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Hygienic Food Handling Practices and Associated Factors Among Food Handlers in Ethiopia: A Systematic Review and Meta-Analysis

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ABSTRACT

BACKGROUND: The food handling practices of food handlers can have a significant impact on the hygienic status of the food. The aim of this study was to determine the prevalence and factors associated with hygienic food handling practices among food handlers in Ethiopia.

METHODS: PubMed, Science Direct, Google Scholar, and the Cochrane Library databases were used to find articles. Only cross-sectional studies that met the criteria for inclusion were considered. STATA version 16 statistical software was used to perform the meta-analysis. The study's heterogeneity was determined using Cochrane *Q* test statistics and the I^2 test. A random effect model was used to calculate the pooled prevalence of hygienic food handling practices.

RESULTS: To estimate the pooled prevalence of hygienic food handling practices in Ethiopia, 9 out of 33 reviewed studies were included. The prevalence of hygienic food handling practices was found to be 48.36% (95% CI: 39.74-56.99) in this study. Factors associated with hygienic food handling practices included; lack of food safety training (OR = 5.38; 95% CI: 1.71, 16.89), negative attitude (OR = 3.28; 95% CI: 1.50, 7.13), lack of access to handwashing facilities (OR = 4.84; 95% CI: 1.72, 13.65), lack of regular medical checkup (OR = 5.37; 95% CI: 3.13, 9.23), and lack of secondary education (OR = 2.51; 95% CI: 1.46, 4.32) among food handlers.

CONCLUSION: In this study, the prevalence of hygienic food handling practices among Ethiopian food handlers was significantly low. Unhygienic food handling practices were attributed to a lack of food safety training, regular medical checkups, handwashing facilities, an unfavorable attitude toward food hygiene practices, and a lack of formal education. As a result, food handlers should receive ongoing food safety and hygiene training.

KEYWORDS: Determinant factors, food handling, food hygiene, food safety, pooled prevalence

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Introduction

Foodborne illnesses pose a public health risk in both developed and developing countries. Billions of people around the world are at risk of consuming contaminated food,[1] and millions become ill as a result of eating unsafe food.[2-4] Consumption of unsafe food causes 600 million cases of foodborne disease and 420 000 deaths worldwide each year, accounting for 30% of all deaths among children under the age of 5 .[5] On the other hand, the scope of the foodborne disease problem varies by region and sub-regions.[6]

Foodborne diseases have a significant global impact, affecting people of all ages, particularly children under the age of 5, who are disproportionately affected in low-income countries.[7] The use of unclean water for cleaning and processing food, as well as poor food-production procedures and food handling, a lack of suitable food storage facilities, and inadequate or poorly implemented regulatory standards, all contribute to an increase in the burden of foodborne diseases in these areas.[2,8,9]

The majority of foodborne illnesses are caused by infections bacteria, viruses, and parasites. *Salmonella*, *Campylobacter*, *Enterohemorrhagic Escherichia coli*, and *Listeria* are the most common bacteria that cause foodborne infections.[10] In viral food-borne transmission, *Noravirus* (NoV), and *Hepatits A virus* (HAV) have been identified as primary threats.[11] In unhygienic conditions, the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) could spread from personnel to food, making contaminated food infectious.[12] Other foodborne diseases caused by intestinal parasites such as *Entamoeba histolytica*, *Giardia lamblia*, *Taenia Species*, *Ascaris lumbricoide*, and *Trichuris trichiura* are linked to unhygienic food handling.[13]

In developing countries, the failure to ensure appropriate hygienic food handling practices is a major cause of concern.[14] Foodborne infections have had a negative impact on these countries' socioeconomic development. Foodborne bacterial illnesses are frequent in Ethiopia, particularly those caused by *Salmonella species*, *Shigella species*, *Taphylococcus aureus*, and *Bacillus cereus*.[15] Most of foodborne illnesses such as *Escherichia*

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coli, *Listeriosis*, and *Camplyobacter* are linked to poor food hygiene practice.[7,15-18] Ensuring food hygiene practices helps to a high level of food safety, which is the most critical aspect of food quality. To protect consumers' health, food safety and hygiene are critical.[18] Due to this fact, the European Union (EU) and the World Health Organization (WHO) both recommend that community measures such as food safety, food hygiene, and water safety be reassessed in light of scientific knowledge, which is critical in addressing foodborne infection prevention.[19,20]

