



Neonatal sepsis and its predictors in Ethiopia: umbrella reviews of a systematic review and meta-analysis, 2023

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Background: Although neonatal sepsis is acknowledged as the primary cause of newborn death in Ethiopia, data on its impact at the national level are limited. Strong supporting data are required to demonstrate how this affects neonatal health. This umbrella study was conducted to determine the overall prevalence of newborn sepsis and its relationship with maternal and neonatal factors.

Methods: This umbrella review included five articles from various databases. The AMSTAR-2 method was used to assess the quality of included systematic review and meta-analysis studies. STATA Version 18 software was used for statistical analysis. A random-effects model was used to estimate the overall effects.

Results: In this umbrella review, 9032 neonates with an outcome of interest were included. The overall pooled prevalence of neonatal sepsis was 45% (95% CI: 39–51%; $I^2 = 99.34$). The overall pooled effect size showed that prematurity was significantly associated with neonatal sepsis [odds ratio = 3.11 (95% CI: 2.22–3.99)]. Furthermore, maternal factors are strongly associated with neonatal sepsis.

Conclusions: Nearly half of Ethiopian neonates are affected by neonatal sepsis. It is critical to reduce premature birth, low birth weight, and preterm membrane rupture to reduce the incidence of neonatal sepsis. Furthermore, it is preferable to design and strengthen policies and programs aimed at improving maternal nutritional status and treating maternal infections, which all contribute to lowering the burden of neonatal sepsis.

Keywords: Ethiopia, meta-analysis, neonatal sepsis, newborns, systematic review

Introduction

Globally, every year, ~4 million children die in the first four weeks of life; 99% of these deaths occur in low-income and middle-income countries and 75% of these deaths are thought to be preventable^[1,2]. In 2019, over 2.4 million neonates perished in their first month of life worldwide. Over 6700 babies die every day, with over one-third of all neonatal deaths occurring on the first day of life, and nearly three-quarters occurring by the end of the first week. Low-income and middle-income nations account for most newborn deaths. Neonatal sepsis is a leading cause of neonatal mortality and morbidity^[3].

Neonatal sepsis is a systemic infection that affects babies throughout the first four weeks of life and can begin at any time^[2,4,5]. It is a clinical disease that appears in the first month of

HIGHLIGHTS

- Neonatal sepsis is the leading cause of newborn death in low-income and middle-income nations.
- In this umbrella review, a total of 9032 neonates with the outcome of interest were included.
- The overall pooled prevalence of neonatal sepsis was 45%.
- Neonatal and maternal factors are profoundly associated with neonatal sepsis.
- it is preferable to design and strengthen policies and programs that aimed to improve maternal nutritional status and treatments of maternal infections that all contribute to decrease the burden of neonatal sepsis.

life as an infection-related symptom, with or without bacteremia. Neonates having sepsis are more likely to be hypothermic at the time of presentation^[5]. In Sub-Saharan Africa and Southern Asia, Sepsis is the primary cause of neonatal death, accounting for 25% of all neonatal mortality^[6]. Despite modest increases in the availability of basic prevention, primary child healthcare, and sector training, neonatal sepsis continues to be the leading cause of neonatal death, accounting for more than one-third of all neonatal deaths^[2,4,7].

According to the Ethiopian Demographic and Health Survey (EDHS), the newborn mortality rate in Ethiopia is 30 per 1000 live births^[8]. Sepsis is a leading cause of neonatal mortality in Ethiopia. Sepsis-related mortality may be associated with a lack of care for women. Evidence showed that the prevalence of antenatal care service utilization is low and below 63%^[9].

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Despite the Ethiopian government's outstanding accomplishments in reducing infant mortality, the neonatal mortality rate has remained stable. Ethiopia is working hard to achieve the Sustainable Development Goals (SDG) to reduce neonatal mortality to less than 12 deaths per 1000 live births. For this purpose, healthcare staff are being educated and healthcare facilities are being expanded around the country. Maternal and neonatal care services have improved dramatically since 2005, with prenatal care increasing from 28 to 74%, skilled care at birth increasing from 6 to 50%, and institutional delivery increasing from 5 to 48%^[10].

