



Incidence and predictors of post spinal anesthesia-induced hypotension for cesarean section in Ethiopia: A systematic review and meta-analysis

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ARTICLE INFO

Keywords:

Meta-analysis

Systematic review

SIH

Pregnant mothers

Ethiopia

ABSTRACT

Introduction: Hypotension is defined as a decrease in mean arterial blood pressure of more than 30% within a 10-minute period after spinal anesthesia. Spinal anesthesia is a subarachnoid block and is the preferred approach for certain surgical procedures, such as cesarean sections. Spinal anesthesia is the most often used neuraxial approach for patients in many institutions because of the superior quality of surgical anesthesia, quick onset of action, excellent patient comfort, and low complication rates. This systematic review and meta-analysis aimed to assess the incidence of SIH and related factors among patients who underwent cesarean sections in Ethiopia.

Methods: This systematic review and meta-analysis was conducted using two different methods. The first was an exploration of electronic databases (PubMed, Scopus, Web of Science, MEDLINE, CINAHL, Cochrane Library, Embase, and Google Scholar) for the presence of evidence about the incidence of spinal-induced hypotension and its predictors among pregnant mothers who underwent cesarean section under spinal anesthesia in Ethiopia. Data were extracted using a Microsoft Excel spreadsheet and analyzed using Stata 17. Quality appraisal was conducted using the PRISMA guidelines and Newcastle–Ottawa assessment scales. Higgins I² tests were used to assess heterogeneity. Sensitivity and subgroup analyses were performed. Egger's test and funnel plots were employed to identify potential publication bias.

Results: The pooled incidence of SIH among pregnant women who underwent cesarean section in Ethiopia was 64.5% (95% CI: 56.2–72.8). The subgroup analysis by region revealed that the pooled incidence of SIH among pregnant mothers in Addis Ababa was 68.6%, and that in the Oromia region was 74%. Baseline systolic blood pressure <120 mmHg (AOR 6, 95% CI 2.878–9.09), newborn weight (AOR 5.4, 95% CI 3.4–7.35), sensory block height (AOR 6.75, 95% CI 4.3–9.201), speed of injection < 10 sec (AOR 4.47, 95% CI 2.348–6.215), and dose of local anesthetics > 2.5 ml (AOR 7.8, 95% CI 6.3–11.56) were significantly associated with SIH.

Conclusion: This systematic review and meta-analysis revealed a high pooled incidence of SIH among pregnant women who underwent cesarean section under spinal anesthesia in Ethiopia. Hence, to reduce SIH and other maternal-related complications among pregnant women, much consideration must be given to increasing anesthesia professionals' knowledge and skills in teaching universities and governmental hospitals in Ethiopia.

Abbreviation: AOR, Adjusted odds ratio; CI, confidence interval; DF, Degree of freedom; SIH, Spinal anesthesia induced hypotension.

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<https://doi.org/10.1016/j.pcorm.2025.100541>

Received 4 May 2025; Received in revised form 26 July 2025; Accepted 12 August 2025

Available online 13 August 2025

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1. Introduction

Hypotension is defined as a decrease in the mean arterial blood pressure of more than 30% in a 10-minute period, and significance was defined as a therapeutic action with fluids or vasopressors within 20 min after spinal anesthesia¹. Spinal anesthesia, also known as subarachnoid block, is the preferred approach for certain surgical procedures, such as cesarean section. It is the most often used neuraxial approach for patients in many institutions because of the superior quality of surgical anesthesia, quick onset of action, excellent patient comfort, and low complication rates. However, its effects are not without risk, as it is linked to considerable hemodynamic alterations, such as hypotension caused by spinal anesthesia, which is a prevalent condition that affects clinicians and patients^{2,3}.

A high BMI, advanced age, and baseline blood pressure below the normal range are other risk factors for the occurrence of hypotension in pregnant women. It can induce increased abdominal pressure, compression of the subarachnoid cavity, and a decrease in cerebrospinal fluid (CSF) volume, which increases spinal block⁴. Thus, several clinical studies have been performed to demonstrate the incidence and predictors of spinal-induced hypotension during cesarean sections worldwide⁴.

Research into the causes of spinal hypotension has resulted in the development and improvement of successful therapy regimens, with a focus on prophylactic vasopressor medications. This approach has been beneficial in well-resourced settings, with maternal comfort and elimination of complications currently being the key treatment goals. Sophisticated strategies are not possible in resource-constrained environments because of insufficient equipment, personnel with experience, and knowledge of diagnosing and managing complications. As a result, in these settings, spinal-induced hypotension remains a major problem in resource-limited settings, such as Ethiopia⁵.

There are cross-sectional and prospective cohort studies conducted in Ethiopia on the burden of spinal-induced hypotension among patients undergoing cesarean sections. However, there is no systematic review or meta-analysis on the incidence of spinal-induced hypotension among pregnant women. Therefore, this systematic review and meta-analysis may provide evidence-based recommendations for the care of pregnant mothers who undergo cesarean sections. This systematic review and meta-analysis aimed to assess the incidence of SIH and related factors among patients who underwent cesarean sections in Ethiopia.

1.1. Review hypothesis

HO1: Spinal anesthesia does not affect the blood pressure of mothers who undergo cesarean section.

HA1: Spinal anesthesia affects the blood pressure of mothers who undergo cesarean section under spinal anesthesia.

2. Methods

2.1. Study design

Systematic review and meta-analysis

2.2. Study setting

The Federal Democratic Republic of Ethiopia comprises nine regional states (AFAR, AMHARA, BENISHANGUL-GUMUZ, GAMBELA, HARARI, OROMIA, SOMALI, SNNPR, and TIGRAY) and two city administrations (ADISS ABABA and DIRE DAWA). It is separated into zones, which are further subdivided into districts, which are further subdivided into kebeles, the lowest administrative divisions, and cover a total area of 1,100,000 km². Ethiopia is the second most populated country in Africa, home to almost 112 million people (56,010,000 women and 56,069,000 men in 2019)⁶⁻⁸.

