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Pharmacological and Non Pharmacological Labor Pain Management among Licensed Obstetric Care Providers in Ethiopia: Practice Patterns and Predictors from a Systematic Review and Meta-Analysis

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Systematic Review

Keywords: Labor Pain Management, Pharmacological Approaches, Non-Pharmacological Approaches, Respectful Maternity Care, Obstetric Care Providers, Midwifery Practice, Systematic Review, Meta-Analysis, Ethiopia

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Abstract

Background: Labor pain is a distinctive physiological and psychological experience requiring effective management to ensure respectful maternity care. Global guidelines recommend both labor pain management approaches, yet implementation in Ethiopia remains inconsistent. This review assessed the pooled prevalence and predictors of labor pain management practices (LPMPs) among licensed obstetric care providers (OCPs).

Methods: A comprehensive search was conducted across major databases and institutional repositories for studies published between 2018 and 2025. Critical appraisal used the Joanna Briggs Institute checklist and the modified Newcastle–Ottawa Scale. Meta-analysis was performed in STATA 17, with heterogeneity assessed using Cochran's Q and I^2. Pooled adjusted odds ratios (AORs) with 95% CI were calculated, and certainty of evidence rated using GRADE.

Results: Twenty studies were included, comprising 5,272 participants for non-pharmacological LPMP (N-PLPMP) and 3,586 for pharmacological LPMP (P-PLPMP). The pooled prevalence of N-PLPMP was 42.8%, whereas P-PLPMP was 21.1%, decreasing to 15.2% after adjustment for publication bias. Knowledge, favorable attitudes, supportive environments, and managment protocol availability were consistently associated with N-PLPMP. Certainty of evidence was moderate for N-PLPMP and low for P-PLPMP.

Conclusions: Both P&NPLPMPs remain suboptimal. Adoption of standardized protocols, strengthened training, and systemic support is essential to advance evidence-based intrapartum care.

Keywords: Labor Pain Management; Pharmacological Approaches; Non-Pharmacological Approaches; Respectful Maternity Care; Obstetric Care Providers; Midwifery Practice; Systematic Review; Meta-Analysis; Ethiopia

Plain Language Summary

Labor pain is one of the most intense experiences women face during childbirth. Health professionals can help manage this pain using medicines (pharmacological methods) or supportive approaches such as breathing, massage, and relaxation (non-pharmacological methods).

We reviewed 20 studies from Ethiopia to understand how often these methods are used by licensed obstetric care providers. We found that about 43% of providers used non-pharmacological methods, while only about 21% used pharmacological methods. After adjusting for potential bias, the use of medicines may be as low as 15%.

Providers were more likely to use non-pharmacological methods when they had better knowledge, positive attitudes, supportive work environments, clear guidelines, and more clinical experience. There was not enough consistent evidence to identify key factors influencing the use of pharmacological methods.

Overall, labor pain management remains underused in Ethiopia compared with international recommendations. Improving training, ensuring the availability of guidelines, and strengthening workplace support could help more women receive effective and respectful pain relief during childbirth.

Introduction

Labor is a complex physical and emotional experience shaped by physiological stimuli and psychological factors, and is widely regarded as one of the most intense forms of pain in human life (1-3). Its intensity is influenced by maternal age, parity, fetal position, cervical status, emotional context, and sociocultural background (3-5). Psychological stress can heighten pain perception and trigger maternal responses such as hyperventilation, catecholamine release, and increased cardiac workload, which may compromise fetal oxygenation (6). Without continuous intrapartum support, including effective labor pain management (LPM), women face greater risks of prolonged labor, psychological distress, and adverse outcomes (1, 7-10).

According to the American College of Obstetricians and Gynecologists (ACOG), maternal request alone is a sufficient indication for labor analgesia, and withholding pain relief when safe options exist is ethically unacceptable (1). LPM should be tailored to each woman's condition, preferences, and facility capacity, balancing effective analgesia with maternal alertness and fetal safety (1, 7, 11, 12). Approaches include both pharmacological and non-pharmacological methods (1, 5, 13-15). Pharmacological techniques encompass systemic, regional, and inhalational agents(1, 5), with neuraxial methods considered the gold standard (16-19). Systemic opioids and nitrous oxide provide moderate relief (1, 20, 21), but remain limited in low- and middle-income countries (16, 22, 23). Despite their effectiveness, pharmacological labor pain management (P-LPMP) methods may be associated with prolonged labor, instrumental delivery, maternal sedation, neonatal respiratory depression, and delayed breastfeeding, contributing to reluctance among obstetric care providers (OCPs) (24-27).

Non-pharmacological labor pain management (N-PLPM) strategies enhance maternal comfort and coping without directly altering pain pathways (5, 9, 14). Techniques such as breathing exercises, massage, hydrotherapy, movement, acupuncture, acupressure, transcutaneous electrical nerve stimulation (TENS), aromatherapy, and relaxation are safe, cost-effective, consistent with respectful maternity care (RMC) principles, and help reduce unnecessary interventions (5, 7, 13, 14, 28, 29). Evidence shows that methods like massage, positioning, relaxation, and music therapy can shorten labor, alleviate pain, and improve emotional well-being (30-36).

In Ethiopia, P-LPMP methods are infrequently implemented (37). Oral analgesics are occasionally used, while parenteral agents such as pethidine and tramadol are more common but often lack standardized protocols (38, 39). Neuraxial techniques are rare outside tertiary hospitals, and inhalational agents are virtually absent (37-39). In contrast, N-PLPM methods such as breathing exercises, massage, and reassurance are more widely applied, though specialized approaches remain limited to urban or pilot settings (39, 40). Ethiopia lacks a national protocol for LPM, leaving practice dependent on institutional norms, provider discretion, and global recommendations, with persistent challenges including shortages of trained OCPs, negative attitudes, unclear guidelines, and resource constraints (39, 41, 42).

Labor pain profoundly shapes women's perceptions of safety and dignity (8). Poorly managed pain contributes to fear, anxiety, and negative birth experiences, while effective and compassionate relief enhances confidence, supports RMC, and promotes positive outcomes (12, 24). The primary goal of LPM is to provide effective analgesia while safeguarding maternal and fetal well-being (1, 7, 43, 44). Evidence shows that women receiving appropriate LPM report greater satisfaction with skilled delivery care (45). Previous Ethiopian studies often lacked clarity on inclusion criteria (38, 40), did not specify types of LPM applied(42), or included student populations, leading to misestimation of actual practice (38-40, 42). This review assesses trends in LPM practices in relation to COVID-19 and focuses exclusively on licensed OCPs to generate accurate estimates of the prevalence and predictors of both pharmacological and non-pharmacological LPM approaches in Ethiopia between 2018 and 2025.

Methods

Protocol and registration

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (46) (Table S1). The protocol was prospectively registered with the International Prospective Register of Systematic Reviews (PROSPERO; CRD420251242040, 2025).

Eligibility criteria

Study selection was guided by the Condition, Context, and Population (CoCoPop) framework. Eligible studies were full-text articles (published, unpublished, or preprints) employing

observational designs (cross-sectional, case-control, or cohort) that reported the prevalence of LPMPs among licensed OCPs in Ethiopia. Studies were included if they examined P-LPMP, N-LPMP, or overall LPMP, and/or assessed at least one associated factor. Licensed OCPs were defined as midwives, obstetricians, nurses, physicians, anesthetists, health officers, Integrated Emergency Surgical Officers (IESOs), or other skilled personnel directly involved in intrapartum care. Only studies published in English between January 1, 2018, and October 3, 2025, were considered.

Exclusion criteria included studies without relevant prevalence data, anonymous reports, editorials, conference abstracts, inaccessible full texts, or those limited to citations. Studies involving students, systematic reviews, meta-analyses, and qualitative designs were excluded. Research focusing solely on laboring women's knowledge, attitudes, or perceptions of pain relief, or studies outside the labor and delivery context (e.g., neonates, oncology, surgical wards) were also excluded.

Information Sources and Search Strategy

A systematic search was conducted to identify primary studies reporting OCPs' LPMP and associated factors in Ethiopia, from inception to October 3, 2025. Major databases included PubMed, ScienceDirect, Cochrane Library, African Journals Online, Wiley Online Library, Europe PMC, and HINARI**.** Additional sources were ProQuest, Google Scholar, and institutional repositories**.** Search strategies combined MeSH terms and keywords related to obstetric care providers, labor pain management, and associated factors, using Boolean operators ("AND," "OR"). The full PubMed search string and database-specific adaptations are provided in Supplementary Table S2**.**

Study selection

We focused on studies examining the practices, behaviors, and decision-making of licensed OCPs regarding labor pain management. Relevant records were retrieved from multiple electronic databases using predefined search terms and filters. After exporting all records to EndNote (version 20.2.1), duplicates were removed. Two reviewers independently screened titles and abstracts against inclusion criteria, classifying studies as included, excluded, or undetermined. Full texts were obtained for all potentially eligible studies, with discrepancies resolved through discussion (Figure 1).

Data Extraction Process

Two reviewers independently extracted data and assessed risk of bias (ROB) using the Joanna Briggs Institute (JBI) checklist and the modified Newcastle–Ottawa Scale (NOS). Inter-rater reliability was evaluated with the Intraclass Correlation Coefficient (ICC) for numeric scores (47) and Cohen's Kappa for categorical ratings (48). Data were recorded in a structured Excel form. Disagreements were resolved by consensus or adjudication by a third reviewer. Extracted variables included study characteristics (author, year, region, facility type, sampling method, and population), primary outcomes (pharmacological or N-PLPMPs), sample size, and response rate (Table S3).

Outcome Measures

The primary outcomes were the prevalence of pharmacological and N-LPMP among licensed OCPs. In addition, the overall prevalence of LPMP was assessed in studies reporting either or both approaches. For each category, when at least two predictors were evaluated across different studies, we examined associated individual-level (e.g., provider knowledge, attitudes, experience) and organizational-level (e.g., supportive environments, protocol availability) factors influencing practice. Extended analyses of pooled prevalence and predictors are provided in Supplementary Appendix 1.

Quality Assessment and Appraisal of Included Studies

The methodological quality and RoB of included studies were assessed using two complementary tools. The JBI checklist was applied for prevalence and observational studies (49) (Appendex S2), and a NOS tailored for cross-sectional designs was used to address confounding and outcome measurement. The NOS provided a domain-based appraisal framework across selection, comparability, and outcome, with a structured star-based scoring system to facilitate synthesis and comparability (50). All assessments were conducted independently by two reviewers, with discrepancies resolved through discussion or adjudication by a third reviewer. Studies were first scored using the JBI checklist (maximum 9 points), and subsequently reappraised with the NOS. For analytical studies, scores ranged from 0–9 stars, while descriptive studies were scored from 0–4 stars, with higher scores indicating lower RoB. Overall RoB was interpreted as low, moderate, or high according to established thresholds.

Detailed scoring criteria and study-specific ratings are presented in Tables 3–4 and Supplementary Tables S4–S6**.**

Data Synthesis and Statistical Analysis

Effect sizes and standard errors (SE) were calculated for prevalence estimates, and odds ratios (ORs) with corresponding SEs were computed for associated factors (Table S3). Meta-analysis was conducted in STATA version 17 (51), using a weighted inverse variance random-effects model to pool prevalence estimates of pharmacological, non-pharmacological, and overall labor pain management practices, given evidence of heterogeneity (52). When outcomes were not directly reported, they were derived from available data. Heterogeneity was assessed using Higgins' I^2 statistic and Cochran's Q test (53). To further investigate potential sources of heterogeneity, we constructed a Galbraith (radial) plot (54). Potential sources of heterogeneity were explored through meta-regression (55) (e.g., region, sample size, study period, setting, health sector, publication year, sampling method) and subgroup analyses (56). Publication bias was evaluated using funnel plots (57), Egger's regression test (58) and Begg's rank correlation (59); when asymmetry was detected, trim-and-fill analysis was applied test was performed to assess whether there was a systematic association between effect sizes and their variances (or standard errors) (60). For pooled ORs derived from ≥10 studies, publication bias was reassessed using both visual and statistical methods. Sensitivity analyses were performed by sequentially excluding individual studies (61). Results were presented using forest plots for pooled prevalence and associated factors, with 95% confidence intervals (CI) (62). Random-effects models were applied when heterogeneity was substantial; otherwise, fixed-effect models were used (63). Agreement between JBI and NOS risk-of-bias assessments was summarized descriptively and visualized with heatmaps and bar graphs (64). Extended statistical outputs are provided in Supplementary Tables and Figures**.**

Certainty of Evidence Assessment (GRADE Framework)

The certainty of evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework (65). Judgments were made after completing all synthesis procedures, including RoB appraisal, meta-analysis, heterogeneity testing, publication bias assessment, meta-regression, sensitivity analyses, and subgroup analyses.