Prevalence of food hygiene practices were studied among food handlers working in public food businesses in some parts of Ethiopia. According to these studies conducted in the country, the prevalences of food hygiene practices have been determined in: Dangila (52.50%),[21] Arba Minch (32.60%),[22] Bahir Dar (67.60%),[23] Woldia (46.50%),[24] Abobo (51.00%),[25] Dessei (72.00%),[26] Debark (40.10%),[27] Bole sub-city (27.40%),[28] and University of Gondar student's cafeteria (46.70%).[29] The outcomes of these studies differ from one location to the next. On the other hand, the identified factors associated with food hygiene practices in these studies do not have the same statistical significance for determining appropriate interventions.

Based on our searching databases, there is no systematic review and meta-analysis conducted on hygienic food handling practices in Ethiopia. Due to this, there is a limitation to access compiled document easily regarding hygienic food handling practices and its associated factors. Lack of a countrywide pooled study that examines the prevalence and factors related to food hygiene practices among food handlers working in food enterprises represents a significant gap. This review can provide well organized data commencing available research works on food handling practices in Ethiopia. The aim of this systematic review and meta-analysis was to determine the pooled prevalence of food hygiene practices and associated factors among food handlers working in food enterprises in Ethiopia. "What was the status of food hygiene practices among food handlers?" and "What were factors associated with food hygiene practices among food handlers in Ethiopia?" were the research questions for this study. The findings of this study could help the governmental institutions like Ethiopian Public Health Institution, Ethiopian Ministry of Health, and non-governmental organizations such as Food and Agriculture Organization (FAO), United Nations International Children's Emergency Fund (UNICEF), and World Health Organization (WHO) to develop and implement effective strategies to improve food handler's food hygiene and safety practices.

Methods

Data sources and search strategy

Two reviewers (BN and NES) independently searched PubMed, Science Direct, Google Scholar, and the Cochrane Library databases for articles published before December 2020, as well as references to other studies. To obtain the articles, the search used the following keywords: "magnitude," "prevalence," "status," "food handling," "hand hygiene," "food hygiene," "determinants," "associated factors," and "Ethiopia." The terms were combined using Boolean operators (AND/OR). In online additional file 1, the full electronic search strategy for PubMed is shown. This systematic review and meta-analysis used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) tool.[30]

Inclusion and exclusion criteria

Articles were included in the review if:

- ***Study area***: Only studies conducted in Ethiopia have been included.
- ***Population***: Food handlers working in food establishments, college/university cafeterias, or street food vendors
- ***Study design*:** Observational studies (cross-sectional studies, case-control studies, and cohort studies) reporting the status of hand hygiene practice and associated factors were considered.
- ***Publication condition***: Articles were included in both published and unpublished condition.
- ***Language***: Only articles written in English were considered, regardless of the year of publication.

Articles excluded from the analysis.

- Articles that were not completely accessible despite at least 2 email contacts with the primary authors were omitted. The omission of these articles is due to a failure to determine the content of the articles in the absence of a complete text.
- Studies in which extracting the required information was difficult were omitted.

Outcome of interest

Food handlers' hand hygiene practices were the primary focus of the study. Hand hygiene practices of food handlers were assessed at key points by asking practical questions like whether they always washed their hands with water and soap. Good hand hygiene was defined as a score above or equal to the mean value on the hand hygiene questions, while poor hand hygiene was defined as a score below the mean value. A determinant of food handlers' hand hygiene practices was the study's second finding. It was based on data calculated using the odds ratio (OR) and binary outcomes from the primary studies included.

Study selection

Two reviewers independently established the studies using the principles of inclusion and exclusion criteria (BN and NES).

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The studies were chosen first based on the importance of their titles and abstracts. After that, full-text articles were collected and checked to ensure that they were eligible. Any inconsistencies were resolved during discussions with the primary author in order to reach an agreement. Discrepancies are resolved or determined by the reviewer's consensus (ZA). The studies were extracted from various databases and imported into EndNote reference management software version x7.1, where duplicates were removed. The PRISMA flow diagram was used to summarize the data collection methods.[30]

Data extraction

Using a pretested data extraction format, 2 investigators (BN and NES) extracted all of the necessary data. Name of first author or research group, year of publication, region/study setting, study design, sample size, and status of hand hygiene practice were all extracted. Reviewers independently collected data on factors associated with food handlers' hand hygiene practices. Data were extracted in a 2×2 table format for the second outcome (factors associated with food hygiene practice), and the odds ratio for each factor was calculated based on the findings of the original studies.