This systematic review and meta-analysis were conducted and reported in accordance with the recommended preferred reporting guidelines for systematic reviews and meta-analyses (PRISMA)⁹. The International Prospective Register of Systematic Reviews (PROSPERO) registration number is CRD42025641878.

2.3. Search strategy

The search strategy for this systematic review and meta-analysis was conducted in two different ways: First, we searched PubMed, Web of Science, MEDLINE, CINAHL, the Cochrane Library, Embase, and Google Scholar for evidence concerning the incidence of spinal-induced hypotension and its predictors among pregnant mothers who underwent cesarean section under spinal anesthesia in Ethiopia.

The retrieval was connected via Boolean logical operators: prevalence OR magnitude OR incidence AND "Hypotension" AND "its associated factors" OR "risk factor" OR "determinant" OR "predictors" AND "among pregnant mothers who undergo cesarean section under spinal anesthesia in Ethiopia, PubMed, Web of Science, MEDLINE, CINAHL, Cochrane Library, Embase, and Google scholar were searched in line with database-specific guidelines via keywords used in PubMed. The second strategy was a manual search of the reference lists of the included studies. We placed 2015–2025 time restrictions on our search for the articles.

2.4. Eligibility

All RCTs and non-RCTs were eligible for inclusion if the outcome evaluated was spinal-induced hypotension and associated predictors, and the study was performed in Ethiopia among pregnant mothers who underwent cesarean section under spinal anesthesia between 2015 and 2025. Articles were excluded if they were published in a language other than English⁸.

2.5. Methods for data extraction and quality assessment

Using a standardized data extraction form, five authors (SSL, FDA, GKG, KS, and YAW) independently extracted the necessary data from the studies included in the final analysis. Data extracted from the included studies were entered into a standardized Microsoft Excel spreadsheet.

Cross-checking was performed to ensure consistency. During the extraction process, conflicts between the extracted data were resolved through logical discussions among the five authors, and the final consensus was agreed upon with the participation of authors MD and DTR. The table contains the author's name, research population, sample size, publication year, study area, study methodology, and assessment tool for spinal-caused hypotension and its predictors in pregnant women.

Data for the listed studies were obtained using a PRISMA-compliant assessment form⁹. The Newcastle–Ottawa quality evaluation scale was used to evaluate the studies included in the final analysis¹⁰. Two independent authors (SSL and YGA) evaluated the quality of the included studies using the Newcastle–Ottawa quality assessment scale, which ranges from 0 to 10. A score of 8 or more indicates good quality, 3–7 indicates moderate quality, and a score of less than this score indicates low quality¹⁰. All disagreements were discussed and resolved by the third, fourth, and fifth authors (TY, YW, and EKB). All six studies considered to be of good quality were included.

2.6. Risk of bias and quality assessment

The risk of bias was independently assessed by two investigators using the Cochrane Manual 5.1.0-recommended RCT risk assessment tool¹¹. The evaluation included random sequence generation, assignment hiding, researcher and participant blinding, outcome evaluation

blinding, outcome data integrity, selective reporting of study results, and other biases. The evaluators were asked to judge “low risk of bias,” “high risk of bias,” or “unclear” for each entry. The Newcastle–Ottawa quality assessment scale (NOS), which includes eight items in three dimensions (selection, comparability, and outcome), was used to evaluate the quality of non-RCTs.

2.6.1. Assessment of the quality of the included studies

This meta-analysis included only cross-sectional and cohort studies. We assessed the quality of nonrandomized studies using the Newcastle–Ottawa Scale (NOS) (Table 1).

2.7. Data statistical analysis

In this systematic review and meta-analysis, we used Review Manager Version 5.4 to pool odds ratios (ORs) and confidence intervals (CIs) for each risk factor. To account for differences in sample size and geographic region, we employed random effects models rather than fixed effects models to determine the incidence of spinal anesthesia-induced hypotension and its predictors among pregnant mothers who underwent cesarean section under spinal anesthesia^{12–14}. STATA 17 was used for the meta-analysis. The heterogeneity of the selected papers was evaluated using Q and I² statistics. An I² value of zero indicated no heterogeneity, whereas I² values of 25, 50, and 75% indicated minimal, moderate, and high heterogeneity, respectively¹⁵. To address this potential heterogeneity, we conducted a sensitivity analysis to identify the most likely source. To assess the spinal-induced hypotension, we conducted a subgroup analysis based on the sample size, publication year, and study setting. We used an ocular funnel plot test to detect publication bias. Statistical significance was set at P < 0.05 for all analyses.

3. Results

3.1. Characteristics of the included studies

In this systematic review and meta-analysis, six studies were evaluated, and 991 pregnant women were included in these six studies. Using the aforementioned search approaches, we discovered 3,947 documents. A second search of the reference lists of publications that were backed by references yielded six papers, bringing the total to 3,090. Prior to screening, 1369 articles were excluded because of duplicate records (n=742), records flagged as ineligible by automation tools (n=289), and records removed for other reasons (n=338). During and after screening, 2180 of these articles were eliminated because they were published more than ten years ago. A total of 391 papers were removed by reading their titles. The remaining eight studies were thoroughly examined to determine whether they should be included in the meta-analysis; however, only six articles⁴ were included, and the remaining two articles^{16,17} were excluded because the outcome of interest was not directly related to spinal-induced hypotension in cesarean delivery under spinal anesthesia (Fig. 1).

3.2. Identification of included studies

This systematic review and meta-analysis included six studies on

Table 1
Quality assessment of the included studies.

