Prevalence and Patterns of Neonatal Birth Trauma in Ethiopia: Systematic Review and Meta-Analysis

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Abstract

Introduction. Neonatal death is still alarming in low-income countries including Ethiopia, accounts 30 death per 1000 alive births. Birth trauma is the second most common contributing factors for the death. Nevertheless, there is no aggregate evidence on the prevalence and patterns of neonatal birth trauma in Ethiopia. Therefore, this study aimed to assess the pooled prevalence and patterns of neonatal birth trauma in Ethiopia. *Methods.* Searching databases including PubMed, MEDLINE, Popline, SCOPUS, Web of Science, EMBASE, CINHAL (EBSCO), Google, Google Scholar, and lists of references were used to search literatures in Ethiopia. STATA version 14 was used for analysis, and the odds ratios of the outcome variable were determined using the random-effects model. Heterogeneity among the studies was assessed by computing values for I^2 and *P*-values. Also, sensitivity analysis and funnel plot were done to assess the stability of pooled values to outliers and publication bias. *Results.* A total of 6 studies with a sample size of 3663 were included in this study. The overall prevalence of neonatal birth trauma was 15% (95% CI: 13-16). Subgaleal hemorrhage (39%), cephalohematoma (27%), and caput succedaneum (24%) were the most common neonatal birth trauma in Ethiopia. Meta-analyses and sensitivity analyses showed the stability of the pooled odds ratios, and the funnel plots did not show publication bias. *Conclusion.* This systematic review and meta-analysis revealed a high prevalence of neonatal birth trauma in Ethiopia. Moreover, most of the neonatal birth injuries were severe and life-threatening that need medical attention to safe the neonates and its life long complications.

Keywords

newborn, neonates, birth trauma, birth injuries, systematic review, meta-analysis, Ethiopia

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Introduction

Globally, an estimated 2.4 million neonatal deaths occur every year.[1] Eventhough neonatal mortality reduction remains a priority agenda of sustainable development goal (SDG-2),[2] neonatal mortality has remained stable for the last half-decade in Ethiopia, accounts 30 death per 1000 alive births.[3] Birth trauma is the second most common cause of neonatal morbidity and mortality.[4]

Neonatal birth trauma is the mechanical destruction or functional deterioration of the neonate's body that mostly occurred during the birth process.[5] It ranges from self-limited to severe and long-lasting complications.[6] The prevalence of neonatal birth trauma varies with the socio-economic status of the countries, health coverage, and feto-maternal health seeking behavior. For instance, it is high in low socio-economic countries and poor quality of obstetric care.[5,7]

Mechanical types of neonatal birth trauma are frequently reported to occur during delivery and the incidence can differ across regions, according to a multitude of sources. Its prevalence ranges from 12.3% to 16.7% in Ethiopia.[8,9] Moreover, the types of birth trauma varies among the existing studies.[8-13]

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The existing studies in Ethiopia are limited to specific geographical areas; hence, they could not represent the prevalence and patterns of birth trauma among neonates at the national level. Moreover, the available data have not been systematically combined to generate a precise understanding of the prevalence and patterns of birth trauma among neonates. A pooled prevalence and patterns of neonatal birth trauma would help policy makers and health managers to make evidence-based decisions and in adopting suitable measures to reduce its incidence and related complications. Thus, we aimed to determine the pooled prevalence and patterns of neonatal birth trauma in Ethiopia.

Methods

Study Protocol and Registration

This systematic review and meta-analysis was conducted to determine the overall prevalence and patterns of neonatal birth trauma in Ethiopia. The findings of this review were reported following the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines.[14] We also used the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) guidelines to conduct the meta-analysis and to report the results.[15] The review was registered under on the PROSPERO with ID number of CRD42023406765.

Eligibility Criteria

All observational studies on the prevalence and patterns of neonatal birth trauma in Ethiopia were included. Similarly, all unpublished and published studies written in the English language were included in the study irrespective of their publication year. However, we excluded the studies that did not report our primary outcome of interest, studies that failed to fulfill the quality criteria, experimental studies, reviews, commentaries, and editorials.