Certainty ratings were conducted separately for prevalence estimates and associated factors across pharmacological, N-LPMP, and overall LPMP. Evidence was evaluated across five domains: RoB, inconsistency, indirectness, imprecision, and publication bias. Downgrades were applied when methodological limitations, substantial heterogeneity, indirect outcomes, wide confidence intervals, or confirmed publication bias were present. Upgrades were considered when findings demonstrated consistency (low heterogeneity, similar effect sizes) and precision (narrow confidence intervals, reliable pooled estimates). Detailed domain-specific ratings are provided in Supplementary Tables 8a–e**.**

Results

Study screening and selection

A total of 912 records were identified between January 1, 2018, and October 3, 2025. Of these, 397 were retrieved from bibliographic databases, including PubMed (n = 46), ScienceDirect (n = 85), Cochrane Library (n = 40), AJOL (n = 35), Wiley Online Library (n = 105), Europe PMC (n = 24), and HINARI (n = 62). An additional 515 records were obtained from grey literature sources, including ProQuest (n = 149), Google Scholar (n = 362), and institutional repositories (n = 4). After removing 189 duplicates, 723 articles remained for title and abstract screening. Of these, 491 were excluded, leaving 232 for full-text review. Following assessment, 212 were excluded for reasons such as focus on women's perceptions of labor pain, studies conducted outside Ethiopia, publication before 2018, outcomes not including LPMP, student populations, systematic reviews, or non-maternal study groups. Ultimately, 20 studies (66-85) met eligibility criteria for inclusion in this systematic review and meta-analysis. The PRISMA flow diagram illustrates the selection process from identification to final inclusion (86) (Figure 1).

Characteristics and narrative synthesis of the included studies

Of the twenty studies included, 15 investigated N-PLPMP with 5,272 participants and 11 examined P-PLPMP with 3,587 participants, yielding 6,905 enrolled individuals and a 95.9% response rate. The combined calculated sample size was 7,202 (Table S3). Sample sizes ranged from 112 at Debre Markos Comprehensive Specialized Hospital in Amhara (79) to 592 in the same region (67). Nineteen studies were multi-facility (66-78, 80-85), while one was single-center (79). Analytical cross-sectional design predominated (n = 19) (66-78, 80-85), with two enriched by qualitative findings (78, 83); one study used a descriptive cross-sectional design

(79). Geographically, 35% were conducted in Amhara region (66, 67, 72, 73, 79, 82, 83), four in the Southern Nations, Nationalities, and Peoples' Region (SNNPR) (77, 78, 80, 84), three each in Oromia (74, 75, 85) and Harari (68, 69, 81), two in Sidama (70, 76) and one in Addis Ababa (71). Twelve studies (60%) collected data during COVID-19 (2020–2022) (66, 68, 69, 71, 74-76, 78-82), seven before (2017–2019) (67, 70, 72, 73, 77, 84, 85), and ne after (2024) (83). Nineteen studies (95%) included diverse OCPs (midwives, obstetricians, nurses, public health officers, IESOs, anesthesiologists) (66-79, 81-85), while one focused solely on midwives (80). Eight employed probability sampling (66, 67, 72, 74-78); twelve used non-probability methods (68-71, 73, 79-85). Eleven studies spanned hospitals and health centers (66-70, 74, 75, 77, 78, 81, 84); eight were hospital-only (71, 73, 76, 79, 80, 82, 83, 85); one was health-center-only (72). Seventeen studies were conducted in public facilities (66, 67, 70-72, 74-85), and three across public and private (68, 69, 73). All studies (66-85) reported LPMP prevalence. Overall prevalence ranged from 32.7% (80) to 78.4% (68). Fifteen studies (66-68, 70, 72, 73, 76-78, 80-85) contributed to pooled N-PLPMP analysis, with prevalence from 23.7% (76) to 67.9% (81); six reported N-PLPMP as a primary outcome (67, 68, 77, 80, 82, 83). Eleven studies (66, 69-73, 76, 78, 81, 84, 85) contributed to pooled P-PLPMP analysis, with prevalence from 4.6% (66) to 50.9% (69); two reported P-PLPMP as a primary outcome (69, 71) (Table 1).

Eighteen studies identified predictors of the overall LPMP (66-78, 80-84). Seventeen (66, 67, 69-78, 80-84) used logistic regression and contributed to pooled adjusted odds ratios (AORs) for the overall LPMP (Sup. Appendix 1). Ten examined both P- and N-PLPMP (66, 70, 72-76, 78, 81, 84) five focused on N-PLPMP (67, 77, 80, 82, 83); two assessed P-PLPMP predictors (69, 71) but lacked overlapping factors for pooled AORs. One study used linear regression (68), one reported crude odds ratios only (85) and one did not assess predictors (79) (Table 2).

Table 1: Characteristics of included studies for the systematic review and meta-analysis of pharmacological and N-PLPM among licensed OCPs in Ethiopia 2025.

First author	Publication year	Data collection period	Study area	Sampling method	Type of health facility	Type of health sector	Sample size		LPMP (%)		
							Calculated	Achieved	Overall	NPLPM	PLPM
Shiferaw A et al (66)	2022	During COVID19	Amhara	PS	HPs and HCs	Public	323	305	48.9	41.3	4.6
Getu AA et al (67)	2020	Before COVID19	Amhara	PS	HPs & HCs	Public	605	592	46.8	46.8	
Eyeberu A et	2022	During	Harari	N-PS	HPs &	Both	464	464	59.3	59.3	

al (68)		COVID19			HCs						
Eyeberu A et al (69)	2023	During COVID19	Harari	N-PS	HPs & HCs	Both	464	464	50.9		50.9
Wakgari N et al (70)	2020	Before COVID19	Sidama	N-PS	HPs & HCs	Public	306	305	56.1	53.1	12.5
Gido R et al (71)	2021	During COVID19	AA	N-PS	HPs	Public	427	391	36.6		36.6
Bishaw AK et al (72)	2020	Before COVID19	Amhara	PS	HCs	Public	309	299	34.4	30.4	8.4
Solomon ET et al (73)	2021	Before COVID19	Amhara	N-PS	HPs	Both	363	336	57.1	48.8	45.2
Melesse GT et al (74)	2021	During COVID19	Oromia	PS	HPs & HCs	Public	280	268	43.3		
Terfasa EA et al (75)	2022	During COVID19	Oromia	PS	HPs & HC	Public	399	398	46		
Alelgn Y et al (76)	2022	During COVID19	Sidama	PS	HPs	Public	376	346	41.3	23.7	17.6
Wassihun B et al (77)	2022	Before COVID19	SNNPR	PS	HPs & HCs	Public	283	272	37.5	37.5	
Foto LL et al (78)	2023	During COVID19	SNNPR	PS	HPs and HCs	Public	421	386	37.1	28.2	25.1
Ganta M et al (80)	2021	During COVID19	SNNPR	N-PS	HPs	Public	415	401	32.7	32.7	
Wondimu L et al (81)	2024	During COVID19	Harari	N-PS	HPs & HCs	Public	250	234	69.7	67.9	7.7
Mekete D et al (82)	2025	During COVID19	Amhara	N-PS	HPs	Public	418	411	42.8	42.8	
Adem M et al (83)	2024	After COVID19	Amhara	N-PS	HPs	Public	416	400	50.5	50.5	
Geltore TE et al (84)	2018	Before COVID19	SNNPR	N-PS	HP & HCs	Public	366	340	37.9	32.1	17.4
Biratu M et al (85)	2019	Before COVID19	Oromia	N-PS	HPs	Public	205	181	55.2	48.1	7.2
Melesse AS et al (79)	2022	During COVID19	Amhara	N-PS	HP	Public	112	112	57.1		

321 AA = Addis Ababa, PS = probability sampling, N-PS = non-probability sampling, HPs =
322 Hospitals, and HCs = Health centers

323 **Table 2:** Characteristics of predictors in included studies for the systematic review and meta-
324 analysis of pharmacological and N-PLPM among licensed OCPs in Ethiopia 2025.

First author	Outcome	Predictors analyzed	Associated predictors
Shiferaw A et al (66)	Overall LPMP	For the overall LPMP	Knowledge, availability of drug and equipment and allow companionship
Getu AA et al (67)	N-PLPM	For the N-PLPM	Knowledge, attitude, availability of LPM protocol, and age of OCPs
Eyeberu A et	N-PLPM	Linear regression	Sex of OCPs, clinical experience, knowledge and attitude

al (68)		for the N-PLPMP	(but they used Linear Regression)
Eyeberu A et al (69)	P-LPM	For the P-LPMP	Training on LPM, attitude and sex of OCPs
Wakgari N et al (70)	Overall LPMP	For the overall LPMP	Profession, work experience, and level of qualification
Gido R et al (71)	P-LPM	For the P-LPMP	Knowledge, work experience and availability of analgesics
Bishaw AK et al (72)	Overall LPMP	For the overall LPMP	Knowledge, attitude, and experience of OCPs
Solomon ET et al (73)	Overall LPMP	For the overall LPMP	Working at private primary hospitals
Melesse GT et al (74)	Overall LPMP	For the overall LPMP	Knowledge and thought of pharmacologic obstetric analgesia have effect on the labor
Terfasa EA et al(75)	Overall LPMP	For the overall LPMP	Sex of OCPs, heard of the World Health Organization pain ladder, attitude, expectation labor pain, having training on LPM and presence of chance for mothers to prefer labor pain management methods in the facility
Alelgn Y et al (76)	Overall LPMP	For the overall LPMP	Knowledge, level of qualification, availability of drugs, and training on labor analgesia
Wassihun B et al (77)	N-PLPM	For the N-PLPM	Clinical work experience, profession, attitude, and working in satisfactory delivery room
Foto LL et al (78)	Overall LPMP	For the overall LPMP	Profession, work experience, attitude, availability of medicines, and place of storage of the medicines
Ganta M et al (80)	N-PLPM	For the N-PLPM	Attitude, knowledge, workload, history of serving as head midwife, age ≥ 31, and receiving in-service training
Wondimu L et al (81)	Overall LPMP	For the overall LPMP	Sex of OCPs, having a positive perception, being a physician, being a midwife, and being a highly qualified OCPs
Mekete D et al (82)	N-PLPM	For the N-PLPM	Work experience, pain expectation**,** presence of management protocol, knowledge, and attitude
Adem M et al (83)	N-PLPM	For the N-PLPM	Knowledge, and attitude towards LPM
Geltore TE et al (84)	Overall LPMP	For the overall LPMP	Knowledge, attitude, and availability of labor analgesia
Biratu M et al (85)	Overall LPMP	Only COR	Not adjusted
Melesse AS et al (79)	Overall LPMP	Not done	None

Quality Appraisal, Risk of Bias, and Reliability

Inter-rater reliability analyses showed acceptable consistency for JBI scores, with moderate agreement for individual ratings (ICC = 0.62; 95% CI: 0.26–0.83) and good agreement for the average of two reviewers (ICC = 0.76; 95% CI: 0.41–0.91; $F(19,19) = 4.22$, $p = 0.001$). Categorical agreement was perfect ($\kappa = 1.00$). For NOS xs scores, reliability was excellent (individual ICC = 0.90; average ICC = 0.95; $F(18,18) = 17.32$, $p < 0.001$), with categorical

agreement also perfect (κ = 1.00). One study assessed with NOS xs2 scored 2/4, indicating moderate risk (Table S7).

Based on JBI, 18 studies (66-78, 80-84) were rated low risk and high quality (five scored 9/9, twelve 8/9, one 7/9), while two scored 4/9 and were moderate risk (79, 85). Overall, 90% of studies were high quality and 10% moderate (Table 3; Table S4). Using the modified NOS framework, three studies (77, 80, 83) scored 7/9 stars (low risk), while 17 scored 5–6 stars (moderate risk) (66-76, 78, 79, 81, 82, 84, 85). The descriptive NOS-xs2 study (79) scored 2/4 stars, also moderate risk.

Across frameworks, 15 studies were low risk by JBI but moderate risk by NOS; three were consistently low risk, and two consistently moderate risk; none were classified as high risk (Figure 2; Figure S1). NOS appraisal further revealed that six studies (68, 69, 72, 79, 84, 85), lacked a justified a priori sample size, undermining statistical power and limiting control for confounders (Tables 4; Tables S5–S6).

Table 3: JBI Critical Appraisal Checklist for included studies in the systematic review and meta-analysis of pharmacological and N-PLPM among licensed OCPs in Ethiopia 2025.

Authors and year of publication	JBI's critical appraisal questions									Quality score (100%)	Risk of bias	Included
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9			
Shiferaw A et al., 2022 (66)	Y	Y	Y	Y	Y	Y	U	Y	Y	88.9	Low	√
Getu AA et al., 2020 (67)	Y	Y	Y	Y	Y	Y	U	Y	Y	88.9	Low	√
Eyeberu A et al., 2022 (68)	Y	Y	Y	Y	Y	Y	U	Y	Y	88.9	Low	√
Eyeberu A et al., 2023 (69)	Y	Y	Y	Y	Y	Y	U	Y	Y	88.9	Low	√
Wakgari N et al., 2020 (70)	Y	Y	Y	Y	Y	Y	U	Y	Y	88.9	Low	√
Gido R et al., 2021 (71)	Y	Y	Y	Y	Y	Y	U	Y	Y	88.9	Low	√
Bishaw AK et al., 2020 (72)	Y	Y	Y	Y	Y	Y	U	Y	Y	88.9	Low	√
Solomon ET et al., 2021 (73)	Y	Y	Y	Y	Y	Y	U	Y	Y	88.9	Low	√
Melesse GT et al., 2021 (74)	Y	Y	Y	Y	Y	Y	N	N	Y	77.8	Low	√
Terfasa EA et al, 2022 (75)	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	Low	√
Alelgn Y et al., 2022 (76)	Y	Y	U	Y	Y	Y	Y	Y	Y	88.9	Low	√
Wassihun B et al., 2022 (77)	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	Low	√
Foto LL et al., 2023 (78)	Y	Y	Y	Y	Y	Y	Y	N	Y	88.9	Low	√

Ganta M et al., 2021 (80)	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	Low	√
Wondimu L et al., 2024 (81)	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	Low	√
Mekete D et al., 2025 (82)	Y	Y	Y	Y	Y	Y	Y	Y	Y	100	Low	√
Adem M et al., 2024 (83)	Y	Y	Y	Y	Y	Y	Y	N	Y	88.9	Low	√
Geltore TE et al., 2018 (84)	Y	Y	Y	Y	Y	Y	Y	Y	Y	88.9	Low	√
Biratu M et al., 2019 (85)	Y	Y	U	Y	N	N	U	N	Y	44.4	Moderate	√
Melesse AS et al., 2022 (79)	Y	Y	U	Y	N	N	U	U	Y	44.4	Moderate	√

Where: Q: Question, Y: Yes =1 point, N: No =0 points, U: Unclear =0 points. The total score was calculated by counting the number of "Yes" responses in each row and presented as a percentage (% score = (total Yes ÷ 9) × 100). Q1: Were the criteria for inclusion in the sample clearly defined? Q2: Were the study subjects and the setting described in detail? Q3: Was the exposure measured in a valid and reliable way? Q4: Were objective, standard criteria used for measurement of the condition? Q5: Were confounding factors identified? Q6: Were strategies to deal with confounding factors stated? Q7: Were outcomes measured in a valid and reliable way? Q8: Was an appropriate statistical analysis used? Q9: Was the response rate adequate, and if not, was the low response rate managed appropriately?

