

# Food handling practice and associated factors among food handlers working in food establishments in Woldia town, Northeast Ethiopia

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## Research Article

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# Abstract

**Purpose:** The food safety issue is a major public health concern. Inadequate food handler's knowledge and food safety practices are the utmost mentioned contributing factors for potential foodborne disease outbreaks. This study aimed to assess food handling practices and determinants among food handlers working in catering establishments in Woldia town.

**Design/methodology/approach:** In total, 288 food handlers were recruited through a simple random selection method. A structured and interviewer-administered questionnaire was used as a data collection tool. Data were analyzed using frequencies and through applying bivariate and multivariate logistic regressions.  $P < 0.05$  was considered statistically significance.

**Findings:** Of total 288 participants, 91.7% were females, and 69.8% were literate. This study revealed that good food handling practice was 46.5% (95%CI:37.01-56.20). In the subgroup analysis, advanced age (adjusted odds ratio (aOR)=12.01; 95%CI:1.96-17.52), married couples (aOR=2.09; 95%CI:1.05-4.78), education (participants who attend grade 7-12 (aOR=2.33; 95%CI:1.14-4.79), and above secondary education (aOR=2.29; 95%CI:1.05-4.61)), monthly income (aOR=2.29; 95%CI:1.14-5.61), work experience above six years (aOR=2.43; 95%CI:2.08-3.17), received training (aOR=1.79; 95%CI:1.68-4.71), inspected by concerned authority (aOR=2.24; 95%CI:1.05-3.09) and knowledge (aOR=3.15; 95%CI:1.02-6.04) were factors associated with food handling practices.

**Originality/value:** Comprehensive and continuous food handling and safety training to food handlers and/or food establishment owners, regular sanitary inspection visits of public food and drink services establishments by concerned authority is compulsory to ensure that all food handlers have the knowledge and the skill to provide safe food.

## Introduction

Foodborne illness is a major public health problem globally (Tessema *et al.*, 2014; WHO, 2015). Each year an enormous number of individuals are at increased risk, and many of them get ill and die due to the consumption of contaminated food (WHO, 2015). Although food handling issues had risen steeply in more affluent societies, the real catastrophe of foodborne diseases played out in low-income countries (WHO, 2015). This could be due to the high proportion of improper food hygienic practices, the deficiency of food safety laws, the low level of food handler's knowledge, attitude, and practice on food safety (Tessema *et al.*, 2014; WHO, 2015). Foodborne disease-related morbidity and mortality in low and middle-income countries, particularly in Africa are steadily highest due to low food hygienic practices at food preparation or service areas (Derse *et al.*, 2017; WHO, 1989). Although the food safety issue is the main public health concern, ensuring food safety to protect people from different foodborne diseases continues a substantial challenge, globally (Ayalew *et al.*, 2013; Bereda *et al.*, 2016; WHO, 1989). As different prior studies mentioned that the most contributing factors for potential foodborne pathogen outbreaks which raised in food and drinking service establishments are due to unsanitary conditions of

the establishments (Mendedo *et al.*, 2017; Kibret and Abera, 2012), food handler's poor personal and food hygienic practices (Kibret and Abera, 2012; Coutts *et al.*, 2017; Shin *et al.*, 2015; Nygren *et al.*, 2013; Ryan *et al.*, 1996; WHO, 2015; Mendedo *et al.*, 2017), and the low level of food handler's food handling knowledge (Abdullahi *et al.*, 2016; Zanin *et al.*, 2017; Walker *et al.*, 2003). Food handlers are anyone who works at a public food and drink service establishments and who handles food or who have direct contact with any food utensils, such as cutlery, dishes, plates, or chopping boards (Scallan EHR *et al.*, 2011; Tessema *et al.*, 2014).

Consumption of unsafe food contributed to transmitting more than 200 known different diseases (Mead PS, 1999). Consequently, about two billion illnesses are associated with foodborne diseases (WHO, 2015). Particularly at public food and drink service establishments, food handlers are the first responsible bodies to contaminate food by acting as either a biological or physical carrier for many pathogenic organisms (Tessema *et al.*, 2014). Among the most common pathogens that cause food contaminations and raise outbreaks due to food handler's poor personal hygiene and low level of food handling practice, few known species are shigella spp (Nygren *et al.*, 2013; Mokhtari *et al.*, 2012; Mama and Alemu, 2016; Saeed and Hamid, 2010), salmonella spp (Mama and Alemu, 2016; Camps *et al.*, 2005; Abera *et al.*, 2010; Saeed and Hamid, 2010), *Staphylococcus aureus* (Argudin *et al.*, 2012; Wakabayashi *et al.*, 2018; Dagneu *et al.*, 2012; Wattinger *et al.*, 2012; Gumbo *et al.*, 2015; Saeed and Hamid, 2010; El-Shenawy *et al.*, 2013; Rall *et al.*, 2010; Jorda *et al.*, 2012; Simsek *et al.*, 2009), *Listeria monocytogenes* (Munoz *et al.*, 2013), *Escherichia coli* (Eltai *et al.*, 2018; Shin *et al.*, 2015; Sanneh *et al.*, 2018), *Giardia lamblia*, *Ascaris lumbricoide*, and *Entamoeba histolytica* (Dagneu *et al.*, 2012; Abera *et al.*, 2010; Saeed and Hamid, 2010), Norovirus (Liu *et al.*, 2015; Coutts *et al.*, 2017).