To this date, plenty of systematic reviews (SRM)^[11,12] have found an inconsistent prevalence of neonatal sepsis in Ethiopia ranging from 40 to 50%^[11] with varying degrees of quality scores. Similarly, there is conflicting information regarding the effects of several variables on neonatal sepsis. Therefore, this umbrella review was conducted in response to the request and advice of a previous Ethiopian methodological study^[13]. As a result, the purpose of this umbrella review was to consolidate many findings of systematic review and meta-analysis studies on neonatal sepsis into a single comprehensive publication where the findings of these reviews could be compared and contrasted. To the best of our knowledge, this is the first umbrella review of neonatal sepsis and its associated predictors in Ethiopia. The findings of this analysis will help the country fulfil the SDG goal of reducing preventable neonatal mortality to less than 12 deaths per 1000 live births by 2030.

Methods

The study was reported by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Additional file 1)^[14]. The umbrella review is registered on PROSPERO with the registration number CRD42023458893.

Eligibility criteria

All eligible systematic reviews and meta-analyses (SRMA) that used observational study designs (cross-sectional, cohort, and case-control studies) to examine the prevalence of neonatal sepsis and the relationship between neonatal sepsis and various factors (maternal, neonatal, and institutional factors) were included. The pre-settled eligibility criteria were as follows: population, neonates (newborns aged below 28 completed days or 4 weeks); exposure, risk factors or predictors of neonatal sepsis (an infection involving bloodstream in newborn aged less than 28 days or 4 weeks); study area, studies conducted in Ethiopia; study design, all SRMA studies; publication condition, both published and unpublished research; and language, studies reported in English. There were no restrictions on the publication dates of SRMA studies. We excluded narrative reviews, editorials, correspondence, abstracts, methodological studies, and literature reviews without a clear research topic, search strategy, or stated article selection technique. We also excluded SRMA cases that did not disclose the prevalence of newborn sepsis and its correlates.

Search strategy

Published systematic reviews and meta-analyses were searched by two authors (A.E. and I.M.) between March and June 2023. SRMA studies were searched using a combination of Boolean

logic operators (AND, OR, NOT), Medical Subject Headings (MeSH), and keywords in the following databases: PubMed, Ovid, CINAHL (EBSCO), Science Direct, African Journal Online, Google Scholar, and Hinari (Additional file 2). A thorough search was conducted using pre-established PICOS criteria.

Key search terms were related to the (((("infant, newborn"[MeSH Terms] OR "infant, newborn"[MeSH Terms]) AND "sepsis"[MeSH Terms]) OR "sepsis"[MeSH Terms] OR ("septic"[All Fields] OR "septic"[All Fields]) AND "infections"[MeSH Terms])) AND ("systematic review"[Publication Type] OR "systematic reviews as topic"[MeSH Terms] OR "systematic review"[All Fields])) OR ("meta-analysis"[Publication Type] OR "meta-analysis as topic"[MeSH Terms] OR "meta-analysis"[All Fields])) AND "ethiopia"[MeSH Terms].

Selection process

To identify systematic reviews and meta-analyses that may have matched the inclusion criteria, all search results were exported to the EndNote X8 citation system, and duplicate articles were eliminated. Subsequently, publications were screened by title and abstract, and the full text of the articles was assessed. The retrieved publications were reviewed separately in duplicates (A.E. and A.D.). Any discrepancies among the authors regarding the admissibility of specific studies were settled through discussion with a third reviewer (I.M.).

Data extraction

Duplicate extraction was conducted for data from the included SRMA studies to assess study quality and evidence synthesis. Data relating to publication period, number of studies in each SRMA study, study design, search strategies, sample size, risk of bias, outcomes, and predictors were extracted using Microsoft Excel 2016.