Search Strategy

Searching databases including PubMed, MEDLINE, Popline, SCOPUS, Web of Science, EMBASE, CINHAL (EBSCO), Google, Google Scholar, and lists of references were used to find out literatures that fit our study objectives. Moreover, experts in the field were consulted to retrieve unpublished studies, and the bibliography of selected articles was reviewed for additional relevant studies.

We used Boolean logic operators (AND, OR, NOT) with Mesh terms, keywords, and word variants for the neonatal birth trauma and newborn birth injury in the search strategy. Depending on the specific requirement of the databases search strings were modified. For instance, PubMed search: (((((("prevalence" AND ("neonate" OR ("newborn" AND ("birth trauma"[All Fields])) [All Fields]))[All Fields]))[All Fields])) OR ("birth injury"[All Fields])) AND ("Ethiopia"[All Fields]). The search strategy is outlined in Supplemental File 1.

Study Selection

All the articles obtained from the selected databases were exported to the EndNote X6 version library, and exact duplicates were removed. Then, the EndNote library was shared between the reviewers (BB, ADH, and ML), and the initial screening of the articles was performed independently using the title and abstract. Any disagreements between the reviewers were solved through discussion, and after a consensus was reached the full text was reviewed. The overall study selection process is presented using the PRISMA statement flow diagram (Figure 1).

Data Extraction

The 2 reviewers (BB and ML) independently extracted the data from the full text of the retained articles. A pre-defined Microsoft excels 2010 was used to extract the data from selected studies under the following heading: author, publication year, setting, region, study design, study subject, and primary outcomes of interest (Table 1). The accuracy of the data extraction was verified by comparing the results of the independently extracted data.

Quality and Risk of Bias Assessment

The quality of the retained articles was appraised independently by the 2 reviewers (BB and ML) using Newcastle–Ottawa Scale (NOS) I^2 since all articles that fulfilled the inclusion criteria were observational studies. The mean score of the author's assessment was taken for a final decision, and any difference was solved by consensus. The included studies were evaluated against each indicator of the tools and categorized as high quality (>80%), moderate quality (60%-80%), and low quality (<60%). Articles with high to moderate quality were included in the review.

