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Prevalence and risk factors of diarrhea among under-five children in Ethiopia: A systematic review and meta-analysis

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Abstract

Introduction In developing countries, safe piped drinking water is generally unavailable, and bottled water is unaffordable for most people. In these countries, diarrhea accounts for the largest cause of disease and nearly 50% of deaths in young children. In Ethiopia, childhood diarrhea is a serious public health issue that affects 13.5 to 30.5% of the children with different diarrheal causes. Nonetheless as of late for work, no thorough comprehensive review for the pooled prevalence of diarrhea as well as the risk factors has been conducted, which was the goal of this systematic review and meta-analysis.

Methods A Search was conducted of numerous international databases, including PubMed, Medline, Embase, Direct Science, Web of Science, Cochrane Library, Global Health, Google Scholar, CINAHL and University Repository. Articles from the last ten (10) years ranged from 2015 to mid-2024 were included. Using a common data extraction format, three authors extracted all required data. The statistical program STATA Version 17 was used to analyze pooled prevalence of diarrhea and the risk factors among children under five years old. The heterogeneity of the studies was evaluated using the I^2 test and the Cochrane Q test statistics. Pooled prevalence of diarrhea and risk factors were calculated. The random effect model was utilized to investigate the relationships between risk factors and prevalence of diarrhea at national level. The random effect size was deemed to be less than 0.05 at a confidence interval of 95% (CI:95%).

Result Out of 2548 studies, 36 studies were eligible for the review from north, southern, central, eastern and western part of Ethiopia. Regarding mothers/caregivers, out of 29,881 total populations, 10,641(36%) them were accessed from the national data reported by single study, 7438 (25%) and 5882(20%) were extracted from studies conducted in the northern and eastern Ethiopia, respectively. The pooled prevalence of two weeks diarrhea among children under five years old for the last ten years was 19.62% (95%CI:15.93, 23.31). Of this, 19.82% (95% CI:12.74–26.90%) and 19.83 (95% CI:15.31–24.36%) were between the interval of 2015–2019, and 2020- mid-2024, respectively. The pooled adjusted odds of improper disposal of child feces (AOR:3.33, 95% CI:2.70, 4.11), unvaccinated against Rota

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virus (AOR:1.81,95% CI:1.55, 2.12) and low maternal education (AOR:1.05, 95%CI:1.00, 1.11) were the risk factors for the prevalence of diarrhea among children under five years old. Meanwhile, the pooled adjusted odds of unimproved latrine (AOR:1.27, 95% CI:1.21, 1.35), improper waste disposal (AOR:2.57,95% CI:2.35, 2.81) and utilized untreated water (AOR:1.72, 95% CI:1.52, 1.94) were the significant risk factors. Also, adjusted odds for lack of handwashing (AOR:3.12, 95% CI:2.52, 3.88) and absence of handwashing during critical times (AOR:3.27,95%CI:3.06,4.49) were the risk factors.

Conclusion A number of risk variables contribute to diarrhea morbidity among children under five years old, which was substantially correlated with water, hygiene and sanitation, illiterate mothers and access to a safe water source. Effective interventions such as promotion and education of proper hygiene, sanitation, proper hand washing; latrine installation at the household and community level; household-based chlorination; and improved water storage to prevent diarrhea among these age group is recommended.

Keywords Children under five years, Diarrhea, Ethiopia, Prevalence, Risk factors

Introduction

Globally, there are nearly 1.7 billion cases of childhood diarrhea disease every year. Diarrhea is the second leading cause of global childhood mortality, responsible for an estimated 1.9 million deaths annually and the common cause of infant death [1]. In 2021, diarrhea caused around 9% of all fatalities in children under the age of five worldwide. It is one of the main causes of death in children. This means that even when a straightforward treatment option is available, more than 1,200 young infants perish every day, or around 444,000 children annually [2, 3]. Diarrheal disease accounts for 1 in 9 child deaths worldwide, and around 88% of the deaths are due to unsafe water, inadequate sanitation, and insufficient hygiene [4]. Diarrheal disease is caused by a variety of bacteria, viruses, and parasites and the infections are primarily spread by contaminated food, water, or person-to-person contact brought on by poor hygiene, which is common among children less than five years old and common in low-middle income countries [5]. This curable and avoidable illness is more prevalent in low- and middle-income countries. The supply of clean water, the usage of sanitary facilities, hygiene construction, maternal personal hygiene, and hygienic supplementary feeding are examples of targeted interventions, however local implementation varies [6].

Children of low- and middle-income countries carry the highest proportion of this disease burden. In Africa, diarrhea accounts for the largest cause of disease and death among young children, and causes nearly 50% of deaths due to diarrhea among young children. Diarrheal disease remains one of the major causes of mortality and morbidity among under-five children worldwide, especially in sub-Saharan African (SSA) countries, including Ethiopia, due to poor sanitation and hygiene. In Ethiopia, childhood diarrhea is a major public health problem in which the prevalence ranges from 13.5 to 30.5% and is affected by multiple factors [7].

As far as the authors knowledge, there was no constructive systematic review and meta-analysis that looked into the prevalence of diarrhea and the factors that are linked to it in Ethiopia, despite the fact that diarrhea in children under five years of age is a major concern in the region. Therefore, this review was conducted in order to ascertain the prevalence of diarrhea and related variables among children under five years of age in the area. On top of this, the following review questions were hypothesized in order to meet the goal of this systematic review and meta-analysis. What is the two-week pooled prevalence of diarrhea for the last ten years among children under five-years old in Ethiopia? What is the two-week pooled prevalence of diarrhea prevalence between 2015 and 2019 and 2020 -mid-2024? What are the contributing risk factors of diarrhea morbidity for the last ten years in Ethiopia?

Methods

Review protocol

The review flow diagram has been adapted using the Preferred Reporting Items for Systematic Reviews (PRISMA) criteria [8]. PICOS, which stands for population (P), intervention (I), comparison (C), outcome (O), and study type (S), was used for scoping and searching review questions [9].

Inclusion and exclusion criteria

Inclusion The study subject/Population stands for under five-years- children in Ethiopia. The type of Intervention and Dependent or outcome were two week and presence of diarrhea, respectively. Cross sectional, case control and cohort studies were included. Published studies, reports and grey document from 2015 to mid of 2024 were included. Also, the whole text as well as an abstract with a defined goal and methodology was included.

Exclusion Children who were more than five years old were excluded in this review. Research designs such as individually or cluster-randomized controlled trials, subsequent controlled, non-randomized studies, time-series studies, quasi-randomized controlled trials, non-

randomized controlled trials, controlled before-and-after studies, and historically controlled studies were excluded. Research with unclear objectives and methods, research published in languages other than English as well as those published before to 2015 were excluded from this analysis.

Searched databases and strategies

Eleven authors- STT, DAA, FA, RA, DA, AB, AM, KS, GH, SL and ST- contributed on searched databases and strategies. Systematically, they performed a search through PubMed, Medline, Embase, Direct Science, Web of Science, Cochrane Library, Global Health, Google Scholar, CINAHL, University Repository, and other homepages, which was then handled by Endnote 20. The following was created using the MeSH (Medical Subject Headings) terminology and keywords along with the Boolean logic operators (AND, OR): Two-Week Diarrhea Prevalence *OR Two-Week Morbidity of Diarrhea "AND" Associated Factor *OR Risk Factors *OR Determinants "AND" Children under five years old "AND" Ethiopia.

Screening of data

Six authors, STT, RA, AB, AM, KS, SL and GH screened entire articles, titles, and abstracts using Microsoft Excel Office 19 (Microsoft Corporation, USA). Lastly, the database results were managed using EndNote 20.4.1 (Clarivate, USA), and superfluous references were removed using Zotero software 5.0 (Roy Rosenzweig Center, USA).

Extraction of data

Ten authors, STT, FA, RA, AB, AM, KS, GH, SL, ST and DAA-extracted the data using an extraction produced by a spreadsheet in Microsoft Excel Office 19 (Microsoft Corporation, USA). It contains the names of the authors, publication year, the sample size, the reported risk factors, the number of references, the quality assessment of the papers and the study's location.