Data item

This umbrella review primary outcome is neonatal sepsis which is measured as neonates with at least one clinical sign and at least two laboratory findings that are suggestive of neonatal sepsis, or neonates who were diagnosed with sepsis by the attending physician and met the criteria within 0–28 days of life. It can be classified as early-onset sepsis which occurs within 7 days of birth and late-onset sepsis which occurs after delivery between 7 and 28 days and is acquired in the neonatal intensive care unit, or the community^[15]. The secondary outcome of this umbrella review is the association of different covariates and neonatal sepsis.

Quality assessment of the systematic review and meta-analyzed studies

The AMSTAR-2 (Assessment of Multiple Systematic Reviews) quality assessment tool was used to evaluate the quality of all relevant systematic reviews and meta-analysis studies^[16]. There are 16 items in the tool, including seven critical domains and nine non-critical domains. The critical domains include protocol registered before the review's start-up, the sufficiency of the literature search, the justification for excluding specific studies, the risk of bias from the studies included in the review, the appropriateness of meta-analytical methods, taking into account the risk of bias when interpreting the review's findings, and the evaluation of the existence and likely effects of publication

bias^[16]. The responses are listed in the instrument as “Yes,” “Partial Yes,” “No,” or “No Meta-analysis conducted.” Two authors scored the 16 questions for each of the included SRMA studies. Any disagreement regarding scoring was resolved by a third reviewer. The results of this umbrella review were classified as high, moderate, low, and critically low using AMSTRA-2^[2] and previous studies^[3–5].

High: no major flaw in critical domains or one non-critical weakness items.

Moderate: no major flaw in critical domains or more than one flaw in non-critical items.

Low: One flaw in critical items with or without non-critical weaknesses.

Critically low: More than one flaw in critical items with or without non-critical weaknesses.

Data analysis

STATA 18 statistical software was used to perform overall data synthesis and statistical analysis. We summarized the range of estimates of the prevalence and predictors of neonatal sepsis reported in each systematic review and meta-analysis study. A narrative synthesis was used to present the findings of the included SRMA studies, followed by an overall meta-analysis. The overall pooled prevalence and effect sizes were analyzed using a random-effects model. A meta-analysis of SRMA studies was conducted using the recommendations of Higgins *et al.*^[17]'s statistic ($I^2 = 75/100\%$ or higher, indicating significant heterogeneity). Due to the inclusion of only five research, publication bias could not be assessed. To assess publication bias, at least ten studies were required.

Results

Search finding

The main electronic medical and health databases and other pertinent sources helped us to identify 235 articles. A total of 198 papers were returned for additional screening, while 37 articles from all identified studies were removed owing to duplication. After evaluation based on the titles and abstracts, 180 of these were eliminated. Four studies were removed from the remaining Eighteen publications because they failed to demonstrate the desired outcome. Finally, this umbrella review included five systematic reviews and meta-analyses (Fig. 1).

Characteristics of included review studies

All systematic reviews and meta-analyses included in this umbrella review study were based on observational studies 101 (62 cross-sectional, 19 case-control, and 20 cohort studies). The median number of studies included in each SRMA was 18, with a range of 8 studies^[11] to 33 studies^[12]. The median number of studies included in each SRMA with the outcome of interest was 15, with a range of 8–27 studies. The median number of participants for each SRMA was 10 449 neonates with a range of a minimum of 4895 to a maximum of 36 016, and the median number of outcomes of interest was 9032 with a range of 4895 (minimum) to 36 016 (maximum) In those 5 SRMA studies a total of 80 547 neonates were included and of this, 9032 neonates were with the outcome of interest (neonatal sepsis).

All of the systematic reviews and meta-analysis studies have been published in the last three years. Of the included SRMA studies, two^[11,18] reported both the prevalence and determinants of neonatal sepsis, two^[19,20] reported only factors, and one^[15] reported only prevalence. According to the included five SRMA studies, the reported estimate of the prevalence of neonatal sepsis ranged from 40.25% (95% CI:34.00%, 46.50%; $I^2 = 99.2\%$)^[18] to 49.98% (CI: 36.06, 63.90)^[11]. The general characteristics of the included systematic reviews and meta-analysis studies are shown in Table 1.

