chronic diseases, from gastrointestinal infections to cancer.[6] Decreasing the risks from food safety hazards is a basic responsibility of any household or production business, regardless of its size.[3,7]

Food-borne-related illnesses have increased over the years, and negatively affect the health and well-being of people globally, and especially in developing nations,[8] but evidence on FBD in low- and middle-income countries is still limited.[9] Consumption of unsafe food not only results in public health problems but also has economic consequences

owing to absenteeism, hospital fees, and international trade losses.[10] The full health effects, as well as the full economic costs of consuming unsafe food, are not well known, but the global impact on health, trade, and development is considered enormous.[9]

According to the World Health Organization (WHO),[8] approximately 600 million people worldwide become ill after consuming contaminated food every year. Among these victims, an estimated 420,000 die, including 125,000 children under the age of 5 years.[6] However, cases of food infections and food poisoning are often underreported. Relative to their population, low- and middle-income countries in South Asia, Southeast Asia, and sub-Saharan Africa have a high burden of FBDs. They account for 53% of all food-borne illnesses and 75% of related deaths.[10,11]

The highest burden of foodborne-related illnesses was reported as 1300 disability-adjusted life-years (DALYs) per 100,000 population in the sub-Saharan African region.[8,9] Approximately 10–20% of FBD outbreaks are due to contamination by the food handler.[9,11] However, food safety, along with its health and economic benefits, has received little attention in diarrheal disease and other food infection control programs in Africa.[11,12]

In Ethiopia, there were 280,458 outpatient cases in 2013.[13] In a study of 1225 pediatric patients attending outpatient clinics in Ethiopia, parasites were detected in 337 cases (30.7%), *Salmonella* in 65 (5.3%), and *Shigella* in 61 (4.9%). Overall, these reports suggest the high toll on the public resulting from poor food safety practices.[12,13]

The food safety system in Ethiopia is not as organized and developed as in developed countries. Thereby, there are limited data on the burden of FBDs and food poisoning caused by poor food safety practices. Moreover, problems of the growing population, urbanization, lack of resources, lack of adequate knowledge, and poor attitude, are aggravating poor food hygiene and safety practice issues.[13]

Ethiopia has introduced a new initiative, the Health Extension Program (HEP), as a means of providing a comprehensive health service for the urban population, including food hygiene and safety, in health extension packages to prevent and control FBDs and food poisoning. As one strategy of this program, households have graduated as model families: household heads were selected and given basic training on the 16 health extension packages.[14] The graduate model families were expected to demonstrate practical changes after receiving training on the packages.

However, there is no quantified evidence on whether the health extension strategy has had an effect on the prevalence of food safety practices and associated factors. Therefore, this study aimed to assess the prevalence and associated factors of food safety practices among health extension model and non-model households in Kombolcha.

## Methods
### Study Setting
The study was conducted in Kombolcha town, Amhara Region, Ethiopia (Figure 1). Kombolcha is located 375 km from Addis Ababa in the northeast direction and 485 km from the capital city of the Amhara region, Bahir Dar. It has a latitude and longitude of 11.050° N, 39.044° E/11.083°N 39.733°E, with an elevation between 1842 and 1915 m above sea level. Based on the 2017 national population projection conducted by the Central Statistics Agency of Ethiopia (CSA), Kombolcha district has a total population of 116,682, of whom 58,480 are men and 58,202 women; 58,480 (50.12%) are urban inhabitants living in the town of Kombolcha, and the rest of population lives in peri-urban *kebeles* around Kombolcha town.[15]

### Study Design and Period
A community-based comparative cross-sectional study was conducted in selected *kebeles* of Kombolcha from April 15 to May 15, 2021.