This critical appraisal was conducted to assess the internal validity (systematic error) and external validity (generalizability) of the studies and to reduce the risk of biases. Quality scores for each article were presented in Supplemental File 2.
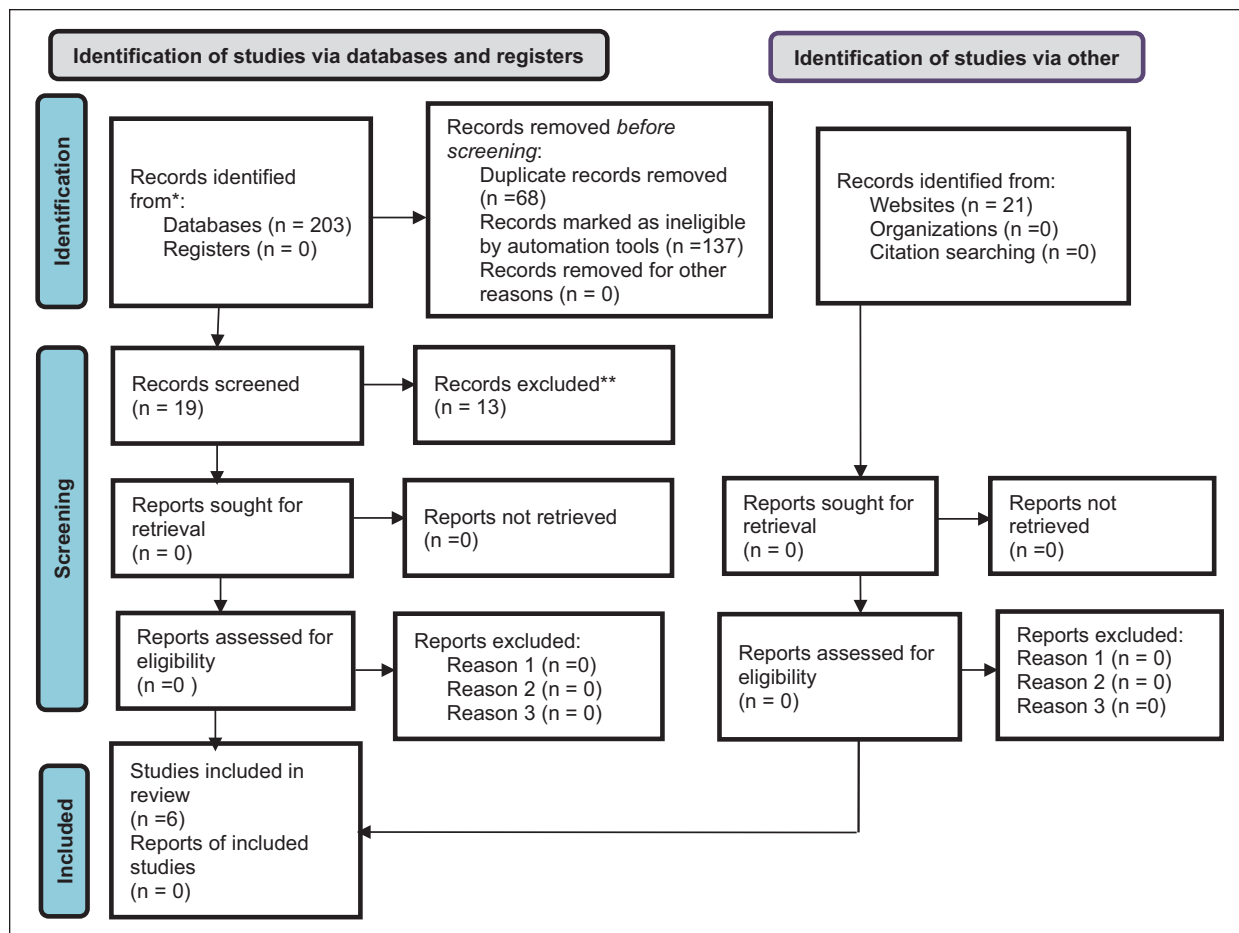
Figure 1. PRISMA statement presentation for systematic review and meta-analysis of neonatal birth trauma in Ethiopia, 2023. Abbreviation: n, number of studies included at each level.

Table 1. General Characteristics of Studies Included in the Systematic Reviews and Meta-Analysis in Ethiopia, 2023.

Author/s	Publication year	Region	Setting	Study design	Study subject	Sample size	Prevalence (%)	Event
Belay et al[8]	2022	SNNPR	IB	CS	Newborn	1315	16.70	220
Biset et al[10]	2022	Amhara	IB	CS	Newborn	594	13.13	78
Tesfaye et al[12]	2017	Oromia	IB	CS	Newborn	272	15.40	42
Tibebu et al[13]	2023	Addis Ababa	IB	CS	Newborn	373	12.90	48
Yemane and Yeshidinber[9]	2019	Addis Ababa	IB	CS	Newborn	717	12.30	88
Tolosa et al[16]	2022	Harari	IB	CS	Newborn	492	16.90	83

Abbreviations: IB, institutional based; SNNPR, Southern Nation, Nationality and People Region; CS, cross-sectional.

Outcome Measures and Statistical Analysis

The primary outcome variable of this review was the prevalence of neonatal birth trauma which was measured based on the absence or presence of the trauma during the labor and delivery process based on physician diagnosis. The pooled prevalence and patterns of neonatal birth trauma were computed from a report of the included articles. The random effect meta-analysis model was employed using STATA 14 software to consider the study-specific true effects across the included studies. A random-effects model for the reported proportion was used to present the pooled prevalence and patterns of neonatal birth trauma in Ethiopia. Forest plots were used to show the prevalence and patterns of neonatal birth trauma

in Ethiopia. Also, subgroup analyses were conducted using the regions and publication year of the studies. Also, sensitivity analyses were computed to assess the stability of pooled values to outliers.