Food handlers can always contribute to ensuring food safety at public food and drink service establishments (Zain and Naing, 2002). A prior study had mentioned that 10–20 percent of foodborne illnesses are due to food contamination by food handlers (Kasturwar NB and Shafee M, 2011). This could be due to the very low food handler's hygiene, inappropriate food cooking measures, and improper food utensil storage which can contribute the way for pathogens to come into contact with food and cause foodborne illness in consumers (Kaferstein FK, 2003). Realizing the food handler's role in food contamination and disease outbreak, the World Health Organization (WHO) develop guidelines to give comprehensive training to food handlers about their role and tasks to insured food safety (World Health Organization, 2006; WHO, 1989). Hence, realizing food safety measures and possible factors that can be the source of foodborne disease is important for all food handlers in controlling and preventing foodborne disease (World Health Organization, 2006; WHO., 2000).

Several socio-demographic and other factors associated with food handler's food handling practices had mentioned from different study settings. Of those, food safety training (Gizaw, 2014b; Derso *et al.*, 2017; Kibret and Abera, 2012), the service year (Gizaw, 2014b; Derso *et al.*, 2017), advanced age (Gizaw, 2014b), education (Derso *et al.*, 2017; Zain and Naing, 2002), marital status (Gizaw, 2014b; Tessema *et al.*, 2014), monthly income (Gizaw, 2014b; Tessema *et al.*, 2014), and knowledge (Tessema *et al.*, 2014; Gizaw, 2014b; Nigusse and Kumie, 2012; Kibret and Abera, 2012) were factors significantly associated with food

handling practices. Moreover, other environmental determinants like poor liquid and solid waste management, water supply, the presence of shower, and toilet facilities are found to be associated with the food handler's food safety practice (Tessema *et al.*, 2014).

In Ethiopia, there is scarce information that revealing magnitudes of foodborne disease due to improper food safety in food and drink services establishments. However, few studies from the different settings of the country revealed that there is a high unsanitary condition in catering establishments (Abera K *et al.*, 2006; Melese A *et al.*, 2018; Kibret and Abera, 2012). Woldia town, the capital of North Wollo Zone, and the focus of this study is urbanizing at a fast rate. It is a stop-over for tourists and the public at large traveling to and from Bahir Dar city, Lalibela, Mekelle, and Afar Region. Hence, many people make use of the food, drink, and accommodation services in the town; as a result, this can raise the risk of foodborne disease. Hence, providing information to the concerned body regarding the level of food handling practices and its associated factors have a vital role in refining food handling practices among food handlers working at food and drink services establishments in the study area. Therefore, this study aimed to assess food handling practices and associated factors among food handlers working at a public food and drink service establishments at Woldia town, Northeast Ethiopia.

## **Materials And Methods**

### ***Study setting and design***

An institutional-based cross-sectional study was carried out from 01 to 30 June 2018. Woldia is the capital of the North Wollo Zone, Amhara region, and it is found in the Northeast of Ethiopia. As previously had described and detailed (Melese A *et al.*, 2018), there were 408 registered public food and drink service establishments in the town, and a total of 956 (302 males and 654 females) food handlers were working in those public food and drink service establishments at the time of data collection. The study area description or geographical location and population projection are briefly described in the previous article (Melese A *et al.*, 2018).

### ***Study population***

All food handlers working at public food and drink service establishments in the town were the focus of this study. For our proper sampling techniques, a total list of public food and drinking service establishments and the number of food handlers were found from the town Trade and Industry Office. Hence, a total of 956 (302 males and 654 females) food handlers were found and used as the source of the study population.

### ***Sample size and sampling procedure***

A single population proportion formula was used to calculate the required sample size. The confidence interval of 95%, marginal error of 0.05, the proportion (P) (52.5%) (Tessema *et al.*, 2014), and 5% non-response rate was considered. Accordingly, the final sample size was calculated to be 288. For proper

sampling techniques, total lists of public food and drink service establishments (n=408), and food handlers (n=956) were found at the Woldia town Trade and Industry Office, as previously described (Melese A *et al.*, 2018). All food handlers working in 408 public food and drink service establishments in the town were recruited. Then, lists and the total number of food handlers in each establishment were found from each establishment owner/or managers at the time of data collection. The selection of food handlers based on their number in each establishment was done using the proportion ( $288/956=30\%$ ). One food handler per establishment was selected. However, due to the presence of more than one food handler in each establishment, we used a simple random sampling method.

### ***Data collection tool***

A structured interviewer-administered questionnaire and observational checklist were used as the data collection tools. The questionnaire was developed through reviewing previously published researches (Tessema *et al.*, 2014; Zain and Naing, 2002; Zanin *et al.*, 2017; Akabanda *et al.*, 2017), and adopted from the WHO (WHO, 1989). The developed questionnaire was subjected to a preliminary validation (Akabanda *et al.*, 2017), peer-reviewed and pilot tested to assess its clarity, the suitability of wording, and the average time needed for its completion. Based on this pilot study, necessary modifications were identified and resolved before a final version was administered, whereas its results were not included in the final survey. The questionnaire was structured into three distinctive sections.

Section one was to collect information on respondents' demographic characteristics such as gender, sex, age, marital status, level of education, religion, monthly income (in birr), and length of employment in public food and drink service establishments.

Section two was concerned with the food handler's knowledge status on food hygienic practices. This section of the questionnaire dealing with food hygiene knowledge comprised eight (8) close-ended questions with multiple possible answers. These questions specifically dealt with respondents' knowledge of personal hygiene, food contamination, foodborne diseases, mode of transmission for foodborne diseases, temperature control, and hygienic practices. A scale ranging between 0 and 8 (representing the total number of questions on food hygiene knowledge) was used to evaluate the overall knowledge of respondents. Food-handlers that obtained total score  $\leq$  the mean value were considered to have "poor" knowledge and those that had scores  $>$  the mean value ( $>50\%$  accuracy) were considered to have "good" knowledge of food hygiene.

