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Efficacy of skin-to-skin contact between mother and newborn during the third stage of labour in reducing postpartum haemorrhage risk

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Abstract

Objective To evaluate the efficacy of skin-to-skin contact (SSC) in reducing the risk of postpartum haemorrhage and blood loss after childbirth.

Background Postpartum haemorrhage is a leading cause of preventable mortality, particularly in developing countries. Although various strategies exist for its prevention, the effect of SSC remains unclear.

Design Systematic review with meta-analysis.

Data sources Searches were conducted in PubMed, Scopus, Cochrane Library, CINAHL, Google Scholar, and Web of Science up to May 2024.

Review methods The PRISMA guidelines were followed. Prospective clinical trials were included and assessed using the revised Cochrane RoB 2 tool for randomized controlled trials and ROBINS-I for non-randomized studies. The meta-analysis was performed using STATA 18.

Results The analysis of 18 prospective clinical trials showed that SSC during the third stage of labour was associated with a reduction in the incidence of uterine atony and a lower likelihood of blood loss greater than or equal to 500 mL. Additionally, SSC was linked to a decrease in mean blood loss during the third stage of labour, the first two hours postpartum, and at 24 h postpartum. No significant differences were found in the incidence of severe postpartum haemorrhage.

Conclusions SSC during the third stage of labour appears to be effective in reducing the risk of uterine atony, blood loss of 500 mL or more, and mean postpartum blood loss. This suggests significant potential for improving obstetric outcomes. However, given the high risk of bias in the studies analysed, caution is required in interpreting these results. Further high-quality research is needed to confirm these benefits, particularly in caesarean sections.

Impact Postpartum haemorrhage is one of the leading causes of maternal mortality, particularly in developing countries. This meta-analysis suggests that SSC during the third stage of labour could be a key intervention in reducing the risk of uterine atony, blood loss of 500 mL or more, and mean postpartum blood loss. These findings are especially

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relevant in countries where access to uterotonic drugs is limited, highlighting the need for cost-effective, evidence-based alternatives to improve maternal health.

Patient or public contribution No patient or public contribution.

Trial registration PROSPERO registration number CRD 42024543192.

Keywords Kangaroo-Mother Care Method, Obstetrical complications, Postpartum Hemorrhage, Skin-to-skin contact, Labor Stage, Third, Uterine Atony

What does this article contribute to the global clinical community?

This article provides evidence on the potential of SSC as an effective and non-invasive strategy to reduce the risk of postpartum haemorrhage. By addressing a gap in the literature, it underscores the importance of considering simple and natural interventions that can significantly impact maternal safety and recovery.

Introduction

Primary postpartum haemorrhage (PPH) is a leading cause of maternal mortality and morbidity globally [1]. PPH is traditionally defined as the loss of more than 500 mL of blood within 24 h after childbirth, while severe PPH is defined as a loss exceeding 1000 mL [2]. However, diagnostic thresholds for PPH vary across international clinical guidelines, which can affect its management and maternal outcomes [3]. The impact of blood loss during childbirth is influenced not only by the volume lost but also by the woman's overall health status. In particular, women who are anaemic before delivery have a diminished capacity to tolerate blood volume loss, increasing the risk of severe complications [4], This issue is especially pertinent in low-income countries, where the prevalence of prepartum anaemia is highest [5].

Each year, an estimated 287,000 women die from complications related to pregnancy and childbirth [6], with 27.1% of these deaths attributed to PPH [3]. Although PPH remains more prevalent in low-income countries, where it affects up to 14% of births [7, 8], an alarming rise in incidence has also been documented in high-income countries, with reported rates ranging between 3 and 5% [9]. The primary cause of PPH is uterine atony, which accounts for 60% to 80% of cases [10].

The third stage of labour (TSL), which begins after the birth of the baby and ends with the expulsion of the placenta, is a critical period in the management of PPH [4]. The interventions used during the TSL primarily aim to expedite placental expulsion and enhance uterine contractions to prevent PPH. Active management of the TSL, which includes the administration of oxytocin as its main component, is a set of interventions recommended for this purpose [11]. Additionally, tranexamic acid could be used alongside current prophylactic uterotonic drugs during the TSL, particularly in women at high risk of PPH [12–14]. In contrast, expectant management involves waiting for the placenta to be expelled through maternal effort [15], without interventions that might interfere with the endogenous release of oxytocin [11], using only gravity or nipple stimulation [15].

Skin-to-skin contact (SSC) between the mother and the newborn is a physiological intervention carried out immediately after birth, placing the naked baby in a prone position on the mother's abdomen or chest for at least the first 60 min without interruption [16].

Women who practice SSC immediately after childbirth have been observed to exhibit higher levels of endogenous oxytocin [17, 18], which could influence uterine contraction and help prevent complications such as PPH. This physiological effect could translate into clinical benefits related to the management of the TSL. A previous meta-analysis concluded that SSC significantly reduces the duration of this phase [19], while a more recent review confirmed these findings, reporting an average reduction of − 4.26 min (95% CI: − 5.70, − 2.81). Additionally, that review identified other benefits associated with SSC, such as an increased likelihood of complete placental integrity (RR: 1.09; 95% CI: 1.02, 1.16) and a significant reduction in both the probability of a supraumbilical uterine fundus position (RR: 0.39; 95% CI: 0.20, 0.76) and the need for uterotonic administration (RR: 0.24; 95% CI: 0.12, 0.48) [20]. However, to date, no reviews have addressed the impact of SSC on variables directly related to PPH, such as uterine atony, the incidence of PPH, or average blood loss. Therefore, our study aims to provide new evidence on the role of SSC in preventing these maternal complications.

Methods

Study design

This systematic review with meta-analysis was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [21]. The PRISMA checklist is provided in Table S1. The protocol for this review was registered in the International Prospective Register of Systematic Reviews (registration number CRD 42024543192).

Data sources and searches

Electronic searches were conducted in PubMed, Scopus, the Cochrane Central Register of Controlled Trials (CENTRAL), CINAHL (EBSCOhost), Google Scholar and Web of Science from the inception of each database until May 2024. The search strategy combined Medical Subject Headings (MeSH) descriptors and free text terms. MeSH terms were adapted for CINAHL. Terms related to SSC were identified ("kangaroo mother care" OR "skin to skin" OR "breast crawl"), as well as terms related to PPH in TSL ("postpartum hemorrhage" OR "blood loss" OR "uterine contraction" OR "third stage labor" OR placenta). No restrictions or filters were applied. The electronic search was supplemented by a manual review of the references of the included trials and a search for clinical trials in ClinicalTrials.gov and the World Health Organization's International Clinical Trials Registry Platform (ICTRP) (Table S2).

Eligibility criteria

We included randomized controlled trials (RCTs), quasi-randomized controlled trials (Q-RCTs), and quasi-experimental trials with a prospective design that compared SSC with routine care in women undergoing vaginal or caesarean delivery. Cluster studies were also eligible. SSC was defined as placing the unclothed newborn on the mother's bare abdomen or chest immediately or as soon as possible after birth, with an emphasis on SSC initiated before placental expulsion. In this position, the newborn could begin to crawl toward the breast and initiate breastfeeding. The comparison group received routine care, which could include separating the newborn from the mother at birth. No neonates in the comparison group received SSC during the TSL.

Types of outcome measures

The following outcomes were included: presence of uterine atony, severe PPH (estimated or measured blood loss of 1,000 mL or more, or as defined by the authors), PPH during TSL (estimated or measured blood loss of 500 mL or more, or as defined by the authors), and mean blood loss (mL) after delivery and within the next 24 h (estimated or clinically measured).