Table 4: Modified NOS-based RoB (NOS-xs and NOS-xs2) for cross-sectional prevalence and association studies assessment checklist for the systematic review and meta-analysis pharmacological and N-PLPM and its predictors factors in Ethiopia, 2025.

Authors and year of publication	Domain one		Domain two		Domain three		Awarded stars	Risk of bias	Included
	I1	I2	I3*	I4	I5*	I6*			
Shiferaw A et al., 2022 (66)	★	★	★	★	★	★	6	Moderate	√
Getu AA et al., 2020 (67)	★	★	★	★	★	★	6	Moderate	√
Eyeberu A et al., 2022 (68)	★	—	★	★	★	★	5	Moderate	√
Eyeberu A et al., 2023 (69)	★	—	★	★	★	★	5	Moderate	√
Wakgari N et al., 2020 (70)	★	★	★	★	★	★	6	Moderate	√
Gido R et al., 2021 (71)	★	★	★	★	★	★	6	Moderate	√
Bishaw AK et al., 2020 (72)	★	—	★	★	★	★	5	Moderate	√
Solomon ET et al., 2021 (73)	★	★	★	★	★	★	6	Moderate	√
Melesse GT et al., 2021 (74)	★	★	★	★	★	★	6	Moderate	√
Terfasa EA et al, 2022 (75)	★	★	★	★	★	★	6	Moderate	√
Alelgn Y et al., 2022 (76)	★	★	★	★	★	★	6	Moderate	√
Wassihun B et al., 2022 (77)	★	★	★	★★	★	★	7	Low	√
Foto LL et al., 2023 (78)	★	★	★	★	★	★	6	Moderate	√
Ganta M et al., 2021 (80)	★	★	★	★★	★	★	7	Low	√

Wondimu L et al., 2024 (81)	★	★	★	★	★	★	6	Moderate	√
Mekete D et al., 2025 (82)	★	★	★	★	★	★	6	Moderate	√
Adem M et al., 2024 (83)	★	★	★	★★	★	★	7	Low	√
Geltore TE et al., 2018 (84)	★	—	★	★	★	★	5	Moderate	√
Biratu M et al., 2019 (85)	★	—	★	★	—	★	4	Moderate	√
Melesse AS et al., 2022 (79)	★	—	NA	★	NA	NA	2	Moderate	√

Where: *: not applicable for prevalence study, NA: not applicable for the prevalence studies, I: Item, ★: =1 point, ★★ =2 points, —: 0 points. I1: Was the study sample being truly/somewhat representative of the target population? I2: Was the sample size justified and satisfactory? I3: Was the study employed gold standard/acceptable and validated tools for the exposure? I4: Was the study employed gold standard/ acceptable and validated tools for the outcome? I5: Were the study estimates adjusted for all the most important confounding factors, and not adjusted for potential mediator(s)? or adjusted for all the most important confounding factors, but also for potential mediator(s)/adjusted for some but not all the most important confounding factors? I6: Were most of the confounding factors controlled for measured through gold standard/ acceptable assessment methods?

Meta-analysis

Non-Pharmacological LPMPs among Licensed Obstetric Care Providers

The pooled prevalence of LPMP among licensed OCPs was 46.93% (95% CI: 42.73–51.14), with substantial heterogeneity ($I^2 = 92.35\%$, $p < 0.001$) (66-85) (Spp. Appendix 1).

Based on fifteen studies (66-68, 70, 72, 73, 76-78, 80-85), the pooled prevalence of N-PLPMP was 42.82% (95% CI: 36.58–49.06; $I^2 = 95.7\%$, $p < 0.001$) (Figure 3). A random-effects model was applied given the high heterogeneity. The Galbraith plot showed most studies within the 95% CIs, consistent with pooled estimates, though scatter around the regression line confirmed substantial variability (Figure 4). To explore sources of heterogeneity, meta-regression, sensitivity, and subgroup analyses were conducted by data collection period, sample size, region, setting, sector, sampling method, publication status, and year.

Meta-Regression of the N-PLPMP

To explore heterogeneity in the pooled prevalence of N-PLPMP, a random-effects meta-regression was conducted using fifteen studies (66-68, 70, 72, 73, 76-78, 80-85). Six study-level covariates were assessed: publication status, health sector type, sampling method,

sample size category, publication year, and NOS-based risk of bias. The model explained only 3.7% of between-study variance (R^2), indicating minimal contribution of these covariates. Residual variation remained high (I^2 = 95.3%), suggesting unmeasured factors accounted for most heterogeneity. Among covariates, non-probability sampling was associated with significantly higher adjusted prevalence (β = +14.93%; 95% CI: 0.81–29.05; p = 0.038). Other factors, including publication status, sector type, sample size, year, and RoB score, showed no significant associations. The intercept indicated an estimated prevalence of 34.1% for the reference group. These findings highlight that unexplored study-level characteristics may drive variability across included studies (Table 5).

Table 5: Meta-regression results for covariates of the N-PLPMP among OCPs in Ethiopia, 2025

Covariates	Category	No of studies	Coefficient (β)	Std. errs.	z	P-value	95% CI
Publication status	Published	11					
	Unpublished	4	− 5.67	9.182304	−0.62	0.537	−23.67 to 12.32
Type of health sector	Both public & private	2					
	Only public	13	− 3.99	10.547	−0.38	0.705	−24.66 to 16.68
Sampling methods	Probability	6					
	Non-probability	9	+ 14.93	7.204659	2.07	0.038	0.81 to 29.05
Sample size	<384	9					
	≥384	6	+0.57	7.536953	0.08	0.940	−14.2 to 15.34
Year of publication	≤2021 -2018	7					
	>2021	8	+ 5.32	6.741511	0.79	0.430	−7.89 to 18.54
NOS- based RoB	Low	3					
	Moderate	12	+ 2.09	9.002356	0.23	0.816	−15.55 to 19.74
_Cons (Intercept)			34.10	16.07642	2.12	0.034	2.59 to 65.61

Sensitivity analysis

A leave-one-out sensitivity analysis under a random-effects model showed that exclusion of any single study did not materially alter the pooled estimate of N-PLPMP, confirming the robustness of the overall findings (Figure 5).

Sub-group analysis of N-PLPMP

Prevalence of N-PLPMP varied by region, highest in Harari at 63.36% (95% CI: 54.95–71.78; I^2 = 80.4%, p < 0.001) and lowest in SNNPR at 32.35% (95% CI: 28.77–35.93; I^2 = 52.8%, p <

0.001). Estimates were comparable in Amhara [43.48% (95% CI: 37.88–49.09; I^2 = 87.2%, p < 0.001)] and Sidama [38.35% (95% CI: 9.54–67.16; I^2 = 98.5%, p < 0.001)], while a single study in Oromia reported 48.07%. No significant difference was observed before (42.33%; 95% CI: 35.68–48.99; I^2 = 90.9%, p < 0.001) and during the COVID-19 pandemic (42.21%; 95% CI: 30.57–53.86; I^2 = 97.5%, p < 0.001). One post-pandemic study (2024) reported 50.5%.

By facility type, prevalence was higher in studies spanning hospitals and health centers (45.74%; 95% CI: 36.48–55.00; I^2 = 96.4%, p < 0.001) compared to hospital-only (40.98%; 95% CI: 31.97–50.00; I^2 = 94.7%, p < 0.001); one health-center-only study reported 30.4%. Prevalence was also higher in studies across public and private facilities (54.16%; 95% CI: 43.87–64.44; I^2 = 88.5%, p < 0.001) than in public-only facilities (41.07%; 95% CI: 34.67–47.47; I^2 = 95.2%, p < 0.001). Sample size had little effect: <384 (42.46%; 95% CI: 33.48–51.43; I^2 = 95.9%) vs. ≥384 (43.38%; 95% CI: 34.17–52.59; I^2 = 96.0%). Non-probability sampling yielded higher prevalence (48.31%; 95% CI: 40.62–56.00; I^2 = 94.9%) than probability sampling (41.97%; 95% CI: 38.33–45.61; I^2 = 93.3%). Published studies reported slightly higher prevalence (43.94%; 95% CI: 36.32–51.56; I^2 = 96.1%) than unpublished ones (39.72%; 95% CI: 28.64–50.79; I^2 = 94.6%). By year, studies from 2018–2021 reported 41.61% (95% CI: 34.60–48.63), while those from 2022–2025 reported 43.86% (95% CI: 33.49–54.23), both with substantial heterogeneity (I^2 > 90%, p < 0.001) (Table 6; Figures S2a-h).

Table 6: Subgroup analysis of the N-PLPMP among OCPs in Ethiopia, 2025

Groups	Outcome	Sub-group	No. of studies	Sample size	Model	Subgroup effect estimate	I^2 (%)	P-value
Region	N-PLPMP	Amhara	6	2343	Random	43.48% (CI: 37.88-49.09)	87.2%	<0.001
		SNNPR	4	1399	Random	32.35% (CI: 28.77-35.93)	52.8%	0.100
		Sidama	2	651	Random	38.35% (CI: 9.54-67.16)	98.5%	<0.001
		Harari	2	698	Random	63.36% (CI: 54.95–71.78)	80.4%	<0.020
Data collection year	N-PLPMP	Prior to COVID-19	7	2325	Random	42.33% (CI: 35.68–48.99)	90.9%	<0.001
		During COVID-19	7	2547	Random	42.21% (CI:30.57–53.86)	97.5%	<0.001
Type of health facility	N-PLPMP	Both hospitals and health centers	8	2898	Random	45.74% (CI: 36.48–55.0)	96.4%	<0.001
		Only hospitals	6	2075	Random	40.98% (CI: 31.97–50.0)	94.7%	<0.001
Health sector	N-PLPMP	Only public health facilities	13	4472	Random	41.07% (CI: 34.67–47.47)	95.2%	<0.001

		Both public and private health facilities	2	800	Random	54.16% (CI: 43.87–64.44)	88.5%	<0.001
Sample size	N-PLPMP	<384	9	2618	Random	42.46% (CI: 33.48–51.43)	95.9%	<0.001
		≥384	6	2654	Random	43.38% (CI: 34.17–52.59)	96.0%	<0.001
Sampling method	N-PLPMP	Probability sampling	6	2200	Random	34.64% (CI: 26.99-42.28)	93.3%	<0.001
		Non-probability sampling	9	3072	Random	48.31% (CI: 40.62 56.0)	94.9%	<0.001
Publication status	N-PLPMP	Published	4	1368	Random	43.94% (CI:36.32-51.56)	96.1%	<0.001
		Unpublished	11	3904	Random	39.72% (CI:28.64-50.79)	94.6%	<0.001
Publication year	N-PLPMP	2018-2021	7	2454	Random	41.61% (CI: 34.60-48.63)	92.4%	<0.001
		2022-2025	8	2818	Random	43.86% (CI: 33.49-54.23)	97.1%	<0.001

Publication bias among the studies for the N-PLPMP

Visual inspection of the funnel plot showed modest asymmetry, with five studies to the left, four within, and six to the right of the pseudo 95% confidence funnel (Figure 6). This imbalance suggested possible asymmetry, but Egger's regression test found no significant small-study effects ($\beta_0 = 16.97$; $p = 0.420$) (Table 7). Begg's rank correlation likewise showed no evidence of bias (Kendall's tau = 0.2381; $p = 0.2350$). Overall, the observed asymmetry is unlikely to reflect systematic small-study effects or selective reporting, indicating low risk of publication bias in pooled N-PLPMP estimates.

Table 7: Egger's test for the N-PLPMP among OCPs in Ethiopia, 2025

Egger's test						
Std_Eff	Coefficient	Std. Err.	Z-value	P>|z|	95% confidence interval	
					Lower	Upper
Slope (β_1)	9.84	7.91	1.24	0.214	–5.67	25.35
Intercept (β_0)	16.97	21.02	0.81	0.420	–24.23	58.17

Pharmacological LPMPs among Licensed Obstetric Care Providers

Eleven studies (66, 69-73, 76, 78, 81, 84, 85) were included in the pooled analysis of P-LPMP, yielding a prevalence of 21.10% (95% CI: 12.46–29.74; $I^2 = 98.3\%$, $p < 0.001$) (Figure 7). A random-effects model was applied due to significant heterogeneity. The Galbraith plot indicated

that most studies fell within the 95% CIs, with no extreme outliers, though the wide scatter and high I^2 confirmed substantial variability (Figure 8). To explore sources of heterogeneity, meta-regression, sensitivity, and subgroup analyses were conducted based on study-level characteristics, including data collection period, sample size, geographic region, setting, sector, sampling method, publication status, and year.