Analysis of data

Six authors namely STT, AM, DA, RA, KS, and ST-contributed on this work. Stata version 17/MP (StataCorp, Texas, USA) was used for data analysis, generated precomputed effect size using restricted maximum likelihood techniques and the random-effect model (Random-Effect REML Model) was used. The pooled prevalence and risk factors of diarrheic children under five years old in Ethiopian were computed. Additionally, a sub-analysis was performed for the prevalence of diarrhea between year to year as well as based on the type of risk factors. A sensitivity analysis was conducted on the pooled prevalence of diarrhea among children under five years old by removing three extremes from the smallest and three from largest. The 95% confidence interval (CI) with a p-value less than 0.05 was deemed statistically significant (CI:95%). The publication bias was identified by a funnel plot using Hedge's g. The objective was to visually represent and assess the link between the effect magnitude (x-axis) and research precision (y-axis) [10].

Synthesis of information

Six authors-STT, KS, GH, SL, DAA and SH-synthesized the data. Synthesis involves combining and evaluating the extracted data in the form findings of prevalence and its risk factors to gain a deeper understanding of the problem in line with the review questions. The synthesis process was aimed to identify patterns, trends, and relationships across studies, leading to a more robust understanding of the evidence on the risk factors and year-by-year occurrence of diarrhea prevalence in the entire country.

Quality assessment

Ten Authors: -AM, DA, FA, RA, AB, AM, KS, GH, SL, DAA and ST-evaluated the paper. The Joanna Briggs Institute (JBI), an international research organization that created and disseminated evidence-based information intended to enhance healthcare practice and health outcomes, was used to evaluate the quality of all published studies [11]. Nine criteria were developed specifically for observational studies rated as (1) Yes, (2) No, (3) unclear, or (4) Not applicable. If the article received < 5 "Yes" votes, it has a high publishing risk or poor paper quality; 5–7 indicates fair or medium publication bias; and 8–9 indicates good or low publication bias [12]. Additionally, funnel plot was done to determine the studies' publication bias within this meta-analysis.

Result

Searched articles

A total of 2548 studies, PubMed ($n = 451$), Medline ($n = 473$), Embase ($n = 245$), Direct Science($n = 254$), the previous systematic review ($n = 15$), Web of Science ($n = 289$), Cochrane Library (358), Global Health ($n = 251$), Google Scholar ($n = 134$), CINAHL ($n = 35$), University Repository ($n = 27$), and reports ($n = 16$) were identified. Finally, 36 studies were eligible (Fig. 1). Of these, 32 of these studies were used to determine the aggregate prevalence of diarrhea in children under five years. The rest four additional studies were used for the risk factors. Based on study distribution, fifteen studies [7, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26] were obtained from the northern part of the country. Eight studies [27, 28, 29, 30, 31, 32, 33, 34] were conducted in eastern Ethiopia. The rest five studies were conducted [35, 36, 37, 38, 39] in Southern Ethiopia; four studies [40, 41, 42, 43] in Western Ethiopia, three studies [44, 45, 46] in Central part of the country and one study [47] was a national survey. Details of the study outcomes and risk

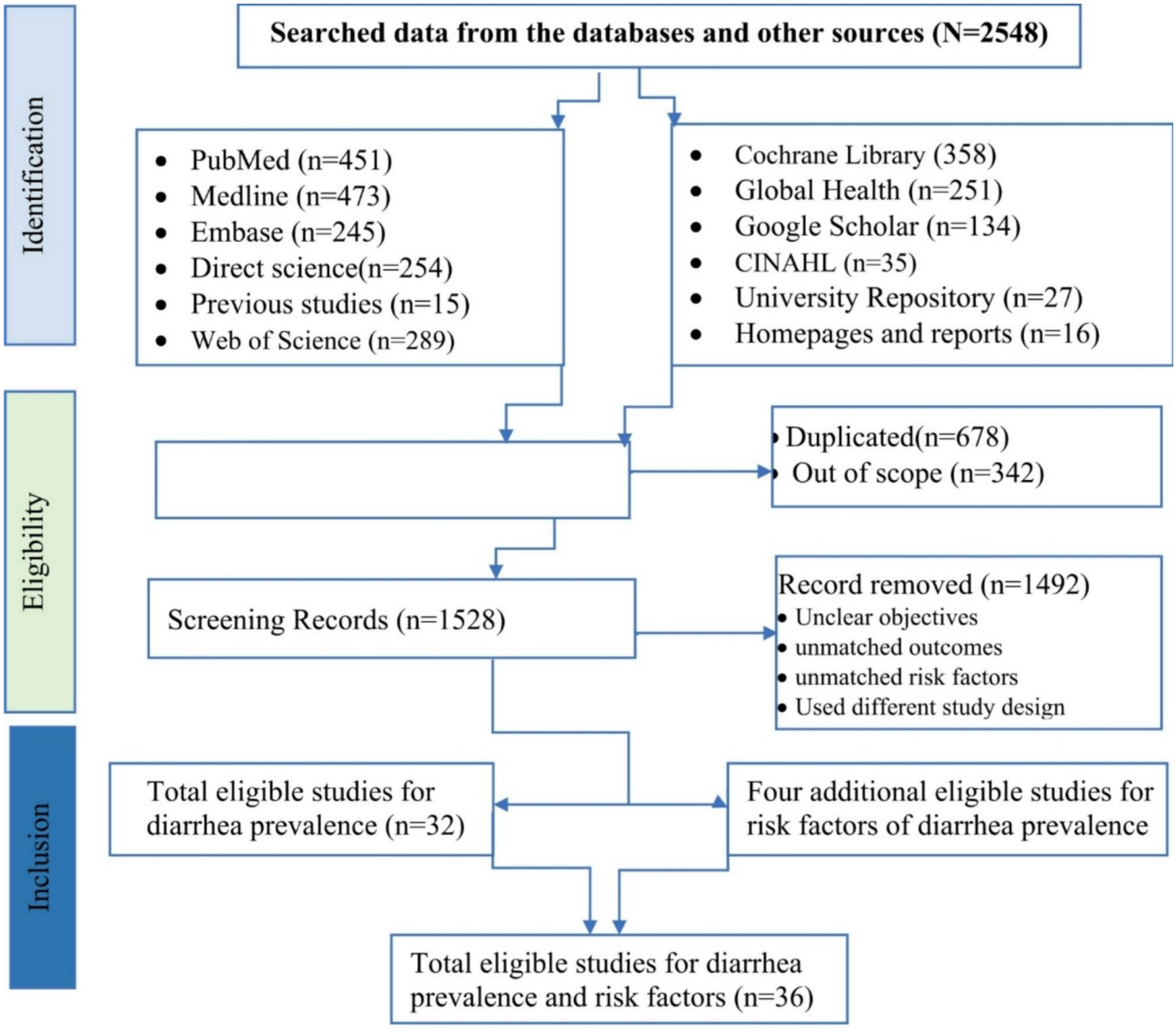

Fig. 1 Shows the flow diagram of searched and eligible studies, adapted from PRISMA 2024

factors across the country are given in the supplementary material (Table 1).

Eligible populations and location

All mothers/caregivers from the different parts of Ethiopia were included. Accordingly, out of 29,881 mothers/caregivers included in the reviewed articles, 10,641(36%) were from national data center, and 7438 (25%) and 5882(20%) were from studies conducted in the northern and eastern part of Ethiopia, respectively (Fig. 2).

Eligible studies for prevalence

From 36 studies, 32 studies were eligible for the two-week prevalence of diarrhea in children under five years old from 2015 to 2024 in Ethiopia. The following table presents list and names of authors, publication year, sample size, prevalence of diarrhea for each study, study location, quality of the article, and reference number (Table 1).

Eligible studies for risk factors

From the 36 studies, all were eligible for risk factors analysis of two-weeks prevalence of diarrhea in children under five years old from 2015 to 2024 in Ethiopia. The following table presented list and name of authors, odd ratio, effect size (Lower limit [LCI] and Upper limit [UCI] and reference number (Table 2).

