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Hand washing practices at critical times and their associated factors among mothers in Ethiopia: A systematic review and meta-analysis

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Abstract

One of the most crucial preventive measures against the spread of infectious diseases is hand washing, a process of hand cleansing that dramatically lowers bacteria in the hands. There is no comprehensive study on hand-washing practices in Ethiopia. Thus, this systematic review and meta-analysis aimed at estimating the pooled prevalence of hand washing practice at a critical time and identifying associated factors among mothers in Ethiopia. Published articles from various electronic databases, such as Medline, Hinari, PubMed, the Cochrane Library, and the Web of Science, were accessed. The search period was from November 1, 2022, to January 10, 2023. The protocol was registered at PROSPERO with registration number CRD42023427409. All observational studies conducted among mothers in the English language were included in the review. Two reviewers independently assessed the articles before inclusion in the final review using the Joanna Briggs Institute Meta-analysis of Statistics Assessment and Review Instrument for critical appraisal. The I-squared test was used to assess heterogeneity. Since the included studies exhibited high heterogeneity, a random-effects model was used to estimate the pooled prevalence of hand washing practice at critical time movements. We found 3,546 studies in our search. Finally, 158 full-text studies were reviewed, and 18 studies fulfilled the inclusion criteria and were included in the final meta-analysis. A total of 6,956 study respondents from 18 studies were included in the study. The results of our study revealed that the pooled prevalence of handwashing practice among mothers was 47.83%, with a 95% confidence interval of 37.27-58.38. From the pooled estimation, there was a significant association between hand washing practice and educational level, knowledge, availability of water, and attitude of mothers. The

pooled prevalence of hand washing practice at critical times among Ethiopian mothers was relatively low, and improving maternal literacy, the availability of water sources in the backyard, and the positive attitude of mothers are needed to maintain and enhance the practice.

Keywords: Hand washing practice, critical time, determinants, systematic review, meta-analysis, Ethiopia

Introduction

Hand washing refers to washing hands with plain or antimicrobial soap and water, and hygienic hand washing is the treatment of hands with an antiseptic hand wash and water to reduce the transient flora without necessarily affecting the resident skin flora. It has a broad spectrum but is usually less efficacious and acts more slowly than the hygienic hand rub (WHO, 2020). Hand washing is an easy, do-it-yourself, and affordable task for every community member.

Water, sanitation, and hygiene (WASH) are essential during disease outbreaks to protect human health, and hand hygiene, in particular, is one of the most important measures to prevent the spread of diseases (Bartram et al., 2010). Many children acquire respiratory, gastrointestinal, and skin infections when hands that are contaminated by pathogens touch their noses, mouths, and eyes either by themselves, mothers, and/or care-givers at homes or schools (Bartram et al., 2010). Regular, appropriate hand washing is therefore one of the best ways of preventing the spread of infections and can save millions of lives annually (Dashefsky et al., 2017).

Hand washing prevents the spread of disease agents, which can greatly lower the incidence of trachoma, lung infections, diarrhoea, and other infections of the skin (Odu et al., 2017). Effective hand washing has been demonstrated to lower the prevalence and incidence of diarrheal illnesses by preventing the spread of several pathogens (Sandora et al., 2008). Diarrhoea is the leading cause of child death in Africa, and it is the second leading cause of child death globally. Worldwide, 88% of the cases of diarrhoea are attributable to unsafe water, inadequate sanitation, and insufficient hygiene (Xu et al., 2022). Despite the knowledge of this fact, many children's care-givers are still not washing their hands effectively (Curtis et al., 2009). Mothers or care-givers are engaged in faecal-oral disease transmission, particularly during disposal of faeces and urine, attending to sick people, handling waste, and contact with domestic animals, in which their hands unintentionally pick up microorganisms and other materials that may be harmful to children (Baye et al., 2019; Williams et al., 2008).

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The use of our hands in many of our daily activities, such as handling objects, handling food, preparing food, cleaning objects, etc., could lead to contamination of our hands, which is why maintaining good hand hygiene is so important. Therefore, some occasions require proper hand washing. After using the restroom, changing diapers, caring for a sick person, handling raw meat, and handling garbage are among the crucial times for hand washing, according to the Centers for Disease Control (Black et al., 2003). Nowadays, in terms of household drinking water, sanitation, and hygiene, only 8% of Ethiopians practice basic hand washing (using water and soap or alternatives), and those who were wealthier and lived in cities did so more frequently than those who were not. Proper hand washing with water and soap at critical times is inadequate (0–34%), according to the findings of a joint monitoring program between the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) (Aweke et al., 2019).

At times, hand washing significantly reduces the likelihood of contracting diarrheal diseases such as dysentery and cholera by 41%. These critical times include after defecation, after handling child or adult feces/cleaning the child's bottom, after cleaning the environment, before preparing food, and before eating food (Baye et al., 2019; Odu et al., 2017). However, handwashing practice at home is affected by many factors. Individual motivations (such as a desire to avoid germs or contamination, being taught hand-washing behaviour from a young age, and family discussion) and risk perception (such as a perception that washing hands with water is effective in removing germs and a perception that washing hands with soap is effective in reducing risk) are the categories into which the factors can be divided (Kelemu et al., 2021; White et al., 2020).

To our knowledge, there is no comprehensive study on hand-washing practices in Ethiopia. Therefore, we performed a meta-analysis to fill the above gaps and planned to consolidate the overall prevalence of hand-washing practice at a critical time and their association with mothers' educational level and the availability of water sources. It would be evidence to understand the magnitude of the problems and tailor preventative actions to the modifiable risk factors to ensure good hand-washing practices.

Study design and methods

The study protocol for registration and reporting

This systematic review and meta-analysis were conducted to determine the pooled prevalence of hand-washing practices at a critical time among mothers in Ethiopia using the standard Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist guideline (Liberati et al., 2009). The protocol was registered at PROSPERO with registration number CRD42023427409.

Searching strategies and sources of information

PROSPERO was used to search for previous systematic reviews and meta-analyses on a related subject to avoid duplication at the very beginning. Only published and all observational studies were considered. The databases Medline, Hinari, Scopes, PubMed CINAHL, Pop Line, Cochrane Library, JBI Library, Web of Science, and Google Scholar were searched for all studies that might be pertinent. By using Boolean operators ("OR" or "AND") and the following words and phrases: hand-washing practice, critical times, factors, mothers, and Ethiopia; we were able to retrieve all papers that have been published since 2000.

The following search terms were Search in PubMed (Hand washing [tw] OR "Hand hygienic" [MeSH Terms] OR "cleanness of hand" [MeSH Terms])) AND Practice [tw] OR "Hand washing practice "[MeSH Terms] OR “hand hygienic practice” [MeSH Terms])) AND Critical times [tw] OR ”Critical times"[MeSH Terms])) AND Determinants [tw] OR "Determinants" [MeSH Terms] OR "Factors"[MeSH Terms] OR "Predictors"[MeSH Terms]) AND Ethiopia). A list of references from identified articles was also reviewed to identify additional articles. The search period of articles was from November 1/2022 to January 10/2023.

PECO Frameworks

Population: hand washing practices among mothers. Exposure: Exposure is a key factor that increases or decreases the likelihood of hand washing practice at critical times among mothers. Context: Ethiopia. Condition: Hand washing practices at critical times. Outcome Measurement: The primary outcome of the study was the prevalence of hand-washing practices among mothers in Ethiopia. The secondary outcome of the study was factors that influenced the primary outcome.

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Inclusion and exclusion criteria

This systematic review included studies that were conducted on the prevalence of hand washing practice at critical times and associated factors in Ethiopia, and participants were among mothers. The review included all studies conducted in Ethiopia, all observational studies and studies published in English language. We considered all published and unpublished studies that were published in the form of journal articles, reports, master theses and dissertations. Conference abstracts and non-human studies articles, their full text, duplicate sources, and pieces of research with unclear methods, interventional studies, and case and report antiparticles excluded. We tried to contact the primary authors of the articles with incomplete information, and we excluded articles that were not accessible after contacting the principal investigator two times via email.