Assessment of the risk of bias of included studies

Two reviewers (SMR and JRA) independently assessed the risk of bias for each included study, following the guidelines of the Cochrane Handbook for Systematic Reviews of Interventions. The assessment focused on the effect of intervention allocation. Disagreements were resolved through discussion and, if necessary, by consulting a third reviewer (AHM). RCTs were assessed using the revised Cochrane RoB 2 (Risk of Bias 2) tool, which covers five domains [22]. For non-randomized trials, the ROBINS-I (Risk Of Bias In Non-randomized Studies—of Interventions) tool, which includes seven domains, was used [23].

Selection of studies and data extraction

Two reviewers (SMR and ABC) independently identified potentially eligible studies by screening titles and abstracts. The full texts of the selected studies were then reviewed. Disagreements were resolved by consensus or, if consensus was not possible, through consultation with a third reviewer (JCMC).

Data were independently collected by two reviewers (ELD and AHM) using a pre-agreed Excel form (AHM, SMR, and JRA). In addition, study design characteristics were extracted according to the checklist of the Non-Randomized Studies Methods Group of the Cochrane Collaboration [24].

Measures of the effect of data processing and data synthesis

The results of the meta-analysis were expressed as relative risk (RR) for dichotomous data and mean difference (MD) for continuous data, both with 95% confidence intervals (CIs). For trials with multiple intervention arms, eligible groups were combined into a single comparison. Statistical analyses were performed using STATA 18. A Der Simonian-Laird random-effects model was applied due to the likely heterogeneity of the studies, whereas a fixed-effects model was used when only one study was included in the meta-analysis.

Statistical heterogeneity was assessed using the Cochrane Q statistic ($p = 0.10$) and quantified with the I^2 index [25]. Sensitivity analyses were conducted to identify sources of high heterogeneity by excluding each study individually to evaluate its impact. Additionally, a sensitivity analysis for dichotomous outcomes was performed by applying a "continuity correction" of 0.5 to zero cells in both groups [26]. Subgroup analyses were planned based on mode of delivery (vaginal versus caesarean section), study type (RCT versus quasi-experimental), and country income level as classified by the World Bank. Countries were grouped into two categories: 'high-income,' which included high-income and upper-middle-income countries, and 'low-income,' which included low-income and lower-middle-income countries [27].

Publication bias was assessed using funnel plots and Egger's test for asymmetry, applicable to results with at least 10 intervention arms ($p \leq 0.05$).

Results

Selection of studies

A total of 911 records were identified, with 770 from databases and 141 from records. After removing 360 duplicates, 551 records remained for evaluation. Of these, 507 were excluded automatically and manually after reviewing titles and abstracts. The full text of 42 records was retrieved, and 7 additional records were identified through citation searches. After thorough review, 29 studies that did not meet the eligibility criteria were excluded: 24 from databases and 5 from citation searches (Table S3). Finally, 20 articles were selected for qualitative analysis, with 18 from databases and 2 from citation searches. Two studies could not be included in the meta-analysis due to missing or incompatible data (Table S4). In total, 18 studies were eligible for inclusion in the meta-analysis. The selection process is detailed in Fig. 1.

Characteristics of included studies

A total of 18 studies were included in this review. The included studies had various designs: 6 were RCTs, of which 5 had a parallel design [17, 28–31], and 1 had a four-arm intervention design [32]. Additionally, 2 were quasi-randomised trials [33, 34], and 10 were quasi-experimental studies [35–44]. Table S5 provides a detailed description of the study designs. A total of 2,749 women participated in the studies, with sample sizes ranging from 40 to 659 participants. The studies were conducted in Egypt, Saudi Arabia, Turkey, India, China, Iraq, Israel and the United States. According to the World Bank's economic classification, most studies were conducted in lower-middle-income countries (Egypt and India), while four studies originated from upper-middle-income countries (China, Iraq, and Turkey) and four from high-income countries (Saudi Arabia, the United States, and Israel). All were conducted in a hospital setting (Table 1).

Participant characteristics

Most women were expected to give birth vaginally, while three were expected to give birth by caesarean section [30–32], all with a single fetus. Although these criteria were not always explicitly stated as inclusion criteria, they were inferred from the study results (Table 1). Table S6 provides detailed information on the inclusion criteria of the studies.

Characteristics of the intervention

The practice of SSC varied among the studies. Most studies described SSC as immediate or initiated at birth,