The authors checked for potential publication bias using visual inspection of a funnel plot and Egger's regression test. Also, the *P*-value of <.05 for I^2 statistics was used to determine the presence of heterogeneity. Similarly, low, moderate, and marked heterogeneity was assigned to I^2 test statistics results of 25%, 50%, and 75%, respectively. The results of the review were reported according to the PRISMA guidelines and presented using a narrative synthesis.[14]

Results

Description of the Studies

A total of 224 papers were found by all searching methods (electronic databases, non-electronic databases, and lists of references). All papers were exported to the endnote library and duplicates (68 papers) were removed. Also, a total of 137 unrelated papers were excluded after titles and abstracts were reviewed. Then, 19 papers were retrieved for detailed examination, and after a full-text review of those papers, 13 papers were excluded due to different populations and outcomes of interest not being reported. Finally, full texts of the remaining 6 papers were selected for the methodological quality assessment using JBI critical appraisal tools. All appraised papers met the inclusion criteria and were included in the final review (Figure 1).

Characteristics of Included Studies

Six cross-sectional studies with a sample size of 3663 were used to determine the patterns and pooled prevalence of neonatal birth trauma in Ethiopia. The prevalence of neonatal birth trauma included in the reviews ranged from 12.3% to 16.7%.[8,9] Of those included studies, 2 were conducted in AA and the other 4 studies were conducted outside of AA (Oromia, Harari/Dire Dawa, Amhara, and SNNPR) (Table 1).

The Pooled Prevalence of Neonatal Birth Trauma

The overall pooled prevalence of neonatal birth trauma among newborns in Ethiopia was 15% (95% CI: 13-16) with I^2=58.19% and a *P*-value ≤.04. The prevalence of neonatal birth trauma ranges from 12% (95% CI: 10-15)[9] to 17% (95% CI: 15-19)[8] (Figure 2).

Publication Bias

To observe publication bias, the Egger regression test revealed no evidence of publication bias among the included studies (*P*=.182) in addition a visual inspection of the funnel plot was done and presented in the figure below (Figure 3).

Meta-Regression to Check the Heterogeneity

A meta-regression analysis was conducted since there was statistically significant heterogeneity, with *I*-square test statistics less than 0.05. The purpose of the analysis was to identify the source of heterogeneity so that the correct interpretation of the findings is made. However, the meta-regression analysis found no significant variable which can explain the heterogeneity. There was no statistically significant study level covariate: sample size and publication year of included studies. Therefore, the heterogeneity can be explained by other factors not included in this review (Table 2).

Subgroup Analysis

Subgroup analysis was computed with the evidence of heterogeneity. Hence the Cochrane I^2 statistic=59.88%, *P*=.04) showed the presence of marked heterogeneity in this study. Therefore subgroup analysis was implemented using the study area (region) and year of publications using random model effect analysis. Regarding the study area (region), the prevalence of neonatal birth trauma was highest out of AA (Oromia, Harari/Dire Dawa, Amhara, and SNNPR) accounting for 16% (95% CI: 14-17) whereas the prevalence of neonatal birth trauma was higher among studies published after 2020, accounting for 15% (95% CI: 13-17) (Figures 4 and 5).

Patterns of Neonatal Birth Trauma

Regarding patterns of neonatal birth trauma, sub-galeal hemorrhage (39%) was the most common followed by cephalohematoma (27%) and caput succedaneum (24%) respectively (Table 3).