Pooled prevalence of diarrhea

The pooled prevalence of two weeks diarrhea among children under five years-old in Ethiopia for the last ten years was 19.62% (95%CI:15.93, 23.31). Of this, 19.82% (95%CI:12.74–26.90) were between 2015 and 2019, and

Table 1 Extracted data for the two-weeks prevalence of diarrhea under five years old from 2015–2024 in Ethiopia

Authors name	Publication year	Sample size	Diarrhea Prevalence	Studies conducted in part of the Country	Paper quality	Ref
Addisu	2015	954	8.00	Southern Ethiopia	Fair	[38]
Gedefaw et al.	2015	667	21.7	Northern Ethiopia	Fair	[22]
Gambura et al.	2016	634	14.6	Southern Ethiopia	Good	[36]
Mohammed & Zungu	2016	477	9.9	Central Ethiopia	Good	[44]
Hashi et al.	2016	1807	27.3	Eastern Ethiopia	Good	[30]
Woldu et al.	2016	704	26.1	Northeast Ethiopia	Good	[19]
Regassa & Lemma	2016	442	14.7	Central Ethiopia	Good	[45]
Teklit, 2015	2016	543	18.00	Northern Ethiopia	Good	[20]
Alelign et al.	2016	312	12.2	Northern Ethiopia	Good	[24]
Tadesse	2016	399	9.00	Central Ethiopia	Good	[46]
Fenta & Nigussie	2016	10,641	12.00	National (EDHS)	Good	[47]
Nagga et al.	2016	295	37.1	Eastern Ethiopia	Fair	[31]
Bizuneh et al.	2017	492	14.6	Eastern Ethiopia	Good	[29]
Bitew et al.	2017	704	26.1	Eastern Ethiopia	Fair	[32]
Gizaw et al.	2017	367	31.3	Eastern Ethiopia	Fair	[33]
Gedamu et al.	2017	998	16.7	Northern Ethiopia	Good	[26]
Asfah et al.	2018	600	-	Northern Ethiopia	Good	[7]
Melese et al.	2019	546	13.60	Southern Ethiopia	Good	[37]
Shine et al.	2020	420	16.4	Northern Ethiopia	Fair	[23]
Alemayehu et al.	2020	722	23.5	Southern Ethiopia	Good	[39]
Delelegn and Belay	2020	306	-	Northern Ethiopia	Good	[25]
Ali et al.	2020	469	-	Eastern Ethiopia	Fair	[34]
Workie et al.	2019	614	23.1	Western Ethiopia	Good	[40]
Delelegn et al.	2020	306	27.62	Western Ethiopia	Good	[41]
Tafere et al.	2020	758	29.9	Northeast Ethiopia	Fair	[17]
Getahun & Adane	2021	485	17.6	Northern Ethiopia	Good	[14]
Hailu et al.	2021	419	23.5	Southern Ethiopia	Good	[35]
Bekele et al.	2021	512	7.8	Western Ethiopia	Good	[42]
Mosisa et al.	2021	407	-	Western Ethiopia	Fair	[43]
Natnael et al.	2021	340	11	Northern Ethiopia	Good	[21]
Mernie et al.	2022	448	10.6	Northern Ethiopia	Good	[13]
Solomon et al.	2022	1146	23.00	Eastern Ethiopia	Good	[27]
Gessesse & Tarekegn	2022	440	15.5	Northern Ethiopia	Good	[18]
Birhan et al.	2023	717	29.0	Northern Ethiopia	Good	[15]
Bitew et al.	2023	417	24.9	Northern Ethiopia	Good	[16]
Getachew et al.	2024	602	7.4	Eastern Ethiopia	Good	[28]

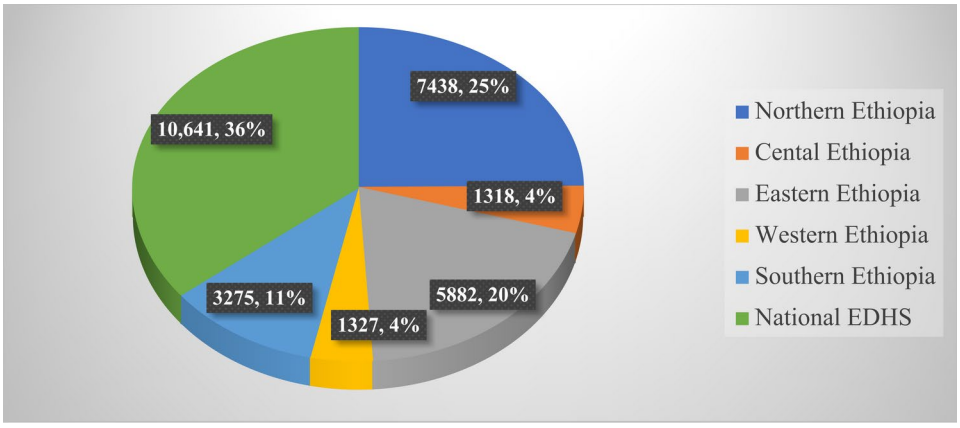

Fig. 2 Number of eligible units in Ethiopia for the systematic review and meta-analysis, 2024

Table 2 Factors associated with occurrence of diarrhea among children less than five years in Ethiopia from 2015–2024 in Ethiopia

Authors list	Type of risk factors	Reference No
Asfaha et al.	lack of improved latrine facility utilization	[7]
Solomon et al.	Didn't use improved of latrine facility	[27]
Workie et al.	Didn't use improved of latrine facility	[40]
Alemayehu et al.	Didn't use improved of latrine facility	[39]
Fenta & Nigussie.	Didn't use improved of latrine facility	[47]
Bekele et al.	Didn't use improved of latrine facility	[42]
Ali et al.	Didn't use improved of latrine facility	[34]
Asfaha et al.	Improper disposal of solid/liquid waste	[7]
Mernie et al.	Improper disposal of solid/liquid waste	[13]
Hailu et al.	Improper disposal of solid/liquid waste	[35]
Workie et al.	Improper disposal of solid/liquid waste	[40]
Tafere et al.	Improper disposal of solid/liquid waste	[17]
Hashi et al.	Improper disposal of solid/liquid waste	[30]
Melese et al.	Improper disposal of solid/liquid waste	[37]
Nagga et al.	Improper disposal of solid/liquid waste	[31]
Mosisa et al.	Improper disposal of solid/liquid waste	[43]
Alemayehu et al.	Improper disposal of solid/liquid waste	[39]
Ali et al.	Improper disposal of solid/liquid waste	[34]
Asfaha et al.	Used untreated, unimproved source of water	[7]
Mernie et al.	Used untreated, unimproved source of water	[13]
Hailu et al.	Used untreated, unimproved source of water	[35]
Birhan et al.	Used untreated, unimproved source of water	[15]
Workie et al.	Used untreated, unimproved source of water	[40]
Delelegn et al.	Used untreated, unimproved source of water	[25]
Hashi et al.	Used untreated, unimproved source of water	[30]
Gedefaw et al.	Used untreated, unimproved source of water	[22]
Bitew et al.	Used untreated, unimproved source of water	[32]
Alemayehu et al.	Used untreated, unimproved source of water	[39]
Fenta & Nigussie.	Used untreated, unimproved source of water	[47]
Natnael et al.	Used untreated, unimproved source of water	[21]
Bekele et al.	Used untreated, unimproved source of water	[42]
Ali et al.	Used untreated, unimproved source of water	[34]
Mernie et al.	Lack of handwash facilities	[13]
Getahun & Adane	Lack of handwash facilities	[14]
Workie et al.	Lack of handwash facilities	[40]
Bitew et al.	Lack of handwash facilities	[16]
Tafere et al.	Lack of handwash facilities	[17]
Bizuneh et al.	Lack of handwash facilities	[29]
Mohammed & Zungu	Lack of handwash facilities	[44]
Nagga et al.	Lack of handwash facilities	[31]
Bitew et al.	Lack of handwash facilities	[32]
Gizaw et al.	Lack of handwash facilities	[33]
Mosisa et al.	Lack of handwash facilities	[43]
Mernie et al.	No handwashing during critical times	[13]
Getahun & Adane	No handwashing during critical time	[14]
Delelegn et al.	No handwashing during critical time	[25]
Bitew et al.	No handwashing during critical time	[16]
Hashi et al.	No handwashing during critical time	[30]
Regassa & Lemma	No handwashing during critical time	[45]
Gambura et al.	No handwashing during critical time	[36]
Gedamu et al.	No handwashing during critical time	[26]
Bitew et al.	No handwashing during critical time	[32]
Ali et al.	No handwashing during critical time	[34]

Table 2 (continued)