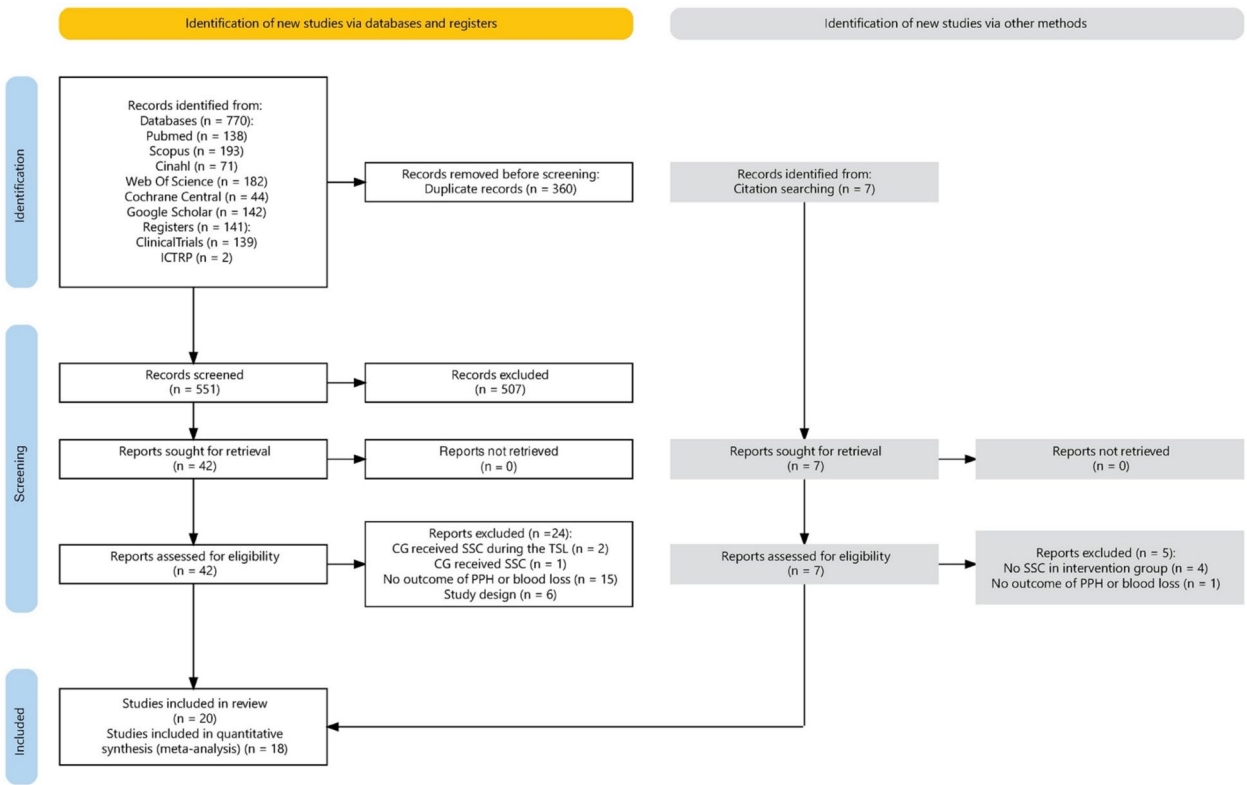

Fig. 1 Flow diagram illustrating the search and selection process

Table 1 Characteristics of the included studies

Author, year	Country	Study	Simple size (n)	Type of population	BM	Intervention group	Control group	Outcomes	Measurement)
Abdelmenem et al., 2019 [33]	Egypt	Q-RCT	100	SG at 38–42 wks., primiparous	V	Immediate SSC during TSL	Routine care and placed in a radiant warmer	Uterine atony	Indirect estimation using visual estimation
Aboushay & Gomaa, 2016 [35]	Saudi Arabia	Q-E	100	SG at 38–42 wks., regardless of parity	V	Immediate SSC for at least 30 min or until the end of the first feeding	Routine care and placed in a radiant warmer	Uterine atony	Indirect estimation using visual estimation
Ahmed et al., 2023 [36]	Egypt	Q-E	60	SG at 38–42 wks., primiparous	V	Immediate SSC during TSL	Routine care	Mean blood loss (mL) during TSL	Direct estimation using calibrated drapes, BRASSS-V Drape type
Al-Alaa et al., 2021 [28]	Saudi Arabia	RCT	100	>18 years, SG at 37–42 wk., regardless of parity	V	Immediate SSC for at least 60 min	Routine care. Subsequently, wrapped in a blanket and given to their mothers during birth and initiation of breastfeeding	Mean blood loss (mL) during TSL	Indirect estimation using visual estimation
Aydin Kartal et al., 2022 [17]	Turkey	RCT	68	18–35 years, SG at 37–42 wks., primiparous	V	Immediate SSC for 30 min	Routine care and placed in a radiant warmer	Mean blood loss (mL) during TSL Mean blood loss (mL) at 24 h	Direct estimation using blood collection bag Adding indirect estimation using gravimetric for the measurement of blood loss at 24 h
Desoky & Metwally, 2018 [37]	Egypt	Q-E	100	SG at 38–42 wks., primiparous	V	Immediate SSC	Routine care and placed in a warmer device	Mean blood loss (mL) during TSL (NR)	NR
El-ayari et al., 2023 [38]	Egypt	Q-E	100	SG at 38–42 wks., primiparous	V	Immediate SSC for 120 min	Routine care	Uterine atony	Indirect estimation using visual estimation
Emam & Elhakm, 2010 [39]	Egypt	Q-E	100	SG at 37–42 wks., primiparous	V	Immediate SSC	Routine care and placed in a radiant warmer	Uterine atony	Indirect estimation using visual estimation
Essa & Ismail, 2015 [40]	Egypt	Q-E	100	SG at 38–42 wks., primiparous	V	Immediate SSC for 120 min	Routine care and placed in a radiant warmer	Uterine atony	Indirect estimation using visual estimation
Huang et al., 2022 [41]	China	Q-E	182	>18 years, SG at 37-42 wks., regardless of parity	V	Immediate SSC for at least 90 min	Routine care and placement in a radiant warmer for 20 min	Mean blood loss (mL) after 2 h	NR
Hublikar & Bhore, 2021 [42]	India	Q-E	40	SG, regardless of parity	V	Immediate SSC for 30–60 min or until the first breastfeeding session	Control group without SSC and initiation of breastfeeding	Mean blood loss (mL) during TSL Blood loss ≥ 500 mL	Direct estimation using calibrated drapes, Kelly´s pad type

Table 1 (continued)

Author, year	Country	Study	Simple size (n)	Type of population	BM	Intervention group	Control group	Outcomes	Measurement)
Kram et al., 2021 [31]	United States	RCT	129	> 18 years, SG, ≥ 38 wks., regardless of parity	C	Immediate SSC	Routine care and placed in a warmer device	Mean intraoperative blood loss (mL)	Indirect estimation using visual estimation
Mejbel & Ali, 2012 [43]	Iraq	Q-E	80	SG, regardless of parity	V	SSC	Routine care, dressed, and taken to a special room	Uterine atony	Indirect estimation using visual estimation
Mohammed et al., 2017 [44]	Egypt	Q-E	180	SG at 38–42 wks., primiparous	V	Immediate SSC during TSL	Routine care and placed in a warmer device	Mean blood loss (mL) during TSL Mean blood loss (mL) after 2 h	Direct estimation by collection in a special calibrated container Adding indirect estimation using gravimetric technique for the measurement of blood loss at 2 h
Parikh et al., 2018 [29]	India	RCT	400	18–35 years, SG at 38–42 wks., primiparous	V	Immediate SSC for 120 min	Routine care. Afterwards, handed over to relatives	Blood loss ≥ 500 mL	Indirect estimation using visual estimation by placing a drape under the woman´s buttocks during birth
Pillai, 2018 [34]	India	Q-RCT	60	NR	V	Immediate SSC for 20 min	CG without SSC	Mean blood loss (mL) during TSL Blood loss ≥ 500 mL	Indirect estimation using gravimetric technique
Zafran et al., 2022 [30]	Israel	RCT	191	18–45 years, SG, term newborn, regardless of parity	C	Immediate SSC until the end of the surgical procedure	Routine care. Subsequently, the infant was kept with their mother or handed to the escort to be held for a few minutes and then transferred to the newborn room	Severe primary PPH	Indirect estimation using visual estimation
Zhang et al., 2023 [32]	China	RCT	659	SG, ≥ 37 wks., regardless of parity	C	Immediate SSC for 30, 60, and 90 min for GI1*, GI2*, and GI3* respectively	Routine care	Mean intraoperative blood loss (mL) Mean blood loss (mL) at 24 h	Direct estimation by suction of collected liquids Adding indirect estimation using gravimetric technique for the measurement of blood loss at 24 h

* Indicates which groups were combined to create a single pairwise comparison

BM Birth mode, *C* Caesarean, *CG* Control group, *IG* Intervention group, *mL* millilitres, *NR* No report, *PPH* Postpartum haemorrhage, *Q-E* Quasi-experimental, *Q-RCT* Quasi-randomized controlled trial, *SG* Singleton pregnancies, *SSC* Skin to skin contact, *TSL* Third Stage of Labour, *V* Vaginal, *wks* weeks of gestation

although one study reported SSC without explicitly defining it [43]. In all studies, the naked newborn was placed on the woman's chest or between her breasts, across the chest, or on the abdomen. The duration of SSC ranged from 20 to 120 min, but four studies did not specify the duration [31, 37, 39, 43]. In the control group, newborns were separated from their mothers to receive routine care. They were then placed in warmers or thermal cribs during the TSL, handed over to relatives [29], or returned to their mothers to initiate breastfeeding [28, 42] (Table 1).

Outcomes

The studies reported various outcomes. Five studies [33, 35, 39, 40, 43] describe uterine atony in terms of "presence of uterine atony" or "excessive blood loss," while one study defines it solely as "uterine atony" without additional specifications [38]. Furthermore, one trial reported blood loss of 1,000 mL or more [30], and three trials reported blood loss of 500 mL or more after delivery [29, 34, 42]. Mean blood loss was reported in ten trials: nine during the TSL [17, 28, 31, 32, 34, 36, 37, 42, 44], two at 2 h [41, 44], and two at 24 h [17, 32]. The description of blood loss measurement is detailed in Table 1.