Study selection and abstraction/extraction process

Retrieved articles were exported to the reference manager software; endnote software was used to remove duplicate studies. The abstract and full text were reviewed by two independent reviewers. The author's name, year of publication, study location, study design, region, sample size, the presence of water and soap, attitudes, and knowledge of the mother were extracted for the assessment of risk factors and the prevalence of hand washing practice at critical times in Ethiopia. The disagreement was handled based on one established article selection criteria. Data were extracted using a standardized data extraction format prepared in Microsoft Excel by two independent authors. Any difference during extraction was solved through discussion.

Quality assessment

Three independent authors appraised the quality of the studies. The Joanna Briggs Institute (JBI) quality appraisal checklist was used (Munn et al.,2019). When there is any disagreement, the authors discuss and resolve it. The critical appraisal checklist has 8 parameters with yes, no, unclear, and not an applicable option. Does the parameter involve the following questions? (1) Where are the criteria for inclusion in the sample clearly defined? (2) Were the study subjects and the setting described in detail? (3) Was the exposure measured validly and reliably? (4) Were objective and standard criteria used for measurement of the condition? (5) Were confounding factors identified? (6) Were strategies to deal with confounding factors stated? (7)

Were the outcomes measured validly and reliably? (8) Was appropriate statistical analysis used?. Studies were considered low-risk when they scored 50% and above on the quality assessment indicators.

Statistical analysis

Before analysis, the necessary data from each original study were extracted using Microsoft Excel spreadsheet. The extracted data were imported and analyzed using STATA version 14.1 statistical software. We generated the logarithm and standard error of the Odds ratio for each original study using the command in STATA. We used Cochrane's Q statistic Chi-square and p-values to check for heterogeneity in the study outcomes. Forest plots were used to present the results of the analysis and to visualize the presence of heterogeneity. Also, point prevalence, as well as 95% confidence intervals, were presented in a forest plot format.

From the result of the statistical test, significant heterogeneity was found among included studies (I^2=99.1%, p<0.001) and a random effects meta-analysis model was performed. We conducted subgroup analysis (based on the region where studies were conducted) to identify the source of heterogeneity, and statistically significant results were declared in the presence of heterogeneity. A funnel test was used to check for publication bias. Further, we checked the statistical significance of publication bias using Egger tests and Begg tests of regression. A p-value of less than 0.05 was used to declare the presence of publication bias.

Operational definitions

Critical Times: This includes before preparing food, before eating a meal, before feeding a child, after visiting a latrine, after cleaning the child's bottom/dispose of child stool, and after cleaning a house or environment (Agerie et al.,2023).

Good Knowledge: mothers who answered ≥80% of knowledge questions correctly.

Positive Attitude: mothers who answered ≥80% of attitude questions correctly.

Good Practice: mothers who wash their hands with water and soap/ash at three or more critical times.

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Results

Search outcomes

Through out our search, we found a total of 3,546 studies that were conducted in different regions of the country. Of the total identified, 1,425 duplicate records were removed, and 2,121 papers were excluded after screening by title and abstract. We assessed the full text of the remaining 107 studies for eligibility, of which 89 studies were excluded because they failed to meet the eligibility criteria or due to different reasons (27 studies did not fulfill the inclusion criteria, 38 articles did not report the outcome variable, and 24 articles were repeated publications). Finally, 18 articles with 6,956 study participants were included as criteria for this systematic review and meta-analysis study (Figure 1).

Eighteen (18) included studies were cross-sectional study designs and were published from 2016 to 2023. In the current meta-analysis, 6,956 study participants were involved to determine the pooled prevalence of handwashing practices among mothers. Study participants were recruited from only females with health and non-health backgrounds. The study adequately addressed the total population of the catchment area to select the sample size as they used appropriate sampling methods.

In the present meta-analysis, three studies were conducted in Addis Ababa (Wana et al., 2023; Metadel et al., 2018; Abreham et al., 2017), seven of which were conducted in the Amahara region (Zemichael et al., 2023, Maereg et al., 2022; Niguse et al., 2022; Agerie et al., 2022; Habtam et al., 2022; Chalachew et al., 2019; Henok et al., 2019), two studies were conducted in Oromia (Mahmud et al., 2022; Assefa et al., 2017), and five studies in South Nation Nationalities and people (Amha et al., 2022; Ashenafi et al., 2022; Alula et al., 2018; Asrat et al., 2018; Behailu et al., 2016) and one study in Harer (Ashenafi et al., 2022).

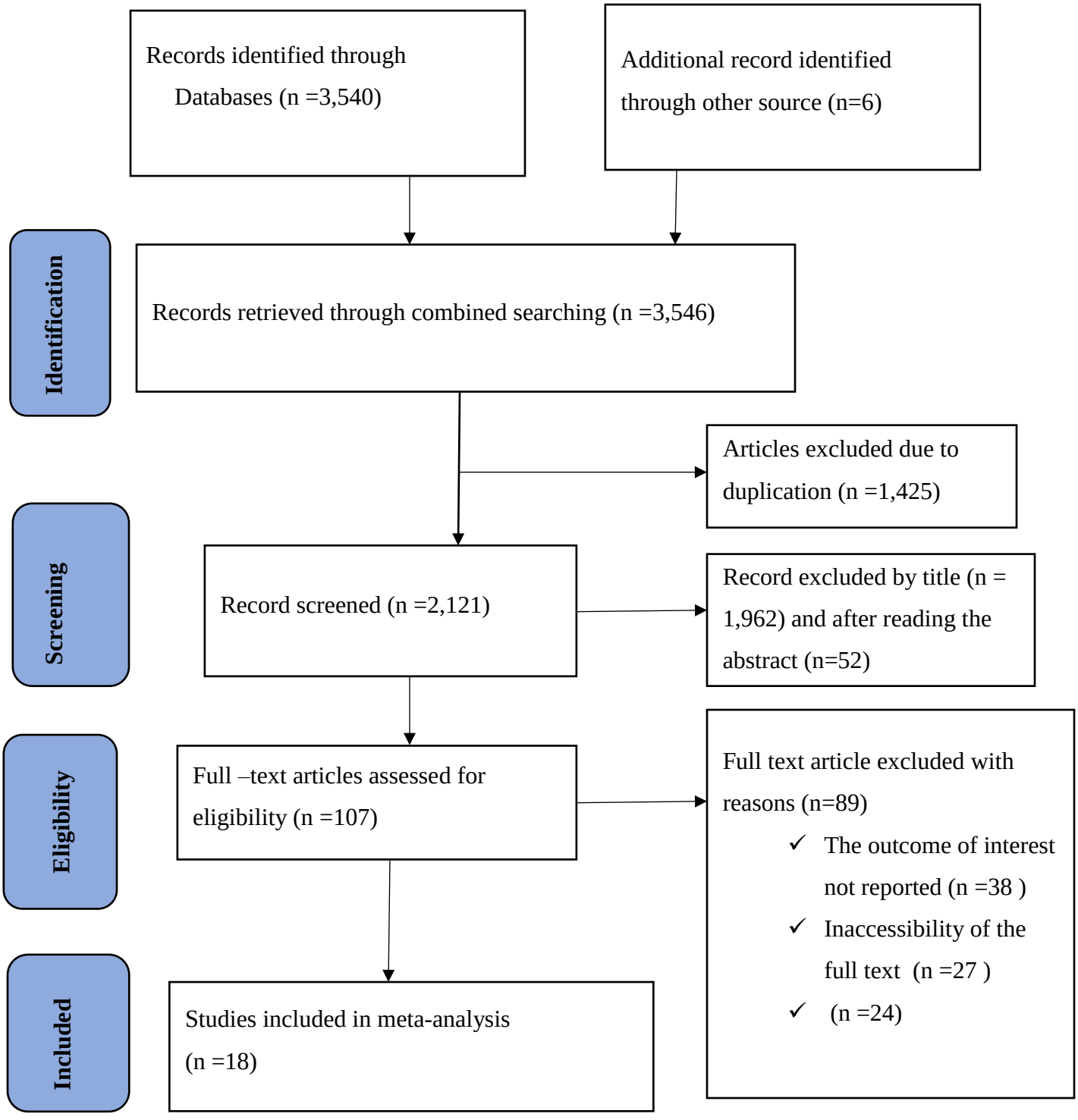

Figure 1. PRISMA diagram shows studies used for Systematic Review and Meta-analysis of the hand washing practice at a critical time movement among mothers in Ethiopia.