Meta-Regression of the P-LPMP

A random-effects meta-regression of eleven studies (66, 69-73, 76, 78, 81, 84, 85) examined five study-level variables: publication status, health sector type, sampling method, sample size, and publication year. The model explained 86.6% of between-study variance (R^2), with residual heterogeneity remaining substantial ($I^2 = 90.7\%$). The overall model was statistically significant (Wald $\chi^2 = 61.94$; $p < 0.001$), indicating that covariates accounted for a meaningful proportion of variability. Two covariates were significant. Studies conducted exclusively in public health facilities reported lower adjusted prevalence of P-LPMP ($\beta = -26.24\%$; 95% CI: −37.54 to −14.95; $p < 0.001$), while studies with sample sizes >384 participants reported higher prevalence ($\beta = +19.71\%$; 95% CI: 10.29–29.13; $p < 0.001$). Publication status, sampling method, and year were not significant ($p > 0.05$). The intercept indicated an estimated prevalence of 40.6% for the reference group. These findings suggest that study setting and sample size are key contributors to variability in reported P-LPMP (Table 8).

Table 8: Meta-regression results for covariates of the P-LPMP among OCPs in Ethiopia, 2025

Covariates	Category	No of studies	Coefficient (β)	Std. errs.	z	P-value	95% CI
Publication status	Published	9					
	Unpublished	2	− 5.39	5.257941	−1.02	0.305	−15.69 to 4.92
Type of health sector	Both public & private	2					
	Only public	9	− 26.24	5.763418	−4.55	<0.001	−37.54 to −14.95
Sampling methods	Probability	4					
	Non-probability	7	−0.38	4.773004	−0.08	0.937	−9.73 to 8.98
Sample size	<384	8					
	≥384	3	+ 19.71	4.806366	4.10	<0.001	10.29 to 29.13
Year of publication	≤2021 -2018	6					
	>2021	5	−5.10	4.479599	−1.14	0.225	−13.88 to 3.68
_Cons (Intercept)			40.63	5.358122	7.58	<0.001	30.13 to 51.14

Sensitivity analysis

Leave-one-out sensitivity analysis under a random-effects model showed that exclusion of any single study did not significantly alter the pooled P-LPMP, confirming the stability of the overall result (Figure 9).

Sub-group analysis of P-LPMP

Subgroup analyses showed variation in P-LPMP prevalence across study characteristics. By region, Harari reported the highest prevalence (29.27%, 95% CI: −13.06–71.61; $I^2 = 99.5\%$, $p < 0.001$), while Sidama reported the lowest (14.99%, 95% CI: 9.99–19.99; $I^2 = 70.1\%$, $p < 0.001$). Estimates in Amhara (19.23%, 95% CI: 0.38–38.08; $I^2 = 98.9\%$) and SNNPR (21.21%, 95% CI: 13.66–28.75; $I^2 = 25.1\%$) were close to the overall pooled prevalence, whereas single studies in Addis Ababa (36.6%) and Oromia (7.20%) precluded pooled estimates. Prevalence was slightly higher during the COVID-19 pandemic (23.68%, 95% CI: 9.74–37.62; $I^2 = 98.8\%$) compared to pre-pandemic studies (18.00%, 95% CI: 7.03–28.97; $I^2 = 97.5\%$), with no post-pandemic data available. By setting, hospital-based studies reported 26.58% (95% CI: 9.90–43.26; $I^2 = 98.3\%$), compared to 19.63% (95% CI: 7.36–31.90; $I^2 = 98.6\%$) in studies spanning hospitals and health centers; one health-center-only study reported 8.4%. Studies across public and private facilities showed markedly higher prevalence (48.22%, 95% CI: 42.65–53.80; $I^2 = 60.7\%$) than public-only facilities (15.11%, 95% CI: 9.06–21.15; $I^2 = 96.1\%$).

Sample size influenced estimates: >384 participants yielded 37.52% (95% CI: 22.56–52.48; $I^2 = 96.9\%$), compared to 14.89% (95% CI: 7.94–21.85; $I^2 = 96.8\%$) in smaller studies. Non-probability sampling produced higher prevalence (25.29%, 95% CI: 12.26–38.31; $I^2 = 98.6\%$) than probability sampling (13.79%, 95% CI: 5.12–22.46; $I^2 = 96.3\%$). Publication status also contributed to variability, with published studies reporting 22.22% (95% CI: 12.02–32.42; $I^2 = 98.5\%$) compared to 16.12% (95% CI: −1.42–33.66; $I^2 = 97.3\%$) in unpublished studies, the latter showing greater uncertainty. By year, prevalence was consistent between 2018–2021 (21.10%, 95% CI: 9.96–32.24) and 2022–2025 (21.11%, 95% CI: 6.13–36.09), both aligning with the overall pooled prevalence of 21.10% (95% CI: 12.46–29.74) (Table 9; Figures S3a-h).

Table 9: Subgroup analysis of the P-LPMP among OCPs in Ethiopia, 2025

Groups	Outcome	Sub-group	No. of studies	Sample size	Model	Subgroup effect estimate	I^2	P-value

Region	P-LPMP	Amhara	3	940	Random	19.23% (CI: 0.38-38.08)	98.9%	<0.001
		SNNPR	2	726	Random	21.21% (CI: 13.66-28.75)	25.1%	0.100
		Sidama	2	651	Random	14.99% (CI: 9.99-19.99)	70.1%	<0.001
		Harari	2	698	Random	29.27% (CI: -13.06-71.61)	99.5%	<0.020
Data collection year	P-LPMP	Prior to COVID-19	5	1461	Random	18.0% (CI:7.03–28.97)	97.5%	<0.001
		During COVID-19	6	2126	Random	23.68% (CI: 9.74–37.62)	98.8%	<0.001
Type of health facility	P-LPMP	Both hospitals and health centers	6	2034	Random	19.63% (CI: 7.36–31.90)	98.6%	<0.001
		Only hospitals	4	1254	Random	26.58% (CI: 9.90–43.26)	98.3%	<0.001
Health sector	P-LPMP	Only public health facilities	9	2787	Random	15.11% (CI: 9.06–21.15)	96.1%	<0.001
		Both public and private health facilities	2	800	Random	48.22% (CI: 42.65–53.80)	60.7%	<0.001
Sample size	P-LPMP	<384	8	2346	Random	14.89% (CI: 7.94–21.85)	96.8%	<0.001
		≥384	3	1241	Random	37.52% (CI: 22.56–52.48)	96.9%	<0.001
Sampling method	P-LPMP	Probability sampling	4	1336	Random	13.79% (CI: 5.12-22.46)	96.3%	<0.001
		Non-probability sampling	7	2251	Random	25.29% (CI: 12.26-38.31)	98.6%	<0.001
Publication status	P-LPMP	Published	9	3020	Random	22.22% (CI: 12.02-32.42)	98.5%	<0.001
		Unpublished	2	567	Random	16.12% (CI: -1.42-33.66)	97.3%	<0.001
Publication year	P-LPMP	2018-2021	6	1852	Random	21.10% (CI: 9.96-32.24)	97.8%	<0.001
		2022-2025	5	1735	Random	21.11% (CI: 6.13-36.09)	98.9%	<0.001

Publication bias among the studies for the P-LPMP

Visual inspection of the funnel plot revealed asymmetry around the pooled effect estimate, suggesting possible small-study effects or selective reporting (Figure 10). Egger's regression test confirmed this, showing a significant association between study precision and effect size (β_1 = 33.07; $p < 0.001$) and a negative intercept (β_0 = –45.39; $p = 0.001$), indicating strong evidence of publication bias. The model explained 71.0% of between-study variance, though residual heterogeneity remained high (I^2 = 95.1%) (Table 10). Begg's rank correlation test also returned a significant result (Kendall's τ = 0.8545; p = 0.0003), suggesting smaller studies disproportionately reported higher prevalence estimates. These findings warrant cautious interpretation of pooled P-LPMP estimates.

Trim-and-Fill analysis for P-LPMP

Using the Run (R_0) estimator, the funnel plot (Figure 11) imputed two studies on the left side of the distribution. The observed pooled prevalence of P-LPMP was 21.10% (95% CI: 12.46–29.74%), which decreased to 15.17% (95% CI: 5.74–24.59%) after imputation. This reduction suggests the original estimate may have been inflated by missing studies with lower prevalence, and the trim-and-fill method provides a more conservative, less biased estimate of P-LPMP in Ethiopia.

Table 10: Egger's test for the P-LPMP among OCPs in Ethiopia, 2025

Egger's test						
Std_Eff	Coefficient	Std. Err.	Z-value	P>|z|	95% confidence interval	
					Lower	Upper
Slope (β_1)	33.07	6.74	4.91	<0.001	19.87	46.28
Intercept (β_0)	–45.39	13.77	–3.30	0.001	–72.39	–18.40

Factors Associated with Obstetric Care Providers' N-PLPMP

Four studies (67, 80, 82, 83) identified a significant association between N-PLPMP and OCPs' knowledge. Despite modest heterogeneity (I^2 = 21.1% random-effects; 30.5% fixed-effects), both models showed knowledgeable OCPs were more likely to practice N-PLPMP (OR ≈ 2.62; 95% CI: 1.97–3.48). For generalizability, the random-effects model was retained. Two studies (67, 82) also found that availability of LPM protocols increased practice odds (OR = 2.45; 95% CI: 1.09–5.53; I^2 = 71.0%; p = 0.030). All five studies (67, 77, 80, 82, 83) reported a strong association with attitude: OCPs with favorable views were more likely to practice N-PLPMP (AOR = 3.54; 95% CI: 2.12–5.93; I^2 = 79.5%; p < 0.001). Work experience also mattered; two studies (77, 82) showed that 6–9 years of experience increased practice likelihood compared to <2 years (AOR = 3.20; 95% CI: 1.89–5.42; I^2 = 0.0%). Similarly, two studies (77, 80) found that favorable work environments significantly increased practice (AOR = 3.24; 95% CI: 2.00–5.27; I^2 = 0.0%) (Table 11; Figures S4a-e).

Additional factors reported in individual studies included age, profession, workload, and training. One study (67) found OCPs aged 20–29 were more likely to practice N-PLPMP (AOR = 4.92; 95% CI: 2.24–10.77), while another (80) reported higher odds among those >30 years (AOR = 2.66; 95% CI: 1.11–6.26). Wassihun B et al. (2022) noted that 3–4 years of experience (AOR = 6.98; 95% CI: 2.29–12.50) and being a midwife (AOR = 1.45; 95% CI: 1.08–4.27)

increased practice (77). Ganta M et al. (2021) reported that head midwife experience (AOR = 2.63; 95% CI: 1.44–4.80) and training on pain management (AOR = 4.66; 95% CI: 2.52–8.61) were positively associated with N-PLPMP, while high workload reduced practice (AOR = 0.34; 95% CI: 0.16–0.71) (80). Similarly, another study found that longer clinical experience (≥10 years) (AOR = 5.45; 95% CI: 1.95–14.97) and a positive perception of LPM (AOR = 3.42; 95% CI: 1.37–9.13) significantly increased N-PLPMP (82).

Table 11: Factors associated with the N-PLPMP among OCPs in Ethiopia, 2025.

Variables (Factors)	Comparator	Outcome	No. of studies	Sample size	Model	Pooled Effect Size (95% CI)	I^2	P-value
Having adequate knowledge of LPM	Poor knowledge	Factor	4	1804	Random	2.62 (1.97- 3.48)	21.1%	<0.001
Availability of LPM protocol	Lack of LPM protocol	Factor	2	1003	Random	2.45 (1.09-5.53)	71.0%	0.030
Favorable attitude LPM	Unfavorable attitude	Factor	5	2076	Random	3.54 (2.12-5.93)	79.5%	<0.001
Clinical experience of 6-9 years	<2 years	Factor	2	683	Fixed	3.20 (1.89-5.42)	0.0%	<0.001
Working in a favorable environment	Unfavorable environment	Factor	2	673	Fixed	3.24 (2.00-5.27)	0.0%	<0.001

Factors Associated with Licensed Obstetric Care Providers' P-LPMP

Two studies (69, 71) examined predictors of P-LPMP among licensed OCPs, but pooled estimates were not calculated due to limited overlap. Eyeberu A et al. (2023) found positive associations with receiving LPM training (AOR = 1.60; 95% CI: 1.02–2.53), favorable attitude (AOR = 9.10; 95% CI: 5.34–15.35), and being female (AOR = 2.07; 95% CI: 1.31–3.26) (69). Gido R et al. (2021) reported significant associations with adequate knowledge of LPM (AOR = 2.70; 95% CI: 1.37–5.23), availability of analgesics (AOR = 3.30; 95% CI: 1.99–5.53), and ≥10 years of clinical experience compared to <5 years (AOR = 4.30; 95% CI: 1.81–10.83) (71).