In section three, which dealt with food hygiene practices, the good hygienic practices of respondents (institutional food-handlers) were assessed and evaluated based on self-reporting of personal hygiene and other safe food handling practices. The section had eighteen (18) questions/statements or checklists with two possible responses: "yes", and "no". Each correct practice reported scored one (1) point. For evaluation, a score  $>50\%$  by an individual respondent was considered as having "good" food hygienic practice.

For administering three well-trained, BSc nurses who have experience in field data collection, and one food safety and environmental sanitation inspection expert were involved in the data collection. The quality of collected data was assured through pilot-testing, translating the tool to the local language (Amharic), and translated back to the English language to check its consistency, training to the data collectors and supervisors, and lastly collected data was checked its completeness and cleaned for analysis.

### ***Data processing and analysis***

We used the statistical package for social science (SPSS) for Windows (version 20.0, 2001, Chicago, IL) for analyses of the data. Cleaned, edited, and complete items were coded and entered into SPSS for analysis. Mean scores of responses were converted into percentages for purposes of easy interpretation of results. The findings were presented using descriptive statistics. The multivariate logistic regression model was computed to analyze the data and to determine the effect of determinants on the outcome variable. Independent variables with  $p < 0.05$  were considered statistically significant.

### ***Ethical considerations***

The study was ethically reviewed and approved by Woldia University research review committee, and a permission letter was also obtained from the Woldia town Municipality office and district health department. Data were collected after informed/written consent was obtained from the public food and drink service establishment owners and interviews follow full consent of the food handlers. Participants were assured that all information they provided was kept confidential and used only for the aim of this study.

## **Results**

### ***Sociodemographic characteristics***

Table 1 illustrates the summarized demographic profile of respondents in this study. A total of 288 food handlers were recruited, and the median age was 23.3 years. Of total, 264 (91.7%) were females, and 237 (82.3%) were single, while 255 (88.5%) were Orthodox Christian. The majority, 201 (69.8%) were literate who attained education up to grade twelve and above. Nevertheless, fewer (14.6%) participants had taken formal training about food preparations and handling practices, but only 16.7% (7/42) had received the certificate. More than half, 173 (60.1%) of food handlers had about 1-5 years of work experience (Table 1).

### ***Food handler's knowledge about food handling practices***

To assess the knowledge status of food handling practice, participants were asked eight knowledge-based questions. Of the total, 182 (63.2%) had adequate knowledge status on food handling practices. More than half, 179 (62.2%) of them have heard of about foodborne diseases, of which 61.1% had good knowledge status. About half, 145 (50.3%) of food handlers had reported that the causes of foodborne

diseases are germs, while 110 (38.2%) had mentioned the cause as an unapproved source. The majority, 109 (37.8%) of food handlers did not know the mode of foodborne disease transmission. Regarding the mentioned reasons for food contamination, 106 (36.8%) had responded dirt utensil as a reason, whereas 37.5% had mentioned the reason as an unapproved source. Of the total, 205 (71.2%) of them mentioned that good personal hygiene can prevent foodborne diseases. The majority, 66%, and 66.3% had realized that raw milk and raw meat can transmit different diseases, respectively (Table 2).

### ***Food handling practices***

This study revealed that good food handling practice was 46.5% (95%CI:37.01-56.20). The observational assessment had shown that more than three-fourth (77.1%) of the food handlers did not wear outer garment/or gown, of which 44.4% had poor food handling practice. The majority, 253 (87.8%) of food handlers had not covered their hair during food handling and preparation, while 174 (60.4%) participants' fingernails had not short trimmed and clean. Moreover, 140 (48.6%) had worn any jewelry on their hand at the time of data collection, about 128 (44.4%) participants had not used soap/or detergent for washing dishes. More than three-fourth (79.5%), and (92.7%) of participants had used soap and water and wash their hands before working with foods and after visiting a latrine, respectively. Furthermore, 72.2% and 82.6% of participants had not preserved ready-to-eat foods in a hygienic container and had not carefully kept food utensils on the shelf, respectively. More than half, 53.5% had not washed their utensils using three washing compartments and they had inadequate food hygienic practice. The majority, 85.1% had not taken medical checkups in the past six months, while 52.4% were not inspected by concerned authority for the last six months (Table 3).

### ***Factors associated with food handling practices***

During bivariate logistic regression analysis: sex, age, marital status, educational status, monthly income, service year, training received, sanitary inspection visit by concerned bodies, knowledge status, and the presence of latrine were significantly associated with food handling practices ( $P < 0.05$ ). After adjusting for confounding effects of the factors in multivariate logistic regression analysis, several such factors: age, marital status, education, monthly income, service years, training received, sanitary inspection visits, and knowledge status were significantly associated with food handling practices ( $p < 0.05$ ) (Table 4).

Participants under 36-40 years of age group had higher odds of good food handling practice as compared to participants under 15-20 years age group (aOR=12.01; 95%CI:1.96-17.52;  $p=0.017$ ). Compared to single participants, the odds of having good food handling practices were higher in married couples (aOR=2.09; 95%CI:1.05-4.78). Compared to illiterate participants, the odds of having a good food handling practice were higher in participants who had attended grades 7-12 (aOR=2.33; 95%CI:1.14-4.79;  $P=0.013$ ) and above secondary education (aOR=2.29; 95%CI:1.05-4.61;  $P=0.046$ ), respectively. The odds of having good food handling practices were higher among food handlers whose monthly income was greater than 500 birr as compared to their counterparts (aOR=2.29; 95%CI:1.14-5.61). A statistically significant association between service years of participants and a good food handling practice was found in this study. Thus, the odds of having good food handling practices were higher among

participants with longer service year experience (6-10years) (aOR=2.43; 95%CI: 2.08-3.17; p=0.034). Formal training to food handlers and/ or public food and drink service establishment owners is compulsory to ensure that all food handlers have the knowledge and the skill to provide safe food. From our study, the odds of having good food handling practices were higher among participants who had received food handling and preparation training as compared with those who didn't receive the training (aOR=1.79; 95%CI:1.68-4.71; p=0.037).