### Study Participants
The source population of the study was all households located in Kombolcha. The study participants were all selected household heads aged >18 years in randomly selected *kebeles* in the study area.
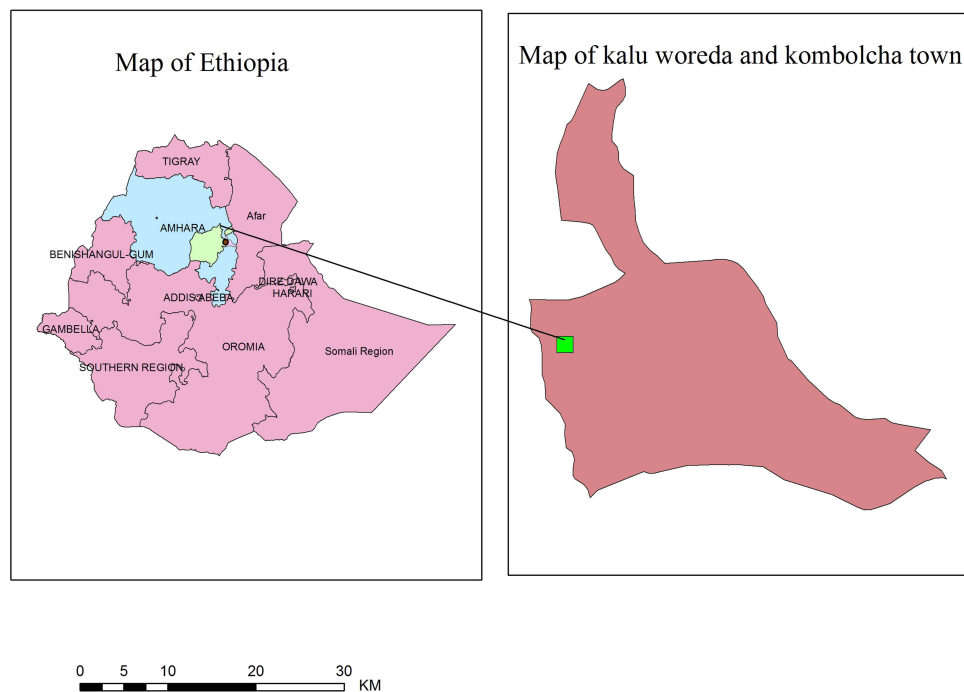
**Figure 1** Map of the study area.

## Sample Size Determination

The sample size needed for this study was calculated with the aim of detecting the difference between model and non-model households of 79% and 36.7%, respectively, using the double population proportion formula. However, it was too small to generalize the results. To obtain an adequate sample size, a different sample size was calculated using commonly associated variables of food safety practices found in previous studies. Finally, the greatest sample size was obtained using the sex of the household head (one of the variables commonly associated with food safety practices).[16] A power of 80%, 95% confidence interval (CI), taking the percentage outcome of food safety practices among male household heads as 30.4%, the AOR for a female household head (1.63), and the ratio of exposed to unexposed as 1:1, were used to calculate the sample size using Epi Info 7 software. Finally, by adding a 10% non-response rates, the final sample size was 672 households (336 for model and 336 for non-model households).

## Sampling Technique and Procedure

There are 12 *kebeles* in the Kombolcha district, from which four *kebeles* were selected randomly. All 672 estimated participants were proportionally allocated to each *kebele* based on the respective numbers of households. A systematic random sampling method was used to select households based on the list of households in each *kebele* from the records of the health offices. However, for those households that had more than one model families, one model family memeber was selected randomly.

## Dependent and Independent Variables

The dependent variable was food safety practices (good/poor). The data collection tool was organized into three parts: Part I contained socio-economic and demographic variables; Part II consisted of environmental, and behavioral factors; and Part III consisted of food safety practice measurement indicators.

# Operational Definitions

## Health Extension Packages

As a preventive health program, the HEP promotes four areas of care, comprising disease prevention and control; family health; hygiene and environmental sanitation (excreta disposal, solid and liquid waste disposal, water supply and safety measures, food hygiene and safety measures, healthy home environment; and personal hygiene); and health education and communication.

## Model Household

Households heads who attended above 75% of the training or 96 hours of the 16 health extension packages were certified as model households (observation of the certificate was mandatory).

## Non-Model Household

Household heads who had not received basic training on the 16 health extension packages and/or who had attended below 75% of the training or 96 hours of the 16 health extension packages were defined as non-model households.

## Food Safety Practices

These were determined using six food safety practice measurement indicators; namely, always washing hands before food preparation, washing food utensils and/or food, using improved water sources to prepare food, storing food in a covered container, keeping cooked and raw food separately, and elevating the container to place food and catering utensils where a child cannot reach them.[5,17,18] Each criterion was given a value of 1 for a positive action of food safety practice or a correct response, and 0 for a negative action or an incorrect response. The sum of these assessment indicators was calculated and the mean score of all observations and interview questions was used as a cut-off point to categorize households into those having good or poor food safety practices.[19] Those households practicing more than the mean score (4.19) of the six food safety practice assessment indicators were considered to have good food safety practices, and those households practicing less than or equal to the mean score (4.19) of the six food safety practice indicators were considered to have poor food safety practices.