Quality assessment

We used the Hoy et al[31] tool for addressing internal and external validity using 10 criteria to determine the risk of bias. The tool included (1) population representation, (2) sampling frame, (3) methods of participant selection, (4) non-response bias, (5) data collection directly from subjects, (6) acceptability of case definition, (7) reliability and validity of study tools, (8) mode of data collection, (9) length of prevalence period, and (10) appropriateness of numerator and denominator. Each item was classified as having a low or high bias risk. Articles having unclear assessment tools for data collection were labeled as having a high risk of bias. Finally, the overall bias risk score was graded based on the number of studies with high bias risk: low (2), moderate (3-4), and high (5).

Data analysis

Data from each study was collected using Microsoft Excel spreadsheets and analyzed using STATA version 16.0 statistical software (Stata Corp, College Station, TX, USA). Cochran's Q statistics and the I^2 test were used to assess statistical heterogeneity. The I^2 test calculates the percentage of variance in effect estimates that can be attributed to heterogeneity rather than sampling error or chance differences. The availability of low, medium, and high heterogeneity was determined by the I^2 test values of 25%, 50%, and 75%, respectively.[32] Similarly, asymmetry of funnel plots and Egger's test with a value of less than 0.05 as a cutoff point to declare the presence of publication bias was used to assess evidence of publication bias. Furthermore, the prevalence of heterogeneity was measured using subgroup analysis. The effect size in this study is calculated using the mean pooled prevalence and odds ratio.

Results

Searching process

Using the database and manual searching, a total of 92 and 268 articles were found. Due to duplication, 327 articles were removed. Based on the title and abstract of the remaining 33 articles, 23 data files were avoided. In addition, 10 full-text articles were screened, with one being rejected because it lacked all of the information required by our eligibility criteria. Finally, this study included 9 articles (Figure 1).

Characteristics of included studies

This systematic review and meta-analysis included 9 articles with a total sample size of 4120 food handlers.[21-29] All of the studies included were cross-sectional. The earliest study was conducted in 2014,[21] and the most recent 2 articles[28,29] were published in 2020. Six studies from Amhara[21,23,24,26,27,29], one from Southern Nations, Nationalities, and People (SNNP),[22] one from Gambela,[25] and one from Addis Ababa city administration[28] were used to obtain overall information on the prevalence of food handling practices. The sample size ranged from 135[26] to 1252[25] in each of the studies (Table 1).

Prevalence of food hygiene practice

In this analysis, the prevalence of hygienic food handling practices in Ethiopia ranged from 27.4% in Bole sub city of Addis Ababa[28] to 72% in Dessie town in Amhara region.[26] According to the random effects model, the pooled prevalence of hygienic food handling practices was 48.36% (95% CI: 39.74-56.99) (Figure 2).

Heterogeneity and publication bias

The existence of heterogeneity and publication bias was determined within the included studies. The included studies had a high level of heterogeneity ($I^2 = 96.9\%$, $P = 0.001$). As a result, a random effects model was used to estimate the pooled prevalence of hygienic food handling practices among food handlers in Ethiopia. The funnel plot and Egger's tests were used to assess publication bias. The funnel plot revealed that the distribution of articles was asymmetrical, whereas Egger's tests revealed that estimating the prevalence of hygienic food handling practices among food handlers was not statistically significant ($P = .859$) (Figure 3).

Subgroup analysis

We used various factors to perform subgroup analysis, including the country's region, sample size, and study area (public