Sensitivity Analysis

Sensitivity analysis was done by removing outliers and inliers, and no significant difference was investigated. While removing outliers, we noticed that the pooled prevalence of neonatal birth trauma was 15% (95% CI 12-18), and after removing inliers, the pooled prevalence was 14% (95% CI 12-15), so we can say this meta-analysis result is not sensitive.
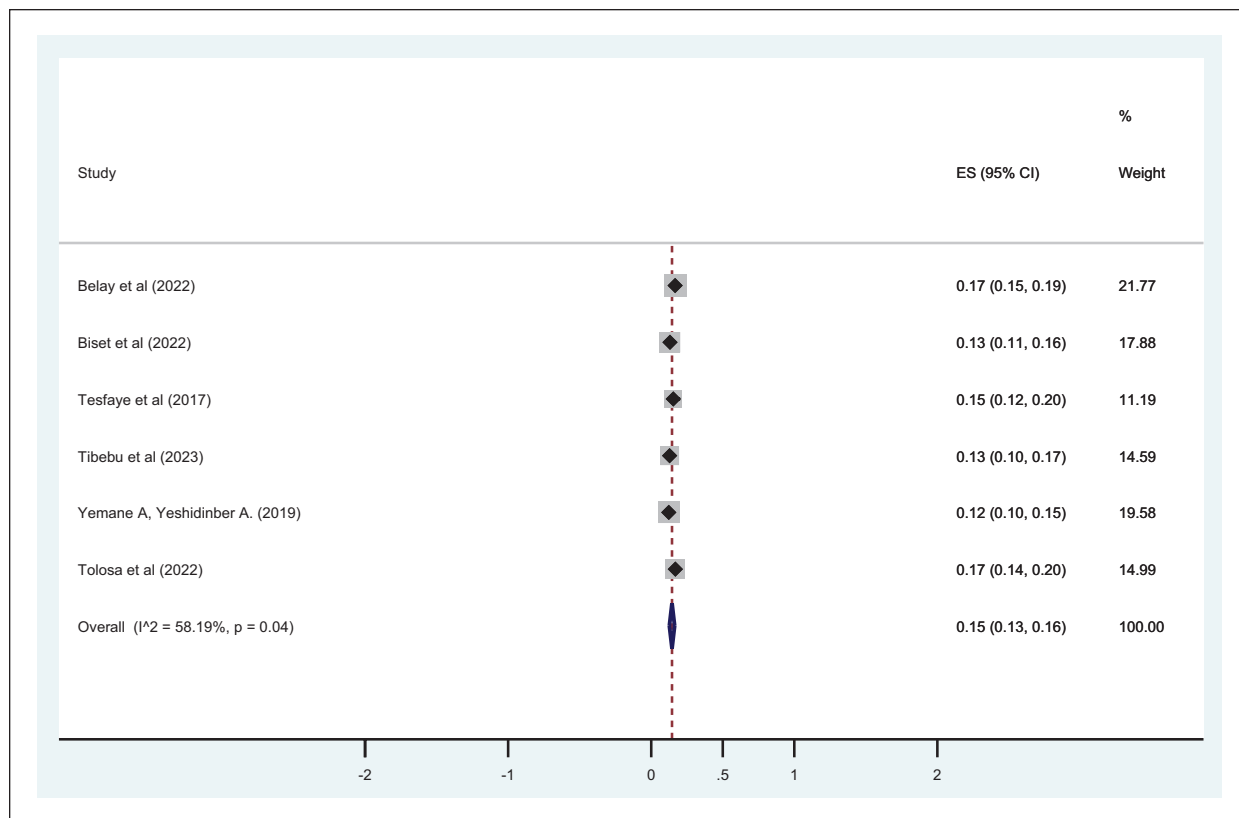
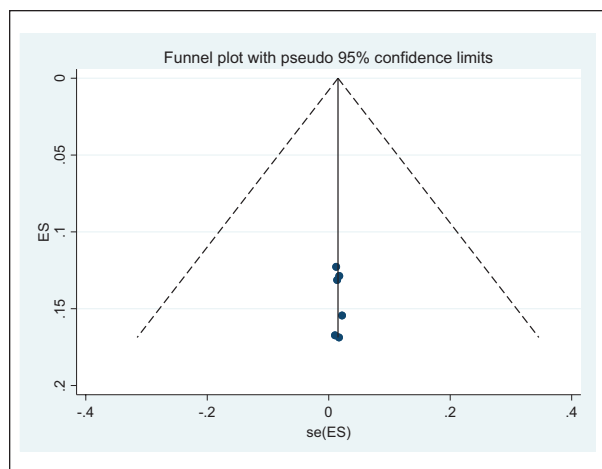**Figure 2.** Forest plot of the pooled prevalence of neonatal birth trauma in Ethiopia, 2023.