## Knowledge

Households reporting more than the mean score (3.27) of the six knowledge assessment indicators[7,20–23] were considered to have good knowledge, whereas households reporting less than or equal to the mean score (3.27) of the knowledge assessment indicators were considered to have poor knowledge.

## Attitude

Households with more than the mean score (6.43) of cumulative responses on 10 attitude measurement indicators were considered to have a good attitude, whereas households with less than or equal to the mean score (6.43) of cumulative responses on 10 attitude measurement indicators were considered to have a poor attitude.

## Improved Latrine

Households with a pour-flush latrine piped to a sewer system, ventilated improved pit latrine (VIPL), pit latrine with slab, or composting toilet, in the dwelling or yard/compound, were classed as having an improved latrine.

## Unimproved Latrine

Households with no latrine or toilet facility or a bucket system, an open latrine, outside yard/compound, shared private facility of any type, outside yard/compound, or shared public facility of any type, or practicing open defecation, were classed as having an unimproved latrine.

## Liquid Waste Disposal

Proper disposal of liquid waste includes a soaking pit, cesspool, or septic tank, compost, and disposal in a designated site, whereas discharge into an open field was considered as improper liquid waste disposal.

### Solid Waste Disposal

Proper disposal of solid waste includes burning, burial in a pit, use as compost, and disposal in a designated site, whereas disposal in an open field was considered as improper solid waste disposal.

## Data Collection and Quality Assurance

A structured questionnaire and observational checklist were adapted from related literature.[5,24] The questionnaire was first prepared in English, then translated to Amharic (local language), and translated back to English to ensure consistency.

Six female environmental health officers who had a bachelor's degree and long experience in data collection were recruited as data collectors. A training manual was also prepared to facilitate the training process. Three days of extensive training were given to the data collectors and supervisors by the principal investigator before the start of the data collection process. The training was mainly focused on interviewing techniques and detailed discussion on each question, including those questions that needed careful attention and observation. Classroom lectures, mock interviews, and field practice were included in the training.

A pretest was conducted using a 5% (n=34) sample size of the total study sample in Haik town, near Kombolcha, to establish face validity and to ensure that the study participants understood what the investigators intended to measure. The pretest was performed by the data collectors to acquaint them with the questionnaire and give them further experience with data collection. The questionnaire was amended based on the results of the pretest.

The six environmental health officers administered the pretested, structured questionnaire by face-to-face interviews with household heads. They also observed participants' food safety practices. During data collection, if the participant was not available at the time of the first visit, the data collectors made another visit to that household on the next day. If they were unavailable again at the second visit, the household was considered as a non-respondent.

Two environmental health experts with a master's degree were involved in supervision. The supervisors were trained together with the data collectors, although the supervisors were separately taught how to supervise the data collectors and how to check the completed questionnaires, for instance, checking for inconsistencies in responses. Supervision was performed thoroughly for data quality control. The completed questionnaires were checked every day before data entry by the supervisors and/or principal investigator for completeness, clarity, and consistency. Any mistakes detected were corrected the next day.

## Statistical Analysis

Data were entered thoroughly using EpiData version 3.1 and exported to SPSS version 25.0 for data cleaning and analysis. Quality control measures, including data cleaning using sorting, graphical exploration of distributions, cross-tabulations, and summary statistics, were performed. A principal component analysis was used to construct a household wealth index (lowest, medium, and highest) after checking its assumptions for communality value >0.5, KMO (sampling adequacy) >0.5 with $p$-value <0.05, and complex structure factor (eigenvalue) >1. Descriptive statistics were used for categorical variables and mean±SD (standard deviation) for continuous variables. Continuous variables were categorized using information from the literature, and categorical variables were recategorized accordingly.

Binary logistic regression was used to examine the statistical association between explanatory variables and food safety practices at the household level. From the bivariable logistic regression analysis, variables with $p<0.25$ were selected as candidate variables for multivariable analysis. Bivariable (crude odds ratio [COR]) and multivariable (adjusted odds ratio [AOR]) logistic regression analyses were conducted and the results presented with 95% CIs. From the multivariable logistic regression analysis, variables with a significance level of $p<0.05$ were considered statistically significant and independently associated with good food safety practices.

Multi-collinearity among independent variables was checked using the standard error with a cut-off value of 2, and none of the variables was found to be collinear, with the maximum standard error reported being 0.27 for good food safety practices as an outcome of interest. Model fitness was also checked using the Hosmer–Lemeshow test, which had a $p$-value >0.05, and the reported Hosmer–Lemeshow test $p$-value was 0.14.