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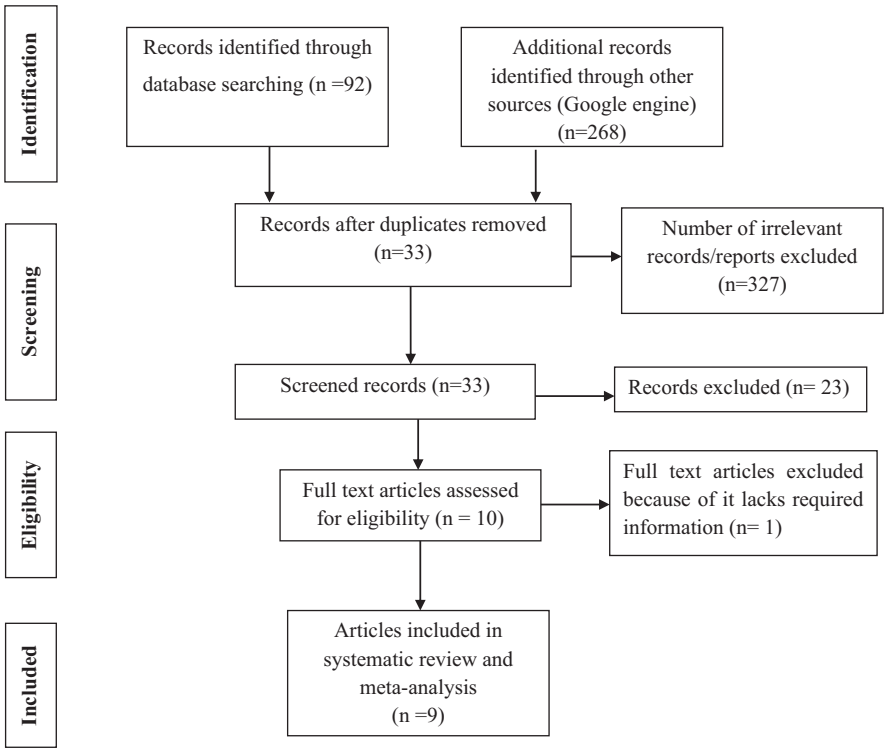


Figure 1. Flow diagram for selecting studies.

Table 1. Characteristics of studies included in a meta-analysis of Ethiopian food handlers' hygienic food handling practices.

AUTHORS	PUBLICATION YEAR	REGION	STUDY SETTING	STUDY DESIGN	SAMPLE SIZE	PREVALENCE (%)	RISK OF BIAS
Tessema et al[21]	2014	Amhara	Dangila	Cross-sectional	406	52.50	Low
Legesse et al[22]	2017	SNNP*	Arba Minch	Cross-sectional	383	32.60	Low
Derso et al[23]	2017	Amhara	Bahirdar	Cross-sectional	422	67.60	Low
Reta et al[24]	2018	Amhara	Woldia	Cross-sectional	288	46.50	Moderate
Okugn and Woldeyohannes[25]	2018	Gambella	Abobo district	Cross-sectional	1252	51.00	Low
Adane et al[26]	2018	Amhara	Dessie	Cross-sectional	135	72.00	Low
Chekol et al[27]	2019	Amhara	Debark	Cross-sectional	422	40.10	Low
Lema et al[29]	2020	Amhara	University of Gondar	Cross-sectional	403	46.70	Low
Abdi et al[28]	2020	Addis Ababa	Bole Sub City	Cross-sectional	414	27.40	Low

*Southern Nations, Nationalities, and People Regional State.

university versus town). As a result, the study's subgroup analysis revealed that the highest prevalence of hygienic food handling practices was found in the Amhara region, at 54.09% (95% CI: 44.36, 63.83); Gambella, at 51.00% (95% CI: 48.23, 53.77); and SNNPRS, at 32.60% (95% CI: 27.91, 37.29), respectively, and the lowest prevalence was found in Addis Ababa city with the prevalence of 27.40% (95% CI: 23.00, 31.80). In addition, based on the sample size of the studies, subgroup analysis was performed. The pooled prevalence of hygienic food handling practices was 50.18% (95% CI: 29.25, 71.12) in studies with a sample size 400, compared to 47.56% in studies with a sample size >400 (95% CI: 37.37, 57.75). Furthermore, subgroup analysis was conducted based on study site, with a pooled prevalence of hygienic food handling practices of 46.70% (95% CI: 41.77, 51.63) and 51.61% (95% CI: 42.53, 60.69) for public university food handlers and towns' food establishments, respectively (Table 2).