Risk of bias in included studies

The included RCTs were assessed as having a "low risk of bias" for randomisation and sequence concealment, although concerns were noted regarding bias in the intervention and the selection of reported outcomes. Most trials had a "low risk of bias" for missing data. Two trials, the assessment of outcomes may have been influenced by knowledge of the intervention (Fig. 2a). More detailed assessments are provided in Table S7. In the quasi-experimental studies, the risk of bias was mostly high, particularly for confounding factors, though it was low for participant selection, classification of interventions, and deviations from the intended intervention. Missing data was generally low risk, except in one study with moderate risk. Outcome measurement was low risk in four studies and high risk in six, while the selection of reported outcomes was mostly moderate risk (Fig. 2b). Specific details of these studies are provided in Table S8.

Uterine atony

Six quasi-experimental studies evaluated the risk of uterine atony in 580 participants who gave birth vaginally and found a significant reduction in the risk of atony in those who received SSC compared with those who received routine care (RR 0.11; 95% CI: 0.05, 0.25). There was minimal heterogeneity ($I^2 = 3.38\%$) [33, 35, 38–40, 43] (Fig. 3a). Sensitivity analysis indicated that the meta-analysis results were robust, with no significant deviation in the RR and 95% CI when any single study was omitted (Table 2 and Figure S1). In the subgroup analysis based on the country's income level, studies from both low-income countries (RR 0.14; 95% CI: 0.05, 0.38; 4 studies, 400 participants) and high-income countries (RR 0.06; 95% CI: 0.01, 0.42; 2 studies, 180 participants) showed a lower incidence of uterine atony in those who received SSC (Fig. 3b). No results were found for uterine atony in those who gave birth via caesarean section. Table 3 shows a summary of the subgroup analysis.

Severe PPH

A single RCT in women who had a caesarean section did not show a significant reduction in the incidence of severe primary PPH in the TSL, defined as 1,000 mL or more, in the SSC group compared with the control group (RR 0.62; 95% CI: 0.21 to 1.89; 1 trial, $n = 191$) (Table 2) [30]. No results were available for severe PPH in women who gave birth vaginally (Table 3).

Blood loos ≥ 500 ml

Three studies involving 540 mothers provided data on blood loss of ≥ 500 mL during the TSL for those who gave birth vaginally. The SSC group showed a significantly lower incidence of PPH compared to the control group (RR 0.18; 95% CI: 0.04, 0.80), with mild heterogeneity ($I^2 = 23.67\%$) (Fig. 4a and Table 2) [29, 34, 42]. Subgroup analysis based on study type revealed significant differences in PPH rates in a single RCT (RR 0.09; 95% CI: 0.04, 0.21; 1 study, 400 participants) (Fig. 4b) [29]. No results for PPH were available for those who underwent a caesarean section. All included studies were from low- to middle-income countries. The effect size remained stable in the sensitivity analysis, even after removing studies where a correction factor of 0.5 was applied to both groups (Figure S2). Table 3 summarises the subgroup and sensitivity analyses.

Mean blood loss (mL) during the third stage of labour

Nine studies evaluated blood loss during the TSL. Compared to routine care, SSC significantly reduced mean blood loss during TSL (MD: −55.50 mL; 95% CI: −79.18, −31.82; 9 studies, 1,396 participants). However, the analysis exhibited high heterogeneity ($I^2 = 92.90\%$) (Fig. 5a and Table 2) [17, 28, 31, 32, 34, 36, 37, 42, 44]. Egger's test ($P = 0.613$) suggested no publication bias among these studies (Figure S3). The sensitivity analysis indicated that the meta-analysis findings were robust (figure S4).

Subgroup analysis indicated a significant reduction in blood loss in quasi-experimental studies (MD: −56.09 mL; 95% CI: −79.90 to −32.28; 5 studies, 440 participants) (Fig. 5b), in women who delivered vaginally (MD: −66.90 mL; 95% CI: −89.63 to −44.18; 7 studies,

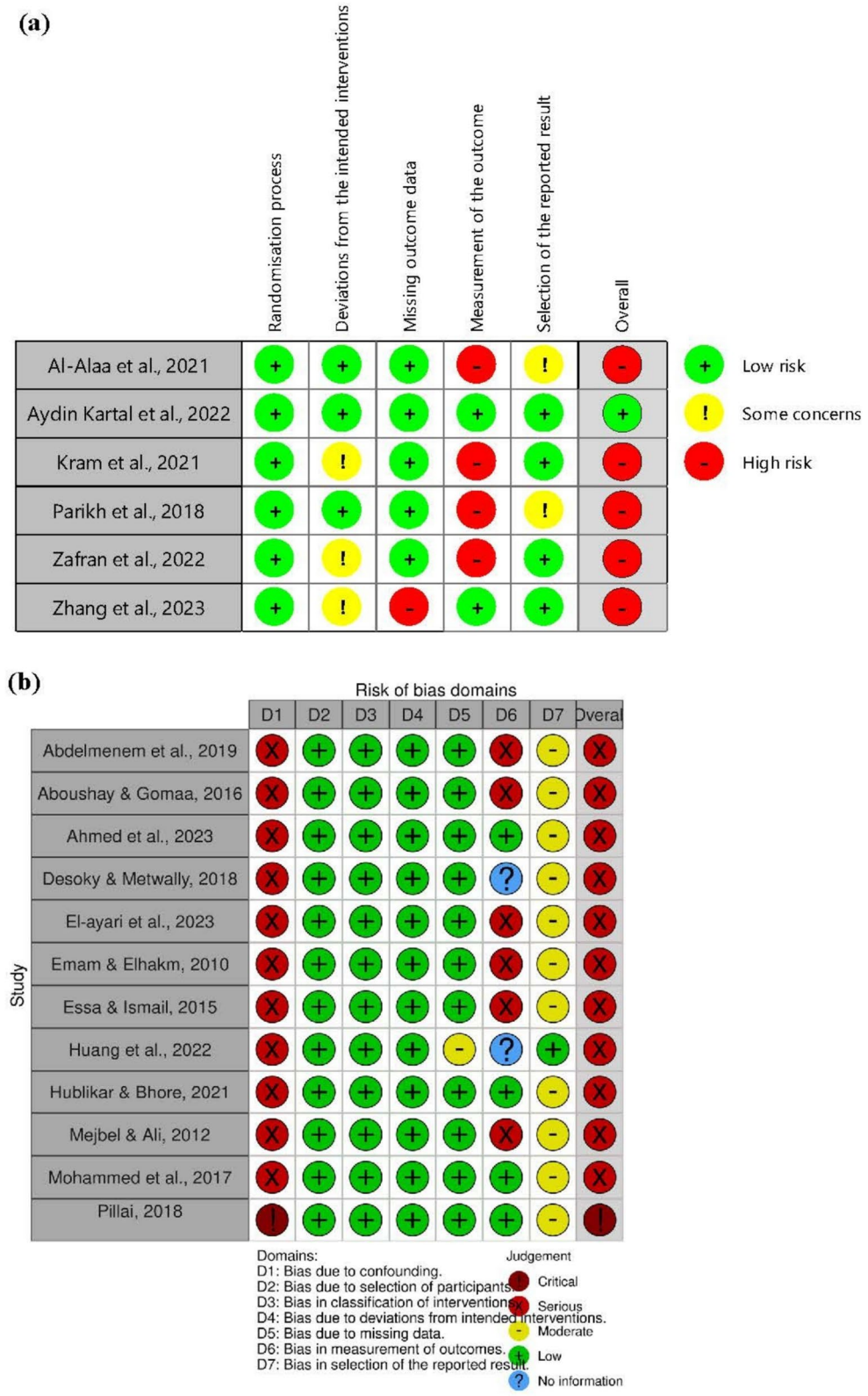

Fig. 2 Bias Risk Assessment in the Studies Included in the Meta-Analysis: **a** Randomized Controlled Trials according to RoB2. **b** Non-Randomized Studies according to ROBINS-I