# Results

## Socio-Demographic Characteristics of the Study Participants

A total of 656 households, 327 from health extension model and 329 from health extension non-model households, participated in the study, with a response rate of 97.62%. Among these participants, 218 (66.7%) were female, and the mean ages (±SD) of model households and non-model households were comparable, at 32±8.47 and 32±9.03 years, respectively. Regarding their educational status, 11.3% and 10.9% of model households and non-model households, respectively, could not read and write, whereas only 17.1% of model households and 14.6% of non-model households had attended secondary level education ([Table 1](#)).

**Table 1** Socio-Demographic Characteristics of Study Households in Kombolcha, Northeastern Ethiopia, 2021

| Variables | Household Type | | | | Total | |
|---|---|---|---|---|---|---|
| | Model | | Non-Model | | | |
| | Frequency | (%) | Frequency | (%) | Frequency | (%) |
| **Age (years)** | | | | | | |
| 18–27 | 126 | 38.5 | 66 | 20.1 | 192 | 29.3 |
| 28–37 | 134 | 41.0 | 79 | 24.0 | 213 | 32.5 |
| 38–47 | 33 | 10.1 | 98 | 29.8 | 131 | 20.0 |
| >47 | 34 | 10.4 | 86 | 26.1 | 120 | 18.3 |
| **Sex of the respondents** | | | | | | |
| Male | 109 | 33.3 | 112 | 34.0 | 221 | 33.7 |
| Female | 218 | 66.7 | 217 | 66.0 | 435 | 66.3 |
| **Marital status** | | | | | | |
| Currently unmarried | 167 | 51.1 | 176 | 53.5 | 343 | 52.3 |
| Currently married | 160 | 48.9 | 153 | 46.5 | 313 | 47.7 |
| **Educational status** | | | | | | |
| Unable to read and write | 37 | 11.3 | 36 | 10.9 | 73 | 11.1 |
| Can read and write only | 64 | 19.6 | 70 | 21.3 | 134 | 20.4 |
| Elementary education | 130 | 39.8 | 128 | 38.9 | 258 | 39.3 |
| Secondary education | 56 | 17.1 | 48 | 14.6 | 104 | 15.9 |
| College/university | 40 | 12.2 | 47 | 14.3 | 87 | 13.3 |
| **Economic status** | | | | | | |
| Lowest | 107 | 32.7 | 116 | 35.3 | 223 | 34.0 |
| Medium | 111 | 33.9 | 111 | 33.7 | 222 | 33.8 |
| Highest | 109 | 33.3 | 102 | 31.0 | 211 | 32.2 |
| **Family size** | | | | | | |
| >5 members | 73 | 22.3 | 90 | 27.4 | 163 | 24.8 |
| ≤5 members | 254 | 77.7 | 239 | 72.6 | 493 | 75.2 |

## Environmental and Behavioral Factors

Among model households, 136 (41.6%) had functional hand-washing facilities, whereas 237 (72%) of the non-model households had no functional hand-washing facilities. Of model households, 181 (55.4%) disposed of liquid waste using properly constructed onsite sanitation management methods, including soak pits and septic tanks, while only 121 (36.8%) of the non-model households disposed of liquid waste properly. Nearly half, 153 (46.8%), of the model households, disposed of solid waste using properly constructed onsite sanitation management methods, including burning, burial in a pit, using as compost, and disposal in designated sites, but 260 (79.0%) of the non-model households disposed of their liquid waste improperly using an open dumping method. Among model households, 245 (74.9%) and 233 (71.3%) had good knowledge of food safety practices and a good attitude towards food safety practices, respectively (Table 2).

## Food Safety Practice Measurement Indicators

The potential range of the cumulative knowledge score was 0–6 and the mean score was 4.19±1.04 (actual range: 1–6). According to the reports from the study participants, the majority of households, 611 (93.1%), used improved water sources to prepare food, 437 (66.6%) always washed their hands before food preparation, 339 (51.7%) always washed food utensils and/or food, 529 (80.6%) stored food in a covered container, 369 (56.3%) kept cooked and raw food separately, and 464 (70.7%) of households used an elevated container in which to place food and catering utensils that a child cannot reach (Table 3).