Primary studies

To determine whether the reviews were based on the same primary evidence, primary studies within the five SRMA studies that were included were mapped. A total of 101 primary studies were included in the review (Table 1). Only nine of the 33 main papers that were included in one SRMA study reported neonatal sepsis. Therefore, the 77 primary studies had outcomes of interest. We identified nine different primary publications after critically evaluating the five SRMA studies that were included. This suggests that at least two SRMA studies have incorporated primary studies. Of the 26 articles considered in one SRMA study, five SRMA studies included one primary study^[22], four SRMA studies included two primary studies^[23,24], three SRMA studies included nine primary studies^[25–33], and two SRMA studies included 14 primary studies^[34–46]. Any umbrella review should always have some overlap, which is one of the shortcomings of this study.

In contrast, six primary studies^[47–52] were specific to only Seyoum *et al.*^[20], two primary studies^[53,54] were only taken into account by Bayih *et al.*^[18], and one primary study^[55] was included by Desta *et al.*^[12] alone, indicating that there was no overlapping of data from the aforesaid nine primary studies resulting in the different prevalence of neonatal sepsis among the included five SRMA studies, which in turn necessitated the conduct of this umbrella review (Table 2).

Meta-analysis of the prevalence of neonatal sepsis

Of the 5 included SRMA studies, only three reported the prevalence of neonatal sepsis. From the umbrella review of these three SRMA studies^[11,15,18], the overall pooled prevalence of neonatal sepsis, as defined as neonates with at least one clinical sign and at least two laboratory findings that are suggestive of neonatal sepsis, or neonates who were diagnosed with sepsis by the attending physician and met the criteria within 0–28 days of life, was 45% (95% CI 39–51%; $I^2 = 99.34$) [Fig. 2]. However, the systematic review findings ranged from 40% (95% CI: 40–44%)^[18] to 50% (95% CI: 49–51%)^[11].

Meta-analysis of predictors of Neonatal sepsis

Of the included SRM studies, four SRM studies^[18–21] examined several factors associated with neonatal sepsis.

Neonatal-related factors were found to be significantly associated with neonatal sepsis in three SRMA studies^[11,12,56]. One SRMA^[11] study showed that neonatal sepsis and low birth weight were significantly correlated. This study found that compared to newborns with normal birth weight, those with low birth weight (< 2.5 kg) had a 1.42 times higher risk of developing