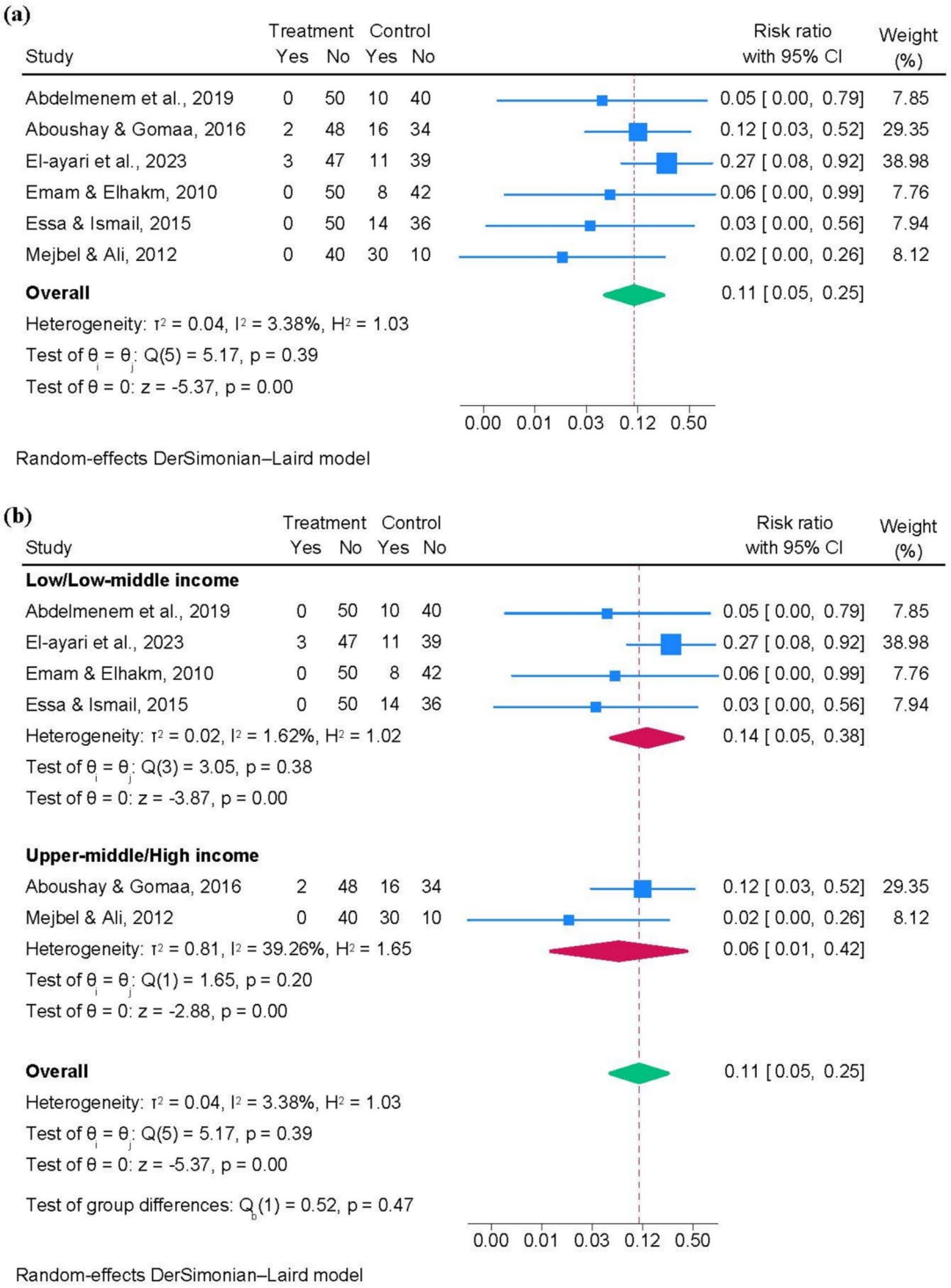

Fig. 3 Meta-analysis of the effect of SSC on uterine atony: **a** Overall effect; **b** Effect according to country income level

Table 2 Individual study results and summary of SSC outcomes during the third stage of labour compared to usual care to prevent postpartum haemorrhage and blood loss

Autor	Categorical variables (nº events/total)						Quantitative variables (mean [SD])					
	Uterine atony		Severe primary PPH		Blood loss ≥ 500 mL		Mean blood loss (mL) during the third stage of labour		Mean blood loss (mL) after 2 h		Mean blood loss (mL) at 24 h	
	SSC	Control	SSC	Control	SSC	Control	SSC	Control	SSC	Control	SSC	Control
Abdelmenem et al., 2019 [33]	0/50	10/50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Aboushay & Gomaa, 2016 [35]	2/50	16/50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Ahmed et al., 2023 [36]	NR	NR	NR	NR	NR	NR	312.67 (51.15)	357.5 (43.13)	NR	NR	NR	NR
Al-Alaa et al., 2021 [28]	NR	NR	NR	NR	NR	NR	168.00 (77.43)	264.00 (90.94)	NR	NR	NR	NR
Aydin Kartal et al., 2022 [17]	NR	NR	NR	NR	NR	NR	206.25 (65.51)	353.57 (209.82)	NR	NR	499.71 (219.60)	933.87 (102.03)
Desoky & Metwally, 2018 [37]	NR	NR	NR	NR	NR	NR	244.6 (27.40)	315.10 (45.30)	NR	NR	NR	NR
El-ayari et al., 2023 [38]	3/50	11/50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Emam & Elhakm, 2010 [39]	0/50	8/50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Essa & Ismail, 2015 [40]	0/50	14/50	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Huang et al., 2022 [41]	NR	NR	NR	NR	NR	NR	NR	NR	234.64 (63.65)	281.37 (72.29)	NR	NR
Hublikar & Bhore, 2021 [42]	NR	NR	NR	NR	0/20	0/20	132.25 (17.95)	154.25 (16.24)	NR	NR	NR	NR
Kram et al., 2021 [31]	NR	NR	NR	NR	NR	NR	559.70 (284.70)	526.80 (299.8)	NR	NR	NR	NR
Mejbel & Ali, 2012 [43]	0/40	30/40	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mohammed et al., 2017 [44]	NR	NR	NR	NR	NR	NR	244.60 (27.40)	315.10 (45.30)	340.40 (62.10)[a]	421.50 (71.10)[a]	NR	NR
Parikh et al., 2018 [29]	NR	NR	NR	NR	6/200	64/200	NR	NR	NR	NR	NR	NR
Pillai, 2018 [34]	NR	NR	NR	NR	0/50	0/50	201.66 (34.33)	275.33 (50.56)	NR	NR	NR	NR

Table 2 (continued)