Sensitivity analysis

Sensitivity analysis was performed using a random-effects model to detect the influence of a single study on the

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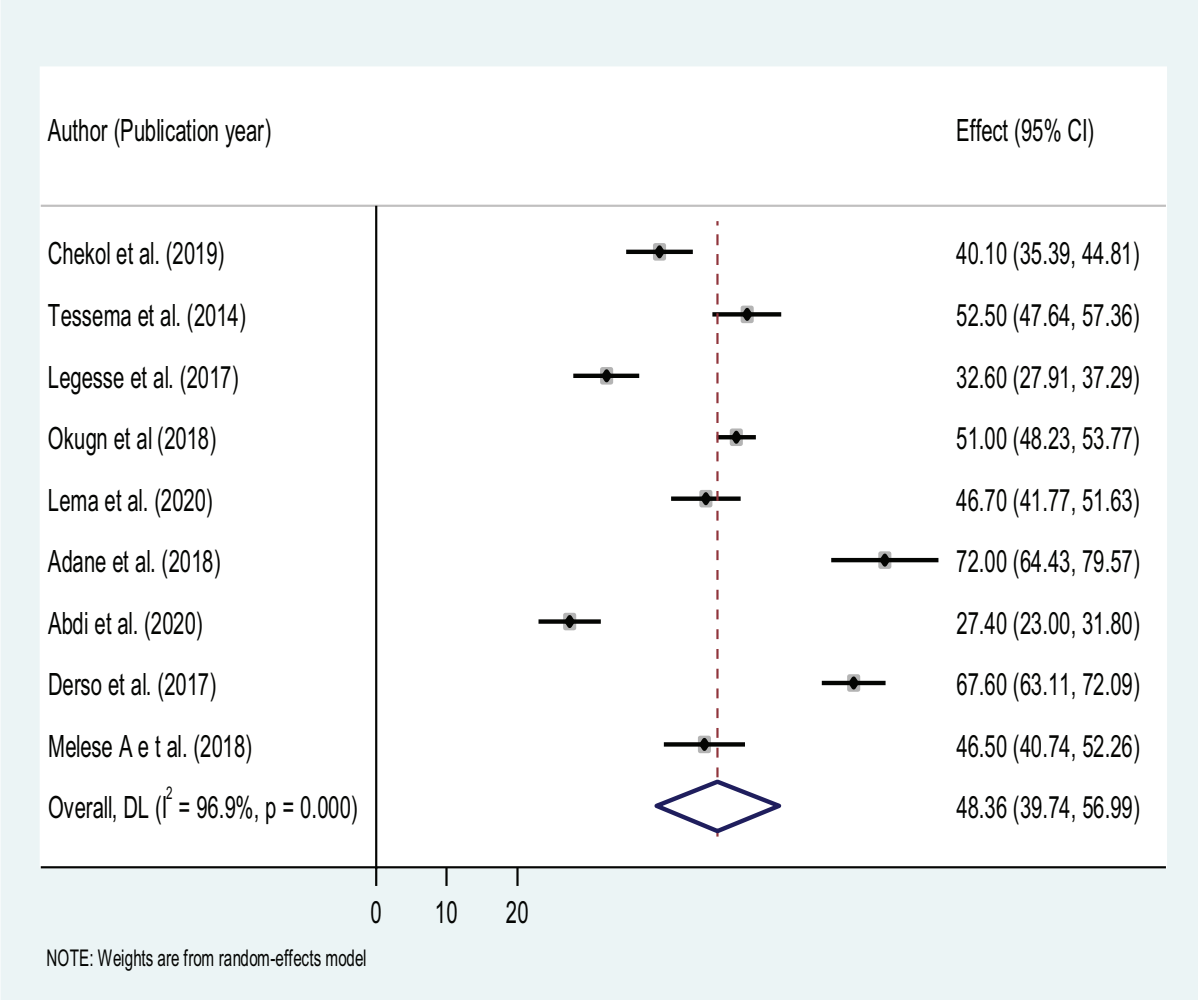


Figure 2. Forest plot of the prevalence of hygienic food handling practices among food handlers in Ethiopia.

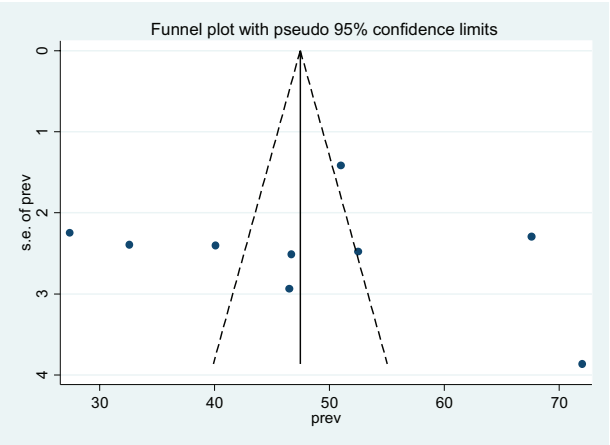


Figure 3. Funnel plot of the transformed prevalence estimates of hygienic food handling practices among food handlers in Ethiopia.

overall meta-analysis. The findings revealed that there was no evidence that a single study had an effect on the overall pooled result of Ethiopian hygienic food handling practices (Figure 4).