Regulatory body's frequent inspection visits of the food and drink establishments and food handler is significant to encourage and assured good sanitation practice. In our findings, food handlers who had inspected by concerned authority for the past six months had higher odds of good food handling practices as compared to those who had not inspected (aOR=2.24; 95%CI:1.05-3.09;  $P=0.028$ ). Moreover, the odds of good food handling practices were higher among food handlers who have good knowledge status as compared to their counterparts (aOR=3.15; 95%CI:1.02-6.04;  $P=0.005$ ) (Table 4).

### ***Food handling practices versus sanitary inspection visits***

During the time of observational assessment, food and drink establishments and food handlers were assessed whether the establishment's environmental sanitary conditions were inspected by the concerned authority for the last six months. Of the total, only 137(47.6%) of food and drink establishments were inspected by concerned authorities. In the multivariable-adjusted model, we found a significant interaction between regulatory frequent inspection visits and good food handling and sanitary practices. After adjusting for confounding factors in multivariable logistic regression analysis, several factors such as storage of food utensils, food handlers with trimmed fingernails, handwashing practice using water and soap before starting food preparation and after visiting the toilet, washing utensils using three compartments and using soap/or detergents for washing dishes were significantly associated with the regulatory bodies' frequent sanitary inspection visits ( $p<0.05$ ) (Table 5).

Food handlers working at food and drink service establishments that were inspected by the concerned authority in the past six months had higher odds of proper storage of food utensil (aOR=2.95; 95% CI: 1.28-4.23;  $P=0.008$ ), had trimmed fingernails (aOR=3.38; 95% CI:1.18-7.812;  $P=0.013$ ), had washed their hands before starting food preparation (aOR=2.53; 95% CI: 1.24-4.16;  $P=0.002$ ), had washed their hands after the toilet with soap and water (aOR=2.21; 95% CI:1.03-4.27;  $P=0.040$ ), had washed their utensils using three compartments (aOR=3.20; 95% CI:1.01-12.50;  $P=0.008$ ), and had used soap/or detergent to wash dishes (aOR=2.23; 95% CI:1.65-7.70;  $P=0.025$ ) (Table 5).

## **Discussion**

Improper food handling practice is one of the major routes for foodborne disease transmission. An emphasis needs to be given to food handling practices by the concerned bodies. Food handlers often have little understanding of the risks of microbial or chemical contamination of food or how to avoid them (WHO, 1989). Therefore, this study provides an insight into the status of food handling practices in the area. This study revealed that good food handling practice was 46.5% (95%CI:37.01-56.20).

This result is lower than other studies conducted from different towns in Ethiopia; Dangla 52.2% (Tessema *et al.*, 2014), Bahirdar 67.6% (Derso *et al.*, 2017), Mekelle 63.9% (Nigusse and Kumie, 2012), and Dire Dawa 52.4% (Getachew, 2016). Similarly, this finding is lower than other studies conducted in Malaysia 59.30% (Nee and Sani, 2011), Jordan 89.43% (Sharif *et al.*, 2013), and Nigeria 54.7% (Havelaar *et al.*, 2013). The difference might come across due to study settings, differences in food handler's sociodemographic, and environmental determinants. The other possible suggestion might be due to improved sanitary inspection and regulation measures in these studies. For instance, the study in Malaysia was conducted on a university campus whereas in Jordan the study was conducted in a hospital setting. In fact, these institutions assumed to have adequate resources and a suitable setup for food handling practice as compared to this study. In addition to this, the education level of food handlers in Malaysia and Jordan might contribute to the variation. The proportion of food handlers who attended secondary school and above were 77% and 94% in Malaysia and Jordan studies respectively, whereas in our study only 35.8%. As education level progresses, food handlers would have improved knowledge and attitude towards good food handling practices (Meleko *et al.*, 2015).

However, this finding is higher than the report from Nigeria 36.5% (Iwu *et al.*, 2017), Gondar, Ethiopia 30.3% (Gizaw, 2014a), and Gamogofa, Ethiopia 32.6% (Legesse *et al.*, 2017), and Debarq 40.1% (Chekol *et al.*, 2019). This might be due to the difference in the study period and the cut-off points used. The study conducted in Gondar town got around 8 years long. Due to globalization access to information improved from time to time and food handlers can develop a good knowledge and positive attitude towards food handling so that they could perform good handling practice relatively better (Henson and Humphrey, 2009). In addition to this, the cut-off points used to determine food handling practice determined in three levels (good, fair, and poor) (Getachew, 2016; Thelwell-Reid, 2014) as compared to this study in which food handling practice was determined in two levels using the minimum cut-off point (good and poor). The cut-off point difference entirely changes the results of the study. In Gamogofa interviewees were mostly males and having primary school and below 68.66% as compared to this study in which only 8.3% of males and 64.2% of primary school and below education level of respondents involved. This is because females had more experience even in their day to day home activity than males and the low education level of food handlers will have poor knowledge and attitude so that not liable to apply basic good handling principles (Getachew, 2016).

The odds of performing good handling practice among food handlers who were of advanced age (31-36 years) was 10.7 times higher as compared to those who were younger (15-20 years). This result is consistent with previous study reports (Lin and Sneed, 2003; Gizaw, 2014b). The possible reason for this could be the fact that good food handling practice behavior can be improved when their age increased and develop experience to handle food safely.