Certainty of Evidence (GRADE result ratings)

The certainty of evidence for pooled N-PLPMP prevalence was rated moderate, supported by consistent findings and low risk of publication bias. In contrast, the pooled prevalence of P-LPMP was rated low-certainty due to considerable heterogeneity and evidence of publication bias. The overall pooled prevalence of LPMP was also rated low, reflecting substantial

heterogeneity (I^2 = 92.4%), moderate risk of bias, and publication bias. For associated factors, certainty varied by the strength and consistency of pooled estimates. Provider knowledge, work experience, and supportive environments were generally rated moderate-certainty, supported by precise estimates and low heterogeneity. Factors with moderate to high heterogeneity or limited data were rated low or very low certainty (Sup. Tables 8a-e).

Discussion

Obstetric care providers are ethically obliged to manage maternal pain as part of respectful maternity care (1, 87). International guidelines, including WHO and ACOG (1, 7), recommend both pharmacological and non-pharmacological methods. In contrast, our review found that fewer than half of licensed OCPs in Ethiopia practiced either approach, with about four in ten reporting N-PLPMP and two in ten reporting P-LPMP. After adjustment for publication bias, P-LPM prevalence decreased further to 15%, underscoring a substantial gap between global recommendations and local implementation (1).

Methodological and contextual factors influenced practice. Non-probability sampling was associated with higher N-LPM prevalence ($\beta = +14.93$; $p < 0.001$), likely reflecting selection bias (88), while studies in public facilities reported lower P-LPM ($\beta = -26.24$; $p < 0.001$). Subgroup analyses showed higher P-LPM in mixed public–private settings, possibly due to better medication availability and patient safety prioritization in private facilities (73, 80). N-PLPMP was also more common in such settings, reflecting greater implementation of respectful maternity care. Hospitals reported higher P-LPM use than health centers, where concerns about side effects and limited surgical capacity may restrict practice. Regional variation, despite similar curricula, likely reflects the absence of standardized protocols and systemic barriers (37, 42).

Our pooled N-PLPMP prevalence (42.8%) aligns with other reviews reporting 43%% (39) and 45.5% (40) though lower than Saudi Arabia (68.3%) (89), highlighting contextual differences. Commonly practiced N-PLPMP methods included psychological support, breathing techniques, massage, ambulation, positioning, and relaxation strategies such as reassurance and encouragement (66-68, 70, 72, 73, 76-78, 80-85), consistent with other studies emphasizing back massage, deep breathing, and psychological support (89-92).

In contrast, pooled P-PLPMP prevalence (21.1%) was lower than other reviews (43.8% (38) and 28% (39), and studies from Nigeria (49.0%) (21) and India (71.3%) (93). Differences in inclusion criteria, outcome definitions, and provider characteristics may explain these discrepancies. Notably, P-LPM prevalence was higher during the COVID-19 pandemic (23.68%) compared to before (18.00%), reflecting increased workloads, infection control measures, and reduced reliance on non-pharmacological methods (94). Other studies similarly reported pandemic-related disruptions to supportive care and greater reliance on pharmacological approaches (95, 96). No significant differences were observed in N-PLPMP across study periods, though post-pandemic data were limited to a single study (83).

Our review identified several provider- and system-level factors significantly associated with N-PLPMP. Knowledge consistently emerged as a strong predictor, with knowledgeable OCPs more than twice as likely to practice N-PLPMP compared to counterparts (38, 40-42, 91). This reinforces the principle that evidence-based practice requires adequate knowledge for effective application (97). Availability of LPM protocols also increased practice likelihood, underscoring the importance of institutional readiness and supportive infrastructure (41). Attitude was another strong determinant: OCPs with favorable attitudes were over three times more likely to practice N-PLPMP, consistent with prior findings (38, 39, 42, 89, 91). The indicates that the N-PLPMP was strongly influenced by the attitudes of OCPs (15).

Work experience contributed as well, with providers having 6–9 years of experience showing higher odds of practice, suggesting that accumulated clinical skills enhance competence and confidence (7, 98). A supportive work environment further promoted practice, highlighting the role of managerial support, adequate staffing, teamwork, and positive workplace culture in improving implementation and reducing mistreatment (12, 99). Additional predictors identified in individual studies included age (67, 80), cadre (midwives vs. other OCPs) (77), leadership roles, workload perception, and receipt of training (80). Together, these findings emphasize that both individual competencies and institutional support strongly influence N-PLPMP.

For P-PLPMP, evidence was more limited, with only two studies reporting associated factors. Training, favorable attitudes, and female sex were positively associated with practice (69), while knowledge, availability of analgesics, and longer clinical experience (≥10 years) were also significant predictors (71). Although pooled analysis was not possible due to limited data, these

findings suggest that similar determinants such as knowledge, attitude, training, and resource availability shape both pharmacological and non-pharmacological practices.

Strengths and Limitations of the Review

This review adhered to PRISMA 2020 guidelines, incorporated multiple databases and grey literature, and applied robust statistical techniques including meta-regression and sensitivity analyses. The use of JBI and modified NOS-based RoB tools highlighted differences in ratings, underscoring the importance of tool selection. Inter-rater reliability analyses showed moderate to good agreement for JBI and excellent reliability for NOS (ICC > 0.90) (47), with perfect categorical agreement ($\kappa = 1.00$).

Limitations must also be acknowledged. Most included studies relied on self-reported practices, introducing potential bias. Certainty of evidence under GRADE was generally low to moderate, reflecting heterogeneity and possible publication bias. In addition, pooled AORs for P-PLPMP could not be calculated due to insufficient comparable data.

Conclusions

This systematic review highlights a substantial gap between international recommendations and the actual practice of LPM among licensed OCPs in Ethiopia. Fewer than half reported using either pharmacological or non-pharmacological methods, with pharmacological practices particularly limited. Knowledge, favorable attitudes, clinical experience, supportive work environments, and the availability of protocols and resources consistently emerged as predictors of N-PLPMP, underscoring the importance of both individual competencies and institutional readiness in ensuring respectful maternity care.

To address these gaps, continuous professional development and targeted training should strengthen provider knowledge, skills, and confidence in both approaches. Teaching institutions should integrate evidence-based LPM into curricula, emphasizing practical skills, RMC principles, and simulation-based training. Health facilities must ensure analgesic availability, standardized protocols, supportive supervision, and adequate staffing to create conducive environments. At the policy level, national guidelines on LPM should be developed, disseminated, and enforced, with monitoring systems to ensure adherence and equity across regions and facility types.

Future research should explore contextual barriers, evaluate interventions, and generate high-quality evidence to inform policy and implementation. Many included studies showed moderate risk of bias under NOS criteria, often due to unclear sample size calculations; rigorous designs and representative sampling are therefore essential to strengthen reliability and generalizability. In summary, coordinated efforts across providers, teaching institutions, health facilities, policymakers, and researchers are needed to bridge the gap between global standards and local practice, ultimately improving maternal pain management and birth outcomes in Ethiopia.

Abbreviations

ACOG	American College of Obstetricians and Gynecologists	NOS	Newcastle–Ottawa Scale
AOR	Adjusted Odds Ratio	N-PLPM	Non-Pharmacological Labor Pain Management
CI	Confidence Interval	N-PLPMP	Non-Pharmacological Labor Pain Management Practice
CoCoPop	Condition, Context, and Population	OCPs	Obstetric Care Providers
COR	Crude Odds Ratio	OR	Odds Ratio
COVID-19	Coronavirus Disease 2019	P-LPM	Pharmacological Labor Pain Management
CPD	Continuous Professional Development	P-LPMP	Pharmacological Labor Pain Management Practice
GRADE	Grading of Recommendations Assessment, Development and Evaluation	PRISMA	Preferred Reporting Items for Systematic Reviews and Meta Analyses
ICC	Intraclass Correlation Coefficient	RMC	Respectful Maternity Care
IESOs	Integrated Emergency Surgical Officers	RoB	Risk of Bias
JBI	Joanna Briggs Institute	SE	Standard Error
LPM	Labor Pain Management	SNNPR	Southern Nations, Nationalities, and Peoples' Region
LPMP	Labor Pain Management Practice	TENS	Transcutaneous Electrical Nerve Stimulation
MeSH	Medical Subject Headings	WHO	World Health Organization

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Authors' Contributions

WFB, FAC, EAK, ATN, and AAG contributed to the conceptualization of the study, while WFB and FAC developed the methodology. Software support was provided by FAC. Formal analysis was performed by WFB, FAC, DGD, CTN, KF, BAM, TMB, FWS, and ZDA. The investigation was carried out by WFB, FAC, EKA, AAG, and ATN, and data curation was managed by WFB, FAC, and ATN. The original draft of the manuscript was prepared by WFB, TWB, FAC, ANB, and ATN, whereas review and editing were undertaken by WFB, GMT, WA, EAS, SZ, YKA, GMA, MBY, AYW, SYK, EAM, AMA, SAB, AAT, BAD, WGS, SMM, YMA, ANB and LWT. Visualization and validation were also performed by WA, FWS, EAS, SZ, YKA, GMA, MBY, AYW, SYK, EAM, AMA, SAB, AAT, BAD, WGS, SMM, YMA, Dr. GMT and LWT. Supervision was provided by TWB, ANB, EAK, Dr. GMT, and AMA. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Ethics Statement

As this study is a systematic review and meta-analysis of previously published research, no new ethical approval was required. The protocol was registered with PROSPERO (2025: CRD420251242040).

Consent Statement

Since this study did not involve direct contact with patients and relied solely on previously published data, obtaining written or verbal consent from participants was unnecessary.

Consent for publication

Not applicable

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Competing interests

The authors declare no competing interests.

Data availability statement

All materials used in this systematic review and meta-analysis are provided as supplementary files. No new datasets were generated, and all relevant data are contained within the manuscript and it's Supporting Information.

AI use statement

Microsoft Copilot was used to assist with language editing for grammar and clarity. No AI tools were used for data analysis, interpretation of results, or generation of scientific content. All intellectual work, including study design, data extraction, and conclusions, was performed solely by the authors.

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Figure Legends

Figure 1: PRISMA flow diagram showing study selection and inclusion for the systematic review and meta-analysis of pharmacological and non-pharmacological labor pain management among licensed obstetric care providers in Ethiopia, 2025

Figure 2: Heatmap showing the joint distribution of risk of bias ratings assigned by the Joanna Briggs Institute checklist and a modified Newcastle-Ottawa Scale tools across 20 included studies.

Figure 3: Forest plot of the non-pharmacological labor pain management among licensed obstetric care providers in Ethiopia, 2025.

Figure 4: Galbraith plot of the non-pharmacological labor pain management among licensed obstetric care providers in Ethiopia, 2025.

Figure 5: Forest plot of leave-one-out sensitivity analysis for non-pharmacological labor pain management among licensed obstetric care providers in Ethiopia, 2025.

Figure 6: Funnel plot of the included studies on the non-pharmacological labor pain management among licensed obstetric care providers in Ethiopia, 2025, showing a symmetrical distribution with no evident publication bias.

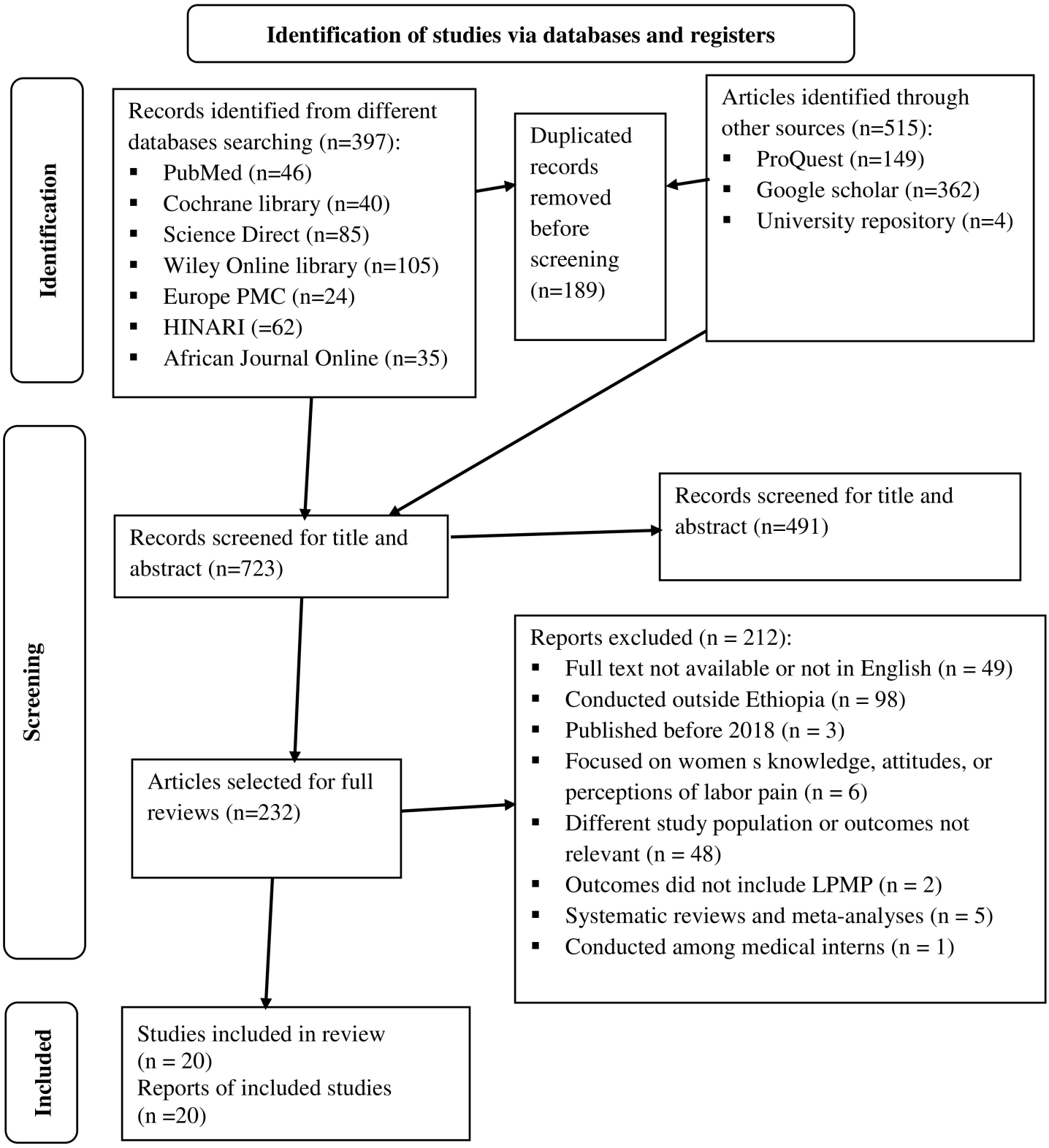
Figure 7: Forest plot of the pharmacological labor pain management among licensed obstetric care providers in Ethiopia, 2025.