Factors associated with hygienic food handling practices of Ethiopian food handlers

In this meta-analysis, we have looked at factors associated with hygienic food handling practices using 9 studies.[21-29] Among 9 articles, the findings of 4 studies[22-24,26] revealed that hygienic food handling practices were significantly associated with food safety training. As a result, the likelihood of hygienic food handling practices occurring was 5.38 times higher among food handlers who had attended food safety training versus those who had not (OR: 5.38 95% CI: 1.71, 16.89). Similarly, 3 studies[23,27,29] looked at the relationship between work experiences and hygienic food handling practices. Work experience is not significantly associated with hygienic food handling practices, according to this meta-analysis. There was also a lot of heterogeneity ($I^2 = 96.7\%$ and $P = .001$) among the studies that were included. In the same way, 2 studies[27,28] were used to calculate the relationship between attitudes and hygienic food handling practices among food handlers. Overall, the findings of these 2 studies revealed that food handlers with a positive attitude were 3.28

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Table 2. Subgroup pooled prevalence of hygienic food handling practices among food handlers in Ethiopia (n = 9).

VARIABLES	CHARACTERISTICS	INCLUDED STUDIES	SAMPLE SIZE	PREVALENCE WITH (%) (95% CI)
Region	Amhara	6	2076	54.09 (44.36, 63.83)
	SNNPSR*	1	383	32.60 (27.91, 37.29)
	Gambella	1	1252	51.00 (48.23, 53.77)
	Addis Ababa City	1	414	27.40 (23.00, 31.80)
Sample size	>400	6	3319	47.56 (37.37, 57.75)
	⩽400	3	806	50.18 (29.25, 71.12)
Study site	Public University Cafeteria	1	403	46.70 (41.77, 51.63)
	Towns' food establishment	7	3303	51.61 (42.53, 60.69)
	Sub-city food establishment	1	414	27.40 (23.00, 31.80)

*Southern Nation, Nationality and People Regional State.

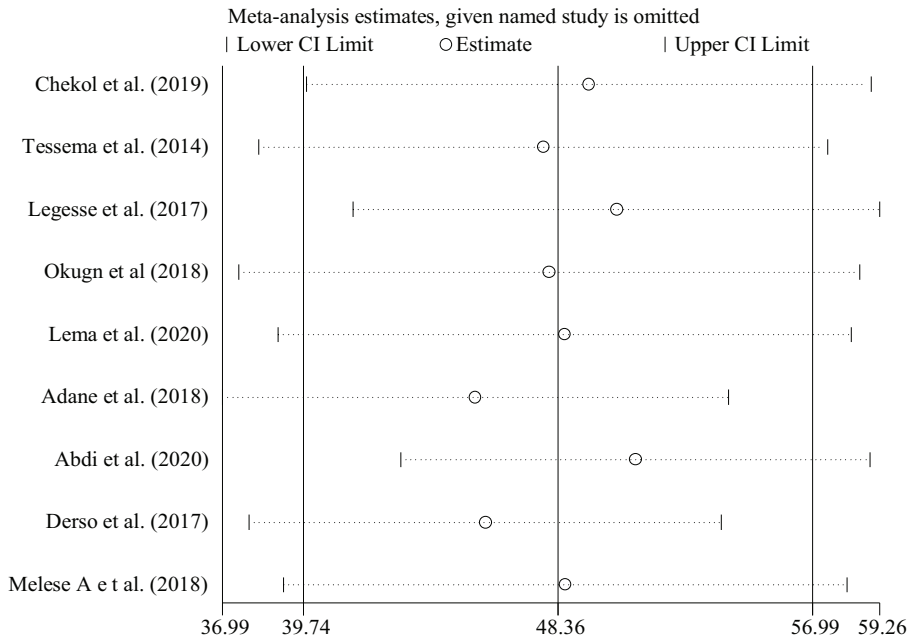


Figure 4. Sensitivity analysis of hygienic food handling practices among food handlers in Ethiopian (n = 9).