Similarly, the odds of performing good handling practice among married couples was 2.09 times higher as compared to single participants. In contrast to this result, the odds of performing good handling practice was 7.5 times higher among divorced participants (Tessema *et al.*, 2014). The possible reason

could be divorced, and married food handlers might have/ or acquired experience and responsibility to have good handling practice during their marriage.

In this study, as compared to illiterates, performing good handling practice was 2.33 and 2.29 times higher among those who had attained grades 7-12 and above grade 12, respectively. This finding was consistent with the study conducted in Bahirdar (Derso *et al.*, 2017), Dire Dawa (Getachew, 2016), Addis Ababa (Meleko *et al.*, 2015), Italy (Buccheri *et al.*, 2007), Jordan (Sharif *et al.*, 2013), Ghana (Akabanda *et al.*, 2017), and Nigeria (Afolaranmi *et al.*, 2015). This is because the depth of knowledge could affect the food handling practice and education can help to enhance knowledge thereby to develop skills of food handlers to work according to the standard procedures to maintain food safety (WHO, 2000; Zain and Naing, 2002; Meleko *et al.*, 2015; Sharif *et al.*, 2013).

The odds of performing good handling practice among food handlers who had 6-10-year experience was 2.43 times higher as compared to those who hadn't. This result is consistent with the study conducted in Bahirdar (Derso *et al.*, 2017), Gondar (Gizaw, 2014b). The possible explanation for this could be because the experience could help food handlers to acquire better knowledge and skills regarding food handling practice.

Besides, food handlers who had received formal training were 1.79 times higher to have good handling practice as compared to those who hadn't. Few earlier studies supported this finding (Derso *et al.*, 2017; Bas *et al.*, 2006; Park *et al.*, 2010; Sharif *et al.*, 2013). This might be training on food handling practices can improve food handler's knowledge about foodborne illness and related issues (Park *et al.*, 2010; World Health Organization, 2006), and this enables them to have a better understanding and realize their responsibilities and food handling practice skills (Park *et al.*, 2010). Food handling staff should receive instruction in food safety and personal hygiene and should be required to undergo a test of their knowledge of the subject; and refresher courses should be given periodically throughout employment (WHO, 1989).

In this study, food handlers who were working at a public food and drink service establishments where they had been inspected by the concerned authority in the past six months were 2.24 times likely to have good handling practices as compared to those who were working at catering establishments which had not been inspected. Moreover, food handlers who were working in the food and drink service establishments where they had been inspected by the concerned authority in the past six months had higher odds of proper storage of food utensils, had trimmed fingernails, had washed their hands with soap and water before starting food preparation, and after visiting the toilet, had washed their utensils using three washing compartments, had used soap/or detergent to wash food utensils. These results were supported by one earlier study (Melese A *et al.*, 2018). The possible reason for this result might be regular sanitary supervision visits to the food establishments supported by education can improve and sustain good food handling practice and sanitary situations of the food establishments.

## Conclusions

In this study, food handling practice was relatively poor. Several factors, such as age, marital status, education, monthly income, experience, training received, sanitary inspection visits by the concerned authority, and knowledge status were associated with good handling practices. Comprehensive and continuous training to food handlers and food establishment owners, regular sanitary inspection visits of the food establishments by concerned authority is highly recommended to promote proper sanitation facilities in the catering establishments and to ensure that all food handlers have the adequate knowledge and the skill to provide safe food.

It is recommended that researchers, educators, food safety communicators, and the media should work towards educating the catering establishments, food handling staff, and the population to advance their food safety knowledge to safer food practices.

### **Limitations**

The social desirability and participant's recall bias might affect the result of this study. Besides, the cross-sectional nature of the study might affect the cause and effect relationship. Furthermore, parasitic and microbiological laboratory investigation were not considered in this study.

## **Declarations**

### **Competing interests**

The authors declare that they have no competing interests.

### **Acknowledgments**

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## Tables

**Table 1:** Sociodemographic profiles of food handlers working in public food and drink service establishments at Woldia town, Northeast Ethiopia, 2018

Characteristics	Categories	Frequency (n)	Percentage (%)
Sex	Male	24	8.3
	Female	264	91.7
Age ( <i>year</i> )	15-20	94	32.6
	21-25	90	31.3
	26-30	78	27.1
	31-35	17	5.9
	36-40	9	3.1
Marital status	Single	237	82.3
	Married	49	17
	Divorced	2	0.7
Educational attainment	Illiterate	87	30.2
	Grade 1-6	98	34
	Grade 7-12	90	31.3
	Grade 12	13	4.5
Religion	Orthodox	255	88.5
	Muslim	18	6.3
	Protestant	10	3.5
	Catholic	5	1.7
Food handler's per monthly income (in birr)	≥500	186	64.6
	<500	102	35.4
Food handling and hygiene training received	Yes	42	14.6
	No	246	85.4
If "yes" for the above question, does the food handler certify? (n=42)	Yes	7	16.7
	No	35	83.3
The service year of food handlers	<1year	98	34.0
	1-5year	173	60.1
	6-10year	11	3.8
	>10 years	6	2.1

**Table 2: Knowledge status on proper food handling practices and safety among food handlers working in public food and drink services establishments at Woldia town, Northeast Ethiopia, 2018.**