Study	Selection	Comparability	Outcome	Total/10
Yilkal T. et al,2022	5	2	2	9
Tewoderos S. et al, 2020	5	2	2	9
Bizuwork G. et al, 2023	5	2	2	9
Ashebir N. et al, 2020	4	2	2	8
Wubie B. et al,2021	5	2	2	9
Sintayehu M.et al, 2022	4	2	2	8

Hint; Data are counted in number

spinal-induced hypotension among 4034 pregnant Ethiopian women⁴. Among all the included studies, two were conducted in the Amhara region^{18,19}, two were conducted in Addis Ababa^{20,21}, one study was conducted in Tigray²², and the remaining study was conducted in the Northern Showa Oromia²³. The study design of three studies was cross-sectional⁴, and the remaining two were observational cohort studies⁴ (Table 2).

Among the included studies, one used a sample size of more than 380²⁰, and the remaining four used a sample size of less than 380⁴. All six studies were published in the last ten years (2015 and above)⁴. Unfortunately, no studies on the incidence and predictors of spinal-induced hypotension have been conducted in Ethiopia before 2015.

3.3. Risk of bias assessment

The risk of selection bias was low in the included studies; three studies did not undergo randomization and had a high risk of selection bias^{19,22,23}. Owing to the particularity of clinical interventions, not all studies can completely blind the implementer and the study participants. Most studies did not disclose a blinded technique for result analysis. Data from all the included studies were fully reported, with a low likelihood of reporting bias. The risk of bias in the selected studies is shown in (Fig. 2).

3.4. Pooled incidence of spinal anesthesia-induced hypotension among pregnant mothers who underwent cesarean section under spinal anesthesia in Ethiopia

This meta-analysis included six studies on spinal-induced hypotension in pregnant women who underwent cesarean sections in Ethiopia. The pooled incidence of SIH in the studies included in this systematic review and meta-analysis ranged from 56.8% at the University of Gondor¹⁹ to 80% at the Gandhi Memorial Hospital, Addis Ababa²¹. The random-effects model revealed that the pooled incidence of SIH among pregnant women who underwent cesarean sections in Ethiopia was 64.9% (95% CI 57.3–72.5). The pooled incidence was influenced by moderate variability (Fig 3).

3.5. Subgroup analysis of the incidence of SIH among pregnant mothers in Ethiopia

Since the pooled prevalence of STIs was influenced by substantial heterogeneity, a subgroup analysis was employed based on the regional study setting, where the study was conducted, and the sample sizes were >198 (average) and <198. The pooled incidence of SIH among pregnant patients in the Amhara region was 56.1% (95% CI 47.6, 64.5), with I²=0.00% and a p-value < 0.05. The pooled incidence of SIH among pregnant mothers in Addis Ababa was 68.6% (95% CI 54.4, 82.8), I²=37.04%, and the p-value was > 0.05. The pooled incidence of SIH among pregnant mothers in the Oromia region was 74% (95% CI 60.4, 87.6), I²=0%, with a P value < 0.05. The pooled incidence of SIH among pregnant mothers in the Tigray region was 59.5% (95% CI 40.2, 78.8), I²=0%, with a p-value < 0.05. In addition, a subgroup analysis was performed considering the sample size. The pooled incidence of SIH among pregnant mothers in studies with sample sizes >198 was 60.4% (95% CI -2.17, 3.38), I²=0.00%, with a p-value > 0.98. The pooled incidence of SIH among pregnant mothers in studies with sample sizes < 198 was 70% (95% CI -0.43, 1.83), I²=0.00%, with a p-value < 0.05 (Table 3) (Fig. 4).

3.6. Heterogeneity

The heterogeneity test of I² revealed 58.74%, indicating substantial heterogeneity. The Galbraith plot revealed no outliers in the studies included in this meta-analysis. (Fig 5)