Authors list	Type of risk factors	Reference No
Mernie et al.	Unsafe disposal of excreta and child feces	[13]
Hailu et al.	Unsafe disposal of excreta and child feces	[35]
Birhan et al.	Unsafe disposal of excreta and child feces	[15]
Tafere et al.	Unsafe disposal of excreta and child feces	[17]
Gambura et al.	Unsafe disposal of excreta and child feces	[36]
Bitew et al.	Unsafe disposal of excreta and child feces	[32]
Alemayehu et al.	Unsafe disposal of excreta and child feces	[39]
Getahun & Adane	Unsafe disposal of excreta and child feces	[14]
Getachew et al.	Unvaccinated Rota virus any other vaccine	[28]
Shine et al.	Unvaccinated Rota virus any other vaccine	[23]
Gedamu et al.	Unvaccinated Rota virus any other vaccine	[26]
Gizaw et al.	Unvaccinated Rota virus any other vaccine	[33]
Mosisa et al.	Unvaccinated Rota virus any other vaccine	[43]
Alemayehu et al.	Unvaccinated Rota virus any other vaccine	[39]
Fenta & Nigussie	Unvaccinated Rota virus any other vaccine	[47]
Bekele et al.	Unvaccinated Rota virus any other vaccine	[42]
Asfaha et al.	low maternal educational level	[7]
Woldu et al.	low maternal educational level	[19]
Teklit	low maternal educational level	[20]
Melese et al.	low maternal educational level	[37]
Alelign et al.	low maternal educational level	[24]
Nagga et al.	low maternal educational level	[31]
Ali et al.	low maternal educational level	[34]
Asfaha et al.	Being index child of older age	[7]
Workie et al.	Being index child of older age	[40]
Bitew et al.	Being index child of older age	[16]
Woldu et al.	Being index child of older age	[19]
Natnael et al.	Being index child of older age	[21]
Shine et al.	Being index child of older age	[23]
Gedamu et al.	Being index child of older age	[26]
Nagga et al.	Being index child of older age	[31]
Gizaw et al.	Being index child of older age	[33]
Fenta & Nigussie.	Being index child of older age	[47]
Mosisa et al.	Being index child of older age	[43]
Asfaha et al.	Maternal history of diarrhea	[7]
Hailu et al.	Maternal history of diarrhea	[35]
Delelegn et al.	Maternal history of diarrhea	[25]
Gambura et al.	Maternal history of diarrhea	[36]
Nagga et al.	Maternal history of diarrhea	[31]
Mosisa et al.	Maternal history of diarrhea	[43]
Alemayehu et al.	Maternal history of diarrhea	[39]
Gessesse & Tarekegn	Maternal history of diarrhea	[18]
Ali et al.	Maternal history of diarrhea	[34]

19.83%(95%CI:15.31–24.36) were between 2020 and mid-2024. The heterogeneity (I^2) of the eligible studies was 40.04%, Tau squared (τ^2) was 21.94 and the homogeneity of the studies (Tau Q (31)) was 61.04 with p-value < 0.001) (Fig. 3).

Risk factors of diarrhea

Unsafe disposal of child feces, unvaccinated children and low maternal education

Previous studies identified that unsafe disposal of child feces [13, 15, 17, 32, 35, 36, 39, 14], unvaccinated Rota virus any other vaccine [23, 26, 28, 33, 39, 42, 43, 47] and low maternal education [7, 19, 20, 37, 24, 31, 34] were risk factors for diarrhea(Table 2). The pooled adjusted odds of unsafe disposal of excreta and child feces (AOR:3.33,

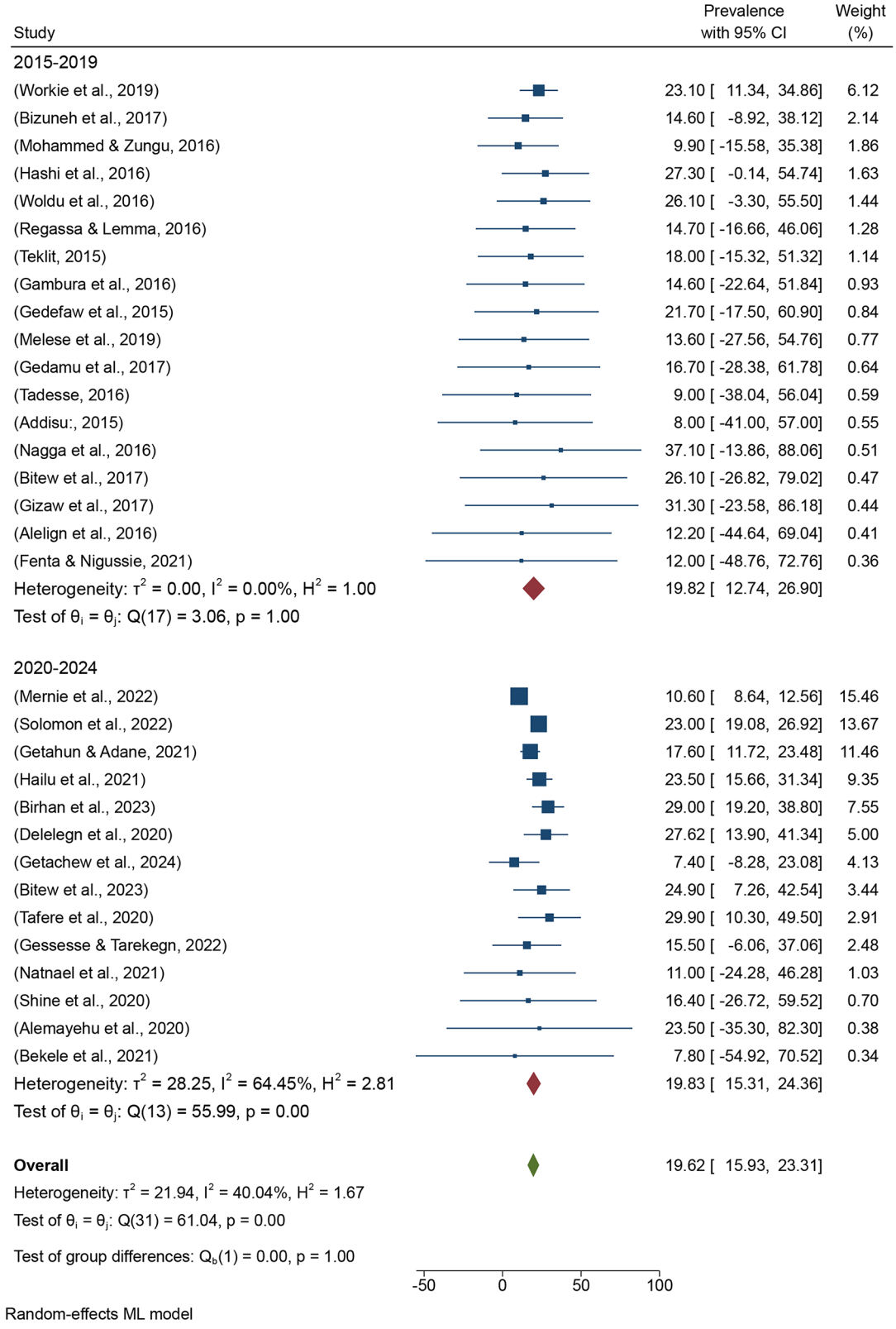

Fig. 3 Pooled prevalence of diarrhea among children under five-years old in Ethiopia from 2015 to mid of 2024

95%CI:2.70, 4.11), unvaccinated against Rotavirus (AOR:1.81, 95%CI:1.55,2.12) and low maternal education (AOR:1.05,95%CI:1.00,1.11) were risk factors for diarrhea morbidity among children under five-years old within the study areas (Fig. 4).

Utilization of unimproved latrine facility, untreated water and improper waste disposal

The studies found that households used unimproved latrine facility [7, 27, 34, 39, 40, 42, 47]; improper disposal of solid and liquid waste [7, 13, 17, 30, 31, 34, 35, 37, 39, 40, 43]; and used untreated, and unimproved water source [7, 13, 15, 21, 22, 25, 30, 32, 34, 35, 39, 40, 42, 47] were the risk factors of diarrhea(Table 2). The pooled adjusted odds of the use of unimproved latrine facility (AOR:1.27, 95%CI:1.21, 1.35), improper waste disposal (AOR:2.57,95%CI:2.35,2.81) and used untreated water (AOR:1.72,95%CI:1.52,1.94) were the risk factors of diarrhea morbidity among under five-year children across the country (Fig. 5).