Characteristics	Categories	Total, n(%)	Knowledge status score	
			Good, n(%)	Poor, n(%)
Do you hear about foodborne disease?	Yes	179(62.2)	176(61.1)	3(1.0)
	No	109(37.8)	6(2.1)	103(35.8)
Causes of foodborne diseases	Germs	145(50.3)	145(50.3)	0(0.0)
	Adding chemicals	6(2.1)	6(2.1)	0(0.0)
	Anger of the God	1(0.3)	1(0.3)	0(0.0)
	Unapproved sources	110(38.2)	7(2.4)	103(35.8)
	Don't know	26(9.0)	23(8)	3(1.0)
What is the mode of transmission of foodborne disease?	Contaminated food	104(36.1)	103(35.8)	1(0.3)
	Contaminated water	65(22.6)	63(21.9)	2(0.7)
	Infected food handlers	10(3.5)	10(3.5)	0(0.0)
	Don't know	109(37.8)	6(2.1)	103(35.8)
The reasons for food contaminations	Dirt hands	24(8.3)	24(8.3)	0(0.0)
	Infected food handlers	33(11.5)	32(11.1)	1(0.3)
	Dirt utensil	106(36.8)	103(35.8)	3(1.0)
	Dirt working environment	6(2.1)	6(2.1)	0(0.0)
	Unapproved sources	108(37.5)	6(2.1)	102(35.4)
	Don't know	11(3.8)	11(3.8)	0(0.0)
The danger temperature zone for potentially hazardous foods	Below 5°C	58(20.1)	1(0.1)	57(19.8)
	5-60°C	189(65.6)	180(62.5)	9(3.1)
	Above 60°C	22(7.6)	1(0.3)	21(7.3)
	Don't know	19(6.6)	0(0.0)	19(6.6)
Can raw milks transmit diseases?	Yes	190(66)	173(60.1)	17(5.9)
	No	72(25)	6(2.1)	66(22.9)
	Don't know	26(9.0)	3(1.0)	23(8.0)
Can raw meats transmit disease?	Yes	191(66.3)	173(60.1)	18(6.3)
	No	70(24.3)	6(2.1)	64(22.2)
	Don't know	27(9.4)	3(1.0)	24(8.3)
Do good personal hygiene prevent from foodborne diseases?	Yes	205(71.2)	162(56.3)	43(14.9)
	No	64(22.2)	15(5.2)	49(17.0)
	Don't know	19(6.6)	5(1.7)	14(4.9)

**Table 3: Observational assessment results on food handler's food handling practice and safety in public food and drink service establishments at Woldia town, Northeast Ethiopia, 2018**

Characteristics	Categories	Total, n(%)	Food handling practice score	
			Good, n(%)	Poor, n(%)
Do food handlers wear outer garments/gown during the visit?	Yes	66(22.9)	40(13.9)	26(9.0)
	No	222(77.1)	94(32.6)	128(44.4)
If "yes" for the above question, does the outer garment/gown was clean? (n=66)	Yes	11(16.7)	9(13.6)	2(3.0)
	No	55(83.3)	33(50)	22(33.3)
Do the food handlers covered their hair while working?	Yes	35(12.2)	27(9.4)	8(2.8)
	No	253(87.8)	107(37.2)	146(50.7)
Do food handler's fingernails short trimmed and clean?	Yes	114(39.6)	70(24.3)	44(15.3)
	No	174(60.4)	64(22.2)	110(38.2)
Do food handlers wear any jewelry/or ring on their	Yes	140(48.6)	46(16.0)	94(32.6)

hand at time of the visit?	No	<b>148(51.4)</b>	<b>88(30.6)</b>	60(20.8)
Do the food handlers clean the work surfaces after each task?	Yes	<b>218(75.7)</b>	<b>116(40.3)</b>	<b>102(35.4)</b>
	No	70(24.3)	18(6.3)	52(18.1)
Used soap/detergent for washing dishes	Yes	<b>160(55.6)</b>	<b>133(46.2)</b>	27(9.4)
	No	128(44.4)	1(0.3)	<b>127(44.1)</b>
Used hot water for washing dishes	Yes	138(47.9)	134(46.5)	4(1.4)
	No	<b>150(52.1)</b>	0(0)	<b>150(52.1)</b>
Wash their utensils using three washing compartments	Yes	134(46.5)	134(46.5)	0(0)
	No	<b>154(53.5)</b>	0(0)	<b>154(53.5)</b>
Did food handlers wash chopping board and knife with soap or belch after using?	Yes	142(49.3)	134(46.5)	8(2.8)
	No	146(50.7)	0(0)	<b>146(50.7)</b>
Did food handlers wash their hands with detergent and water before working with food?	Yes	<b>229(79.5)</b>	107(37.2)	<b>122(42.4)</b>
	No	59(20.5)	27(9.4)	32(11.1)
Did food handlers wash their hands with detergent and water after visiting the toilet?	Yes	<b>267(92.7)</b>	129(44.8)	<b>138(47.9)</b>
	No	21(7.3)	5(1.7)	16(5.6)
Did food handlers keep ready-to-eat foods in hygienic container?	Yes	80(27.8)	75(26.0)	5(1.7)
	No	<b>208(72.2)</b>	59(20.5)	<b>149(51.7)</b>
Did food handlers keep food utensils in safe manner in shelf/or cabinet?	Yes	50(17.4)	50(17.4)	0(0)
	No	<b>238(82.6)</b>	84(29.2)	<b>154(53.5)</b>
Did food handlers keep uncooked foods separately from cooked food?	Yes	<b>203(70.5)</b>	116(40.3)	<b>87(30.2)</b>
	No	85(29.5)	18(6.3)	67(23.3)
Did food handlers store perishable ready-to-eat foods in the refrigerator?	Yes	<b>191(66.3)</b>	<b>110(38.2)</b>	<b>81(28.1)</b>
	No	97(33.7)	24(8.3)	73(25.3)
Did food handlers take a medical checkup in the past six months?	Yes	43 (14.9)	35(12.2)	8(2.8)
	No	<b>245(85.1)</b>	99(34.4)	<b>146(50.7)</b>
Sanitary inspection	Yes	137(47.6)	86(28.9)	51(17.7)
	No	<b>151(52.4)</b>	48(16.7)	<b>103(35.8)</b>