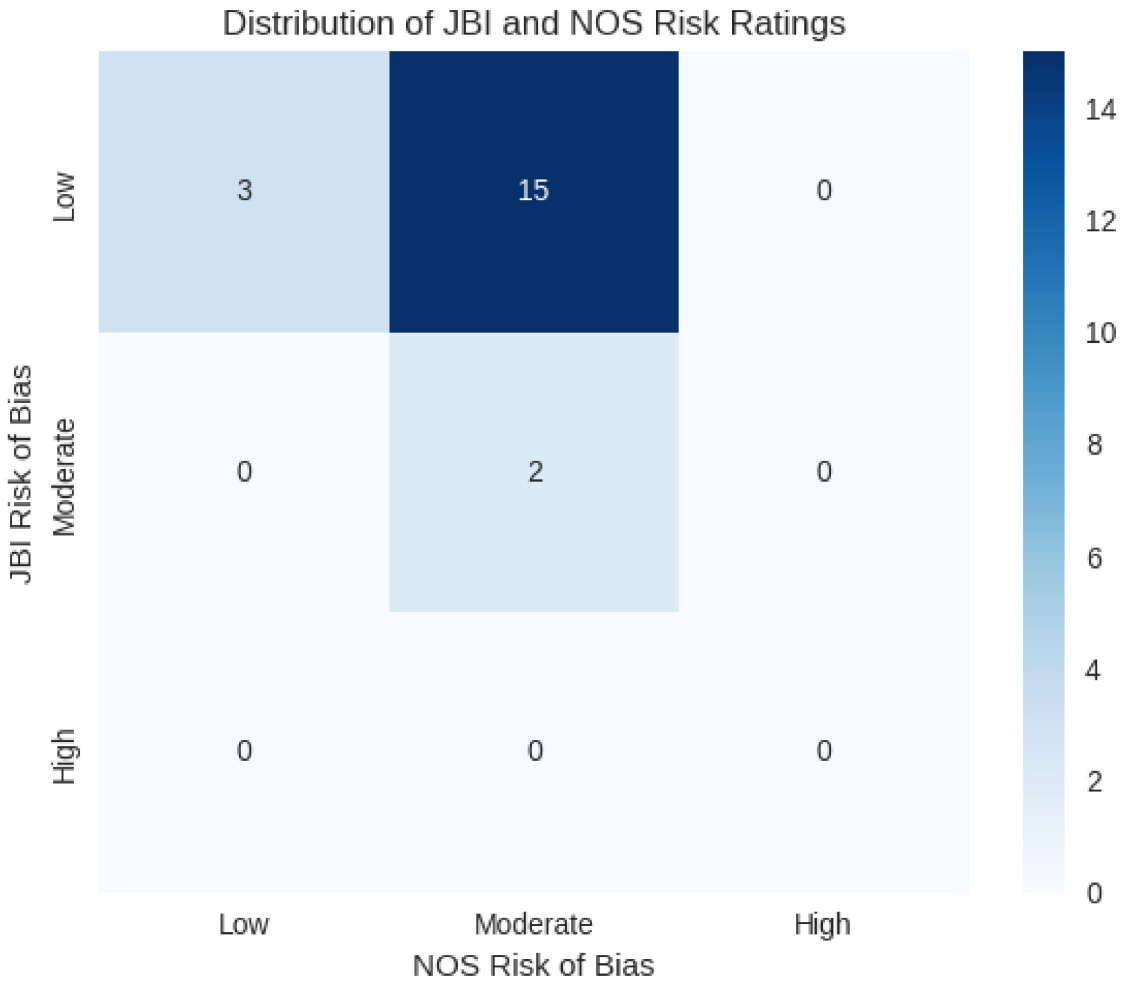
Figure 8: Galbraith plot of the pharmacological labor pain management among licensed obstetric care providers in Ethiopia, 2025.

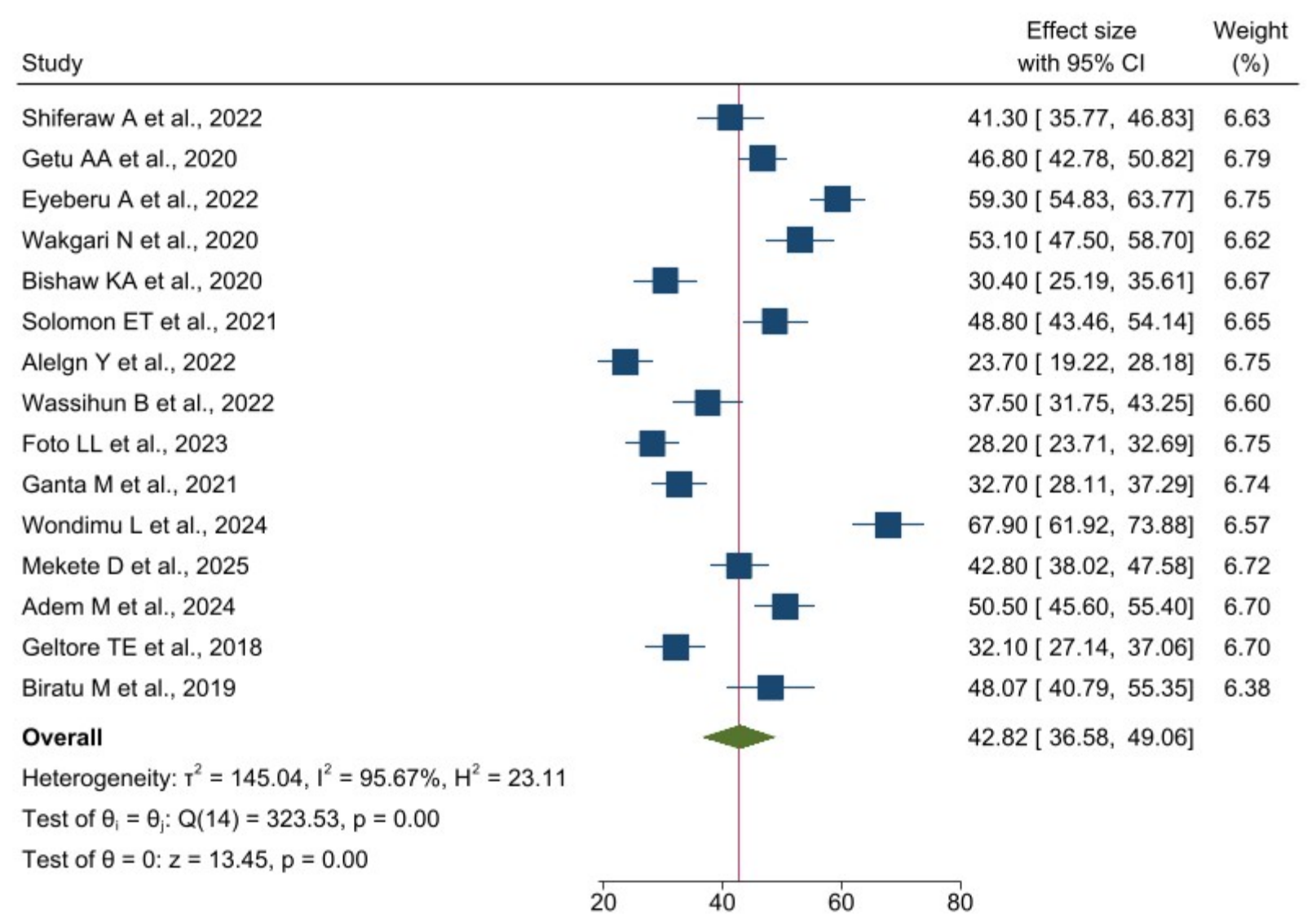
Figure 9: Forest plot of leave-one-out sensitivity analysis for pharmacological labor pain management among licensed obstetric care providers in Ethiopia, 2025.

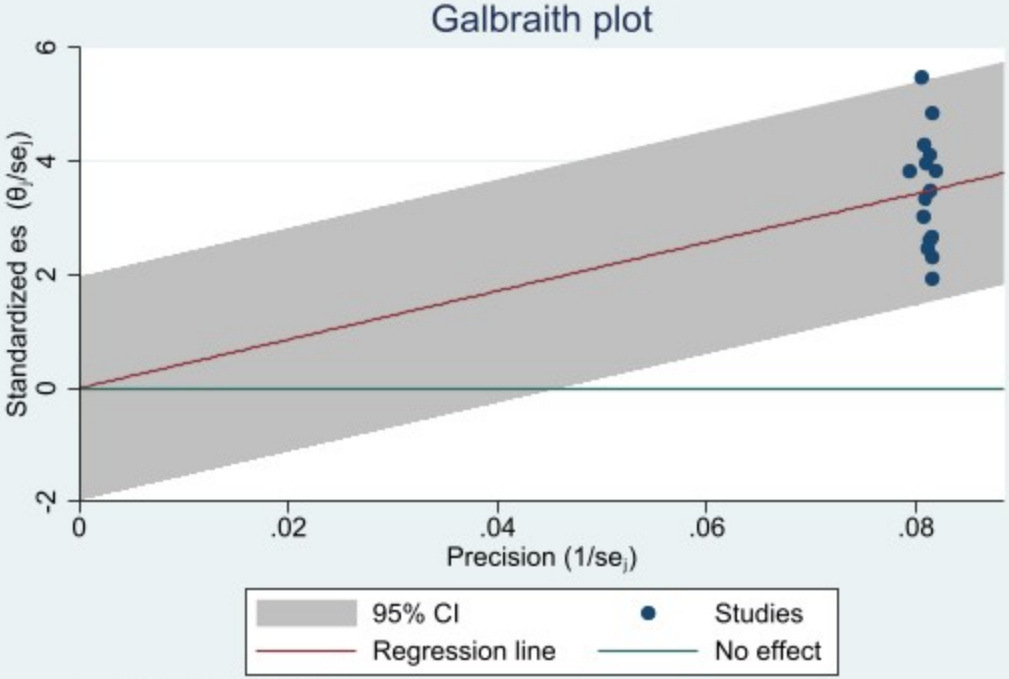
Figure 10: Funnel plot of the included studies on pharmacological labor pain management among licensed obstetric care providers in Ethiopia, 2025.