Lack of handwashing facility and not washing hands during critical times

The previous studies found that lack of handwashing facilities [13, 14, 16, 17, 29, 31, 32, 33, 40, 43, 44] and not washing hands during critical times [13, 14, 16, 25, 26, 30, 32, 34, 36, 45] were the risk factors(Table 2). The figure showed that pooled adjusted odds of lack of handwashing by mother and/or caregivers at their home (AOR:3.12,95%CI:2.52,3.88) and not washing hands during critical times by mother and/or caregivers (AOR:3.27,95%CI:3.06,4.49) were the risk factors of diarrhea morbidity among children under five-years old across the country (Fig. 6).

Index child's age and maternal history of diarrhea

The index child's age [7, 16, 19, 21, 23, 26, 31, 33, 40, 43, 47] and maternal history of diarrhea [7, 18, 25, 31, 34, 35, 36, 39, 43]were risk factors of diarrheal diseases(Table 2). Accordingly, the pooled adjusted odds of the index child's age (AOR:3.47,95%CI:2.98,4.05) and maternal history of diarrhea (AOR:4.21,95%CI:3.23,5.48) were the risk factors of diarrhea diseases among children under five-years old in the country (Fig. 7).

Publication bias

Quantitative analysis utilizing the JBI critical assessment checklist revealed that 30.56% of the publications met fair quality publication criterion and 69.44% of them met the good quality of publication criterion (Table 1). The results of a thorough meta-analysis of funnel statistics, the asymmetrical scatter plots, displayed every scatter pointing away from the vertical line and the center of the funnel (Fig. 8).

Discussion

In the current systematic review and meta-analysis, from the 2548 searches, thirty-six (36) studies from all around the country were included. Of these, all reported the risk factors, whereas 32 studies reported prevalence of diarrhea without risk factors (Fig. 1). From the eligible studies, fifteen studies [7, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26] were obtained from the northern part of the country. Eight studies [27, 28, 29, 30, 31, 32, 33, 34] were conducted in eastern Ethiopia. The rest five studies were conducted [35, 36, 37, 38, 39] in Southern Ethiopia; four studies [40, 41, 42, 43] in Western Ethiopia, three studies [44, 45, 46] in Central part of the country and one study [47] was a national survey. Details of the study outcomes and risk factors across the country are given in the supplementary material (Table 1). Out of 29,881 reviewed subjects, 10,641 (36%) found from the national survey, and 7438 (25%) and5882(20%) found from northern and Eastern Ethiopia, respectively. Moreover, the remaining subject: 3275 (11%), 1327 (4%) and 1318 (4%) reported from the southern, western and Central Ethiopia, respectively (Fig. 2).

The two weeks pooled diarrhea prevalence among children under five years old in Ethiopia for the last ten years was19.62% (Fig. 3). This report brings together and summarizes the prevalence of diarrhea under five years old in Ethiopia that has an important policy implication for decision-makers and those interested in water, sanitation, hygiene and public health. The findings confirm that risk factors such as lack of safe water, sanitation and hygiene remains one of country's most urgent health challenge related with diarrhea in children under five years in the last ten years. Diarrhea is mainly spread by the fecal-oral route, which is prevalent in countries with limited infrastructure like Ethiopia. Adequate and expanded water and sanitation services, which benefit many children, would contribute to a considerable reduction in diarrhea. This is because diarrhea in children under five years old is strongly associated with inadequate water, sanitation, and hygiene practices [35, 48].

The current finding is higher than the 15.30% prevalence reported by meta-analysis report from sub-Saharan Africa [49]. However, it was lower than the 21.70% meta-analysis reported from in Indian [50] and 22% from Ethiopia in the last six years [51]. The pooled prevalence of diarrhea at national level was 19.82% between 2015 and 2019 and 19.83% between 2020 and mid of 2024(Fig. 3). This suggests the requirement of an improvement regarding Ethiopia's two-week diarrhea prevalence among children under five years of age. The incidence of the two-weeks diarrhea among children under the age of five has shown nearly similar magnitude for the last 10 years' five-by-five-year classification. The random effect model found that the I-squared heterogeneity for the total

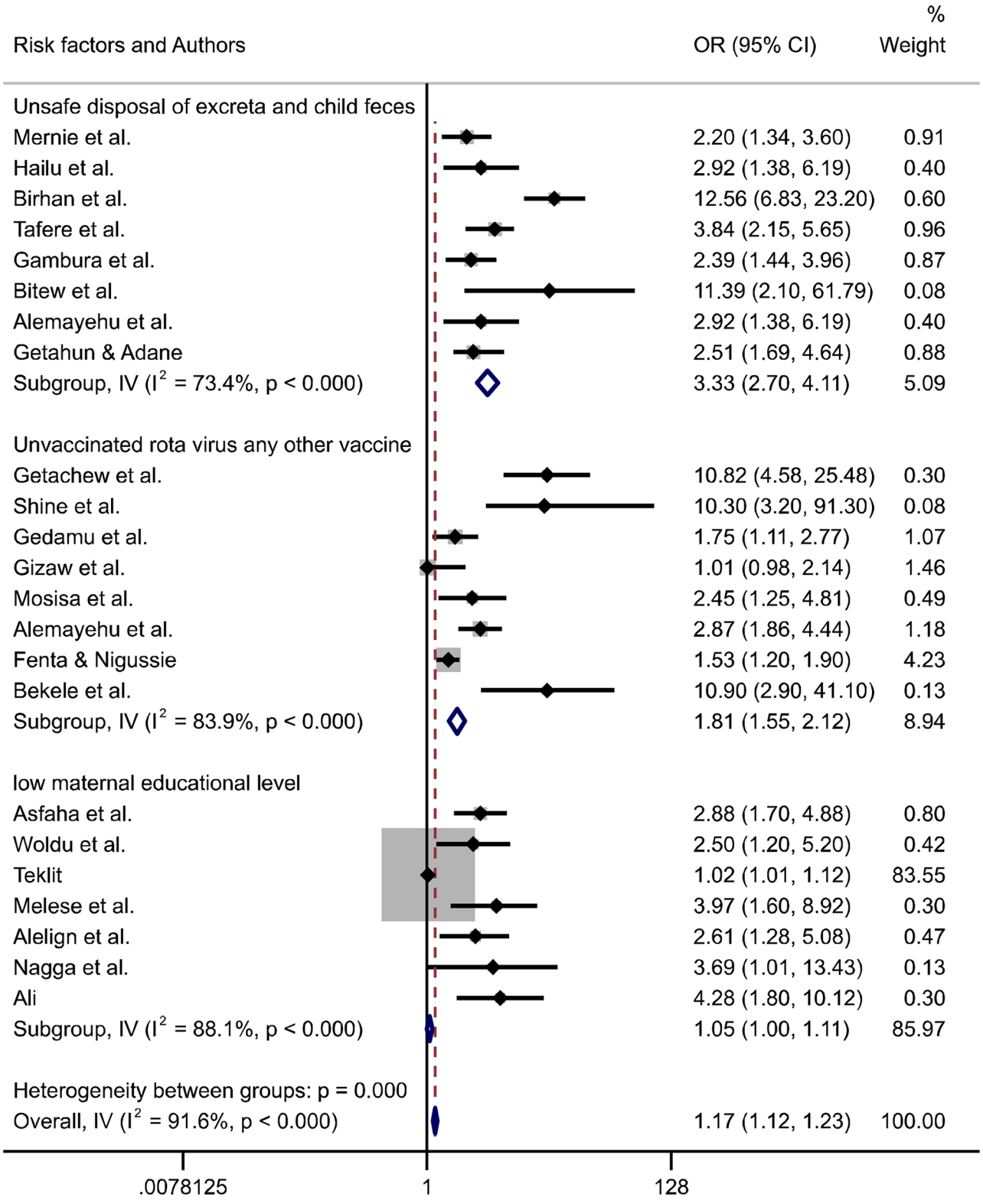

Fig. 4 Factors associated with occurrence of diarrhea among children less than five years in Ethiopia from 2015–2024