Figure 3. Funnel plot for neonatal birth trauma in Ethiopia, 2023.

Discussion

This systematic review and meta-analysis tried to investigate the prevalence and patterns of neonatal birth trauma in Ethiopia. Accordingly, a pooled prevalence of neonatal birth trauma was 15% (95% CI: 13-16). The finding was higher than a systematic review and meta-analysis report from Iran (2.7%).[17] Similarly, it was higher than the studies finding in Nigeria (5.7%),[18] India (1.4%),[19] and Cameroon (1.8%).[20]

The discrepancy might be related to the availability and accessability of quality obstetrics care and the continuum of maternal care across the nations. For instance, only 43% and 48% mother attended the fourth antenatal care and skilled birth attendants respectively in Ethiopia.[3] Moreover, instrumental deliveries (forceps and vacuums) which are the most contributors for neonatal birth trauma are commonly practiced in Ethiopia.[21] The difference in socio-demographics, socio-economics, sample size, sampling methods, and gender inequality play a vital role for the discrepancy of neonatal birth trauma across the countries.[5,18,19,22] In addition, early childbirth and childhood malnutrition of a mother influence pelvic diameters.[23,24]

Subgaleal hemorrhage (41%), caput succedaneum (29%), cephalohematoma (21%), skeletal fractures (18%), soft tissue injuries (14%), and peripheral nerve

Table 2. Meta-Regression Analysis to Check Heterogeneity on Neonatal Birth Trauma in Ethiopia, 2023.

Variables	Coefficients	SE	P	[95% CI]
Publication year	−.0019146	0.0125161	.911	−0.0196482, 0.0137022
Sample size	−2.1303	3.2007	.565	−0.0000131, 5.01003
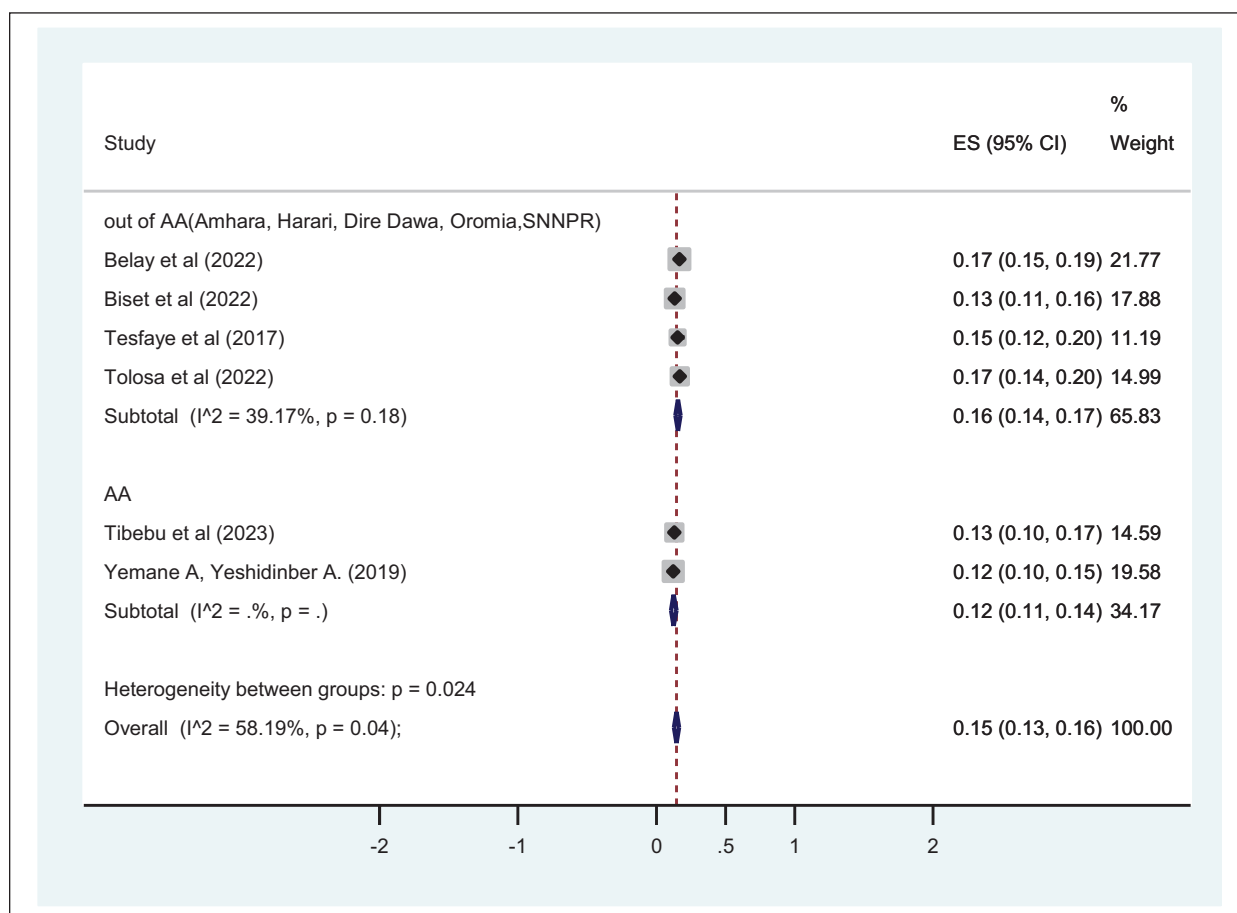
Figure 4. Forest plot of the subgroup analysis by publication year of neonatal birth trauma in Ethiopia, 2023.