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Characteristics of the primary studies

Accordingly, the minimum sample size was 40 (Mahmud et al., 2022) and the maximum was 682 (Ashenafi et al., 2022). The lowest prevalence (19.8%) of hand washing practice at critical times was reported in studies conducted in Addis Abeba administrative city (Metadel et al., 2018), whereas the highest prevalence (89.6 %) was reported in a study conducted in Wondogenet in the Oromia region (Assefa et al., 2017) (Table 1).

Table 1. Characteristics of studies included in the systematic review and meta-analysis on the level of Good hand washing practice at critical times movement among mothers in Ethiopia.

Authors Name	Pub. Year	Study area	Region	Study design	Sample Size	Prevalence(95%CI)	Study Quality
Ermias W. et al. (Wana et al., 2023)	2023	Addis Abeba	Addis A.	Cross-sectional	315	74.4	Low risk
Aberham I. et al. (Abreham et al., 2017)	2017	Addis Abeba	Addis A.	Cross-sectional	385	61.3	Low risk
Metadel M. et al. (Metadel et al., 2018)	2018	Addis Abeba	Addis A.	Cross-sectional	563	19.8	Low risk
Zemichael G. et al. (Zemichael et al., 2023)	2023	North Gondar Zone	Amahara	Cross-sectional	384	28.8	Moderate risk
Henok D. et al. (Henok et al., 2019)	2019	Debark Town	Amahara	Cross-sectional	402	52.3	Low risk
Agerie Z. et al. (Agerie et al., 2022)	2022	Debark Town	Amahara	Cross-sectional	423	44.9	Low risk
Meareg W. et al. (Maereg et al., 2022)	2022	Kolladiba town	Amahara	Cross-sectional	349	51.2	Low risk
Habtamu A. et al. (Habtam et al., 2022)	2022	Tegedie Zone	Amahara	Cross-sectional	576	33.6	Low risk
Niguse Y. et al. (Niguse et al., 2022)	2021	Gondar Town	Amahara	Cross-sectional	415	82.2	Low risk
Chalachew T. et al. (Chalachew., 2019)	2019	Debretabor Town	Amahara	Cross-sectional	645	30.1	Low risk
Mahmud A. et al. (Mahmud et al., 2022)	2022	Jimma Town	Oromia	Cross-sectional	40	52.5	Moderate risk
Assefa D. et al (Assefa et al., 2017)	2017	Wondogenet	Oromia	Cross-sectional	264	89.6	Low risk
Asrat M. et al. (Asrat et al., 2018)	2018	Bench Maji Zone	SNNPR	Cross-sectional	422	38.9	Moderate risk
Ashenafi A. et al. (Ashenafi et al., 2022)	2022	Gedeo Zone	SNNPR	Cross-sectional	422	44.9	Low risk
Behailu B. et al. (Behailu et al., 2016)	2016	Arba Minch Town	SNNPR	Cross-sectional	350	22.23	Moderate risk
Alula B. et al (Alula et al., 2018)	2018	Hosanna town	SNNPR	Cross-sectional	246	69.8	Low risk
Amha A. et al. (Amha et al., 2022)	2022	Wolaita Zone	SNNPR	Cross-sectional	586	28.1	Moderate risk
Ashenafi A. et al. (Ashenafi et al., 2022)	2022	Harer Town	Harer	Cross-sectional	682	37.0	Low risk

Pooled prevalence of handwashing practice at critical times in Ethiopia

Based on the main studies included, the prevalence of hand washing practice at critical times among mothers in Ethiopia was between 19.8% and 89.6% (20, 29). However, the forest plots below show the predicted overall prevalence of handwashing practice at critical times among mothers in Ethiopia. The 18 included studies revealed that a pooled prevalence of hand washing practice at critical time movement among mothers in Ethiopia was 47.83% with a 95% confidence interval of 37.27- 58.38, representing significant heterogeneity between included studies (I^2 = 99.1%; P-value 0.001). The random effects model was used to analyze the pooled prevalence (Figure 2).

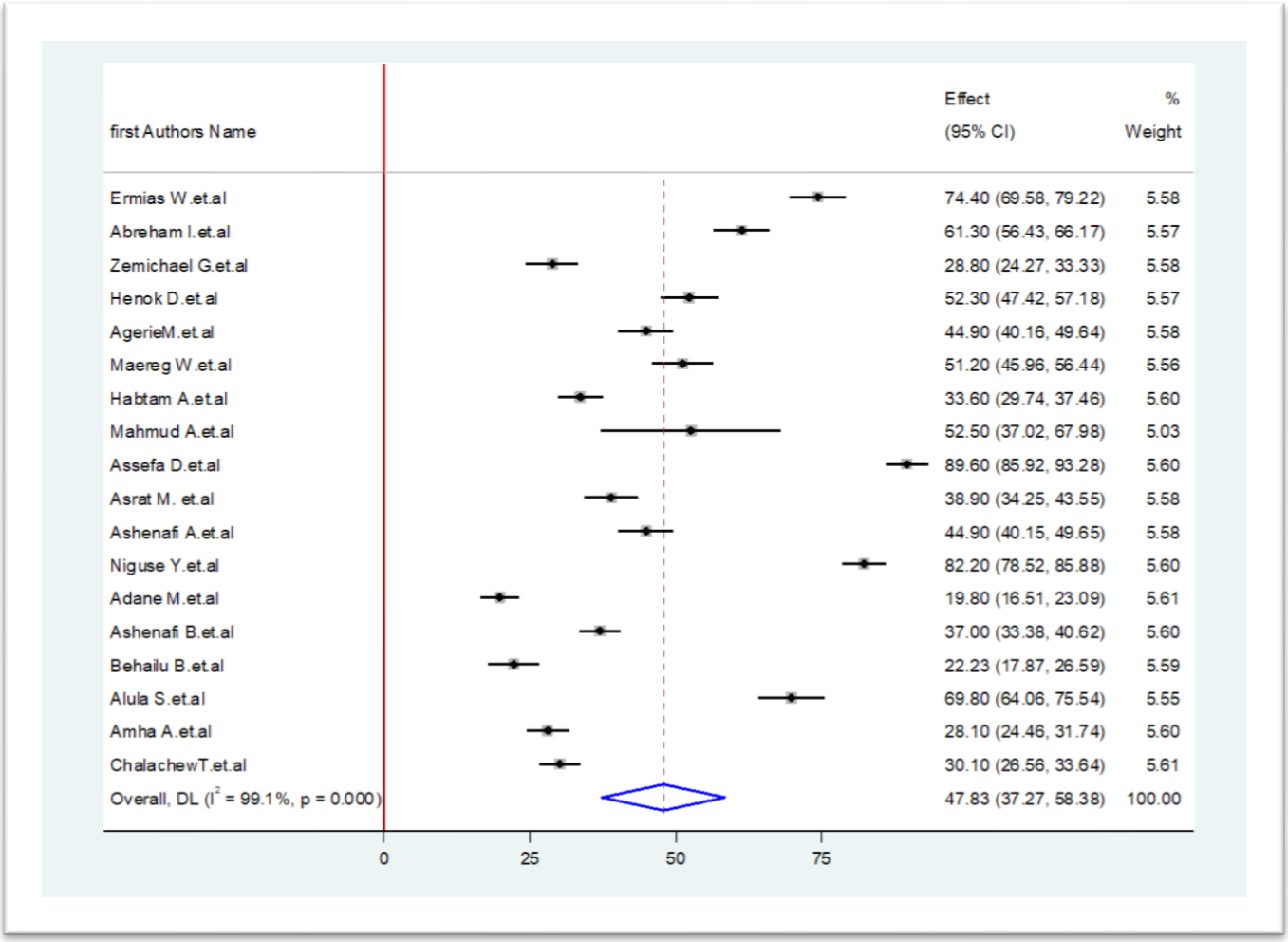

Figure 2. Forest plot for the pooled level of good hand washing practice at a critical time's movement among mothers in Ethiopia.