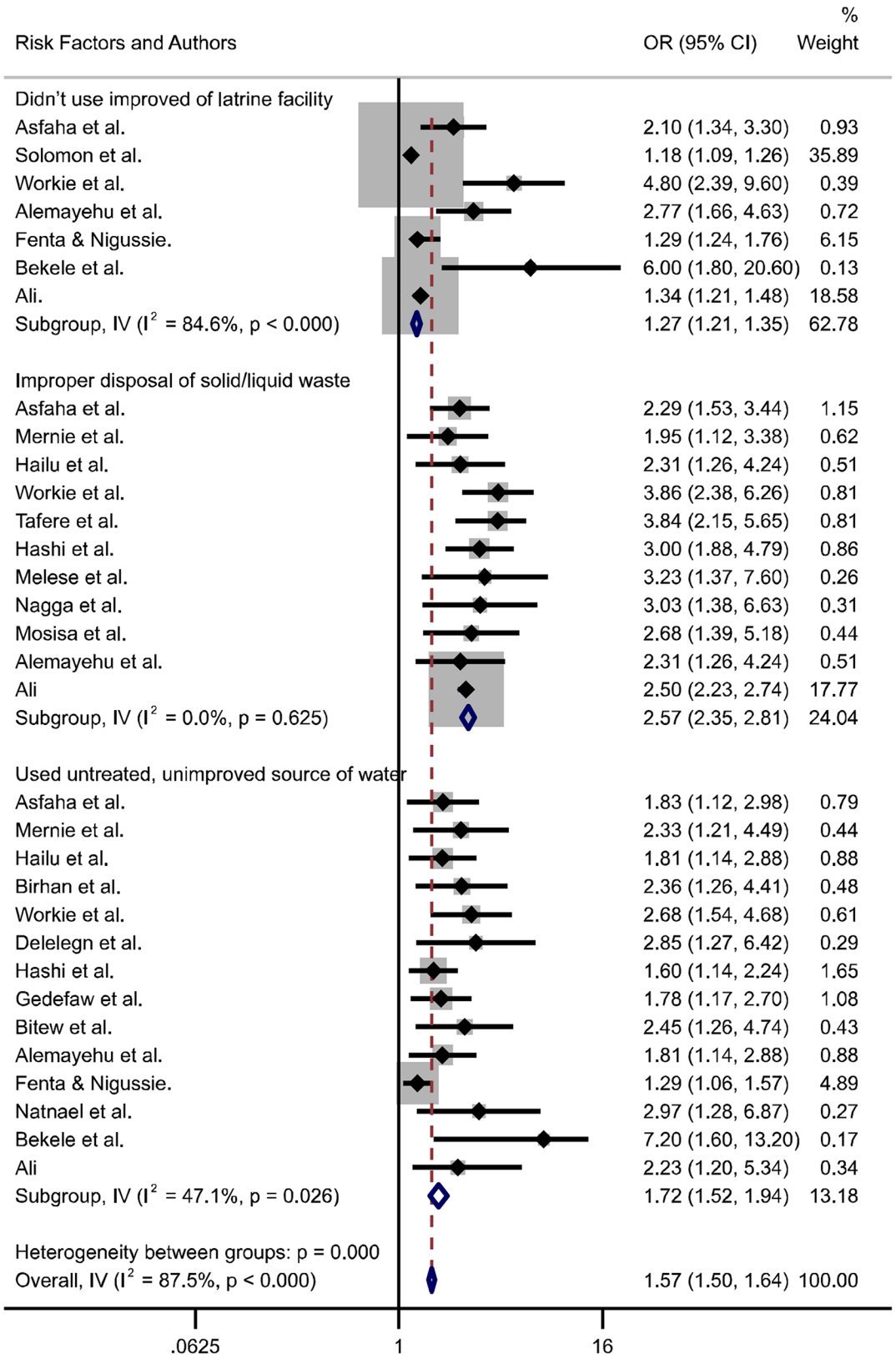

Fig. 5 Factors associated with occurrence of diarrhea among children less than five years in Ethiopia from 2015–2024

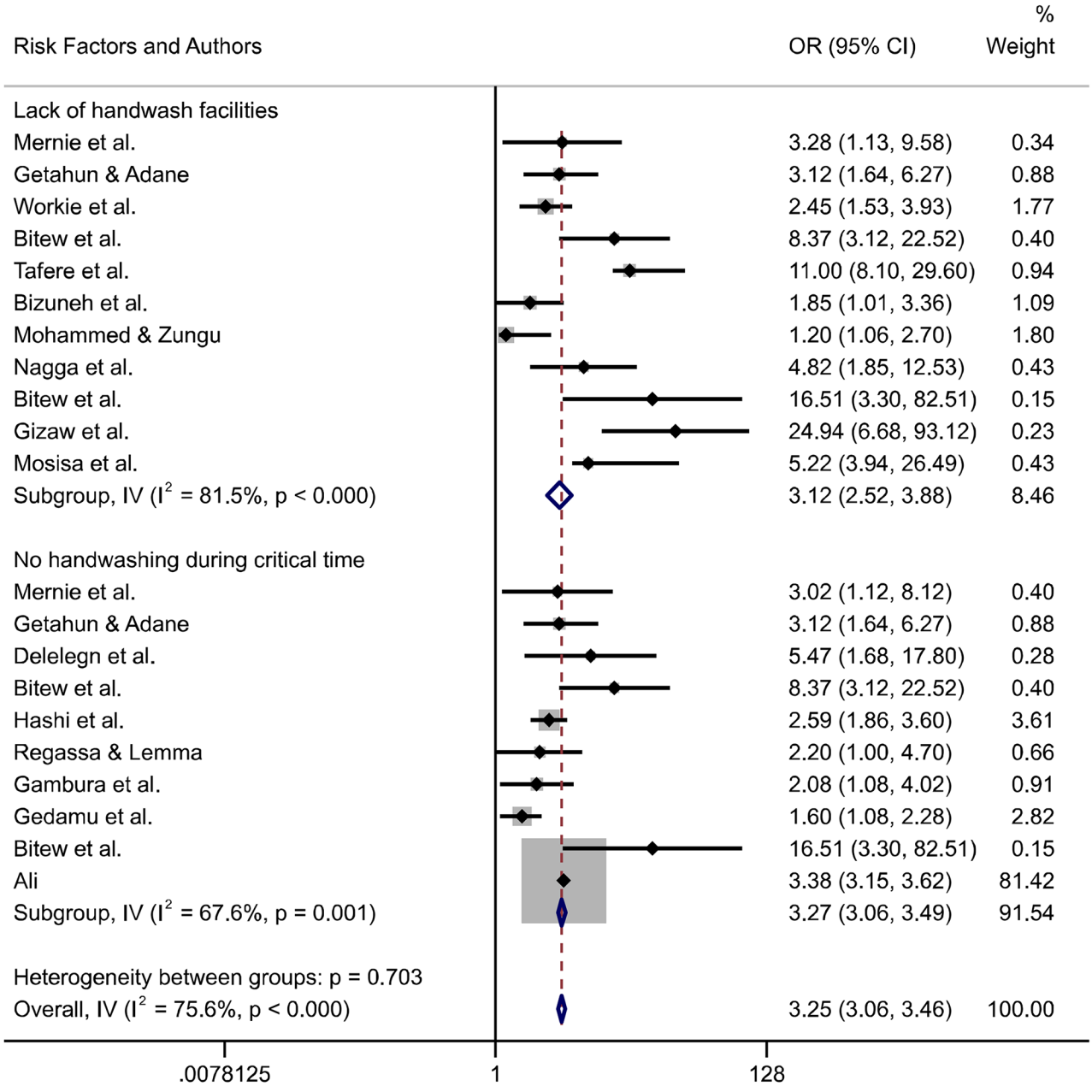

Fig. 6 Factors associated with occurrence of diarrhea among children less than five years in Ethiopia from 2015–2024

studies was 40.04% (p-value < 0.001) (Fig. 3), indicating that it is below 50% according to Higgins interpretation [52]. The large amount of heterogeneity for the unaccounted variability in this review was due to residual heterogeneity. This is because an I^2 value at a p-value of less than 0.05 shows a real effect variance due to observed effect variation, and not due to sampling error. Furthermore, the real value of Tau squared in this meta-analysis was 21.94 (Fig. 3), indicating the degree to which the true effect size varies from each other. In other words, the Q-statistic value was 61.05 (p-value < 0.05), which offers a test of the null hypothesis, indicating every study included in the analysis had an effect size that was either the same or comparable to the model chosen in accordance with Higgins elucidations [52].