injuries (13%) were the types of birth trauma. Most of those neonatal birth traumas are severe and life-threatening. Continuum of maternal care, early identification of obstructed labor and interventions, limiting instrumental deliveries, and timely referral and treatment of life-threatening types of birth traumas are crucial to save the life of newborns and to prevent life long complications. Moreover, training of staffs on safe instrumental delivery and early neonatal assessment is crucial to minimize the prevalence and severity of birth trauma.

This systematic review and meta-analysis was tried to investigate a pooled prevalence of newborns birth trauma and its pattern using all primary studies conducted in Ethiopia. However, it did not assess the predictors of neonatal birth trauma. Another limitation of the review was it included only neonatal birth trauma happened at health institutions without considering home delivery.

Conclusion

This systematic review and meta-analysis revealed that a pooled prevalence of neonatal birth trauma was relatively high in Ethiopia. Majority of neonatal birth injuries were severe and life-threatening medical attention which need the adherence to national obstetrics guidelines to minimize neonatal birth trauma and its life long complications. Moreover, since the number of existing studies did not assess the trends, it needs surveillance and routine reporting systems on newborn birth trauma in Ethiopia.
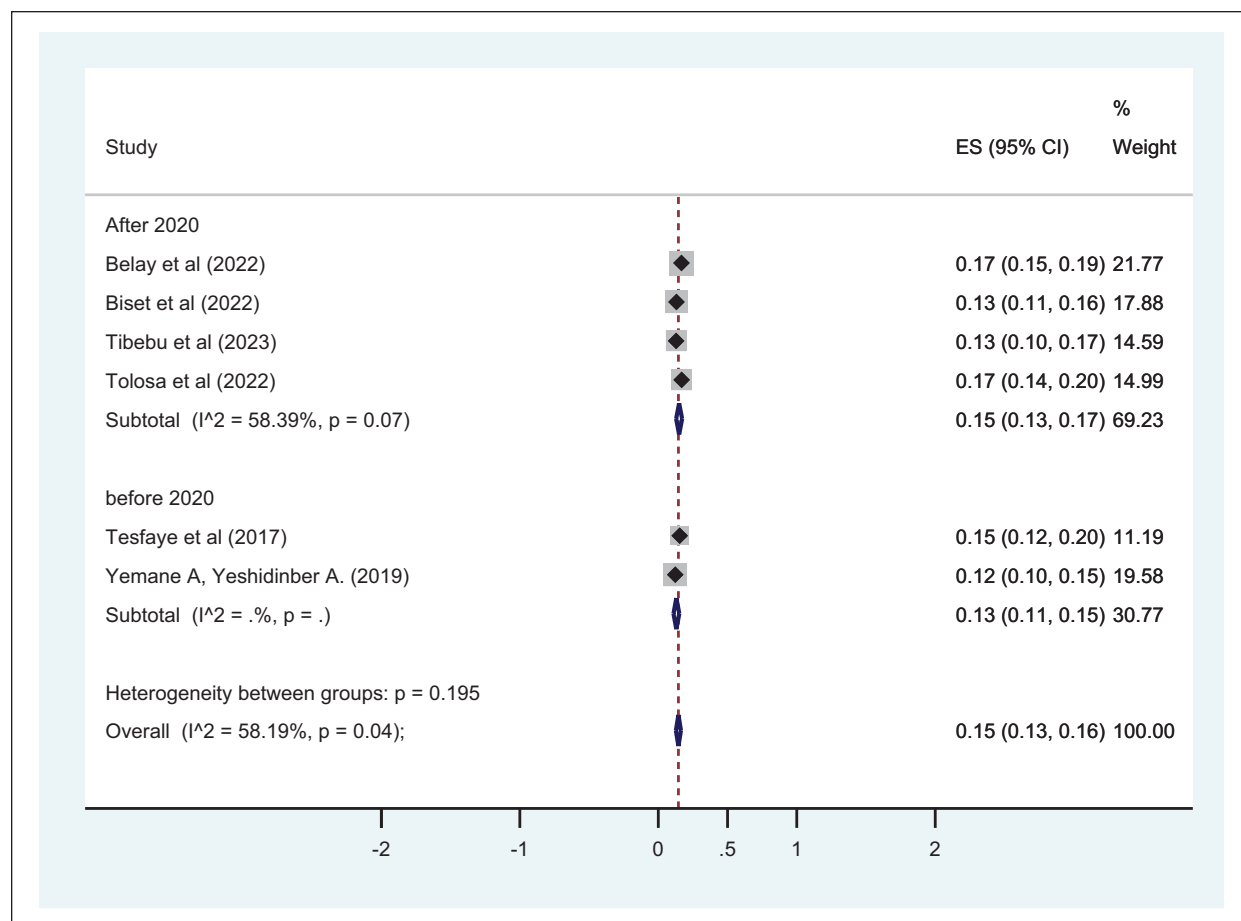
Figure 5. Forest plot of the subgroup analysis based on the region of neonatal birth trauma in Ethiopia, 2023.

Table 3. Patterns of Neonatal Birth Trauma in Ethiopia, 2023.

Types of newborn birth trauma	Model	Status of heterogeneity	Prevalence (95% CI)	I^2 (%)	P-value
Sub-galeal hemorrhage[9,10,12,13,16]	Random	Marked	39 (15-64)	96.46	.00
Caput succedaneum[8,10,13,16]	Random	Less	24 (13-36)	83.16	.00
Cephalohematoma[8-10,13,16]	Random	Marked	27 (11-42)	93.06	.00
Skeletal fractures[8,9,12,16]	Random	Marked	18 (4-32)	93.20	.00
Soft tissue injury[8,9,12,13,16]	Random	Marked	17 (5-48)	97.57	.00
Nerve injury[8,9,13,16]	Random	Less	13 (6-21)	74.24	.01

Consent for Publication

Not applicable.

Declaration of Conflicting Interests

Funding

Ethics Approval and Consent to Participate

Not applicable.

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Supplemental Material

Supplemental material for this article is available online.

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