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Components of handwashing practice at critical times

The pooled prevalence of specific critical times for hand washing practice was analyzed. The most common was before, during preparing food 34.93 with a 95% confidence interval of 29.52, 40.3, followed by before and after eating food was 28.67% with a 95% confidence interval of 20.13, 37.22. The pooled prevalence of after using the toilet, after changing diapers, and after any polluting activities (like sick with vomiting or diarrhea) was 27.88% (95% CI: 22.09, 33.67), 22.14 (95% CI: 16.87, 27.40), and 17.05% (95% CI: 10.00, 24.097) respectively (Table 3).

Table 2. The pooled estimate of individuals critical times for hand washing practice in Ethiopia.

Critical time movement	No of the included studies	Sample size	Pooled estimate with 95% CI	Heterogeneity (I^2) (p-value)
Before preparing food	12	1,546	34.93 (29.52,40.35)	91.6% (<0.001)
Before and after eating food	12	1,546	28.67 (20.13,37.22)	93.5% (<0.001)
After using the toilet	10	983	17.05(9.998,24.097)	97.0% (<0.001)
After changing diapers or cleaning up a child	9	856	27.88 (22.09,33.67)	92.9% (<0.001)
After any polluting activities (like sick with vomiting or diarrhea)	6	674	22.14 (16.87,27.40)	96.0% (<0.001)

Subgroup analysis

In this meta-analysis, we computed a subgroup analysis for the prevalence of handwashing practice at critical time movement based on the region where the study was conducted. Accordingly, the prevalence ranged from 37.0% with a 95% confidence interval of 33.38 - 40.62 in the administrative city of Harer 71.84% with a 95% confidence interval of 35.52-108.17 in the Oromia region (Figure 3).

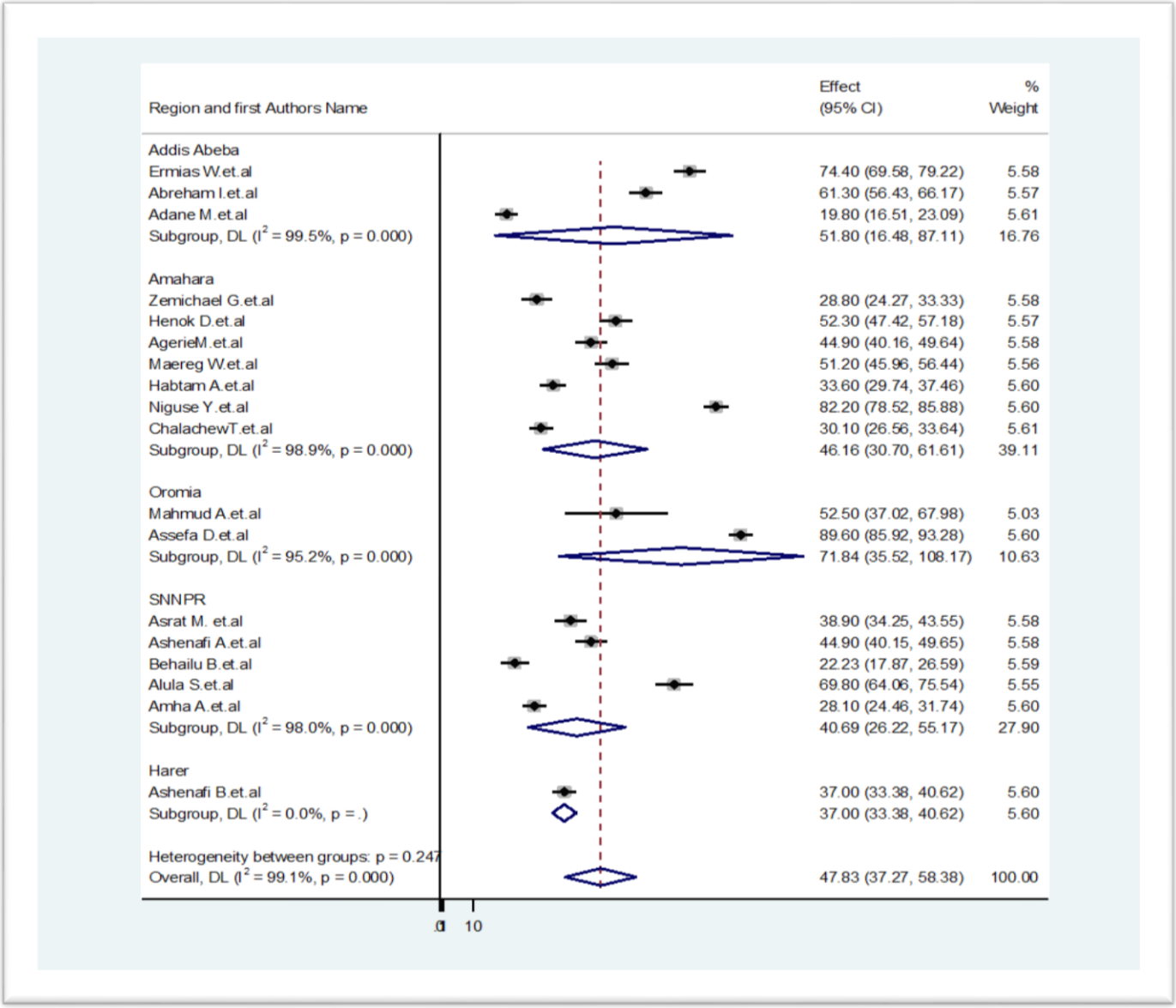

Figure 3. The pooled prevalence of Hand washing practice at critical time movement among mothers, at 95% CI, and heterogeneity estimate with a *p*-value for subgroup analysis.

Publication bias

To assess the presence of publication bias, a funnel plot and Egger test at a 5% significant level were performed. The funnel plot was asymmetry, and Begg's tests showed that there was a statistically significant presence of publication bias with P=0.019 (the presence of unpublished studies), but Egger tests showed that there was no statistically significant with P=0.295 (the presence of small study effects) (Figure 4).