In addition, predisposing factors such as mothers or caregivers' habit of disposing excreta/stool or feces in an unsafe manner was analyzed in order to determine the pooled adjusted odds of diarrhea among children under five years. Accordingly, mothers or caregivers who disposed excreta/stool or feces in an unsafe manner had a 3.33-fold increased risk of diarrhea among under-five children compared to children whose mothers or caregivers disposed in a safe manner (Fig. 4). This suggests

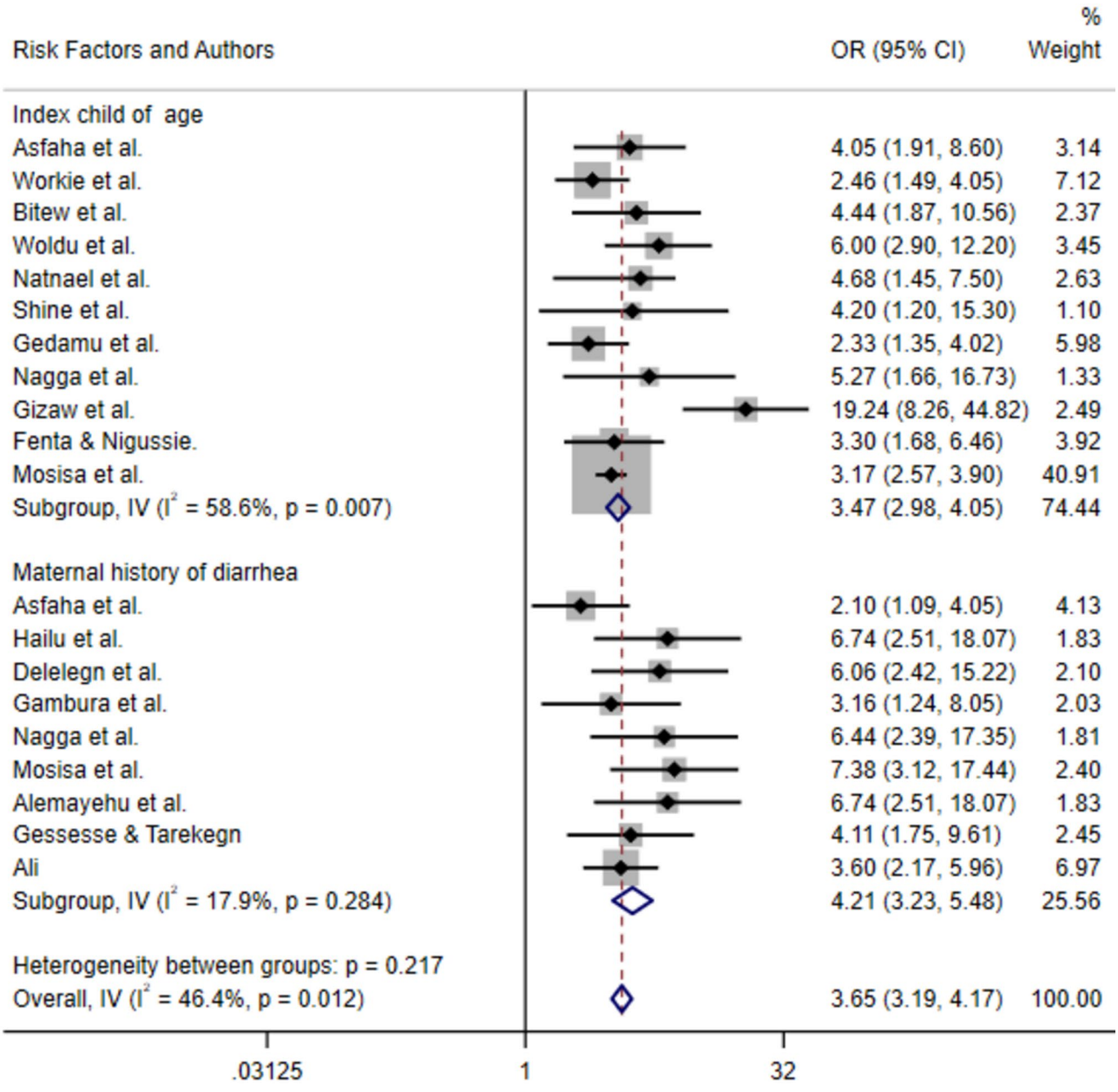

Fig. 7 Factors associated with occurrence of diarrhea among children less than five years in Ethiopia from 2015–2024

that children who had improper stool disposal by their families were more likely to have higher risk of experiencing acute diarrhea. Additionally, a significant correlation was found between childhood diarrhea and rotavirus vaccination status in the pooled multivariable analysis. Accordingly, children who did not receive a rotavirus vaccination had a 1.81-fold increased risk of diarrhea compared to those who received the vaccination (Fig. 4). More than 5% of pediatric diarrhea hospitalizations worldwide are thought to be caused by rotavirus [53]. This suggests that immunization against the rotavirus is a still a valid method of preventing diarrheal illness in children under five years of age.

The analysis found that children whose mothers or caregivers improperly disposed solid waste were 2.57 times more likely to have diarrhea compared to mothers/caregivers disposed of solid waste properly (Fig. 5). This indicates that children whose households did not properly dispose solid waste as well as liquid waste experienced a higher incidence of diarrhea than children whose households did. This finding is in line with the single study reported by Mernie et al. [13]. In addition, children of mothers or caregivers who used unimproved source of water had 1.72 times greater chances of acute diarrhea than children of mothers or caregivers who fetched water from an improved source (Fig. 5). The majority of people

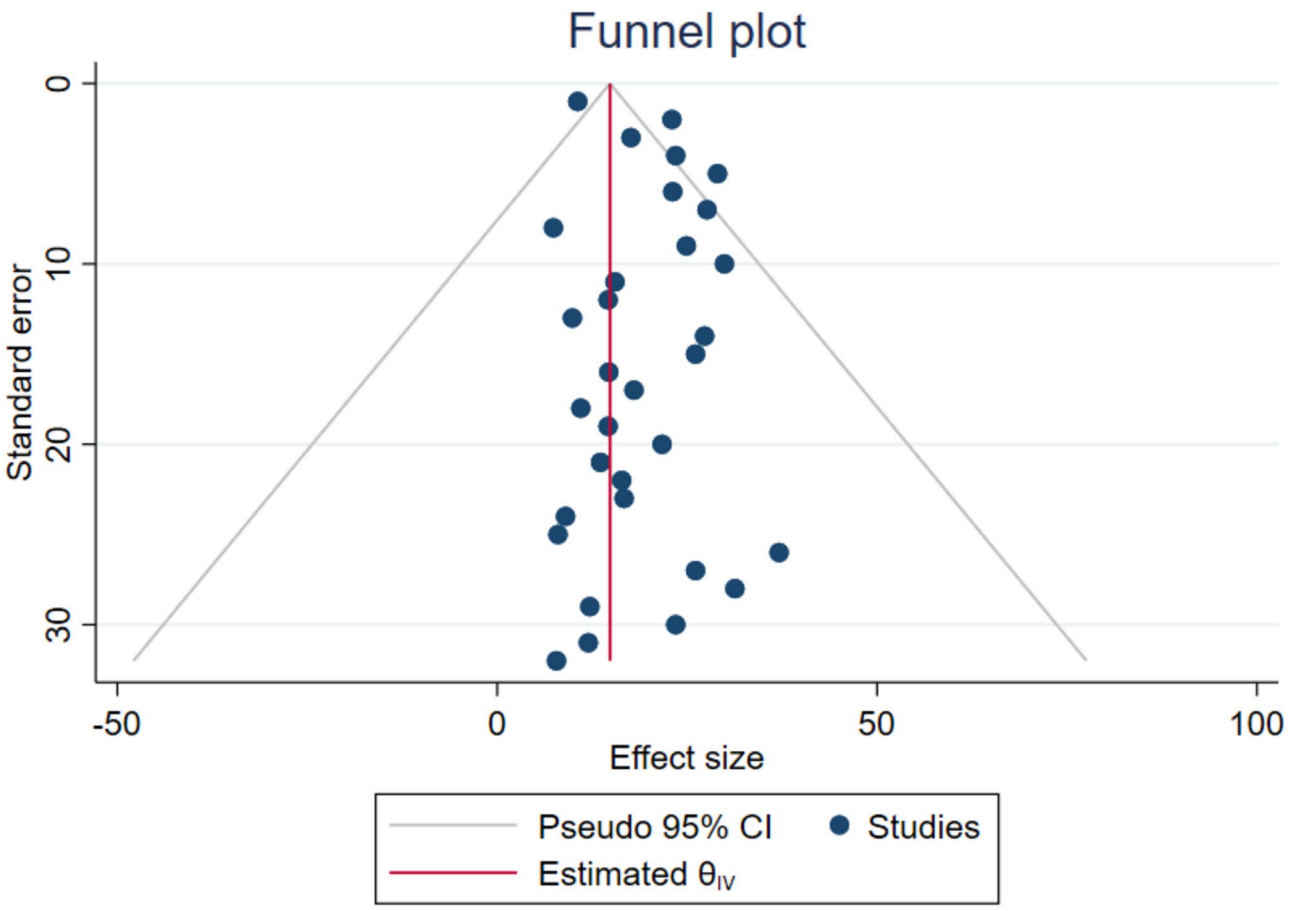

Fig. 8 The funnel plot of publication bias for eligible studies from 2015 to mid of 2024