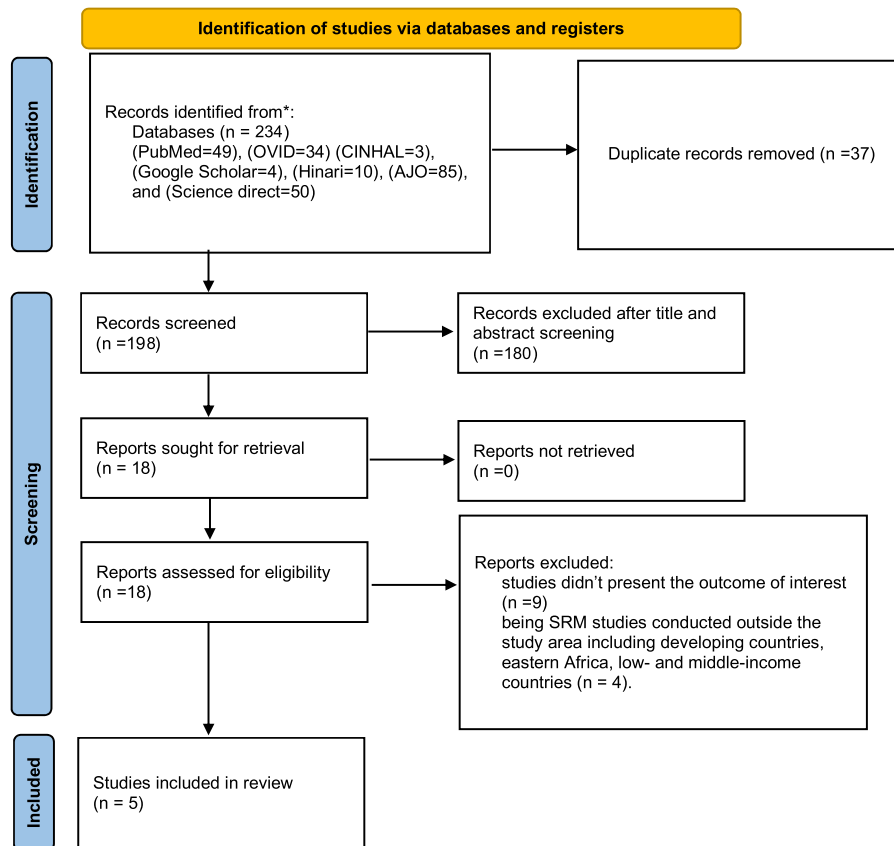


Figure 1. PRISMA 2020 flow diagram for searching, screening, and identification of SRM studies.

neonatal sepsis infection [odds ratio (OR) = 1.42 (95% CI, 1.07, 1.88)].

Prematurity was significantly associated with neonatal sepsis in two SRMA studies^[11,12]. According to the SRMA studies, preterm babies had a 3.36-fold increased risk of contracting neonatal sepsis compared to term children [OR = 3.36, 95% CI: 2.50, 4.54]. Another SRMA found that preterm newborns were 2.33 times more likely than term newborns to suffer neonatal sepsis [OR = 2.33 (95% CI: 1.15, 4.71)]. The overall effect estimates showed that the odds of developing neonatal sepsis were three times higher among premature neonates than term neonates [OR = 3.11 (95% CI: 2.22–3.99)] (Fig. 3).

Furthermore, neonates having low APGAR scores at first and fifth minutes were 3.74 and 2.72 times more likely to develop neonatal sepsis than neonates with normal APGAR scores [(OR:3.74, 95 CI:1.29–10.81)] and [(OR:2.72, 95 CI:2.02–3.67)], respectively in one of the SRMA studies^[56].

Of the reported factors, maternal-related factors were significantly associated with neonatal sepsis in two SRMA studies^[18,56]. One SRMA study^[18] revealed that when compared to neonates born to women without prenatal urinary tract infection, those with antenatal urinary tract infection had a 3.55-fold increased risk (OR = 3.55, 95% CI: 2.04–5.06) of developing neonatal sepsis. Additionally, compared to neonates born to mothers without intrapartum fever, those born to such mothers were 3.63 times more likely to experience neonatal sepsis (OR = 3.63, 95% CI: 1.64–5.62). Another SRMA study

demonstrated the importance of a prolonged rupture of membranes in the development of newborn sepsis (adjusted odds ratio 4.03, 95% CI:1.88–8.60). Additionally, delayed breastfeeding initiation was significantly associated with newborn sepsis (OR, 3.41; 95% CI:2.18–5.36).

Quality assessment

The methodological quality of the included studies was evaluated using the AMSTAR-2 critical appraisal of SRMA studies^[16]. Quality scoring was performed using 16 items, with each item scored from 0 to 2 points, and the overall quality of the included studies was moderate. The quality of the included SRMA was limited in reporting on several quality assessment items, including using PICO in the inclusion criteria, details regarding excluded studies, protocol registration, and a source of funding for the included studies (Table 2).

Discussion

Currently, five SRMA studies assessed neonatal sepsis in Ethiopia. SRMA studies have been considered to provide substantial evidence for decision-making in health programs and efforts. However, when the number of individual reviews increases, it may become tiresome and cumbersome for users^[57]. As a result, an umbrella review was carried out to consolidate the five SRMA studies on neonatal sepsis into a single document,