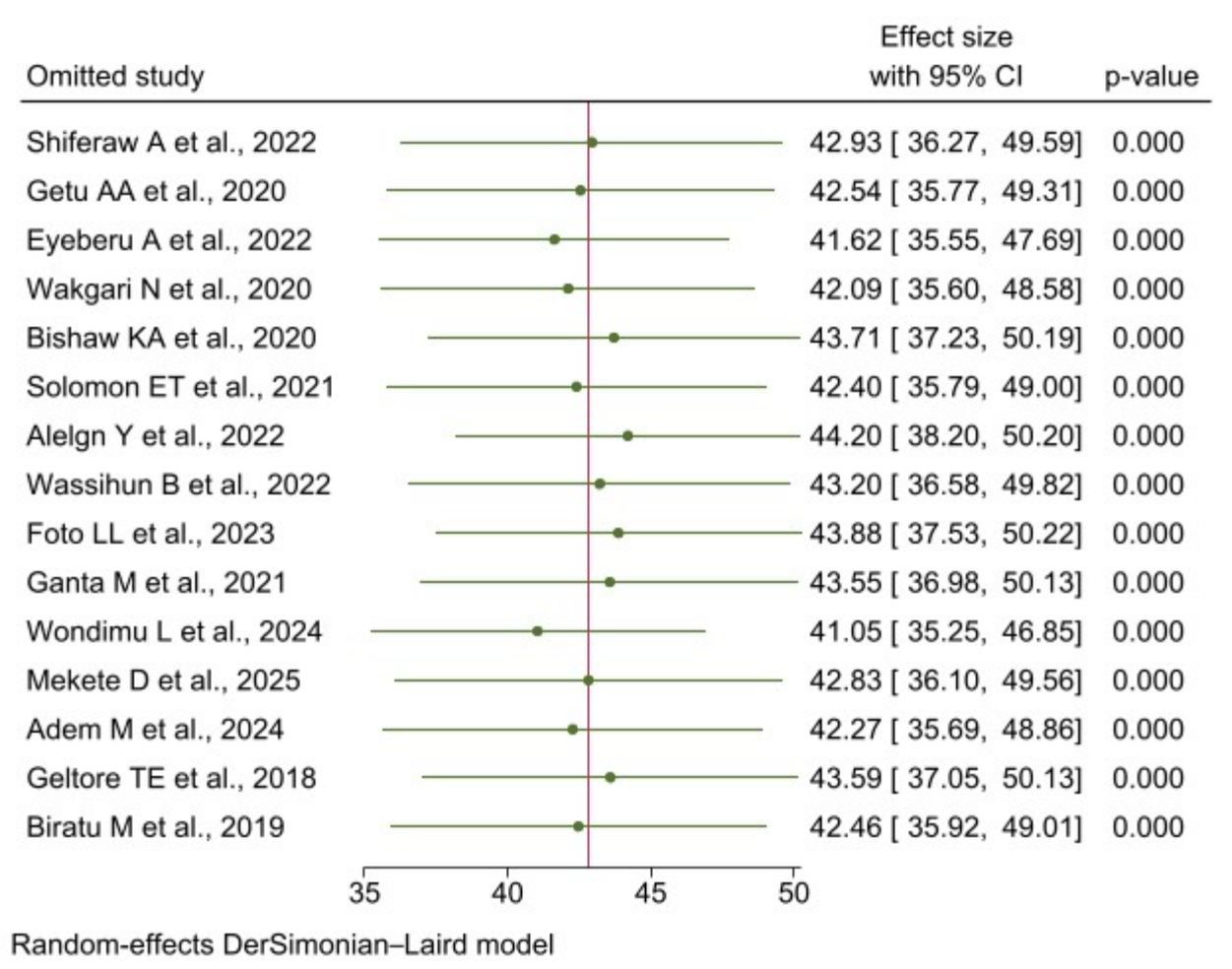
Figure 11: Trim-and-fill funnel plot of the included studies assessing pharmacological labor pain management among P-LPMP among licensed obstetric care providers in Ethiopia, 2025.

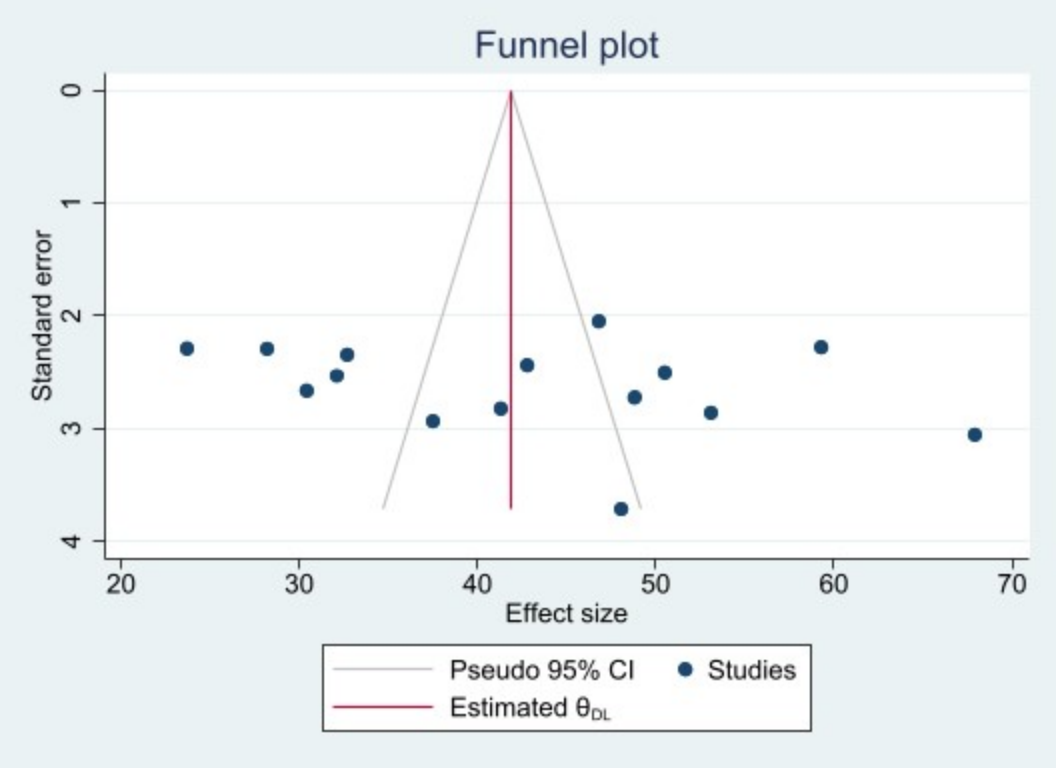

Identification of studies via databases and registers
Identification
Records identified from different databases searching (n=397):
PubMed (n=46)
Cochrane library (n=40)
Science Direct (n=85)
Wiley Online library (n=105)
Europe PMC (n=24)
HINARI (=62)
African Journal Online (n=35)
Duplicated records removed before screening (n=189)
Articles identified through other sources (n=515):
ProQuest (n=149)
Google scholar (n=362)
University repository (n=4)
Screening
Records screened for title and abstract (n=723)
Records screened for title and abstract (n=491)
Articles selected for full reviews (n=232)
Reports excluded (n = 212):
Full text not available or not in English (n = 49)
Conducted outside Ethiopia (n = 98)
Published before 2018 (n = 3)
Focused on women s knowledge, attitudes, or perceptions of labor pain (n = 6)
Different study population or outcomes not relevant (n = 48)
Outcomes did not include LPMP (n = 2)
Systematic reviews and meta-analyses (n = 5)
Conducted among medical interns (n = 1)
Included
Studies included in review (n = 20)
Reports of included studies (n =20)

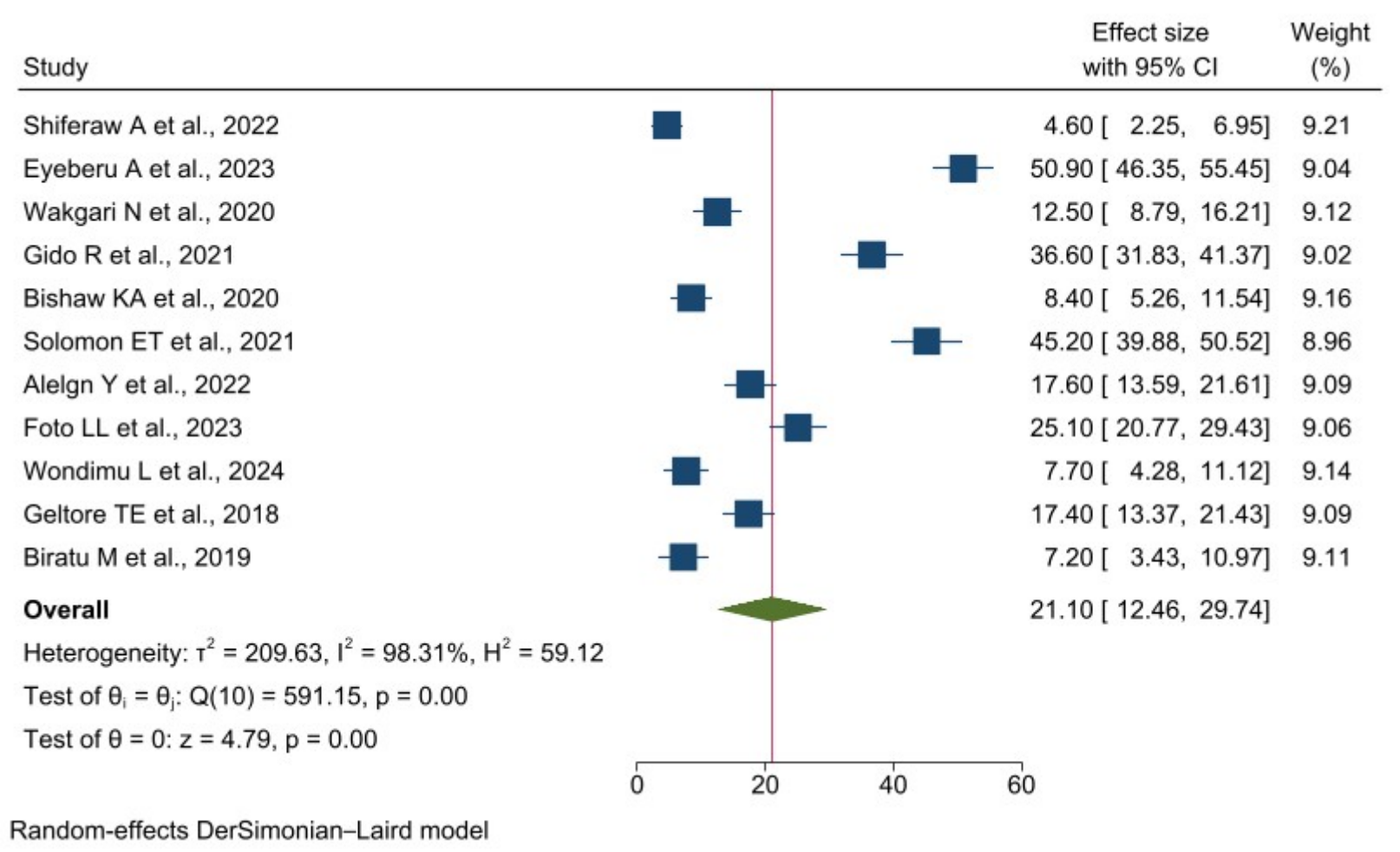

Distribution of JBI and NOS Risk Ratings
JBI Risk of Bias
Low
Moderate
High
3
15
0
0
2
0
0
0
0
Low
Moderate
High
NOS Risk of Bias
14
12
10
8
6
4
2
0

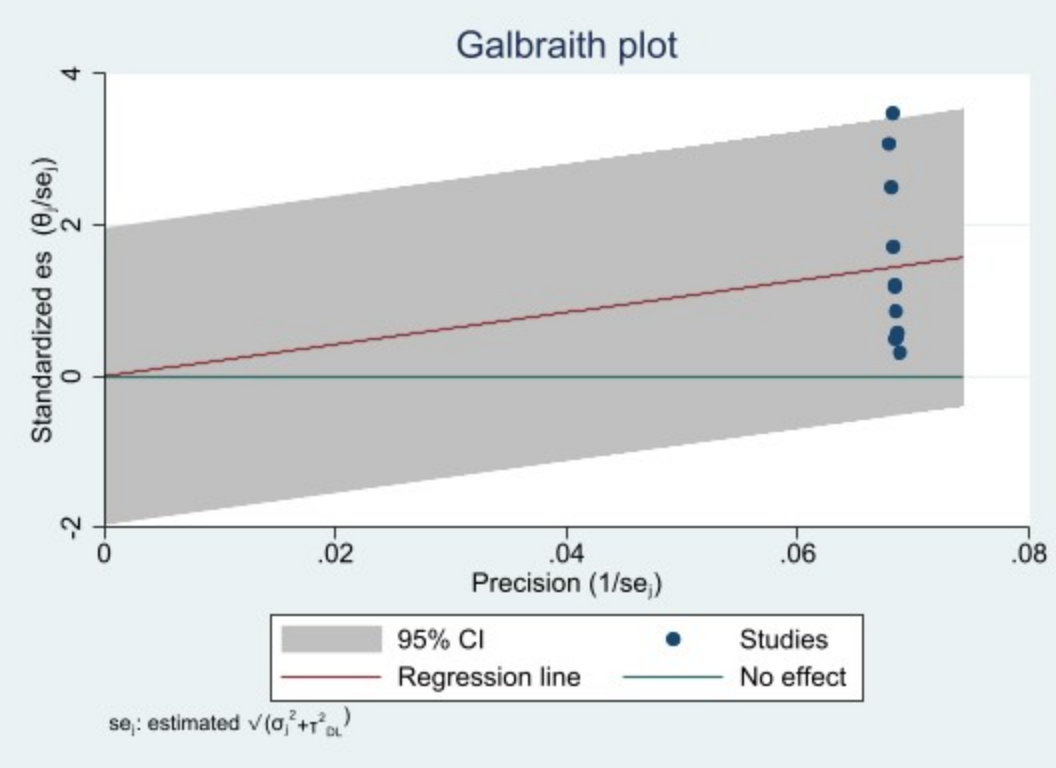

Study
Effect size with 95% CI
Weight (%)
Shiferaw A et al., 2022
41.30 [35.77, 46.83]
6.63
Getu AA et al., 2020
46.80 [42.78, 50.82]
6.79
Eyeberu A et al., 2022
59.30 [54.83, 63.77]
6.75
Wakgari N et al., 2020
53.10 [47.50, 58.70]
6.62
Bishaw KA et al., 2020
30.40 [25.19, 35.61]
6.67
Solomon ET et al., 2021
48.80 [43.46, 54.14]
6.65
Alelgn Y et al., 2022
23.70 [19.22, 28.18]
6.75
Wassihun B et al., 2022
37.50 [31.75, 43.25]
6.60
Foto LL et al., 2023
28.20 [23.71, 32.69]
6.75
Ganta M et al., 2021
32.70 [28.11, 37.29]
6.74
Wondimu L et al., 2024
67.90 [61.92, 73.88]
6.57
Mekete D et al., 2025
42.80 [38.02, 47.58]
6.72
Adem M et al., 2024
50.50 [45.60, 55.40]
6.70
Geltore TE et al., 2018
32.10 [27.14, 37.06]
6.70
Biratu M et al., 2019
48.07 [40.79, 55.35]
6.38
Overall
42.82 [36.58, 49.06]
Heterogeneity: τ^2 = 145.04, I^2 = 95.67%, H^2 = 23.11
Test of $\theta_i = \theta_j$: Q(14) = 323.53, p = 0.00
Test of θ = 0: z = 13.45, p = 0.00
20
40
60
80
Random-effects DerSimonian–Laird model