times more likely to practice hygienic food handling than those with a negative attitude (OR: 3.28, 95% CI: 1.50, 7.13). The investigators also looked at the link between the availability of a hand washing facility and hygienic food handling practices using 3 studies.[23-25] The combined results of this meta-analysis revealed that food handlers who did not have access to a hand washing facility were 4.84 times more likely to engage in unhygienic food handling than those who did (OR: 4.84, 95% CI: 1.72, 13.65). In contrast, a meta-analysis of the relationship between regular medical checkup and hygienic food handling practices among food handlers[22,26] found that food handlers who did not have regular medical checkup were 5.37 times more likely to have unhygienic food handling practices than those who did (OR: 5.37, 95% CI: 3.13, 9.23). The association between educational level and hygienic food handling practices was also used. Food handlers who had completed secondary school were 2.51 times more likely to have hygienic food handling practices than those who had not completed secondary school, according to the combined results of this meta-analysis (OR: 2.51, 95% CI: 1.46, 4.32) (Table 3).

Discussion

The aim of this systematic review and meta-analysis was to identify the prevalence of and factors associated with hygienic food handling practices among Ethiopian food handlers. According to the study, the overall pooled prevalence of hygienic food handling practices among Ethiopian food

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Table 3. Factors associated with hygienic food handling practices among food handlers in Ethiopia.

S. N.	FACTORS	AUTHORS (PUBLICATION YEAR) AND I^2 WITH P-VALUE	ODDS RATIO (95% CI)
1.	Food safety training	Legesse et al[22]	11.04 (5.43, 22.44)
		Adane et al[26]	8.22 (2.36, 28.59)
		Reta et al[24]	1.32 (0.68, 2.53)
		Derso et al[23]	7.94 (3.12, 20.23)
		Overall, DL (I^2 = 86.4%, P = .000)	**5.38 (1.71, 16.89)**
2.	Work experience	Chekol et al[27]	2.43 (1.59, 3.72)
		Lema et al[29]	0.68 (0.45, 1.01)
		Derso et al[23]	0.15 (0.08, 0.26)
		Overall, DL (I^2 = 96.7%, P = .000)	**0.63 (0.15, 2.70)**
3.	Attitude	Chekol et al[27]	2.21 (1.41, 3.48)
		Abdi et al[28]	4.89 (3.04, 7.86)
		Overall, DL (I^2 = 82.2%, P = .018)	**3.28 (1.50, 7.13)**
4.	Handwashing	Okugn and Woldeyohannes[25]	13.57 (8.24, 22.35)
		Derso et al[23]	2.30 (1.36, 3.88)
		Reta et al[24]	3.62 (2.22, 5.89)
		Overall, DL (I^2 = 92.2%, P = .000)	**4.84 (1.72, 13.65)**
5.	Regular medical checkup	Legesse et al[22]	5.48 (2.65, 11.36)
		Adane et al[26]	5.24 (2.34, 11.76)
		Overall, DL (I^2 = 0.0%, P = .936)	**5.37 (3.13, 9.23)**
6.	Educational status	Derso et al[23]	3.40 (1.72, 6.72)
		Lema et al[29]	1.95 (1.08, 3.54)
		Overall, DL (I^2 = 31.0%, P = .229)	**2.51 (1.46, 4.32)**

handlers was 48.36% (95% CI: 39.74-56.99). This result is almost in agreement with the study done in Malaysia (50%).[33] However, it is higher than the study result reported from Imo state in Nigeria (37%).[34] This study's finding, on the other hand, was lower than studies conducted in Ghana[35] and Sokoto of Nigeria.[36] The disparity could be attributed to differences in procedure or variation in social and cultural, and personal hygiene practices.[9] It might be also linked to inequitable sanitary conditions among food handlers, such as lack of safe water and other sanitary facilities, which can contribute to poor adherence to food hygiene practices.[36]

The prevalence of hygienic food handling practices in Ethiopia varies from region to region, and even within a region, according to this study's sub-group analysis. The socio-economic, environmental factors, and food handlers' behavioral features, as well as the premises nature of food facilities, could all play a role in this variations between and within regions. There was a significant heterogeneity among included studies. This heterogeneity is due to differences in sample size, study settings, study populations, training given to study populations as intervention, and timing of outcome measurements.[37]

It was also aimed in this study to identify factors linked to hygienic food handling practices among Ethiopian food handlers. Accordingly, food safety training, hand washing facilities, regular medical checkups, and educational status were all found to be strongly linked to hygienic food handling practices in this study.