Table 1**Characteristics of included systematic review and meta-analysis studies**

s.no.	Author and years	Publication period of primary studies	Included studies	Search strategies	Sample size	Risk of bias	The primary outcome of the review	Reported prevalence (%)	Reported factors
1.	Assemie <i>et al.</i> 2020 ^[15]	2005–2019	18 studies (8 Cross-sectional and 10 cohort studies)	PubMed, Cochrane Library, ScienceDirect, Web of Science, and Google Scholar	10 495	Clear quality appraisal of studies reported using NOS	Prevalence of neonatal sepsis	45% (95% CI: 35, 55; $I^2 = 99.3\%$)	None
2.	Bayih <i>et al.</i> , 2021 ^[18]	2005–2019	27 studies (23 cross-sectional, 3 case-control 1 cohort study designees)	Google Scholar, HINARI, SCOPUS, and PubMed	36 016	Clear quality appraisal of studies reported using NOS	The burden of neonatal sepsis and its association with antenatal UTI and intrapartum fever	40.25% [95% CI:34.00%, 46.50%; $I^2 = 99.2\%$]	Antenatal urinary tract infection OR = 3.55 (95% CI: 2.04, 5.06), having intrapartum fever OR = 3.63 (95% CI: 1.64, 5.62)
3.	Belachew and Tewabe, 2020 ^[21]	2014–2018	8 studies (7 cross-sectional and 1 cohort study designs)	PubMed, CINAHL, EMBASE, Google Scholar, Web of Science, Cochrane Library databases, and African Health Science library	9032	Clear quality appraisal of studies reported using NOS	Prevalence of neonatal sepsis and its association with birth weight and gestational age	49.98% (CI: 36.06, 63.90)	Low birth weight OR = 1.42 (95% CI, 1.07, 1.88) and preterm OR = 3.36 (95% CI: 2.50, 4.54)
4.	Seyoum <i>et al.</i> , 2023 ^[20]	Before 3/31/2022	15 studies (8 case-control, 7 cross-sectional)	PubMed/Medline, Hinari, and Google Scholar	4895	Clear quality appraisal of studies reported using NOS	Determinants of neonatal sepsis	Na	Prolonged rupture of membrane (OR:4.03, 95% CI:1.88–8.60), low first-minute APGAR score (OR: 3.74, 95% CI:1.29–10.81), low fifth-minute APGAR score (OR:2.72, 95% CI:2.02–3.67), and delayed initiation of breastfeeding (OR: 3.41, 95% CI:2.18–5.36)
5.	Desta m <i>et al.</i> 2021 ^[19]	2014–2020	33 studies (17 cross-sectional, 9 case-control, 7 cohort) 9 studies reported neonatal sepsis (6 cross-sectional, 3 case-control)	PubMed, Web of Science, SCOPUS, CINAHL, Google Scholar, African Journals Online databases, and Science Direct.	20 109 2601	Clear quality appraisal of studies reported using NOS	effect of preterm birth on adverse perinatal and neonatal outcomes	NA	Preterm [OR = 2.33 (95% CI: 1.15, 4.71)]

NA, not applicable; OR, odds ratio.

Table 2
Quality of assessment using AMSTAR-2

Authors	Year	AMSTAR-2 items ^a																Quality score	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		Total
Assemie <i>et al.</i> ^[15]	2020	0	1	1	2	2	2	2	1	1	0	2	2	2	2	2	2	24	Moderate
Bayih <i>et al.</i> ^[18]	2021	2	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	30	High
Belachew and Tewabe ^[21]	2020	0	1	0	2	2	2	2	2	1	2	2	2	2	2	2	2	26	Moderate
Desta <i>et al.</i> ^[19]	2021	2	1	0	2	2	2	2	1	2	2	2	2	2	2	2	2	28	Moderate
Seyoum <i>et al.</i> ^[20]	2023	2	1	1	2	2	2	2	1	2	0	2	2	2	2	2	0	25	Moderate

AMSTAR, Assessment of Multiple Systematic Reviews.

^aScores for each item are between 0 and 2, where one point is awarded if the study had partial inclusion of methods that reduced bias, and two points were awarded for full inclusion of methods to reduce the risk of bias. This tool is available at https://amstar.ca/Amstar_Checklist.php.

which revealed that neonatal sepsis was widely prevalent and a serious public health issue in Ethiopia. Furthermore, many variables related to the mother’s socio-demography, prenatal period, intrapartum period, and neonatal-related factors were statistically significant in predicting the burden of neonatal sepsis in Ethiopia.