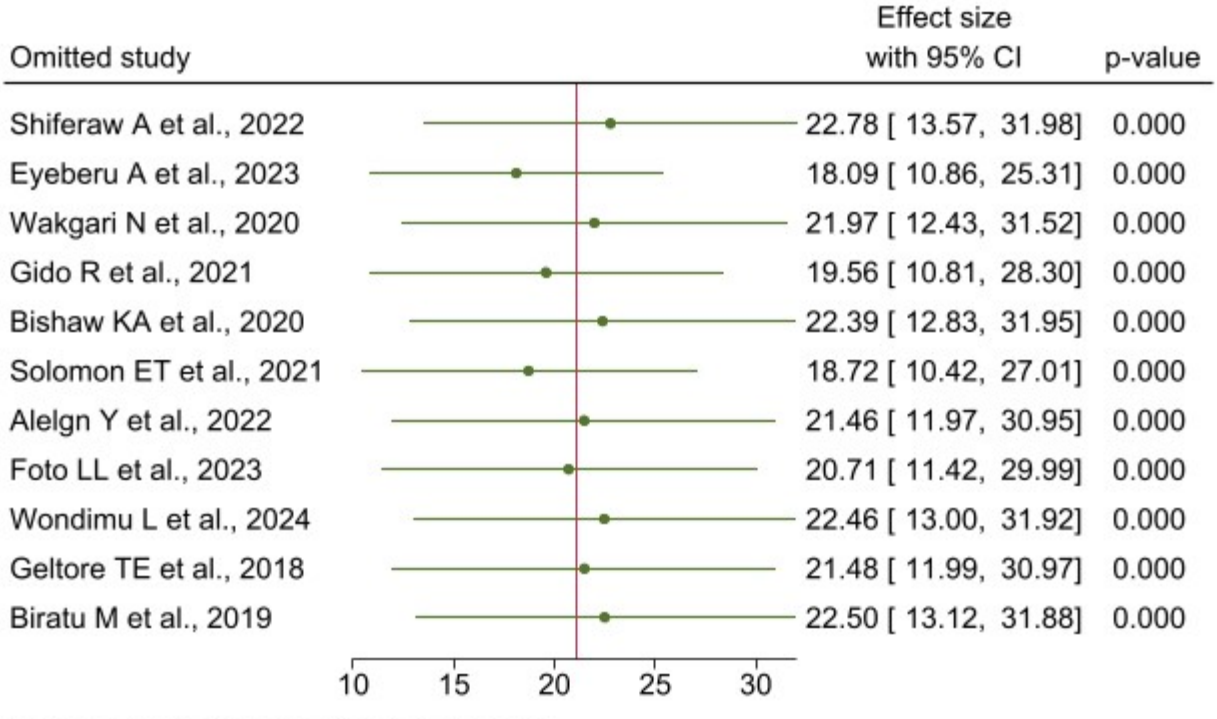

Galbraith plot
Standardized es (θj/sej)
6
4
2
0
-2
0
.02
.04
.06
.08
Precision (1/sej)
95% CI
Studies
Regression line
No effect
sej: estimated √(σj²+τ²DL)

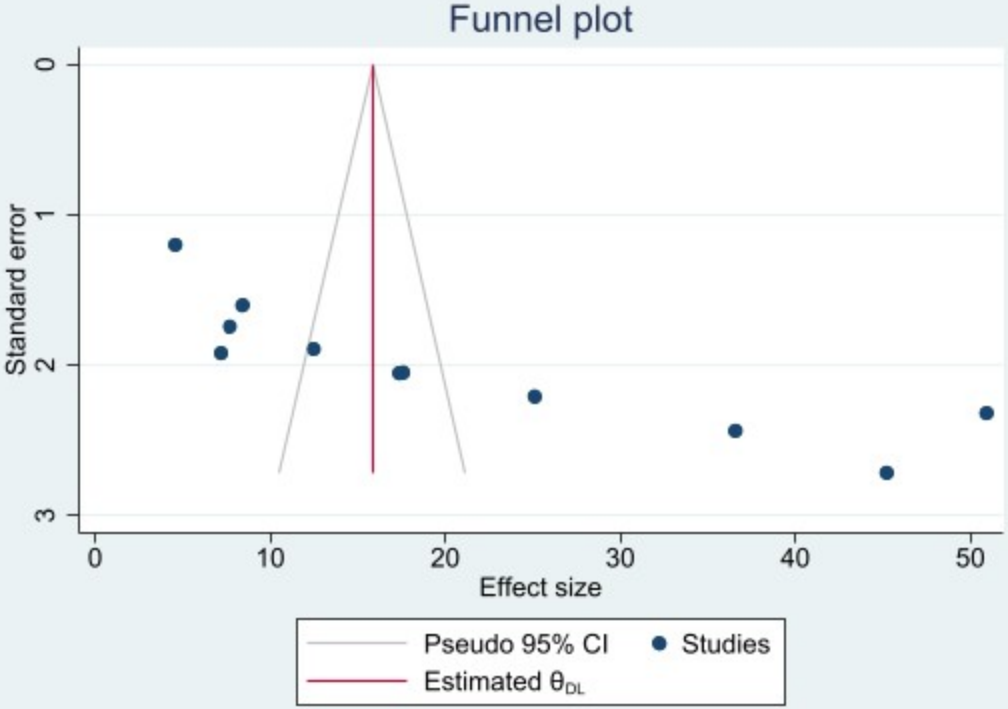

Omitted study
Effect size with 95% CI
p-value
Shiferaw A et al., 2022
42.93 [36.27, 49.59]
0.000
Getu AA et al., 2020
42.54 [35.77, 49.31]
0.000
Eyeberu A et al., 2022
41.62 [35.55, 47.69]
0.000
Wakgari N et al., 2020
42.09 [35.60, 48.58]
0.000
Bishaw KA et al., 2020
43.71 [37.23, 50.19]
0.000
Solomon ET et al., 2021
42.40 [35.79, 49.00]
0.000
Alelgn Y et al., 2022
44.20 [38.20, 50.20]
0.000
Wassihun B et al., 2022
43.20 [36.58, 49.82]
0.000
Foto LL et al., 2023
43.88 [37.53, 50.22]
0.000
Ganta M et al., 2021
43.55 [36.98, 50.13]
0.000
Wondimu L et al., 2024
41.05 [35.25, 46.85]
0.000
Mekete D et al., 2025
42.83 [36.10, 49.56]
0.000
Adem M et al., 2024
42.27 [35.69, 48.86]
0.000
Geltore TE et al., 2018
43.59 [37.05, 50.13]
0.000
Biratu M et al., 2019
42.46 [35.92, 49.01]
0.000
35
40
45
50
Random-effects DerSimonian–Laird model

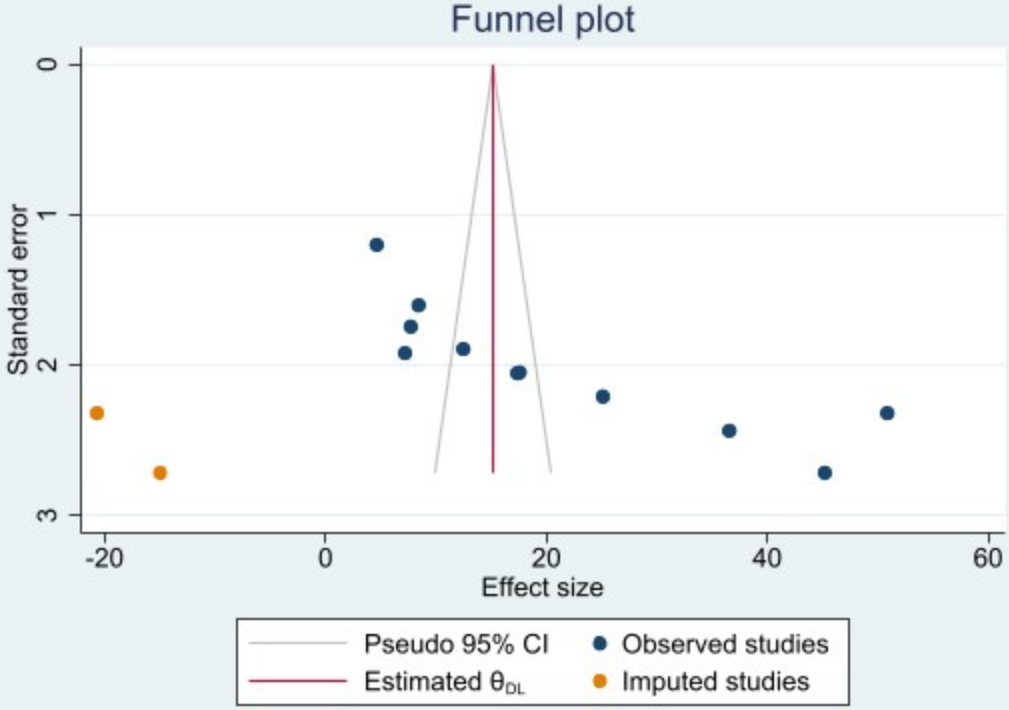

Funnel plot
Standard error
0
1
2
3
4
20
30
40
50
60
70
Effect size
Pseudo 95% CI
Studies
Estimated θDL


Study
Effect size with 95% CI
Weight (%)
Shiferaw A et al., 2022
4.60 [2.25, 6.95] 9.21
Eyeberu A et al., 2023
50.90 [46.35, 55.45] 9.04
Wakgari N et al., 2020
12.50 [8.79, 16.21] 9.12
Gido R et al., 2021
36.60 [31.83, 41.37] 9.02
Bishaw KA et al., 2020
8.40 [5.26, 11.54] 9.16
Solomon ET et al., 2021
45.20 [39.88, 50.52] 8.96
Alelgn Y et al., 2022
17.60 [13.59, 21.61] 9.09
Foto LL et al., 2023
25.10 [20.77, 29.43] 9.06
Wondimu L et al., 2024
7.70 [4.28, 11.12] 9.14
Geltore TE et al., 2018
17.40 [13.37, 21.43] 9.09
Biratu M et al., 2019
7.20 [3.43, 10.97] 9.11
Overall
21.10 [12.46, 29.74]
Heterogeneity: τ^2 = 209.63, I^2 = 98.31%, H^2 = 59.12
Test of $\theta_i = \theta_j$: Q(10) = 591.15, p = 0.00
Test of θ = 0: z = 4.79, p = 0.00
0
20
40
60
Random-effects DerSimonian–Laird model


Galbraith plot
Standardized es (θj/sej)
4
2
0
-2
0
.02
.04
.06
.08
Precision (1/sej)
95% CI
Studies
Regression line
No effect
sej: estimated √(σj²+τ²DL)


Omitted study
Effect size with 95% CI
p-value
Shiferaw A et al., 2022
22.78 [13.57, 31.98]
0.000
Eyeberu A et al., 2023
18.09 [10.86, 25.31]
0.000
Wakgari N et al., 2020
21.97 [12.43, 31.52]
0.000
Gido R et al., 2021
19.56 [10.81, 28.30]
0.000
Bishaw KA et al., 2020
22.39 [12.83, 31.95]
0.000
Solomon ET et al., 2021
18.72 [10.42, 27.01]
0.000
Alelgn Y et al., 2022
21.46 [11.97, 30.95]
0.000
Foto LL et al., 2023
20.71 [11.42, 29.99]
0.000
Wondimu L et al., 2024
22.46 [13.00, 31.92]
0.000
Geltore TE et al., 2018
21.48 [11.99, 30.97]
0.000
Biratu M et al., 2019
22.50 [13.12, 31.88]
0.000
10
15
20
25
30
Random-effects DerSimonian–Laird model


Funnel plot
Standard error
0
1
2
3
0
10
20
30
40
50
Effect size
Pseudo 95% CI
Studies
Estimated θDL


Funnel plot
Standard error
0
1
2
3
-20
0
20
40
60
Effect size
Pseudo 95% CI
Estimated θDL
Observed studies
Imputed studies

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementaryTable1showsPRISMAchecklist.docx
- SupplementaryTable2showssearchingstrategy.docx
- SupplementaryTable3showsdataextraction.xlsx
- SupplementaryTable4showstheJBIbasedRoB.docx
- SupplementaryTable5DescriptionofthemodifiedNOSRoB.docx
- SupplementaryTable6showsthemodifiedNOSRoB.pdf
- SupplmentaryTable7showsreliabilityRoB.xlsx
- SupplmentaryTable8showstheGRADE.docx
- SupplementaryFigure1ShowsBargraphofRoB.docx
- SupplementaryFigure2atohSubgroupanalysisNPLPMP.docx
- SupplementaryFigure3atohSubgroupanalysisPLPMP.docx
- SupplementaryFigure4atoePooledpredictorsNPLPMP.docx
- SupplementaryAppendix1OverallLPMPAnalysisResult.docx
- SupplementaryAppendix2JBIChecklistforAnalyticalCrossSectionalStudies.pdf