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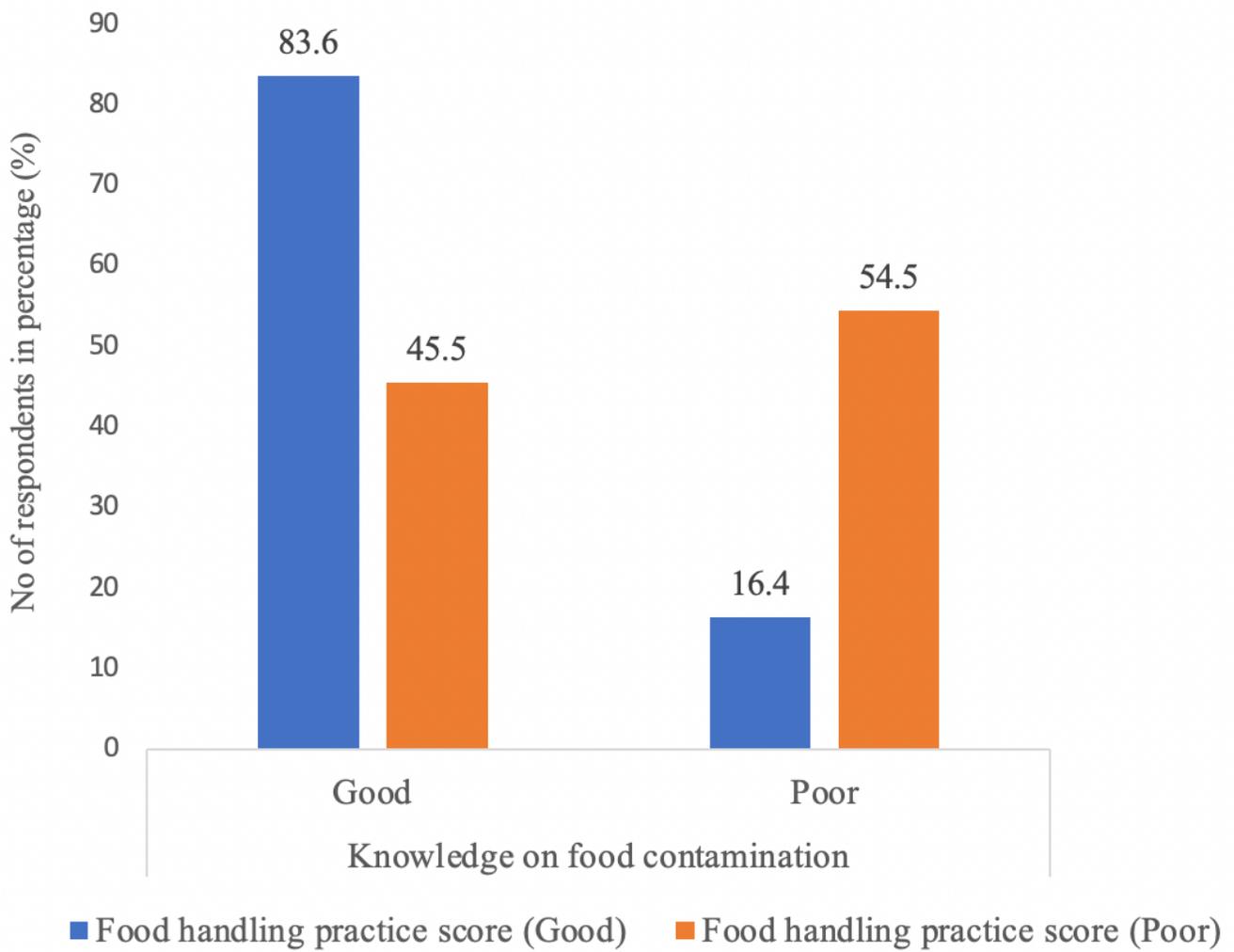
**Table 4:** Determinants associated with food handlers' food handling and safety practices at Woldia town, Northeast Ethiopia, 2018

Characteristics	Categories	Food handling practice score		aOR(95%CI)	p-value
		Good	Poor		
Sex	Male	17	7	1	
	Female	117	147	2.93(1.81-10.68)	0.091
Age (years)	15-20	58	36	1	
	21-25	42	48	2.09(1.05-4.17)	0.067
	26-30	25	53	4.51(1.79-11.33)	0.051
	31-35	6	11	10.69(2.04-56.04)	0.05
	36-40	3	6	12.01(1.96-17.52)	0.017
Marital status	Single	107	130	1	
	Married	27	22	2.09(1.05-4.17)	0.005
	Divorced	0	2	-	-
Educational attainment	Illiterate	19	68	1	
	Grade 1-6	40	58	2.91(1.41-4.99)	0.057
	Grade 7-12	65	25	2.33(1.14-4.79)	0.013
	Grade >12	10	3	2.29(1.05-4.61)	0.046
Food handler's per monthly income (in birr)	≥ 500	112	74	2.29(1.14-5.61)	0.001
	<500	22	80	1	
Service year of food handlers	<1year	46	52	1	
	1-5year	74	99	0.55(0.29-1.07)	0.077
	6-10year	8	3	2.43(2.08-3.17)	0.034
	>10years	6	0	-	-
Food handling and preparation training received	Yes	22	20	1.79(1.68-4.71)	0.037
	No	112	134	1	
The sanitary inspection	Yes	86	51	2.24(1.05-3.09)	0.028
	No	48	103	1	
<b>Knowledge status</b>	Good	112	70	3.15(1.02-6.04)	0.005
	Poor	22	84	1	
Presence of latrine	Yes	133	111	2.13(1.08-5.64)	0.069
	No	1	43	1	