This umbrella review found that neonatal sepsis is a major public health concern for neonatal health in Ethiopia. The included five SRMA studies on the prevalence of neonatal sepsis in Ethiopia pointed out a summary estimate of 45% (95% CI 39–51%) which is higher than the study conducted in Iran (15.98%)^[58], in East Africa (29.65%)^[59], and low middle-income counties (17.2%)^[60]. This variation could be attributed to the preventive strategies used in each country, clinical criteria for sepsis diagnosis, differential sensitivity and specificity of culture methods used in different laboratories, maternal health during pregnancy, sanitary conditions in the delivery room, and socioeconomic status^[61,62]. Furthermore, our analysis only covered Ethiopia, whereas the study in East Africa and low-income and middle-income countries explicitly included a plethora of countries with a lower incidence of neonatal sepsis, and hence had a lesser effect in the region than Ethiopia. This finding suggests that Ethiopia’s newborn health requires considerable attention. The Ethiopian Ministry of Health has made several efforts to lessen the effects of newborn sepsis, but the results are not encouraging. Neonatal sepsis is a major cause of neonatal mortality, and research suggests that the prevalence of neonatal mortality is increasing over time^[8]. Furthermore, early-onset neonatal sepsis accounts for more than three-fourths of neonatal sepsis which was found to be 75.4%^[15]. Thus, the majority of the interventions may give less emphasis to late-onset neonatal sepsis

in which the burden is not decreased. To improve neonatal health and lower sepsis-related mortality, the current risk-reduction-focused approaches will need to be revised in light of this study.

Numerous maternal- and neonatal-linked factors are associated with neonatal sepsis. This finding is supported by findings from India^[63], eastern Africa^[64], sub-Saharan Africa^[65], China^[66], and globally^[67]. Prematurity was substantially associated with newborn sepsis among the neonatal-related variables. According to the overall effect estimates, preterm newborns had a threefold increased risk of neonatal sepsis compared with term newborns. Preterm newborns are more susceptible to sepsis because of their immature immune systems. Therefore, it is critical to strengthen and reconsider the programs and approaches already in place for the prevention and treatment of premature labour. In addition to preterm birth, key factors linked to neonatal sepsis that are frequently discussed include birth asphyxia, low birth weight, low APGAR scores, and resuscitation^[63–65,68]. This suggests that to lessen the impact of sepsis on newborn health, the current programs need to review and completely address all neonatal-related risk factors.

The leading causes of newborn sepsis were determined to be related to maternal factors. The most frequently mentioned causes are protracted labour, early membrane rupture, maternal infection, and delayed breastfeeding initiation. Studies conducted in sub-Saharan Africa, eastern Africa, India, and China^[63–65,67,69] have supported this. These risk factors could lead to bacterial infections, weaken immunity, and make it easier for the infection to be transmitted vertically from mother to newborn. This study also suggests that there is a need for rapid postpartum treatment as well as the prescription of intrapartum prophylaxis for high-risk

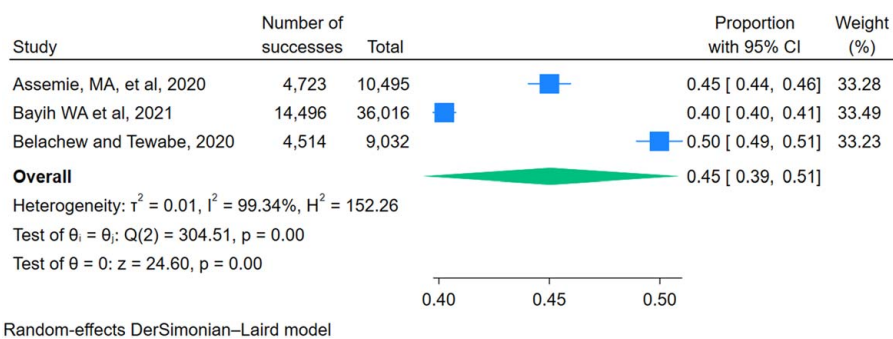


Figure 2. Umbrella review of systematic reviews and meta-analysis studies on the prevalence of neonatal sepsis in Ethiopia, 2023.

