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REVIEW

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The use of hydrotherapy in the first stage of labour: A systematic review and meta-analysis

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Abstract

Aim: To explore the effect of hydrotherapy applied in the first stage of labour on the health of mother and newborn.

Methods: This systematic review and meta-analysis was carried out by following PRISMA. The studies were obtained by scanning EBSCO, PubMed, Science Direct, Ovid, Web of Science and Scopus electronic databases. Twenty studies published between 2013 and 2023 were included.

Results: The total sample size of the studies was 8254 (hydrotherapy: 2953, control: 5301). Meta-analyses showed that the perception of pain decreased, comfort level and vaginal birth rate were higher and assisted vaginal birth rate and APGAR scores in the first minute were lower in women who underwent hydrotherapy. There was no difference between groups in terms of the duration of the first and second stage of labour, episiotomy, perineal trauma, intrapartum and postpartum bleeding amounts, use of pain medication and labour augmentations, APGAR scores in the fifth minute, positive neonatal bacterial culture and neonatal intensive care unit need.

Conclusion: This study revealed that the results that hydrotherapy decreased the perception of pain and assisted birth, increased the rate of vaginal birth and comfort level and did not adversely affect the health of the mother and baby during the birth process.

KEYWORDS
hydrotherapy, intrapartum care, labour, midwifery, nursing, women's health

Summary statement

What is already known about this topic?

- Hydrotherapy is a non-pharmacological technique used in labour.

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- Studies showed that hydrotherapy applied in the first stage of labour is an effective technique for lessening the intensity of labour pain, reducing the need for assisted vaginal childbirth and augmentation and lowering episiotomy rates.

What this paper adds

- This study summarizes the evidence that hydrotherapy is effective in increasing vaginal birth rates and comfort, reducing pain during labour and assisted vaginal birth rates.
- This review revealed that hydrotherapy does not impact the duration of the first and second stages of labour, perineal trauma or episiotomy, the use of pain relief, labour augmentation, intrapartum/postpartum haemorrhage and neonatal outcomes.

The implications of this paper:

- Increasing availability for reliable evidence about the effectiveness of hydrotherapy for reducing pain in the first stage of labour and rates of assisted vaginal birth, increasing vaginal birth rates, comfort and satisfaction is likely to be beneficial both in theory and practice for all stakeholders, including pregnant women, midwives, nurses and obstetricians.

1 | INTRODUCTION

Childbirth is a physiological process and it can be difficult and painful for some women giving birth (Cowan et al., 2017). Keeping mother and child safe during labour, appropriately managing issues that may occur and making the mother comfortable are components of intrapartum care. Various pharmacological and non-pharmacological methods are employed in lessening the pain of women in labour and increasing their comfort (Cluett et al., 2018; Liu et al., 2014). Pharmacological methods include interventions such as regional pain management and general anaesthesia and non-pharmacological methods that include applications such as massage, breathing techniques, positioning, music, acupressure, reflexology and aromatherapy (Abo-Romia & El-Adham, 2014; Henrique et al., 2018).

Hydrotherapy is one of the non-pharmacological methods used in childbirth in both the first and second stages of labour. Hydrotherapy is used in the form of hot showers as well as in methods such as immersion in water, hot, cold or warm baths in bathtubs or immersion in warm water in a jacuzzi (Cowan et al., 2017; Taghavi et al., 2015). Observational and experimental research has revealed that the application of hydrotherapy during labour for at least 20–30 min at a temperature of 37–38°C increases blood circulation, promotes muscle relaxation and raises endorphin levels, resulting in lessening pain and increasing the mother's satisfaction with the birth process (Mollamahmutoğlu et al., 2012; Taşkın, 2019). Studies also indicate that the use of hydrotherapy in labour may diminish the production of catacholamine and reduce the use of analgesics as well as the risk of operative childbirth and anxiety (Cluett et al., 2018; Gayiti et al., 2015; Taghavi et al., 2015). Meanwhile, it has also been stated that hydrotherapy does not have an effect on neonatal outcomes (Büyük et al., 2020; Cluett et al., 2018).