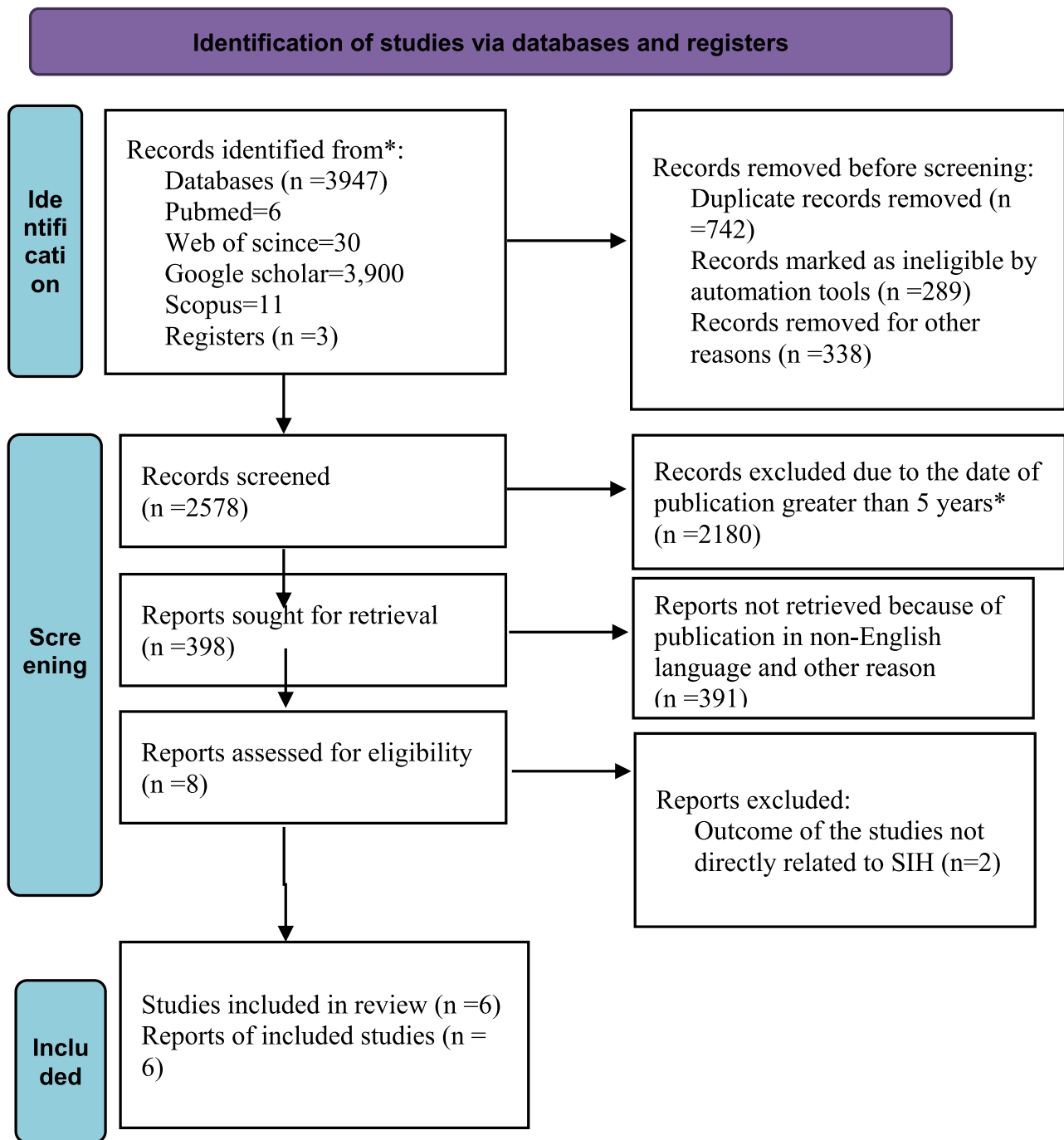


Fig. 1. PRISMA flow chart of the review process.

Table 2

Characteristics of studies on spinal anesthesia-induced hypotension among pregnant mothers in Ethiopia.

Sr. no	Author/year	Number of citation	Study area	Study design	Sample size	Outcome variable	%SIH
1	Yilkal Tadesse. et al, 2022	3	Bahirdar	Cross-sectional	143	SIH	0.559
2	Tewoderos Shitemaw. et al, 2020	59	Addis Ababa	Cross-sectional	410	SIH	0.64
3	Bizuwork Girma. et al, 2023	8	North Showa	Cohort	140	SIH	0.74
4	Ashebir Nigussie. et al, 2020	5	Addis Ababa	Cross-sectional	60	SIH	0.8
5	Wubie Birlie. et al, 2021	9	Gondar	Cohort	238	SIH	0.568
6	Sintayehu Mulugeta. et al, 2022	4	Mekele	Cohort	84	SIH	0.559

%SIH- Incidence of spinal anesthesia-induced hypotension

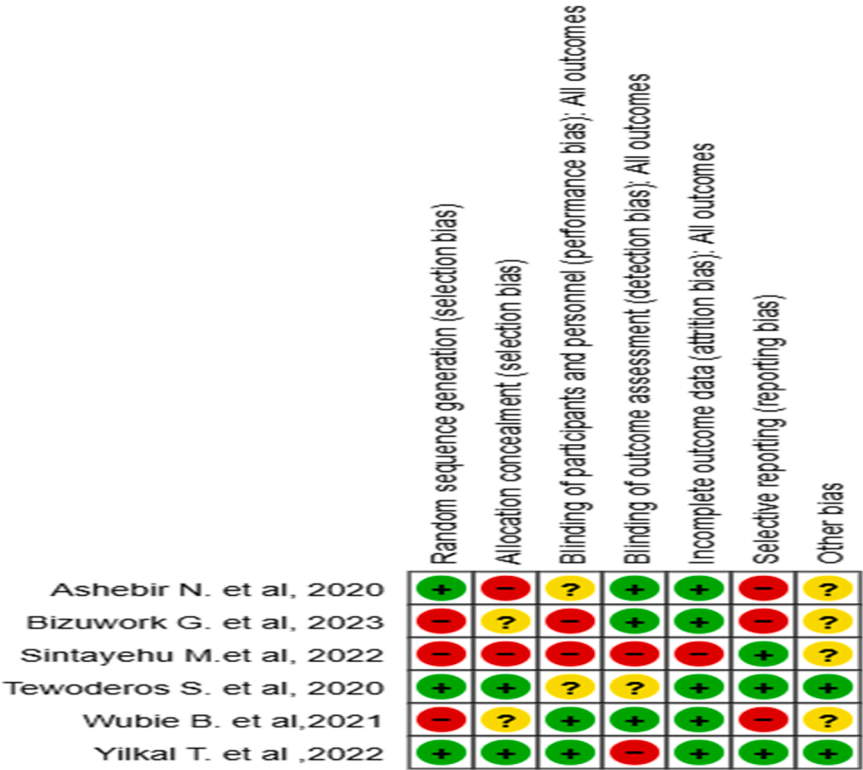


Fig. 2. B Risk of bias summary.