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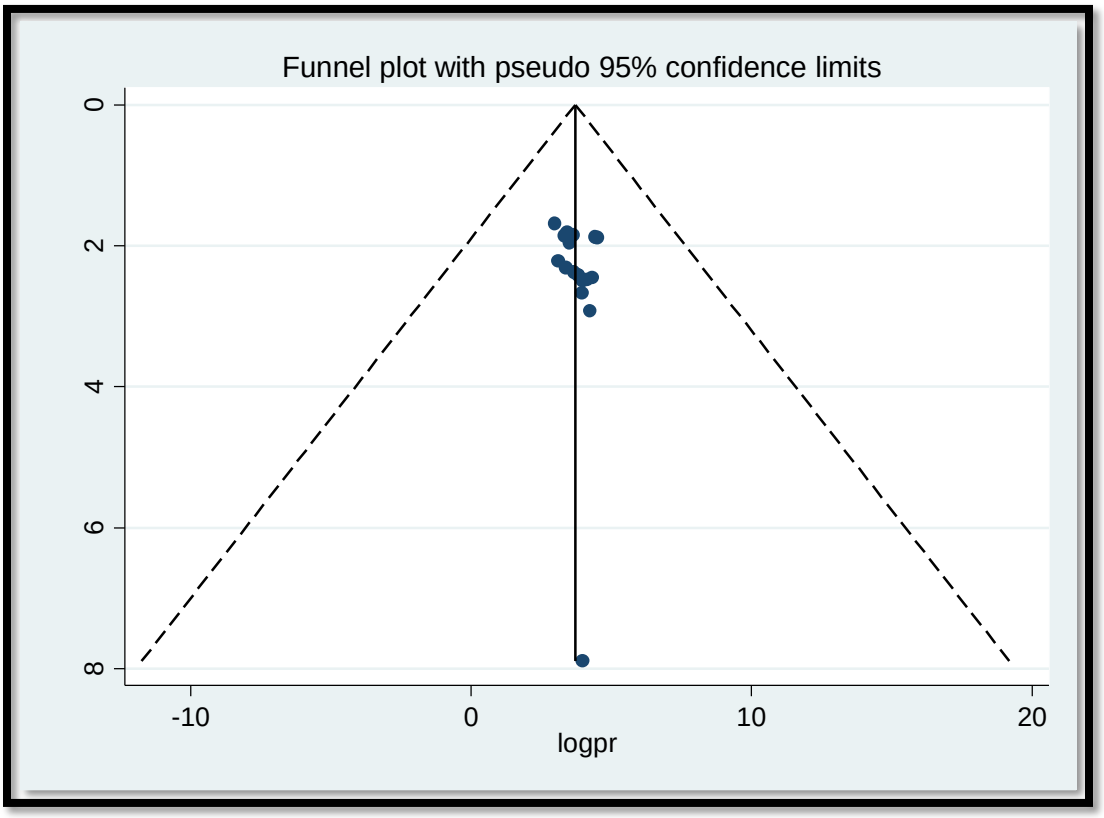

Figure 4. Funnel plots for publication bias of hand washing practice at a critical time movement among mothers in Ethiopia.

Counter-enhanced Funnel Plot

The funnel plot was asymmetric and showed a small study effect. The counter-enhanced funnel plot makes a difference in recognizing between publication bias and other causes of asymmetry. It showed that small studies were found not only in the area of statistical significance but also in the areas of non-statistical significance. So the asymmetry may have been caused by several factors and not exclusively by publication bias (Figure 5).

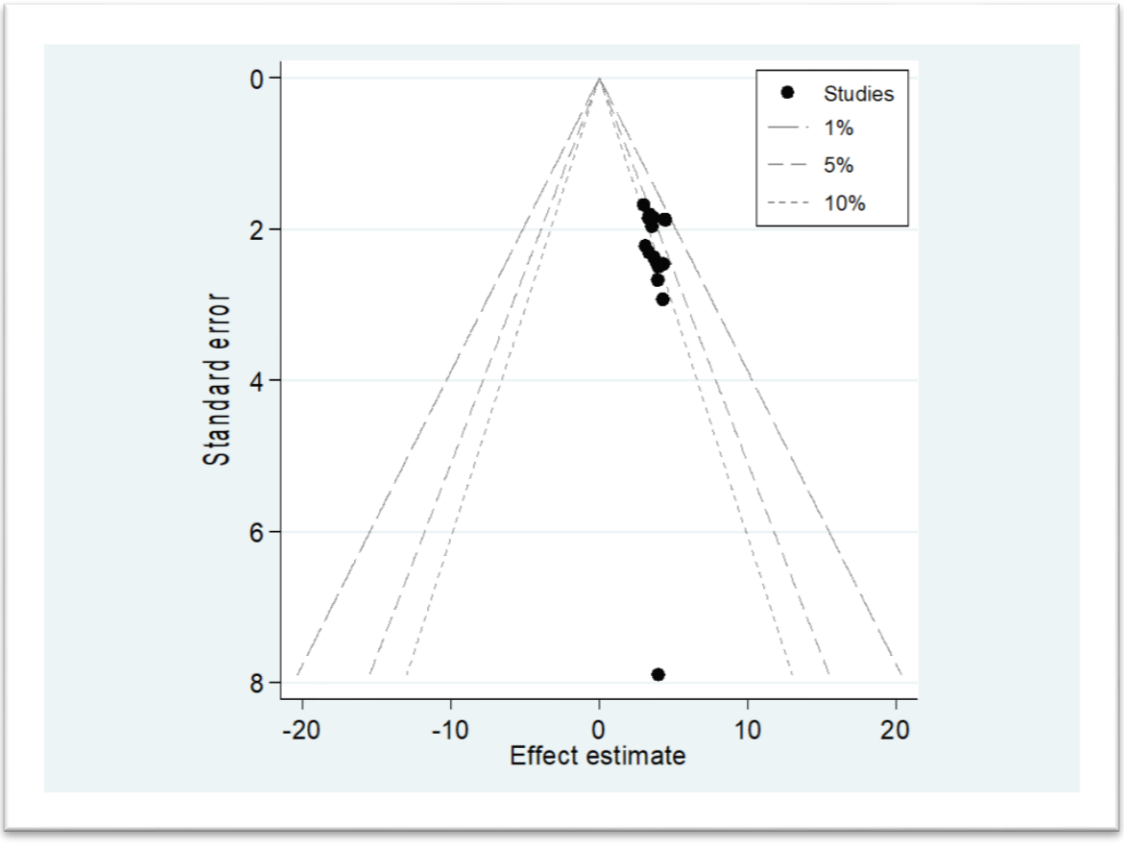

Figure 5. Contour-enhanced funnel plots publication bias of the prevalence of hand washing practice at critical time movement among mothers in Ethiopia.

Trim and fill analysis

Begg regression test p-value of the study was <0.001, which showed the presence of publication bias. Also, asymmetric distribution was observed in the funnel plot. The trim and fill analysis showed the presence of six (6) unpublished studies (Figure 6).

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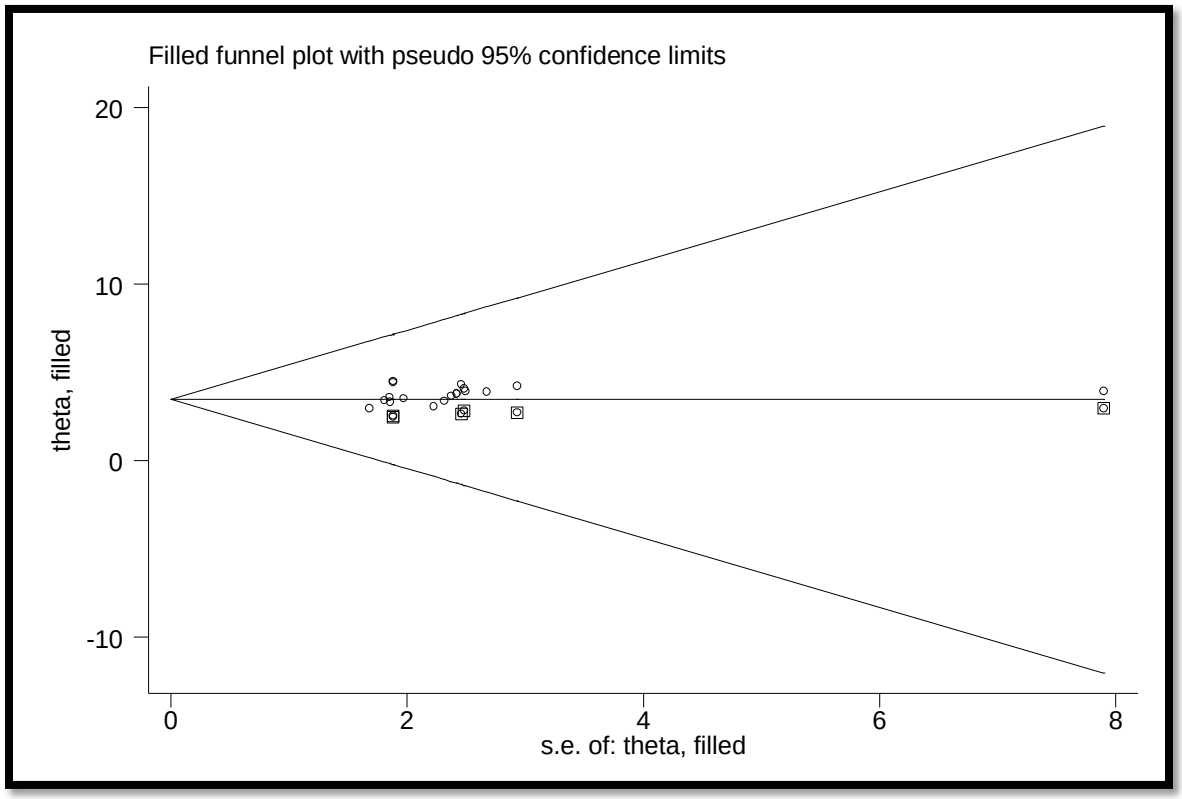