Autor	Categorical variables (nº events/total)						Quantitative variables (mean [SD])					
	Uterine atony		Severe primary PPH		Blood loss ≥ 500 mL		Mean blood loss (mL) during the third stage of labour		Mean blood loss (mL) after 2 h		Mean blood loss (mL) at 24 h	
	SSC	Control	SSC	Control	SSC	Control	SSC	Control	SSC	Control	SSC	Control
Zafran et al., 2022 [30]	NR	NR	5/102	7/89	NR	NR	NR	NR	NR	NR	NR	NR
Zhang et al., 2023 [32]	NR	NR	NR	NR	NR	NR	345.40 (76.35)[b c]	350.00 (74.76)[b c]	NR	NR	605.10 (336.41)[a b c]	750 (224.27)[a b c]
Egger bias (p value)	NC		NC		NC		0.613		NC		NC	
Q Cochran (p value)	0.390		NC		0.270		< 0.001		0.020		< 0.001	
I^2 95% CI	3.38		NC		23.67		92.90		82.99		97.03	
RR 95% CI	0,11 (0.05, 0.25)[d]		0,62 (0.21, 1.89)[e]		0,18 (0.04, 0.80)[d]		NC		NC		NC	
MD CI 95%	NC		NC		NC		−55.50 (−79.18, −31.82)[d]		−63.96(−97.64, −30.28[d]		−287.45 (−570.89, −4.01)[d]	

CI Confidence interval, *MD* Mean difference, *mL* millilitres, *NC* Not calculated, *NR* Not reported, *PPH* Postpartum haemorrhage, *RR* Risk ratio, *SD* Standard deviation, *SSC* Skin to skin contact

[a] Average blood loss calculated from the total sum of average blood loss of the study up to the time point

[b] The standard deviation was extracted according to the Cochrane Manual

[c] Combination of two groups reported in a single group according to the Cochrane handbook

[d] Random effects model (DerSimonian–Laird)

[e] Mantel–Haenszel fixed effect

Table 3 Meta-analyses, sensitivity analyses and sub-group of the effect of skin-to-skin contact

Outcome	Analysis	No. of studies	No. of participants	Effect estimates	95% CI	I^2 (%)	Cochran's Q (*p*-Value)
Uterine atony	**Primary analysis**	6	580	0.11 (RR)	0.05, 0.25	3.38	0.390
	Sub-group analyses						
	Vaginal birth	6	580	0.11 (RR)	0.05, 0.25	3.38	0.390
	Caesarean section	NC	NC	NC	NC	NC	NC
	RCT	NC	NC	NC	NC	NC	NC
	QE	6	580	0.11 (RR)	0.05, 0.25	3.38	0.390
	Lower-income setting	4	400	0.14 (RR)	0.05, 0.38	1.62	0.380
	Higher-income setting	2	180	0.06 (RR)	0.01, 0.42	39.26	0.200
Severe primary PPH	**Primary analysis**	1	191	0.62 (RR)	0.21, 1.89	NC	NC
	Sub-group analyses						
	Vaginal birth	NC	NC	NC	NC	NC	NC
	Caesarean section	1	191	0.62 (RR)	0.21, 1.89	NC	NC
	RCT	1	191	0.62 (RR)	0.21, 1.89	NC	NC
	QE	NC	NC	NC	NC	NC	NC
	Lower-income setting	NC	NC	NC	NC	NC	NC
	Higher-income setting	1	191	0.62 (RR)	0.21, 1.89	NC	NC
Blood loss ≥ 500 mL	**Primary analysis**	3	540	0.18 (RR)	0.04, 0.80	23.67	0.270
	Sensitivity analyses						
	Exclusion studies with continuity correction for zero events in both groups	1	400	0.09 (RR)	0.04, 0.21	NC	NC
	Sub-group analyses						
	Vaginal birth	3	540	0.18 (RR)	0.04, 0.80	23.67	0.270
	Caesarean section	0	NC	NC	NC	NC	NC
	RCT	1	400	0.09 (RR)	0.04, 0.21	NC	NC
	QE	2	140	1.00 (RR)	0.06, 15.62	0.00	1.000
	Lower-income setting	3	540	0.18 (RR)	0.04, 0.80	23.67	0.270
	Higher-income setting	0	NC	NC	NC	NC	NC
Mean blood loss (mL) during TSL	**Primary analysis**	9	1,396	−55.50 (MD)	−79.18, −31.82	92.90	< 0.001
	Sub-group analyses (all studies)						
	Vaginal birth	7	608	−66.90 (MD)	−89.63, −44.18	90.70	< 0.001
	Caesarean section	2	788	−3.98 (MD)	−16.92, 8.95	0.0	0.470
	RCT	4	956	−56.10 (MD)	−127.77, 15.57	92.12	< 0.001
	QE	5	440	−56.09 (MD)	−79.90, −32.28	92.30	< 0.001
	Lower-income setting	5	440	−56.09 (MD)	−79.90, −32.28	92.30	< 0.001
	Higher-income setting	4	956	−56.10 (MD)	−127.77, 15.57	92.12	< 0.001
Mean blood loss (mL) after 2 h	**Primary analysis**	2	362	−63.96 (MD)	−97.64, −30.28	82.99	0.020
	Sub-group analyses						
	Vaginal birth	1	362	−63.96 (MD)	−97.64, −30.28	82.99	0.020
	Caesarean section	0	NC	NC	NC	NC	NC
	RCT	0	NC	NC	NC	NC	NC
	QE	2	362	−63.96 (MD)	−97.64, −30.28	82.99	0.020
	Lower-income setting	1	180	−81.10	−100.60, −61.60	NC	NC
	Higher-income setting	1	182	−46.73	−66.52, −26.94	NC	NC

Table 3 (continued)

Outcome	Analysis	No. of studies	No. of participants	Effect estimates	95% CI	I^2 (%)	Cochran's Q (*p*-Value)
Mean blood loss (mL) at 24 h	**Primary analysis**	2	727	−287.45 (MD)	−570.89, −4.01	97.31	< 0.001
	Sub-group analyses						
	Vaginal birth	1	68	−434.16 (MD)	−515.55, −352.77	NC	NC
	Caesarean section	1	659	−144.90 (MD)	−189.75, −100.05	NC	NC
	RCT	2	727	−287.45 (MD)	−571.89, −4.01	97.31	< 0.001
	QE	0	NC	NC	NC	NC	NC
	Lower-income setting	0	NC	NC	NC	NC	NC
	Higher-income setting	2	727	−287.45 (MD)	−570.89, −4.01	97.31	< 0.001

CI Confidence interval, *MD* Mean difference, *mL*, millilitres, *NC* Not calculated, *Q-E* Quasi-experimental, *RCT* Randomized controlled trial, *RR* Risk ratio

608 participants) (Figure S5a), and in low-income countries (MD: −56.09 mL; 95% CI: −79.90 to −32.28; 5 studies, 440 participants) (Figure S5b). Table 3 summarises the subgroup analysis.

Mean blood loss (mL) after 2 h

Two quasi-experimental studies assessed mean blood loss at 2 h postpartum in women who gave birth vaginally. Compared with routine care, SSC significantly reduced mean blood loss at 2 h postpartum (nonspecified outcome) (MD: −63.96 mL; 95% CI: −97.64, −30.28; 2 trials, 362 participants). However, the analysis showed high heterogeneity (I^2 = 82.99%) (Table 2 and Figure S6a) [41, 44]. The reduction in blood loss was consistent across country income levels (Figure S6b). No data were available on mean blood loss at 2 h postpartum for women who underwent caesarean section (Table 3).

Mean blood loss (mL) at 24 h

Two RCTs assessed mean blood loss at 24 h postpartum in upper-middle-income countries. The results showed that mean blood loss was significantly lower in the SSC group compared with the routine care group (MD: −287.45 mL; 95% CI: −570.89, −4.01; 2 trials, 727 participants) (Table 2 and Figure S7a) [17, 32], with high heterogeneity (I^2 = 97.31%). Subgroup analysis showed a reduction in blood loss after both vaginal birth (MD: −434.16 mL; 95% CI: −515.55, −352.77; 1 trial, 68 participants) and caesarean section (MD: −144.90 mL; 95% CI: −189.75, −100.05; 1 trial, 659 participants) (Figure S7b). Table 3 summarises the subgroup analysis.