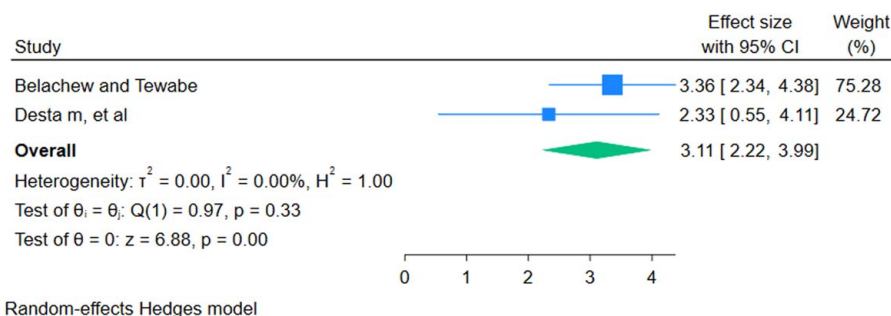


Figure 3. Umbrella review about the effect of prematurity on neonatal sepsis in Ethiopia, 2023.

pregnancies. Therefore, the presence of risk factors may be a useful target for interventions to prevent or reduce sepsis in newborns.

Overall, this review's findings will be used to inform decision-making, resource allocation, program revision, and policy and program design to promote neonatal health and reduce the incidence of neonatal sepsis in Ethiopia. Contrary to infants, Ethiopia has made significant strides in recent years to lower the mortality rate for children under the age of 5. A newborn and child health program package with community-based newborn care, newborn care at the border, and neonatal intensive care unit packages is being implemented by the Federal Ministry of Health^[70]. It will not be possible to meet the coverage goals for 2024. Ethiopia must, therefore, expedite the implementation of programs about infant and child health. It is crucial to coordinate comprehensive and multi-sectoral interventions across all sectors of neonatal health because neonatal sepsis is a complex illness and one of the leading causes of infant death in Ethiopia.

Strengths and limitations of the study

One of the strengths of this umbrella review is that there is no comprehensive evaluation of neonatal sepsis in Ethiopia has been performed. The limitation of the study includes all of the studies included in this analysis were observational studies and the study suffers from limitations of the observational study approach. Another limitation of this study is it was not possible to compare early- and late-onset sepsis, because the risk factors are different based on the age of the neonate and it needs further investigation. Furthermore, this umbrella review may be constrained by the overlap of the primary studies with those considered by the SRMA.

Conclusions

Neonatal sepsis affects approximately half of Ethiopian newborns. Preterm birth and the causes of preterm membrane rupture must be minimized. Additionally, it is preferable to develop and strengthen policies and programs that seek to improve maternal nutritional counselling and treatments for maternal infections, because these measures collectively contribute to a reduction in the incidence of neonatal sepsis.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Source of funding

None.

Author contribution

The review was developed and planned by A.E. The manuscript's draft was completed by A.E.*, I.M., and A.D., and A.E.* is the umbrella review's principal investigator. The search terms were developed by A.E.*, I.M., and A.D., who also vetted and picked the studies. Data extraction and study quality assessment were performed by A.E. and A.D. Analyses were performed and the text was thoroughly reviewed by all authors. The final paper was read and approved by all writers.

Conflicts of interest disclosure

The authors declared that have no competing interests.

Research registration unique identifying number (UIN)

The article is registered on <https://www.crd.york.ac.uk/prospero/>. The registration number is CRD42023458893.

Guarantor

Addis Eyeberu and Adera Debella.

Availability of data and materials

The data that support the review findings of this study are available upon submitting a reasonable request to the corresponding author.

Provenance and peer review

Not commissioned, externally peer-reviewed.

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