**Table 5:** Food handling practices in relation to sanitary inspection activity at Woldia town, Northeast Ethiopia,2018

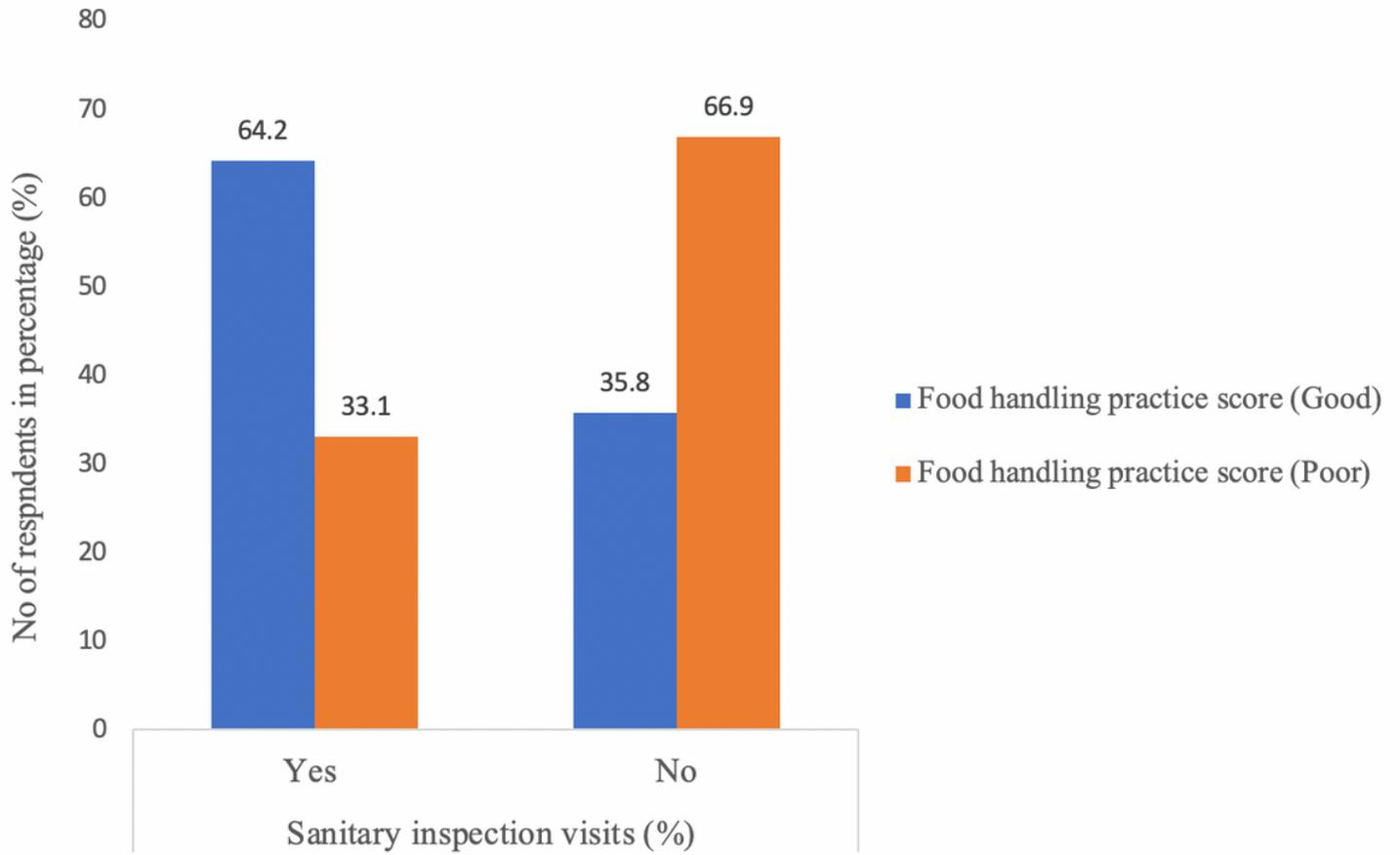
Characteristics		Sanitary inspection		aOR (95% CI)	p-value
		Yes	No		
Storage of food utensils	Proper	30	20	2.95(1.28-4.23)	0.008
	Improper	107	131	1	
Food handler with trimmed fingernails	Yes	72	42	3.38(1.18-7.812)	0.013
	No	65	109	1	
Food handler's hair was covered	Yes	28	7	3.32(1.11-7.94)	0.079
	No	109	144	1	
Food handler wash his/her hands before starting the food handling	Yes	114	115	2.53(1.24-4.16)	0.002
	No	23	36	1	
Washing hands after visiting toilet with soap and water	Yes	134	133	2.21(1.03-4.27)	0.040
	No	3	18	1	
Washing utensils using three compartments	Yes	86	48	3.20(1.01-12.50)	0.008
	No	51	103	1	
Using soap/detergent for washing dishes	Yes	90	70	2.23(1.65-7.70)	0.025
	No	47	81	1	
Stored perishable ready- to- eat foods in the refrigerator (n=226)	Yes	53	7	2.20(1.08-7.49)	0.061
	No	70	96	1	

## Figures



**Figure 1**

Knowledge on food contaminations and food handling practices of food handlers working in public food and drink service establishments at Woldia town, Northeast Ethiopia, 2018



**Figure 2**

Food handling practice score versus sanitary inspection visits of public food and drink establishments at Woldia town, Northeast Ethiopia, 2018