**Table 2** Environmental and Behavioral Factors of Food Safety Practices Among Health Extension Model and Non-Model Households in Kombolcha, Northeastern Ethiopia, 2021

| Variables | Household Type | | | | Total | |
|---|---|---|---|---|---|---|
| | Model | | Non-Model | | | |
| | Frequency | Percent (%) | Frequency | Percent (%) | Frequency | Percent (%) |
| **Status of a latrine for use** | | | | | | |
| **Unimproved** | 97 | 29.7 | 164 | 49.8 | 261 | 39.8 |
| **Improved** | 230 | 70.3 | 165 | 50.2 | 395 | 60.2 |
| **Functional hand-washing facility** | | | | | | |
| **No** | 191 | 58.4 | 237 | 72.0 | 428 | 65.2 |
| **Yes** | 136 | 41.6 | 92 | 28.0 | 228 | 34.8 |
| **Liquid waste disposal** | | | | | | |
| **Improper** | 146 | 44.6 | 208 | 63.2 | 354 | 54.0 |
| **Proper** | 181 | 55.4 | 121 | 36.8 | 302 | 46.0 |
| **Solid waste disposal** | | | | | | |
| **Improper** | 174 | 53.2 | 260 | 79.0 | 434 | 66.2 |
| **Proper** | 153 | 46.8 | 69 | 21.0 | 222 | 33.8 |
| **Knowledge of food safety** | | | | | | |
| **Poor** | 82 | 25.1 | 212 | 64.4 | 294 | 44.8 |
| **Good** | 245 | 74.9 | 117 | 35.6 | 362 | 55.2 |
| **Attitude towards food safety practices** | | | | | | |
| **Poor** | 94 | 28.7 | 202 | 61.4 | 296 | 45.1 |
| **Good** | 233 | 71.3 | 127 | 38.6 | 360 | 54.9 |

**Table 3** Overall Food Safety Practices and Their Measurement Indicators Among Health Extension Model and Non-Model Households in Kombolcha, Northeastern Ethiopia, 2021

| Food Safety Practice Indicators | Response | |
|---|---|---|
| | **No (%)** | **Yes (%)** |
| Do you always wash your hands before preparation? | 219 (33.4%) | 437 (66.6%) |
| Do you always wash food utensils and/or food? | 317 (48.3%) | 339 (51.7%) |
| Do you always use improved water sources to prepare food? | 45 (6.9%) | 611 (93.1%) |
| Do you always store in a covered container? | 127 (19.4%) | 529 (80.6%) |
| Do you always keep cooked and raw food separately? | 287 (43.8%) | 369 (56.3%) |
| Do you always use an elevated container to place food and catering utensils (child cannot reach)? | 192 (29.3%) | 464 (70.7%) |
| **Overall food safety practice using mean score** | **Good** | **293 (44.7%)** |
| | **Poor** | **363 (55.7%)** |

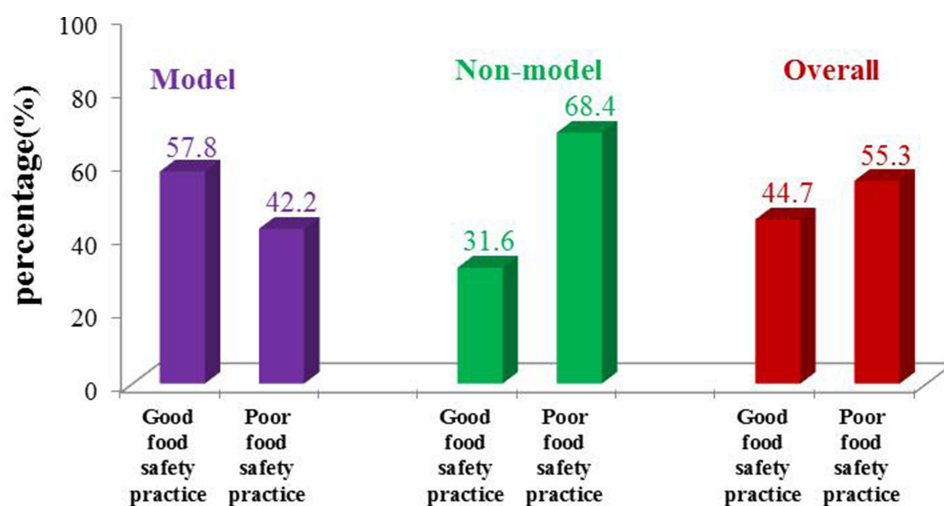## Prevalence of Food Safety Practices

Out of 656 households, 293 (44.7%; 95% CI: 40.5–48.4%) had good food safety practices, comprising 189 (57.8%; 95% CI: 53.0–63.1%) of model households and 104 (31.6%; 95% CI: 26.5–36.7%) of non-model households with good food safety practices, respectively. Since the prevalence confidence intervals did not overlap, we can conclude that there is a significant variation in food safety practices between the health extension model and non-model households (Figure 2).