in this study area mainly utilize water from standpipes that are shared by the community. Plastic barrels pushed by donkey carts are used to carry the water to their homes. In addition, the town's water supplies are frequently erratic, depriving the locals of water and forcing them to rely on unsafe substitutes. The greater incidence of diarrhea in homes without water may be explained by mothers' unhygienic habits being exacerbated by the absence of a reliable and accessible source of water, as explained by Bizuneh et al. [29].

Furthermore, the analysis also showed that among children under five years of age, the risk of diarrhea was 1.27 times higher among children whose mothers or caregivers used an unimproved latrine facility than children whose mothers or caregivers used an improved latrine facility (Fig. 6). This finding is slightly consistence with the previous study s than the pooled odds of lack of availability of latrine 2.00 times occurrence of diarrhea as compared to those have available latrine according the previous study reported by [51]. The pooled odds of children from illiterate mothers for the occurrence of diarrhea morbidity was 1.05 times higher compared to those from literate mothers (Fig. 6). Regardless of the effect size, the above finding is in agreement with other studies that reported more than 2.5 times for mothers who were illiterate compared to mothers who were literate [49, 51]. Also, other findings demonstrated that children with mothers with lower educational attainment were 3.00 times more likely to have diarrhea diseases compared to children with mothers with higher educational attainment [7]. The analysis also revealed that children whose mothers or caregivers did not wash their hands had a 3.12 times higher risk of diarrhea morbidity than children whose mothers or caregivers washed their hands (Fig. 6). Other study reported that, lack of handwashing was a significant factor to predicting diarrhea among children under five years of age. A study conducted in eastern part of Ethiopia reported a significant positive association between the availability of hand washing facility and childhood diarrhea [54]. Therefore, the current evidence indicated that lack of a consistent source of water supply could have served as a factor that exacerbated lack of hand washing facilities, which in turn predicted diarrhea. The review also showed that the risk of diarrhea was 3.27 times higher for children whose mothers or caregivers neglected to wash their hands during critical moments

as compared to children whose mothers or caregivers did (Fig. 6).

The meta-analysis also found a substantial correlation between a child's age and the onset of diarrhea. Children between the ages of 12 and 23 months had 3.47 times higher chance of contracting diarrheal illnesses compared to children aged 0–11 months (Fig. 7). This could be because the ages of children between 12 and 23 months are when the babies begin to crawl and move about the house, which makes it easy for them to eat contaminated or unclean items. On the other hand, most children cease receiving breast milk around this time as well, which exposes them to food-borne pathogens and removes the protective effects of breast milk. We also found that children from households where mothers/caregivers had previously suffered from diarrheal disease were 4.21 times more likely to encounter diarrhea than children from households where there had been no history of diarrhea in the preceding two weeks.

The overall quality of the papers was also evaluated. According to the JBI critical assessment checklist, 30.56% of the studies met the fair quality of publication criterion, and 69.44% met good quality for eligible studies (Fig. 8). The results of a thorough meta-analysis of funnel statistics are the asymmetrical scatter plots, which scattered from the vertical line and the center of the funnel. From a statistical perspective, the funnel plot indicated publication bias demonstrated by the scatter plots or dots asymmetrically distributed, or unevenly distributed on the left and right sides of the vertical line, thereby highlighting the area where 95% of the impact size was observed. The vertical line should indicate the predicted shape in the absence of bias, which corresponds to a symmetrical funnel expressed as the standard error or precision of the study, according to validated study [10]. Conventionally, however, the vertical axis should divide the scatter plot or dots into equal scatter with accurate distribution, with straight lines denoting 95% confidence intervals. Effect sizes at the bottom of the funnel indicates low study precision, but dots at the top of the funnel in this figure suggest high study precision [55].

Strengthen and limitation

Strengthen

This meta-analysis provides insights by including combined data from multiple studies across the country, increasing sample size and statistical power, leading to more precise and reliable estimates and facilitating evidence-based decision-making. Also, in this meta-analysis many of the eligible studies met the requirements in terms of size, subject matter, and study methodology, which made it easier for us to incorporate the data at the national level. Furthermore, studies on diarrhea in children under five years old were categorized so that several risk variables, such as water, sanitation, and hygiene, were responsible for the diarrhea, leading to an easy search strategy.

Limitation

The current systematic review and meta-analysis has certain limitations: There was not much studies found from south, west, and central regions of the country expect national data. This could result in studies that are unevenly distributed across the country, as the result it is difficult to generalize the status of prevalence of diarrhea and associated risk factors in children less than 5 years old across the country. Studies lack scientific rigor, this significantly limit the extent to which current studies may be used as a basis for policy or even estimations of the illness of diarrhea on families in terms of economic impact and other aspects. Furthermore, almost all the included studies employed a cross-sectional design, which may introduce selection and information bias during the sampling process, with confounding factors being another limitation of this design.

Conclusion

The pooled prevalence of two weeks of diarrhea among children under five years old in Ethiopia for the last ten years was higher compared to the sub-Saharan Africa. The incidence of two-week diarrhea among children under the age of five have shown similarity between 2015 and 2019 and 2020 and mid of 2024. This suggested the need for reduction of diarrhea diseases prevalence among children under five years of age across the country. Poor latrine facilities, inappropriate solid and liquid waste disposal, untreated and unimproved water sources, inadequate handwashing facilities, lack of handwashing during critical times, unsafe excreta and child faecal disposal, unvaccinated Rota virus vaccine, level of maternal education, and maternal history of diarrhea were found to be risk factors for diarrhea in children under five years of age. We recommend that stakeholders, including the government, civil society organizations, and the local population, ensure improved water, sanitation, and hygiene (WASH) practices within the community in order to reduce these risks. Also, to further improve the health of children under five years of age, measures such as health information dissemination about sanitation and hygiene at the family and community levels, encouraging good hygiene, boiling or treating water, washing hands with soap, and vaccinations are recommended.

Abbreviations

AOR	Adjusted Odds Ratio
CI	Confidence Interval
LMIC	Low-Middle-income
MeSH	Medical Subject Headings
PICOS	Population (P), Intervention (I), Comparison (C), Outcome (O) and study type (S)

PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
REML	Restricted Maximum Likelihood
SSA	Sub- Saharan African
WASH	Water, Sanitation, and Hygiene

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-22939-2.

Supplementary Material 1

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Author contributions
Eleven authors- STT, DAA, FA, RA, DA, AB, AM, KS, GH, SL and ST- contributed on searched databases and strategies. Six authors, STT, RA, AB, AM, KS, SL and GH screened entire articles, titles, and abstracts. Ten authors, STT, FA, RA, AB, AM, KS, GH, SL, ST and DAA-extracted the data using an extraction produced a spreadsheet in Microsoft Excel Office 19. Six authors namely STT, AM, DA, RA, KS, and ST-contributed on analysis work. Six authors-STT, KS, GH, SL, DAA and SH-synthesized the data. Ten Authors: -AM, DA, FA, RA, AB, AM, KS, GH, SL, DAA and ST-evaluated the paper.

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Data availability
The extracted raw data are found on supplementary material (Attached). However, datasets utilized for the analysis are found on the hands of corresponding authors, that could be available upon reasonable request.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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