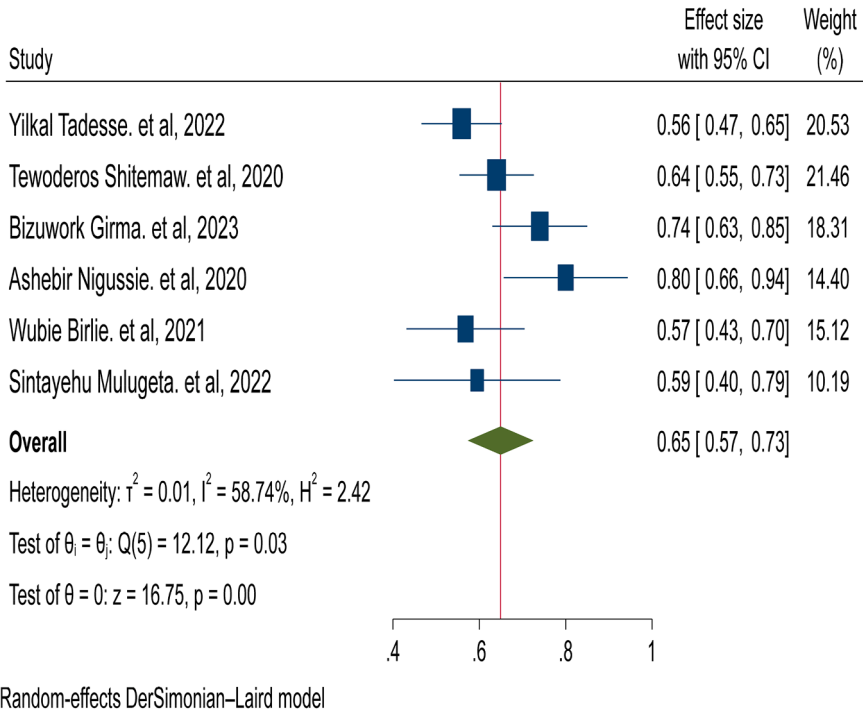


Fig. 3. Frost plot for the incidence of SIH among pregnant mothers in Ethiopia.

3.7. Sensitivity analysis

We conducted a sensitivity analysis to identify the source of heterogeneity affecting the pooled SIH incidence among pregnant mothers who underwent cesarean section under spinal anesthesia in Ethiopia. According to the findings of the sensitivity analysis, the pooled

estimated incidence of SIH obtained when each study was excluded from the analysis was within the 95% confidence interval of the pooled incidence of SIH when all studies were fitted together. Furthermore, the sensitivity analysis results revealed that the pooled incidence of SIH ranged between 61.6% (95% CI 53.5, 69.8) and 67.8% (95% CI 59.7, 75.8) when each study was excluded from the analysis (Table 4).

Table 3
Subgroup analysis of the incidence of SIH among pregnant mothers in Ethiopia.

Sub group	Number of studies	Estimate		Heterogeneity		
		Incidence %	95% CI	I2 (%)	Q(DF)	P value
Region						
Amhara	2	0.561	0.476, 0.645	0.00	0.01 (1)	< 0.05
Adiss Ababa	2	0.686	0.544, 0.828	37.04	1.59 (1)	> 0.05
Oromia	1	0.740	0.604, 0.876	0	-0.00 (0)	< 0.05
Tigray	1	0.595	0.402, 0.788	0	0.00 (0)	<0.05
Sample size						
>198	2	0.620	0.547, 0.692	0.00	0.76 (1)	< 0.05
<198	4	0.673	0.553, 0.794	71.84	10.66 (3)	< 0.05

CI-confidence interval, DF- degree of freedom

3.8. Publication bias

The presence or absence of publication bias in the incidence of SIH was assessed using two methods. The first was Egger's publication bias plot. The results revealed that publication bias did not exist and that its p-value was not significant (P value=0.1586) for SIH, implying that

there is no significant publication bias for the incidence of SIH among pregnant mothers who underwent cesarean section under spinal anesthesia in Ethiopia. Additionally, a visual inspection of a funnel plot for the logit event rate of incidence of SIH among pregnant mothers in line with its standard error suggests supportive evidence for the absence of publication bias (Fig. 6).

3.9. Predictors of SIH among pregnant mothers who undergo cesarean section in Ethiopia

Among all studies included in this meta-analysis, only four reported predictors of SIH ⁴. Baseline systolic blood pressure <120 mmHg ^{19,20}, newborn weight ²⁰, sensory block height ^{18,20}, time interval between spinal induction and skin incision ²⁰, anesthetist experience ²⁰, type of uterotonic agent used (oxytocin to ergometrine) ²¹, patient positioning prior to SA (supine to lateral) ¹⁹, duration of crystalloid load before 20 min ^{19,21}, speed of injection < 10 s ¹⁹, maternal BMI ²¹, absence of spinal additives ¹⁹, and dose of local anesthetics > 2.5 ml ²⁰. A baseline blood pressure of < 120 mmHg had a 6-fold predictive effect on the development of spinal-induced hypotension; a newborn weight > 3500 g had a 5.53-fold greater SIH; a sensory block height > T6 had a 6.75-fold greater SIH; a crystalloid load before 20 min had a 6.8-fold greater SIH; a dose of local anesthetics > 2.5 ml was associated with a 7.815-fold greater SIH; and the speed of injection of local anesthetics into the subarachnoid space within < 10 s was 4.47-fold greater than that of patients receiving local anesthetics for > 10 s (Table 5). A forest plot