Figure 6. Filled funnel plots for publication bias of prevalence of hand washing practice among mothers in Ethiopia

A Leave-out-one sensitivity analysis

A leave-out-one sensitivity analysis was done to evaluate the effect of each study on the pooled prevalence level of occupational injuries by excluding each study step-by-step. The results showed that the excluded study did not bring any significant change to the estimated level of hand-washing practices (Table 3).

Table 3. A-leave-out-one sensitivity analysis for the prevalence of hand washing practice at critical time movement in Ethiopia.

Study omitted	**Pooled Estimate**	**95% Conf. Interval**
Ermias W. et al.	46.25	(35.56 - 56.94)
Abraham I. et al.	47.03	(36.02 - 58.03)
Zemichael G. et al.	48.95	(37.96 - 59.93)
Henok D. et al.	47.56	(36.46 - 58.66)
Agerie M. et al.	48.00	(36.86 - 59.13)
Maereg W. et al.	47.62	(36.55 - 58.70)
Habtam A. et al.	48.67	(37.52 - 59.81)
Mahmud A. et al.	47.57	(36.72 - 58.43)
Assefa D. et al.	45.32	(35.99 - 54.64)
Asrat M. et al.	48.35	(37.23 - 59.47)
Ashenafi A. et.al	48.00	(36.86 - 59.13)
Niguse Y. et al.	45.77	(35.78 -55.75)
Metadel M. et al.	49.48	(38.92 - 60.05)
Ashenafi B. et al.	48.47	(37.21- 59.72)
Behailu B. et al.	49.33	(38.52 - 60.15)
Alula S. et al.	46.53	(35.69 -57.37)
Amha A. et al.	48.99	(37.98 - 60.01)
Chalachew T. et al.	48.87	(37.78- 59.97)
Combined	**47.82**	**(37.27- 58.37)**

Meta-regression analysis

To assess the underlying source of heterogeneity the meta-regression analysis was computed by using the year of publication, the region where the studies were conducted, and the sample size

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of the included studies. However, there was statistically insignificant heterogeneity (p-value=0.974, 0.996, and 0.584 respectively (Table 4).

Table 4. Meta-regression analysis based on year of publication, Region, and Sample size of studies.

The possible source of heterogeneity	Coefficient	Standard error	P-value
By Year of Publication	1.007	0.230	0.974
By Region	0.001	0.348	0.996
By sample size of the studies	-0.002	0.003	0.584

Predictors of handwashing practice at critical time movement in Ethiopia

We performed a meta-analysis to identify associated factors of handwashing practice at critical time movement using the random effects model. During the extraction process, we planned to show the association of every factor with the outcome variable. However, we could not check for the association of each factor with the handwashing practice because factors listed in one study were not found in others and the differences in the categorization of predictor variables in each primary study. Therefore, we performed the pooled effect of four predictor variables on the outcome variable, educational level, availability of water and soap, knowledge, and attitude of mothers in Ethiopia.

The association between the availability of water and Soap in handwashing practices

The association between handwashing practice and the availability of water and soap was evaluated using eight (8) studies (Zemichael et al., 2023; Amha et al., 2022; Wana et al., 2023; Maereg et al., 2022; Agerie et al., 2022; Habtam et al., 2022; Henok et al., 2019; Chalachew., 2019). The result revealed that the pooled effect of having water and soap was significantly associated with the hand-washing practice. Mothers who had sufficient water and soap were 5.19 times better at practicing hand washing at a critical time than those who reported a lack of water and soap with a confidence interval of 4.05-6.66. No heterogeneity was detected across the studies (I-squared = 0.0%, p = 0.709); as a result, we used a random effect model (Figure 7).

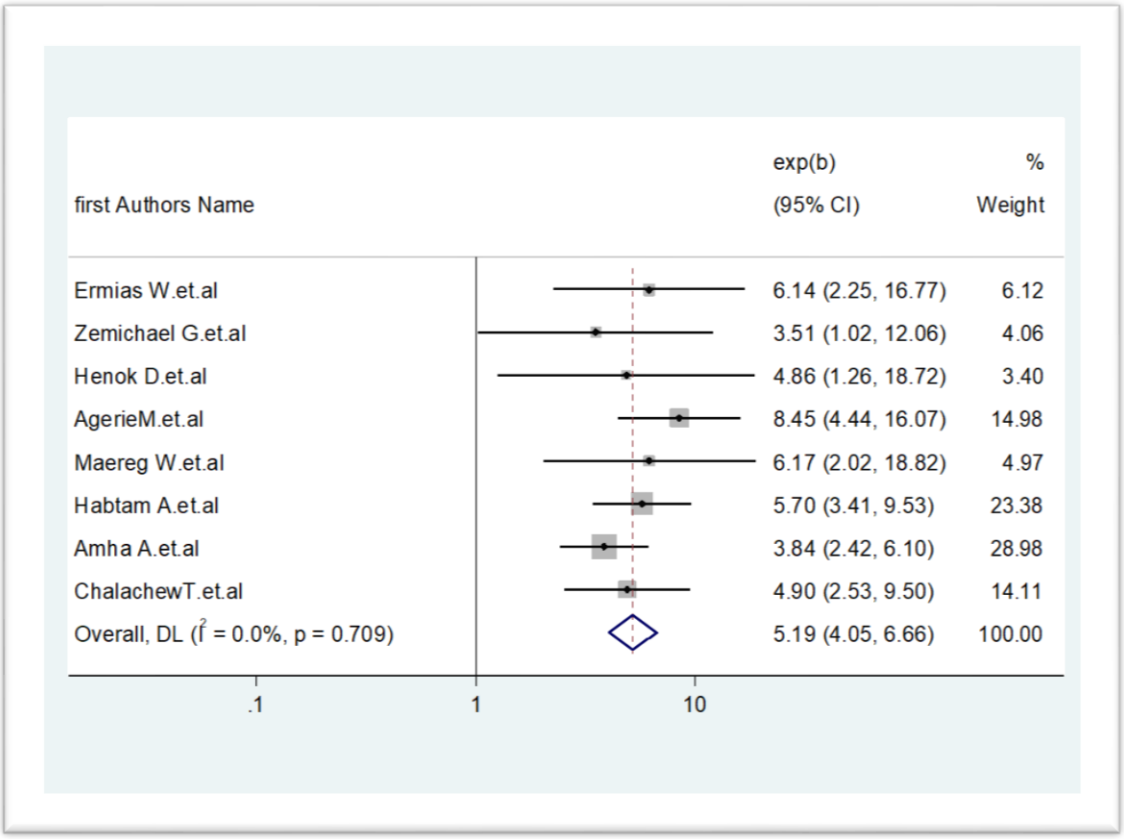

Figure 7. Forest plot showing the association between handwashing practice at critical times and availability of water and soap.