Discussion

Main findings

This systematic review assessed the effectiveness of SSC in reducing PPH and blood loss. The results showed that SSC significantly reduced the risk of uterine atony in women undergoing vaginal delivery compared with routine care, although this effect was not assessed in women undergoing caesarean section. For severe PPH, a single trial did not show a significant reduction in women undergoing caesarean section. However, SSC was effective in reducing blood loss ≥ 500 mL in vaginal births, with a significant reduction in mean blood loss in the TSL. In addition, a reduction in blood loss was observed both in the first two hours and at 24 h postpartum in women who delivered vaginally. In women who had a caesarean section, there was no significant reduction in blood loss during the TSL, but there was a reduction in blood loss at 24 h postpartum.

Interpretation of study findings and clinical implications

Our findings suggest that SSC is an effective intervention to reduce uterine atony, blood loss exceeding 500 mL, and average blood loss following vaginal births. This direct contact generates non-noxious tactile stimulation that activates C-tactile (CT) afferent fibres, a type of low-threshold, unmyelinated mechanoreceptors present in human hairy skin, which respond to gentle touch and slow, massage-like strokes [45]. The activation of these fibres contributes to the stimulation of the oxytocinergic system, promoting the release of oxytocin both in the bloodstream and in the brain [46].

Additionally, a newborn placed in SSC with the mother is capable of initiating breast-seeking behaviour and deciding the timing of the first feeding [47]. During this process, the baby stimulates the mother's nipple through rhythmic hand movements, begins to lick and suck the nipple, which also contributes to oxytocin release and the early establishment of breastfeeding [47, 48]. However, nipple stimulation alone does not appear to be sufficient to reduce PPH rates. A Cochrane review found no

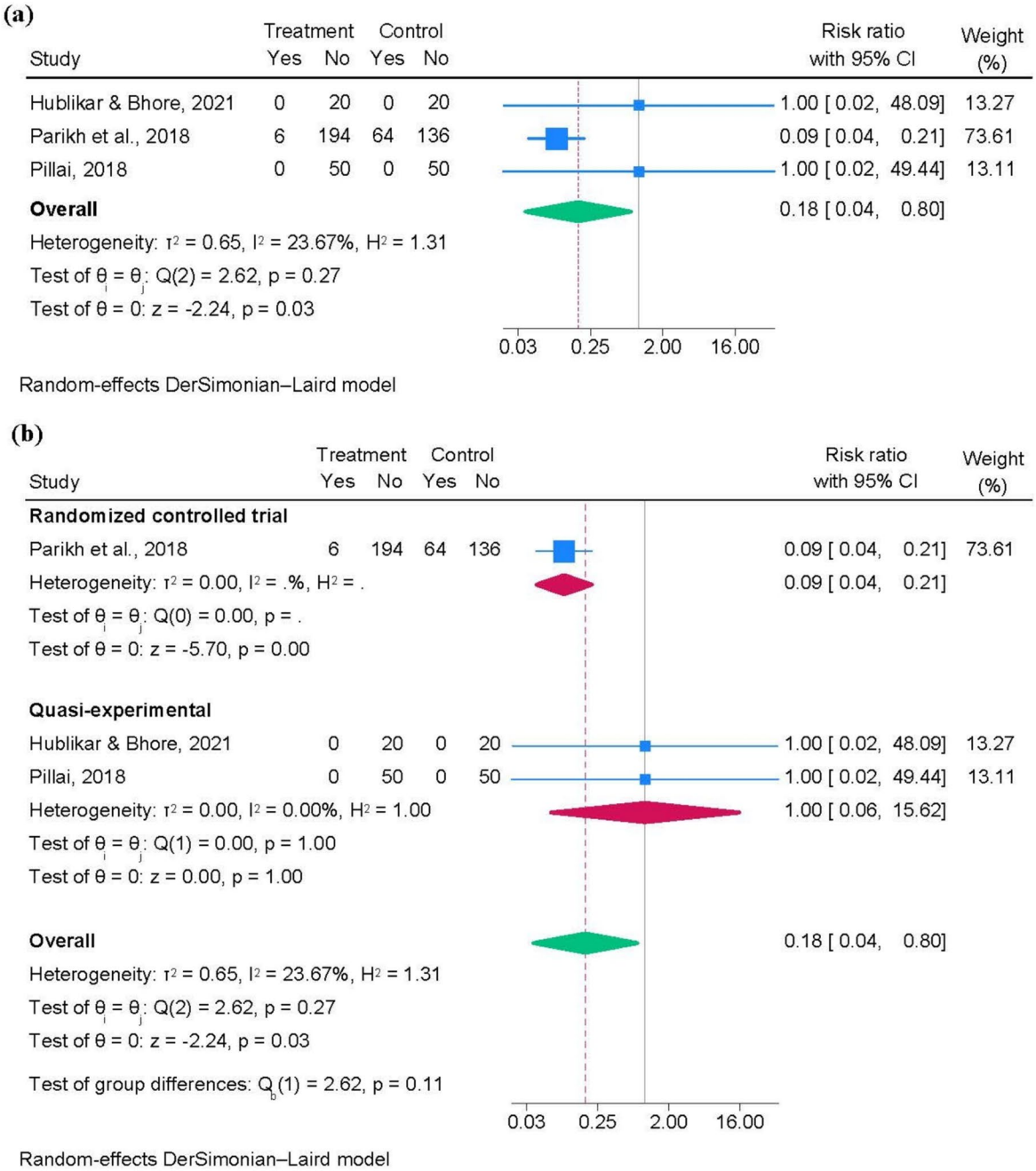

Fig. 4 Meta-analysis of the effect of SSC on blood loss ≥ 500 mL: **a** Overall effect; **b** Effect according to study type

significant differences in PPH rates (≥500 mL) between the breastfeeding and no treatment groups (RR 0.95; 95% CI: 0.77, 1.16) [49].

Two studies included in the review compared the effect of SSC on blood loss with a control group who started breastfeeding during the TSL. The results showed that the group that received SSC had less blood loss than the group that only initiated breastfeeding without SSC, but this did not change the effect of the intervention towards zero [28, 42]. This may be due to the time that elapses between placement of the newborn in the SSC and the first breastfeeding, with the average time to initiate breastfeeding varying between 15 and 48 min in different studies [32, 39, 40, 50]. In addition, newborns in SSC tend to initiate breastfeeding earlier than those wrapped in blankets [50, 51]. Therefore, the greater effect on PPH