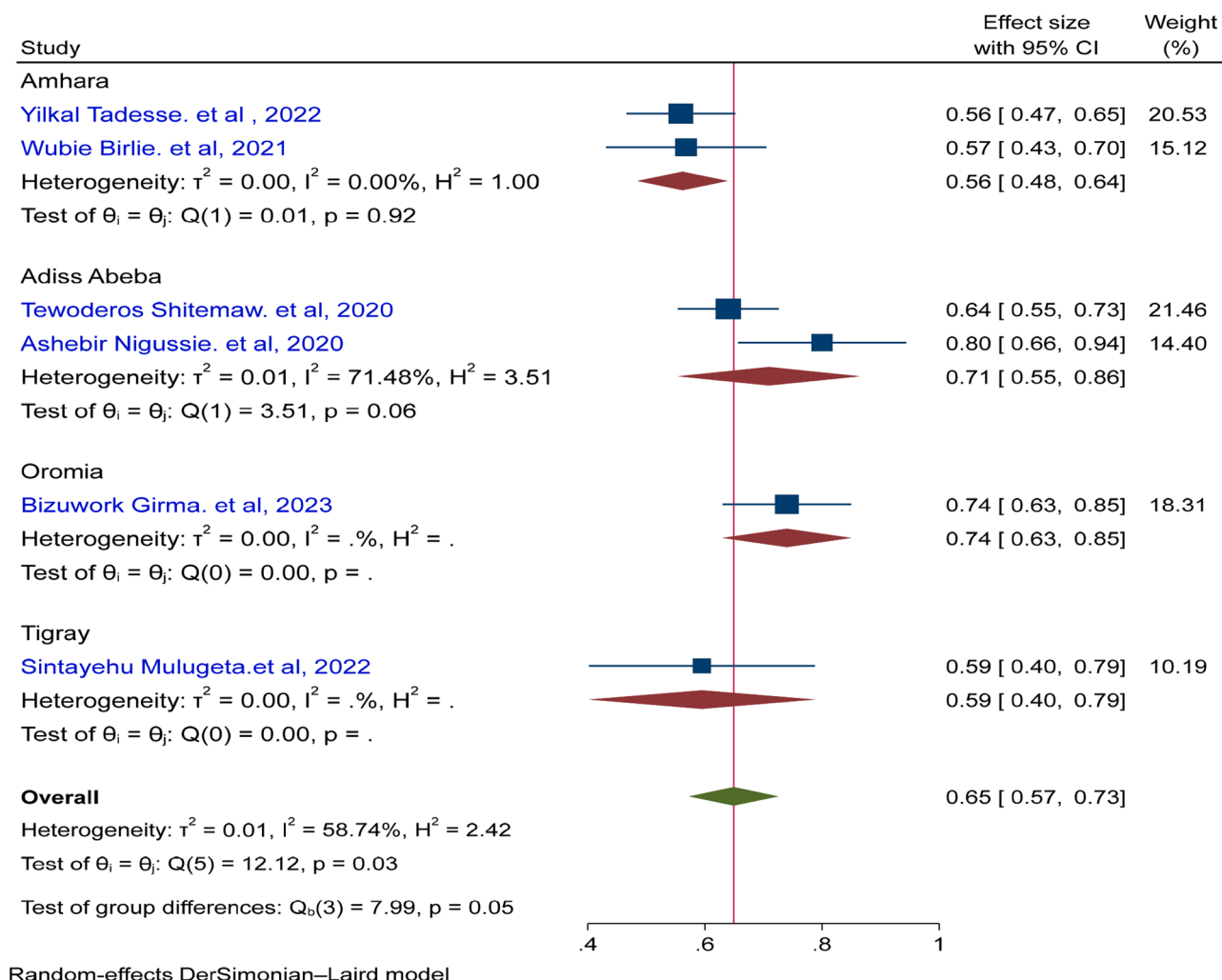


Fig. 4. Frost plot of the subgroup analysis for the incidence of SIH among pregnant mothers across regions.

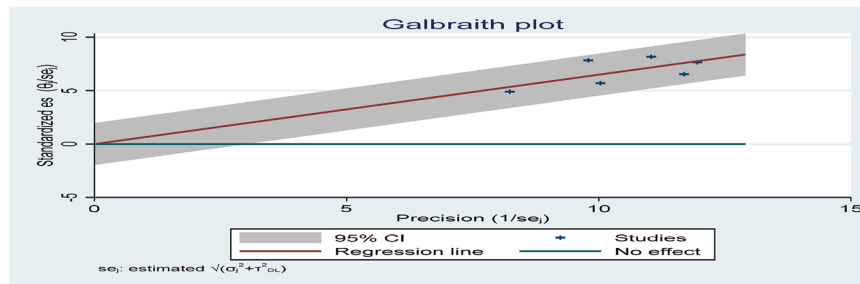


Fig. 5. Galbraith plot for heterogeneity and outliers.

Table 4

A sensitivity analysis of the incidence of SIH among pregnant mothers who underwent cesarean section in Ethiopia when each indicated study was removed at a time with its 95% confidence interval.

Sr. no	Omitted study	Incidence of SIH (%)	95% CI
1	Yilkal Tadesse. et al, 2022	67.3	59.3, 75.2
2	Tewoderos Shitemaw. Et al, 2020	65.2	55.2, 75.3
3	Bizuwork Girma. et al, 2023	62.8	54.9, 70.8
4	Ashebir Nigussie. et al, 2020	62.5	55.6, 69.3
5	Wubie Birlie. et al, 2021	66.4	57.8, 75.0
6	Sintayehu Mulugeta. et al, 2022	65.6	57.1, 74.1

CI- confidence interval

describing the associations between predictors, such as baseline systolic blood pressure <120 mmHg, sensory block height above T7, and a crystalloid loading duration of > 30 min for intraoperative spinal-induced hypotension among pregnant mothers who underwent cesarean section is presented in (Figs. 7, 8, and 9).

4. Discussion

This systematic review and meta-analysis examined six studies with 991 participants from 2015 to 2025 to assess the pooled incidence of SIH and its associated factors among pregnant mothers who underwent cesarean sections under spinal anesthesia in Ethiopia. According to this meta-analysis, the pooled incidence of SIH among pregnant women in Ethiopia who underwent cesarean sections under spinal anesthesia was 64.5%. SIH was significantly associated with a baseline systolic blood pressure <120 mmHg, newborn weight, sensory block height, injection speed < 10 seconds, and local anesthetic dosage > 2.5 ml. The cumulative incidence of SIH among the included studies was 64.5%, with a 95% confidence interval of 56.2–72.8. SIH was significantly associated with baseline systolic blood pressure <120 mmHg, newborn weight,

sensory block height, injection speed < 10 seconds, and local anesthetic dosage > 2.5 ml. The cumulative incidence of SIH among the included studies was 64.5%, with a 95% confidence interval of 56.2–72.8. Baseline systolic blood pressure less than 120 mmHg, newborn weight, sensory block height, speed of injection less than 10 s, and local anesthetic dose > 2.5 ml were significantly associated with SIH.