The association between handwashing practice and knowledge

Nine (9) studies revealed that having a good knowledge of mothers was significantly associated with handwashing practices (Zemichael et al., 2023; Ashenafi et al., 2022; Maereg et al., 2022; Habtam et al., 2022; Henok et al., 2019; Asrat et al., 2018; Chalachew, 2019; Assefa et al., 2017; Behailu et al., 2016). Knowledgeable mothers were more likely to have higher handwashing practice than those with poor knowledge about hand washing at critical times with an estimated odds ratio of 2.21 (AOR = 2.21,95% CI (1.74-2.81)). Since there was moderate heterogeneity, we used a random effect model (I^2 = 57.60%, p = 0.016, (Figure 8).

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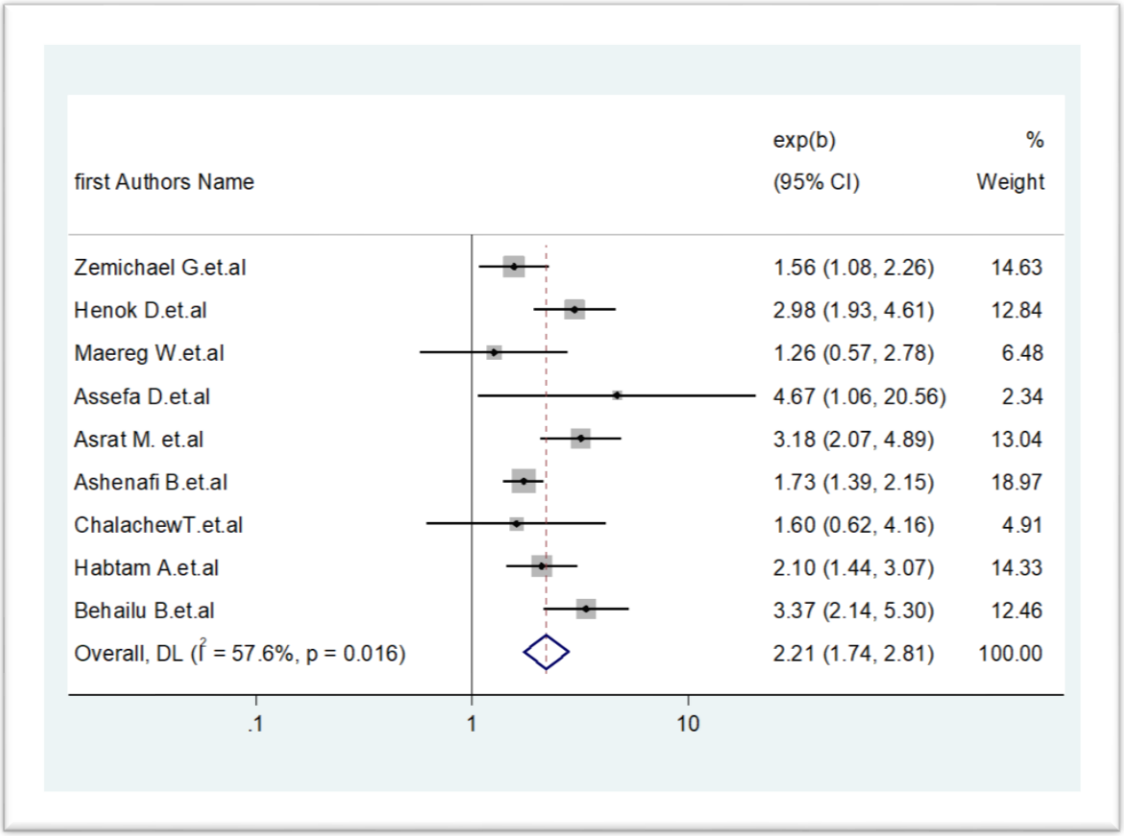

Figure 8. Forest plot showing the association between hand washing practice at critical time movement and knowledge among mothers.

The association between handwashing practice and educational level

The association between handwashing practice and educational level was evaluated using five (5) studies (Wana et al., 2023; Habtam et al., 2022; Henok et al., 2019; Alula et al., 2018; Abreham et al., 2017). The result revealed that the pooled effect of the educational level was significantly associated with the handwashing practice at a critical time. Mothers who have diplomas were 1.77 times more likely to practice handwashing at critical time than the reference, with an estimated OR of 1.77. (OR =1.77, 95%CI = 1.14, 2.75). Moderate heterogeneity was detected across the studies (I^2 = 78.8%, p = 0.001); as a result, we used a random effect model (Figure 9).

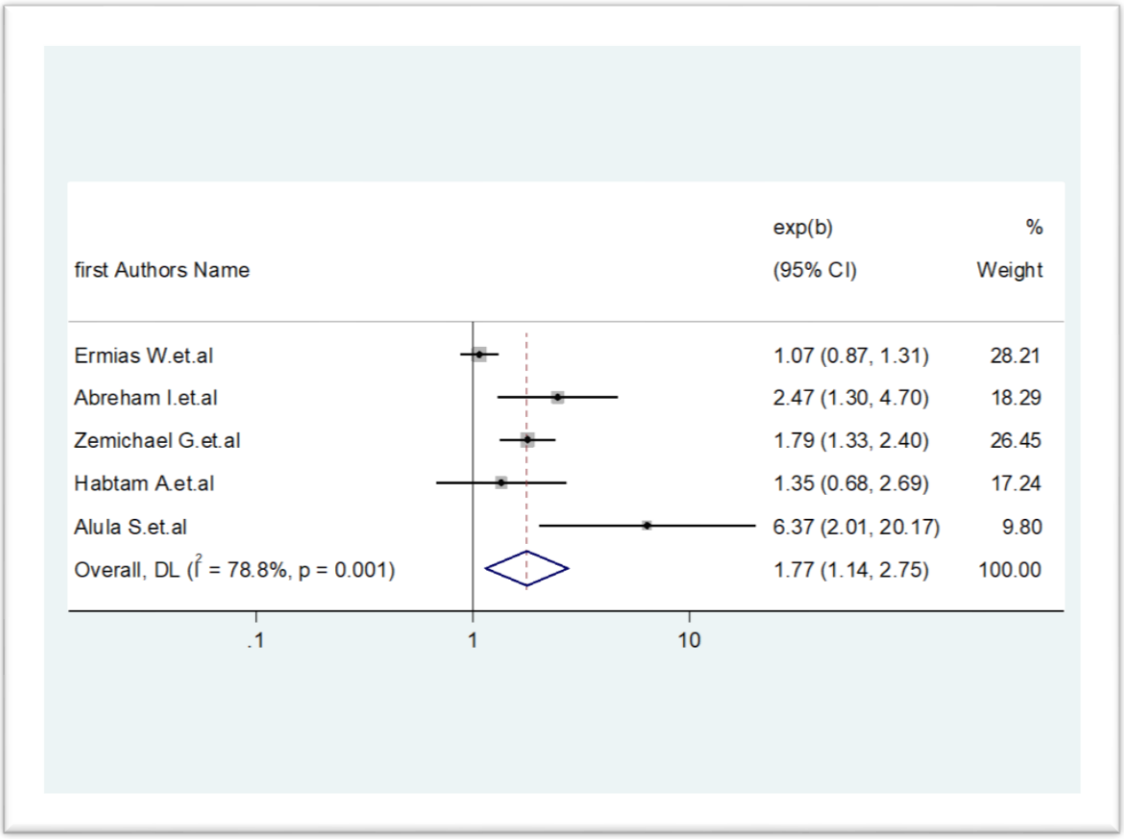

Figure 9. Forest plot showing the association between handwashing practice movement and educational level among mothers.

The association between handwashing practice and attitudes

The association between handwashing practice and the attitudes of mothers was evaluated using four (4) studies (Henok et al., 2019; Assefa et al., 2017; Yasu et al., 2017; Behailu et al., 2016). The result revealed that the pooled effect of attitudes was significantly associated with hand-washing practice. Mothers who have positive attitudes towards handwashing were 2.50 times more likely to practice handwashing than mothers with negative attitudes (OR = 2.50, 95%CI = 1.92, 3.26). No heterogeneity was detected across the studies (I^2 = 0.00%, p = 0.490); as a result, we used a random effect model (Figure 10).