## Factors Associated with Food Safety Practices Among Model Households

From the multivariable analysis of split data collected from health extension model households, we found that female households (AOR: 4.95; 95% CI: 2.77–8.86), and households with functional hand-washing facilities (AOR: 5.03; 95% CI: 2.70–9.36), proper solid waste management (AOR: 4.21; 95% CI: 2.26–7.83), and good knowledge (AOR: 5.40; 95% CI: 2.94–9.95) were more likely to have good food safety practices than their counterparts.

## Factors Associated with Food Safety Practices Among Non-Model Households

From the multivariable analysis of split data collected from health extension non-model households, we found that households with improved latrines (AOR: 3.34; 95% CI: 1.96–5.69), functional hand-washing facilities (AOR: 2.15; 95%



**Figure 2** The prevalence of self-reported food safety practices among health extension model and non-model households in Kombolcha, Northeastern Ethiopia.

CI: 1.21–3.83), and proper liquid waste management (AOR: 1.95; 95% CI: 1.13–3.37) were more likely to have good food safety practices than their counterparts.

## Factors Associated with Food Safety Practices from Pooled Data

An overall multivariable logistic regression analysis was carried out to evaluate the combined effect of multiple associated factors by adjusting for confounding variables. The results indicated that being a model household, and having a female household head, proper solid waste management, and good knowledge of and a good attitude towards food safety practices, were significantly associated with good food safety practices.

In this study, model households were 2.99 times (AOR: 2.99; 95% CI: 1.98–4.52) more likely to have good food safety practices than non-model households, whereas female households were 3.13 times (AOR: 3.13; 95% CI: 2.13–4.59) more likely to have good food safety practices than their counterparts. Households with proper solid waste management were 2.32 times (AOR: 2.32; 95% CI: 1.54–3.48) more likely to have good food safety practices than households with improper solid waste management.

Those households with good knowledge were 2.05 times (AOR: 2.05; 95% CI: 1.43–3.03) more likely to have good food safety practices than households with poor knowledge about food safety. The odds of good food safety practice among households with a good attitude towards food safety practice were 1.74 times (AOR: 1.74; 95% CI: 1.22–2.49) higher than in households with a poor attitude (Table 4).

## Discussion

Occurrences of food-borne illness and food poisoning are mainly attributed to a lack of knowledge on food safety and poor food safety practices, and are a major health problem in sub-Saharan Africa, including Ethiopia.[12] To prevent this public health problem cost-effectively, the government of Ethiopia and other concerned stakeholders should emphasize knowledge of food safety and good safety practices at the household level. Therefore, this study generates evidence on the levels of food safety practices and their determinant factors among health extension model and non-model households in northeastern Ethiopia.

This study showed that there was a significantly higher prevalence of good food safety practices among model households compared to non-model households. This confirmed the results of previous studies conducted in Abobo district, Southwestern Ethiopia, and Hawassa City, Sidama, Ethiopia.[16,25] Good food safety practices showed significant variation between model (57.8%) and non-model households (31.6%).

The reason for this large and significant variation may be that model families of the HEP were better implementers than non-model families, such that health extension workers gave more emphasis to training, practice, support, and follow-up on food safety measures to model households than to non-model households, and certified them as a model household when they fully applied all of the packages. This training and follow-up enabled them to bring knowledge and skills development to model households, which therefore had better food safety practices than non-model households.

The prevalence of good food safety practices among model households (57.8%; 95% CI: 53.0–63.1%) in this study was lower than the prevalence of good food hygiene practices (79%) among model households reported from a comparative cross-sectional study in Abobo district, Southwestern Ethiopia. This discrepancy may due to differences in the implementation of food safety measure packages, variations in time, differences in the study setting, variation in training, and the level of social acceptance of practices among model households. However, the level of good food safety practices among non-model households (31.6%; 95% CI: 26.5–36.7%) was consistent with the findings (36.7%) of a study conducted in Abobo district, Southwestern Ethiopia.[16]

The overall prevalence of good food safety practices among model and non-model households was 44.7% (95% CI: 40.5–48.4%) and this prevalence was higher than in studies carried out in Northwest Ethiopia (40.1%),[20] Bole Sub-city in Addis Ababa (27.4%),[18] Arba Minch Town (32.6%),[22] and West Arsi Zone (27.5%), Ethiopia,[26] Imo State, Nigeria (37%),[27] and Lahore, Pakistan (0.3%).[28] This difference may be due to the improvements in health extension service approaches and other community health education services as interventions during the time gap between the studies. For instance, successive training on food hygiene and safety in the current study area could increase good food safety practices, since training is the best intervention through which to improve knowledge, which is a key factor in improving practice.