The pooled incidence of SIH among the included studies was 64.5%, with a 95% confidence interval (CI) of 56.2–72.8. These rates were higher than those reported in studies in the Middle East and Saudi Arabia, which reported 31.4%, 23.9%, and 30.1% for mild, moderate, and severe hypotension, respectively²⁴; South Asia in India, which reported incidences of mild, moderate, and severe hypotension of 20%, 35%, and 40%, respectively²⁵; and Central Europe, which reported 5.4%¹. This disparity could be attributed to research conducted in resource-limited settings in East Africa. The pooled incidence of SIH among pregnant mothers who underwent cesarean section under spinal anesthesia was lower than that reported in studies conducted in Southeast Asia and Bangkok, which were 76.7% and 65.1%, respectively^{26,27}. This difference might be due to the study setting and the accuracy of diagnosing hypotension because of resource limitations in monitoring patients under anesthesia.

This study revealed an inline incidence of SIH among pregnant

Table 5

Characteristics of pooled predictors of SIH among pregnant mothers in Ethiopia.

Variables	AOR	95% CI	P value
Baseline systolic blood pressure <120 mmHg	4.94	2.30–7.58	< 0.05
Newborn weight	5.373	3.389–7.36	< 0.05
Sensory block height	3.68	0.64–6.72	< 0.05
Duration of crystalloid load before 20 min	18.08	-0.43–36.58	< 0.05
Dose of local anesthetics > 2.5 ml	7.815	6.27–11.56	< 0.05
Speed of injection < 10 sec	4.47	2.35–6.21	< 0.05

CI- confidence interval

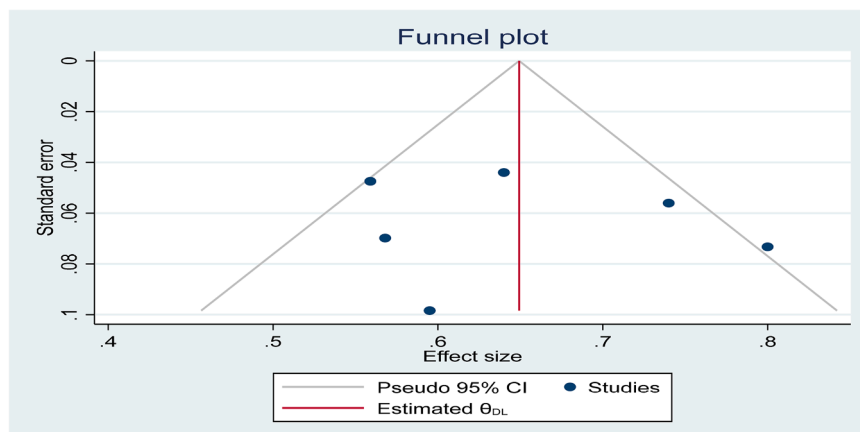


Fig. 6. Funnel plot for the incidence of SIH among pregnant mothers in Ethiopia.

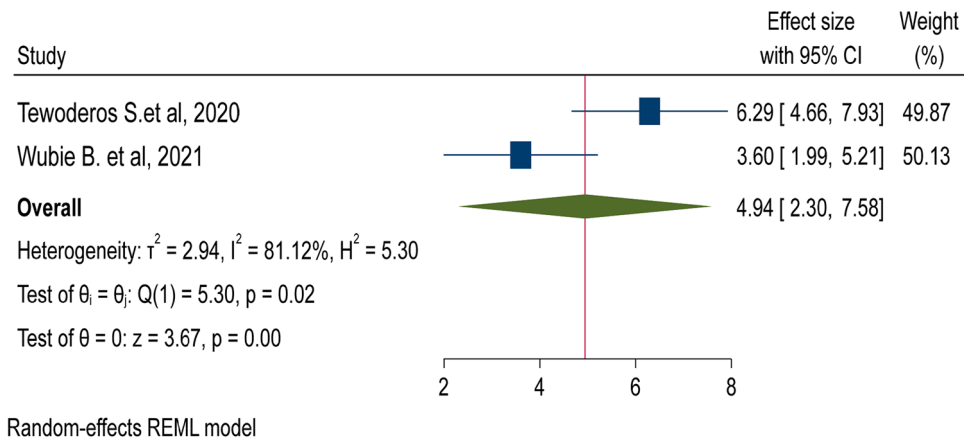


Fig. 7. Frost plot of baseline systolic blood pressure <120 mmHg.

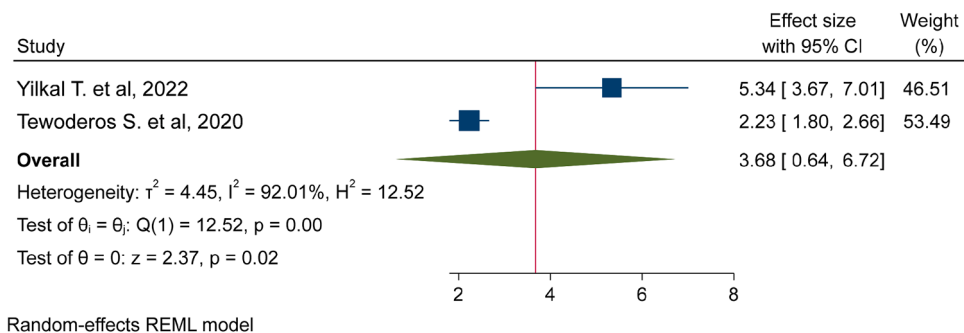


Fig. 8. Frost plot of the sensory block height above T7.