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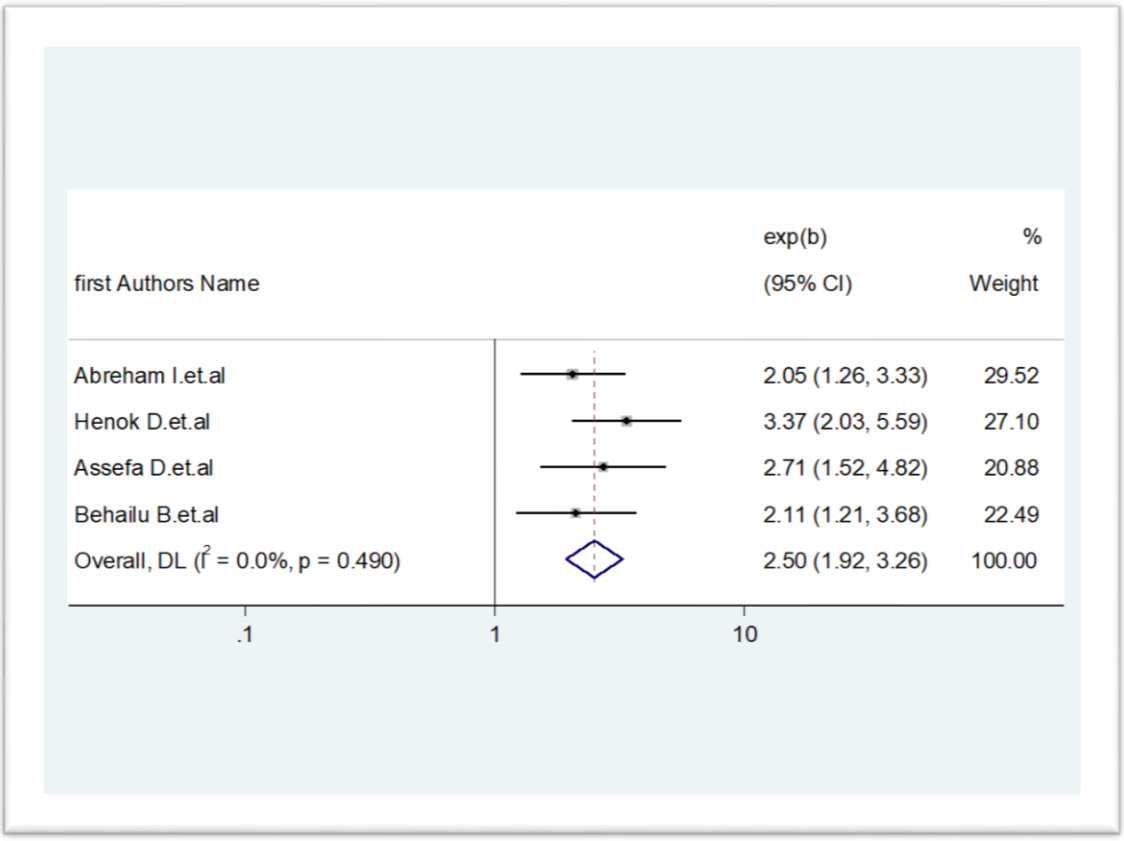

Figure 10. Forest plot showing the association between hand washing practice at critical time movement and attitudes among mothers.

Discussion

This systematic review and meta-analysis, including 18 studies published between 2016 and 2023, were included to assess the pooled prevalence of handwashing practice at critical times and factors associated with handwashing practice among mothers in Ethiopia. As far as our knowledge is concerned, this meta-analysis was the first of its kind in Ethiopia to estimate the pooled prevalence and predictors of handwashing practice among mothers in the country.

The result of our study revealed that the pooled prevalence of handwashing practice at critical times among mothers was 47.83% with a 95% confidence interval of 37.27,58.38. This is in line with previous reports in Nigeria (Aigbiremolen et al., 2015). The handwashing practice at critical times in the current study was lower than a study conducted among mothers in Mandalay (Oo et al., 2014) and among mothers of children in Lagos, Nigeria (Ogwezzy-Ndisika et al., 2019).

The differences in the practice of hand washing among mothers may be because of differences in socioeconomic status, level of health services, living standard differences among the study settings, and the difference in ways used for assessing hand washing practice and techniques of assessment. For example, the method used in the current study and in other studies (Odu et al., 2017; Aigbiremolen et al., 2015).

Before, during, and after preparing food, hand washing practice is the highest of all critical time hand washing practices in our study. This is like another study in Taluk of India (Ashwini et al., 2020). But higher than Pune of India (12.53%) (Pandve et al., 2016).

In this review, using the toilet, changing diapers or cleaning up a child, and any polluting activities are the most critical time for hand washing practice and their pooled prevalence varies from country to country due to different reasons that might be explained by many factors such as: lack of knowledge, incorrect behavior patterns, insufficient training, heavy workloads, and poverty. In the study area, the perception of cleanliness is the major barrier to following the recommended practice of hand hygiene.

This low hand hygiene practice in the current review might be explained by many factors such as: lack of knowledge, availability of water, attitudes, and educational level of mothers. In most developing countries, the perception of cleanliness is the major barrier to following the recommended practice of hand hygiene. In the area, households may not use cleaning agents if there is no visible dirt or unpleasant odor. Lack of knowledge about critical times and the right technique of hand washing might also explain low hand hygiene practice in the area (Xu et al., 2022).

Moreover, since rural households are engaged in outdoor activities with a heavy workload, they will not have access to handwashing facilities and may not have time to follow the steps of effective handwashing. To them, it seems like an additional time consumption, and moreover, soap is not always available in the area due to cost (White et al., 2020).

In the current study, knowledge, attitude, and water availability were significantly associated with the hand-washing practice of mothers at critical times. Mothers with good knowledge tended to have better hand-washing practices than those with poor knowledge. This was in line with previous studies (Maqbool et al., 2021). But in other studies (Ogwezzy-Ndisika et al., 2019) knowledge was not associated with hand hygiene practice. Surface-level knowledge does not lead to desirable behavioral change that elicits better practice. Mothers with a desirable attitude

had better hand-washing practices. This is in line with other studies (De Wandel et al., 2010). However, attitude was not associated with hand-washing practice in other studies (Pang et al., 2015). This might be because of other potential factors that will contribute to the practice than attitude in earlier studies. Study subjects who reported that they had sufficient water for hand washing had better hand washing practice at critical times. Water availability is a significant factor in hand washing practice in earlier studies (Aigbiremolen et al., 2015, Rabbi et al., 2013).

Strengths and limitations of the study

We searched articles systematically and included studies using clearly defined criteria to minimize selection bias. It is possible that we missed some relevant literature as only articles in English and some databases were not searched. Additionally, we included preprint articles that have not yet been peer-reviewed, and the results from these studies may change in the future and methodological biases may be present.

Conclusions

Handwashing practice at critical times among mothers was relatively low. The availability of water, knowledge, and attitude were significant factors affecting handwashing practices. Therefore, improving the availability of water sources in the backyard and increasing the positive attitudes of mothers are needed to maintain and enhance the practice. Further, policies and programs targeted at improving the knowledge and attitude of mothers regarding handwashing practice at critical times need to be informed about washing hands using cleaning agents and maintaining the recommended process at all critical times.

Abbreviations

CI: Confidence Interval, DF: Degree of Freedom, OR: Odds Ratio, PRISMA: Preferred Reporting Items of Systematic Reviews and Meta-Analysis.

Declaration

Ethical approval and consent to participate

Not applicable

Consent for publication

Not applicable

Competing interests

The authors state that they have no competing interests.

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Availability of data and materials

Data and all materials of the manuscript are with the primary author and available at any time on request.

Conflict of interest statement

We declared that we have no conflict of interest.

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