Food handlers who received food safety training were 5.38 times more likely to gain experience with hygienic food handling practices than those who did not. The findings of research conducted in Ethiopia[38,39] and Ghana[40] support this conclusion. This could be because food handlers who did receive food safety training may have the necessary knowledge and experience because they may have received professional advice during training[41] in terms of food hygiene as well as transmission and prevention of foodborne diseases.[42] As a result, food safety training appeared to be a good predictor of food hygiene practices.

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The combined findings of this meta-analysis revealed that work experience is not significantly related to hygienic food handling practices. However, of the 3 studies examined, Chekol et al[27] and Derso et al[23] discovered a significant association in a single study. Teffo and Tabit[43] concluded, in support of the current study, that work experience in food handling did not improve food handlers' overall hygienic food handling practices. As a result, validating the concept of good hygienic food handling is primarily accomplished through effective food safety training for food handlers.

Furthermore, Al-Ghazali et al[44] found that food handlers with less experience performed better on hygienic practices than those with more years of experience. So, rather than having experience in promoting food hygiene, food safety training will improve the system.[45] As a result, it is the attainment of food safety training rather than the experience of food handlers that determines food hygiene practices.

Food handlers' attitude, which is a proximal component in translating food hygiene practice into observable action, influences their level of handling practice.[46] Food handlers who have a positive attitude toward safe food handling practice have a 3.28 times higher chance of using hygienic food handling techniques than those who have a negative or fair attitude, according to this study. Previous studies conducted among food handlers in Ethiopia[38,47] and Malaysian[48] supported our findings. However, an Iranian study found no statistically significant association between attitudes and food hygiene practices.[49]

In our study findings, accessibility of handwashing facilities was significantly increases hygienic food handling practices of food handlers. The current finding supported by the study of Yenealem et al,[46] which states that the lack of handwashing facilities lead food handlers to be engaged in unhygienic food handling practices.

Compared to those who do not have medical cheek up, food handlers with medical cheek up are 5.37 times more likely to have good food handling practice. This result is consistent with previous studies conducted in Ethiopia[41] and Bangkok.[50] A medical examination should be required before beginning to work with food.[51] This is due to the fact that food handlers who had their health status checked had a better understanding of safe food handling. During their medical checkups, they also received professional advice, which improved their overall food handling performance.

In the current study, having formal education had increased hygienic food handling practices of food handlers, which is consistent with the study conducted by Dagne et al[38] and Tuglo et al.[40] This maybe expressed as the higher the education level of food handlers, the more likely to perform good hygienic food handling practices. But, other study in Ghana found that food handlers with a low level educational status were more likely to have hygienic food handling practices than those with a higher educational status, contrary to our findings.[52] The justification could be that hygienic food handling practices are not only learned through formal education in schools, but also through friends, parents, and the media. However, a lack of awareness or a lower level of education affects their attitude, which is reflected in their food hygiene practices. Food handlers who had attained higher level of educational status have better knowledge, a positive attitude, and follow good hygienic practices.[45] As a result, food handlers should be encouraged to obtain at least a basic education as well as training in food hygiene and safety practices before assigned in food establishments.

There are several limitations to this study. We only searched papers published in English, even if the discovery of publications in languages other than English is consistent with others. Furthermore, because all the studies in this review were cross-sectional, additional confounding variables could affect the outcome variable.

Conclusion

In this study, the prevalence of hygienic food handling practices among food handlers in Ethiopia was found to be significantly low. Lack of food safety training, a lack of regular medical checkups, a lack of hand washing facilities, an unfavorable attitude toward food hygiene practices, and a lack of formal education were all factors contributing to the low prevalence of hygienic food handling practices. Thus, the authors recommended that food workers should receive food safety training, have regular medical checkups, have access to hand washing facilities, and receive health education about food hygiene and safety procedures.

Author Contributions

The draft proposal was created by BN and NES. By critically reviewing, providing relevant input, and contributing to the intellectual substance of the study, all authors (BN, NES, and ZA) significantly contributed to the conception, conceptualization, and manuscript preparation of this systematic review. All authors read and approved the final manuscript.

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Supplemental Material

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