**Table 4** Bivariate and Multivariate Logistic Regression Analysis of Factors Associated with Food Safety Practices (FSP) Among Health Extension Model and Non-Model Households in Kombolcha, Northeastern Ethiopia, 2021

| Variables | FSP | | COR (95% CI) | AOR (95% CI) | *p*-Value |
|---|---|---|---|---|---|
| | Good | Poor | | | |
| **Household type** | | | | | |
| Model | 189 | 138 | 3.17 (2.15–4.08) | 2.99 (1.98–4.52) | <0.001 |
| Non-model | 104 | 225 | 1 | 1 | |
| **Age of the respondents (years)** | | | | | |
| 18–27 | 90 | 102 | 1 | 1 | |
| 28–37 | 99 | 114 | 0.97 (1.51–3.14) | 0.98 (0.63–1.53) | 0.917 |
| 38–47 | 61 | 70 | 1.24 (0.69–2.22) | 1.88 (1.09–3.19) | 0.210 |
| >47 | 43 | 77 | 0.81 (0.44–1.49) | 0.99 (0.57–1.73) | 0.986 |
| **Sex of the respondents** | | | | | |
| Female | 228 | 207 | 2.64 (1.87–3.73) | 3.13 (2.13–4.59) | <0.001 |
| Male | 65 | 156 | 1 | 1 | |
| **Economic status** | | | | | |
| Lowest | 104 | 119 | 1 | 1 | |
| Medium | 106 | 116 | 1.05 (0.72–1.52) | 1.13 (0.74–1.72) | 0.574 |
| Highest | 83 | 128 | 0.74 (0.51–1.09) | 0.65 (0.42–1.01) | 0.054 |
| **Status of a latrine for use** | | | | | |
| Improved | 227 | 168 | 1.24 (0.91–1.7) | 1.69 (1.17–2.46) | 0.056 |
| Unimproved | 136 | 125 | 1 | 1 | |
| **Functional hand-washing facility** | | | | | |
| Yes | 116 | 112 | 1.47 (1.06–2.03) | 1.20 (0.83–1.75) | 0.333 |
| No | 177 | 251 | 1 | 1 | |
| **Liquid waste management** | | | | | |
| Proper | 163 | 139 | 2.02 (1.48–2.76) | 2.31 (1.59–3.35) | <0.001 |
| Improper | 130 | 224 | 1 | 1 | |
| **Solid waste management** | | | | | |
| Proper | 126 | 96 | 2.09 (1.51–2.91) | 2.32 (1.54–3.48) | 0.640 |
| Improper | 167 | 267 | 1 | 1 | |
| **Knowledge of food safety practices** | | | | | |
| Good | 178 | 184 | 1.51 (1.10–2.06) | 2.05 (1.43–3.03) | <0.001 |
| Poor | 115 | 179 | 1 | 1 | |

(*Continued*)

**Table 4** (Continued).

| Variables | FSP | | COR (95% CI) | AOR (95% CI) | *p*-Value |
|---|---|---|---|---|---|
| | **Good** | **Poor** | | | |
| **Attitude towards food safety practices** | | | | | |
| Good | 175 | 185 | 1.43 (1.05–1.95) | 1.74 (1.22–2.48) | 0.002 |
| Poor | 118 | 178 | 1 | 1 | |

**Note**: 1=reference category.

However, the prevalence of good food safety practices was lower than in other studies conducted in Ethiopia, in Gondar City (49.0%),[7] Debark Town (49.1%),[29] Dangila Town (52.5%),[30] Debre Markos Town (54%),[31] and in Paris, France (65%).[32] The discrepancy may also be due to the low performance in training and supervision on food safety measure packages and lower educational status of respondents (only 29.2% had above secondary education) compared to the previous studies, which, in turn, lowers the prevalence of good food safety practices in this study. This means that different local governments can increase the capacity of the community to actively participate in FBD prevention and control activities through implementing good food safety practices.