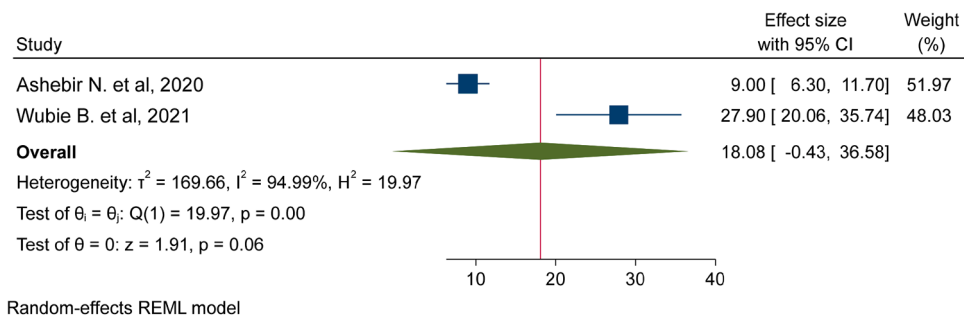


Fig. 9. Frost plot of the duration of crystalloid loading for more than 30 minutes.

mothers who underwent cesarean section under spinal anesthesia in studies conducted in East Africa, Kenya, which was 64%²⁸. These similarities may be due to the same socio-demographic status of the study population and similarity of the study settings.

Pregnant mothers with baseline systolic blood pressure <120 mmHg^{19,20} are at increased risk for SIH among pregnant mothers who undergo cesarean sections under spinal anesthesia in Ethiopia. This finding is supported by findings from Central Europe, Germany²⁹, East Africa, Rwanda³⁰, East Asia, and Taiwan³¹. This might be because pregnant mothers who are indicated for cesarean section may experience preoperative bleeding secondary to rupture of the membrane and uterine contraction.

Newborn weight²⁰ and sensory block height^{18,20} are associated with SIH among pregnant mothers who undergo cesarean sections under spinal anesthesia in Ethiopia. This finding is supported by findings from East Asia and Taiwan³¹. This may be because increased neonatal weight causes aortocaval compression by the gravid uterus, leading to reduced venous return and preloading.

The duration of crystalloid load before 20 min^{19,21} was associated with SIH among pregnant women who underwent cesarean section under spinal anesthesia in Ethiopia. This finding is supported by findings from East Africa, Ethiopia³², East Asia, and South Korea³³. This is because the short half-life (30–60 minutes) of crystalloids results in fast excretion and discrepancy with the time of patient arrival in the operating room and its half-life in the plasma.

A speed of injection < 10 s¹⁹ and a dose of local anesthetics > 2.5 ml²⁰ are associated with SIH among pregnant mothers who undergo cesarean section under spinal anesthesia in Ethiopia. This finding is supported by findings from East Asia, China³⁴, Southeast Asia, and Indonesia³⁵. Europe, France³⁶, and the Middle East, Turkey³⁷. This is because the rapid administration of a local anesthetic agent in the subarachnoid space causes high and total spinal pressure (above T4), which, in turn, causes profound hypotension. Therefore, these patients may require airway control.

4.1. Strengths and limitations of the study

We conducted this systematic review and meta-analysis, including research that met the previously stated criteria in the methodology section, and only considered English-language publications. Publications in the Research Square or organizational repository that had not yet undergone peer review were excluded from each section of this review and meta-analysis, and this type of study is new to the study area. Therefore, these are major strengths of this study. Most of the included studies were cross-sectional and cohort studies with moderate and low levels of evidence. As a result, subsequent single-study findings may differ, and methodological and result reporting biases may exist, which may be limitations of this study.

5. Conclusion

This systematic review and meta-analysis revealed that the pooled incidence of SIH among pregnant mothers who underwent cesarean section under spinal anesthesia in Ethiopia was high. Baseline systolic blood pressure <120 mmHg, newborn weight, sensory block height, duration of crystalloid load before 20 min of spinal anesthesia administration, dose of local anesthetics, and speed of injection were major predictors of SIH.

Implications of the results for health institutions, policy makers, and future research

The results of this systematic review and meta-analysis on SIH among pregnant mothers have potential implications for clinical practitioners, policy makers, and future researchers.

For clinical practitioners; the findings of this study provide important evidence for clinical practitioners working on SIH to address much concern about information dissemination and to detect potential predictors of SIH.

For policy makers; policymakers and program designers should develop strategies to increase knowledge and skills related to SIH among anesthesia professionals. Clinical training concerning patient management of hypotension should be prepared in an updated manner.

For future researchers; the high pooled incidence of SIH among pregnant mothers could be an initiative for further qualitative research to explore barriers to and facilitators of SIH prevention among pregnant mothers in Ethiopia.

Funding

The authors received no specific funding for this work.

Data availability

No datasets were generated or analyzed during the current study.

Declarations ethics approval and consent to participate

As a review of previously published research, ethical approval was neither required nor guaranteed for the study.

Consent for publication

Not applicable.

CRedit authorship contribution statement

Sintayehu Samuel Lorato: Writing – original draft, Software, Formal analysis. **Feleke Doyore Agide:** Formal analysis, Conceptualization. **Genanew Kassie Getahun:** Formal analysis, Conceptualization. **Kedir Seid Yesuf:** Data curation, Conceptualization. **Yohannes Addisu**

Wondimagne: Writing – review & editing, Conceptualization. **Mitiku Desalegn:** Methodology, Conceptualization. **Dawit Tesfaye Rundasa:** Methodology, Conceptualization. **Yohannes Godie:** Methodology, Conceptualization. **Tolasa Yadate:** Methodology, Investigation, Conceptualization. **Yisehak wolde:** Methodology, Formal analysis, Conceptualization. **Eyob Ketema Bogale:** Software, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Sintayehu Samuel reports administrative support and statistical analysis were provided by Wachemo University. Sintayehu Samuel reports a relationship with Wachemo University that includes: employment and non-financial support. Sintayehu Samuel has patent pending to Assignee. No conflict of interest between co-authors to declare. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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