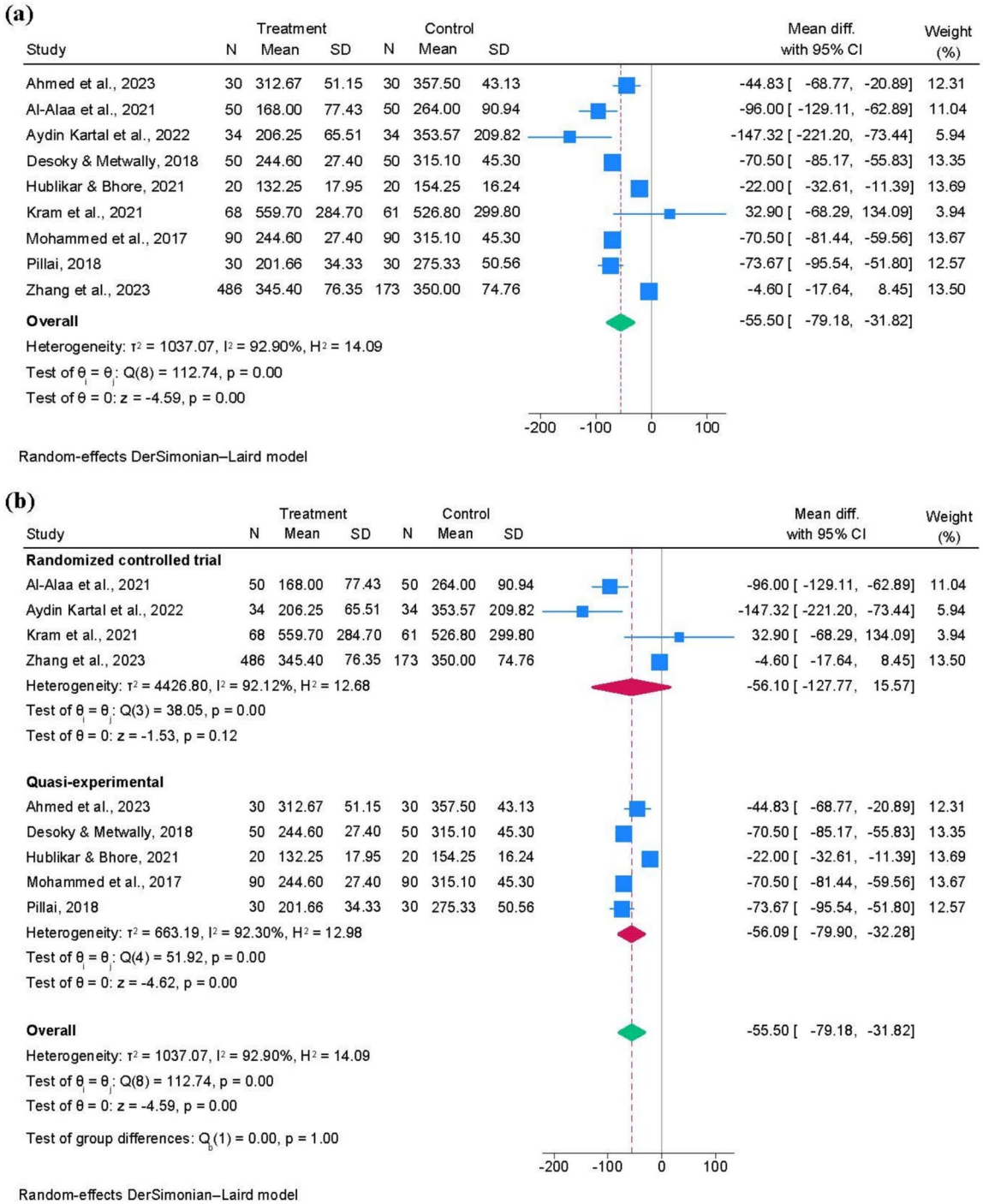

Fig. 5 Meta-analysis of the effect of SSC on mean blood loss: **a** Overall effect; **b** Effect according to type of study

prevention during the TSL seems to be more closely associated with SSC and the baby's gentle stroking of the mother's chest than with nipple suction.

No significant reduction in severe PPH was observed in women undergoing caesarean section. Some studies suggest that oxytocin levels do not increase significantly in response to SSC in mothers with planned caesarean section [30, 50]. However, SSC showed a beneficial effect in reducing blood loss at 24 h postpartum, especially when the duration of SSC was prolonged. Zhang et al.,

2023 included three intervention groups that received 30, 60 and 90 min of SSC during caesarean section, and the group with the longest duration of SSC had the lowest blood loss at 24 h. Immediate and continuous delivery of SSC in the operating theatre is safe for both mother and newborn, without increasing operative time [31], infection rates or length of maternal hospital stay [30]. In addition, there is less perceived postoperative pain and greater satisfaction with the birth experience [51].

Strengths, limitations, and future research

This review was primarily based on studies conducted in healthy women without significant comorbidities or risk factors for PPH, which limits the generalisability of the findings to populations with coagulation disorders or other haematological conditions. Additionally, the results cannot be extrapolated to women undergoing caesarean sections due to the small sample size in these cases. Another limitation is the lack of information on the timing of breastfeeding initiation in the control group, which prevents subgroup analysis. However, a major strength of this review is that it fills a gap in the literature, as no previous meta-analyses have examined the effect of SSC on PPH and postpartum bleeding.

This review was primarily based on studies conducted in women in good health, without significant comorbidities or risk factors for PPH, which limits the generalisability of the findings to populations with coagulation disorders or other haematological conditions. Additionally, the results cannot be generalised to women undergoing caesarean section due to the small sample size in these cases. Another limitation is the lack of information on the timing of breastfeeding initiation in the control group, which prevents subgroup analysis. However, a major strength of this review is that it fills a gap in the literature, as no previous meta-analyses have examined the effect of SSC on PPH and postpartum bleeding.

There are several reasons for the lack of confidence in the estimated effect size of SSC. First, many of the included studies used visual methods to estimate bleeding. The visual estimation of bleeding is the most commonly used method in clinical practice [52]. However, it tends to underestimate blood loss [53]. Objective quantification methods, such as volumetric measurement and gravimetry, offer greater accuracy [54]; nevertheless, the available evidence is insufficient to support the superiority of one method over another in estimating blood loss [55].

Most of the included trials were from low- and middle-income countries, where the incidence of PPH is higher due to limited resources. However, in subgroups analysed by income level, SSC was consistently associated with a lower incidence of PPH, and less blood loss compared with routine care. SSC is an accessible and cost-effective intervention that can be implemented in all types of settings to reduce PPH rates. However, implementation of SSC remains low in low-income countries [56], with rates of 28% in India [57] and 42% in sub-Saharan Africa, where Nigeria has the lowest prevalence (11.7%) [58].

Future research should focus on conducting RCTs to confirm these findings and to establish a stronger causal relationship. It is important to increase the number of studies evaluating the effect of SSC in women undergoing caesarean section, and to standardise the methods and criteria for measuring blood loss. Further studies are also needed to determine the optimal duration of SSC to maximise oxytocin release and uterine contraction. While our study focuses on reducing blood loss, future research should evaluate clinically relevant outcomes to provide a more comprehensive understanding of the impact of interventions. These outcomes include admission to intensive care units, blood transfusion rates, and peripartum hysterectomy rates [59].

Conclusions

SSC is an effective intervention for reducing uterine atony, blood loss greater than 500 mL and postpartum blood loss in women undergoing vaginal delivery. Although no significant reduction in severe PPH was observed in women undergoing caesarean section, SSC showed a beneficial effect in reducing blood loss at 24 h postpartum, with the duration of SSC during caesarean section being a key factor in maximising these benefits. SSC is recommended as a strategy to prevent PPH in both high- and low-income countries, suggesting that clinical guidelines for PPH prevention should include SSC as an effective strategy within expectant management. However, further randomised controlled trials are needed to confirm these findings, particularly in women undergoing caesarean section. There is also a need to standardise methods of measuring blood loss and to determine the optimal duration of SSC to maximise its clinical benefits, particularly in terms of oxytocin release and PPH prevention.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12884-025-07425-2.

Supplementary Material 1.

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Authors' contributions

All authors were closely involved in the study design. SMR, ABC, JCMC, ELD and AHM reviewed the literature. SMR,AHM and JRA performed data analysis.

SMR wrote the first draft. All were closely involved in revising the article and consented with the final version.

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Declarations

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Competing interests
The authors declare no competing interests.

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