The multivariable logistic regression results showed that being a model household head (having received safety training) was a strong predictor of good food safety practices, which showed that the odds of performing good food safety practices among model household heads was 2.99 times higher compared to their counterparts. The result is corroborated by previous, similar studies, conducted in Debarq Town,[29] Gondar City,[7] Abobo district,[16] and Hawassa City, South Ethiopia,[25] Ghana,[33] Bangladesh,[34] Imo State, Nigeria,[27] and Saudi Arabia.[35] This could be explained by household heads who have received food safety training having a better understanding of safe food handling practices compared to household heads without food safety training.

Female household heads also had a greater likelihood of having good food safety practices than their male counterparts, similarly to a previous study.[16] This indicates that female household heads accept food safety training and practices more readily than male household heads. Households with proper solid waste management were more likely to have good food safety practices than those with improper solid waste management, which confirms the results of previous, similar studies.[16,36] A possible reason for this association is that food waste is a type of solid waste which can cause food contamination if it is improperly disposed of. To keep food safe, it is important to manage food waste and other solid wastes according to the recommended regulations.

The odds of performing good food safety practices among the study participants who had good knowledge of food safety practices was 2.05 times higher than in respondents who had poor knowledge. This study finding was also seen in previous studies carried out in Shashemene Town, Central Ethiopia,[26] Bole Sub-city, Addis Ababa,[18] Debre Markos Town, Ethiopia,[31] Dangila Town,[30] Gondar City,[7] and Debarq Town, Northwest Ethiopia,[29] Ghana,[1] Imo State, Nigeria,[27] Bangladesh,[34] Jordan,[37] and Sarawak and Petaling Jaya, Malaysia.[38,39] This association indicated that food safety practices are highly influenced by increasing knowledge scores regarding food safety.

In this study, a good attitude towards food safety was also a significant predictor of good food safety practices. This finding is in line with results from cross-sectional studies conducted in Bole Sub-city, Addis Ababa,[18] Northwest Ethiopia,[20] Debarq Town[29] and Debre Markos Town, Ethiopia,[31] Imo State, Nigeria,[27] Kuwait,[40] Lahore, Pakistan,[28] and Sarawak and Petaling Jaya, Malaysia.[38,39] A possible reason for this association is that training in food safety measure packages leads to a good attitude, which may improve the behavior around and practice of food safety.

## Limitations

This study was not without limitations, which should be considered in the interpretation of our findings. This study employed a cross-sectional research design, which limits the establishment of causal pathways. Owing to the specific study areas explored in this study, the findings may not be generalizable to the whole of Ethiopia. However, food safety

practices were assessed by information provided by the respondents and standardized observational checklists, which may reduce reporting bias.

## Conclusions

The overall prevalence of food safety practices among households was not satisfactory in the study area, despite significant variation between model and non-model households. The results showed that the prevalence of food safety practices among model households has not made good progress compared to the national Health Extension Program targets. Furthermore, food safety practices among non-model households are too low and continue to be a public health problem.

Being a model household, and having a female household head, proper solid waste management, and good knowledge of and attitude towards food safety were significantly associated with good food safety practices among households. Interventions should focus on the identified determinant factors during food safety and hygiene education programs. Continuous supportive supervision is required to enhance the knowledge and skills of food handlers to comply with better food safety practices. Regular audits should also be implemented to ensure the permanence of effective and continuous health extension training.

## Abbreviations

AOR, adjusted odds ratio; CI, confidence interval; COR, crude odds ratio; FBD, food-borne disease; HEP, Health Extension Program; WHO, World Health Organization.

## Data Sharing Statement

The data sets used and/or analyzed during the current study are available from the corresponding author and upon reasonable request.

## Ethical Approval and Consent

The study was conducted in accordance with the Declaration of Helsinki. The ethical approval letter was obtained from the Institutional Ethical Review Committee of the College of Medicine and Health Sciences of Wollo University with the issue number of CMHS/366/13/21. Owing to the presence of illiterate participants, verbal informed consent, rather than written, was obtained from the participants before the commencement of data collection. The verbal consent process was approved by the Institutional Ethical Review Committee of the College of Medicine and Health Sciences of Wollo University, and each participant's consent was recorded as the data collectors informed them that their information would not be used for purposes other than scientific research and would be not disclosed to any third party. Participants were informed that participation would be voluntary and that they could withdraw at any time for any reason. Confidentiality and anonymity were maintained by avoiding possible identifiers such as the names of the study participants, by using identification numbers as a reference. Finally, health education was given to the study participants about good food safety practices after the data collection had ended.

## Disclosure

All authors declare that they have no competing interests in this work.

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