Systematic reviews and meta-analysis studies have reviewed the evidence for the effectiveness of hydrotherapy in labour and delivery. These studies report significant heterogeneity in many outcomes related to the maternal and neonatal effects of hydrotherapy and flag that, because of this, more studies on the subject are needed (Cluett et al., 2018; Shaw-Battista, 2017). One recent systematic review and meta-analysis focused only on neonatal outcomes of hydrotherapy (Vanderlaan et al., 2018), and another included very few studies on hydrotherapy (Domínguez-Solís et al., 2021). Three other reviews focused on specific outcomes related to maternal and infant health (Burns et al., 2022; Cristina et al., 2022; Zhang & Yang, 2022). Unlike these systematic reviews, this study reports more comprehensive results specifically on the effects of hydrotherapy use in the first stage of labour on maternal and infant health. The data obtained are expected to contribute to the improvement of intrapartum care services as well as to the accumulation of knowledge in the national and international literature.

1.1 | Aim and research questions

The study's purpose was to determine the effects of hydrotherapy in the first stage of labour on maternal and neonatal health. The questions for the studies were: (1) What is the effect of hydrotherapy intervention in the first stage of labour on the duration of labour, pain, comfort, use of anagesics and augmentation, mode of birth, perineal trauma and blood loss? (2) What is the effect of hydrotherapy intervention in the first stage of labour on neonatal APGAR score, infection and NICU admission?

2 | METHODS

This systematic review and meta-analysis followed the PRISMA checklist in creation of the study protocol and writing the article (Page et al., 2021). The protocol of the study was registered on the PROSPERO database (Registration Number: CRD42020214361).

2.1 | Eligibility criteria

The studies contained in this study met the criteria of PICOS. Participant (P): Pregnant women in the first stage of labour. Intervention (I): Application of hydrotherapy (immersion in hot water, showering or bathing in hot water). Comparison (C): No application of hydrotherapy (control group). Outcomes (0): Maternal and neonatal outcomes as described in studies. Study design (S): Randomized controlled studies, quasi-experimental and observational studies with control/comparision groups (retrospective, cohort and case–control) were included. Articles published between 2010 and 2020 in Turkish and English were included. The reason for including studies conducted before 2010 is that a systematic review of legacy studies on the subject has been performed (Shaw-Battista, 2017).

Studies that applied hydrotherapy to local areas (such as the feet), used hydrotherapy in combination with other non-pharmacological techniques, used hydrotherapy only in the second stage of labour and were at risk of serious bias were excluded.

2.2 | Information sources and search strategy

The literature was searched from November 2020 to May 2023 using the EBSCO, PubMed, Science Direct, Ovid, Web of Science, Scopus, Dergipark and Turkish National Thesis Centre databases using the keywords '(hydrotherapy OR immersion in water OR water immersion OR labor in water OR shower OR bath) AND (labor OR labor OR birth)'. Reference lists of included studies and previous systematic reviews were checked for additional research.

2.3 | Study selection

Two researchers did the selection of the studies independently. Initially, the duplicate studies were excluded, and studies selected if they met the research criteria when screened by title, abstract and full text, respectively.

2.4 | Data extraction

A data extraction instrument devised by the researchers was used in obtaining the study data. With this data extraction tool, data were obtained from included studies on the place and year, year of publication, research design, sample size, mean age of mothers, mode of application of hydrotherapy and the effects of hydrotherapy on maternal and neonatal health.

2.5 | Methodological quality appraisal

The quality of the articles in randomized controlled studies were assessed with Version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2) (Sterne et al., 2019) and in observational and quasi-experimental studies with the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) (Sterne et al., 2016) tool. Eight of the articles included in the review were evaluated with ROBINS-1, seven with RoB-2. The following criteria were used in evaluating overall bias risk using the ROBINS-I and RoB 2 (Sterne et al., 2016, 2019). Low risk of bias determined that the study carried low bias risk in all domains. Moderate risk of bias determined that the study indicated a low–moderate risk of bias in all domains. Some concern indicated concern in at least one domain but that no domain carried a high bias risk. Serious/high risk of bias determined that the study carried a high risk of bias in at least one or more domains. Studies that had a serious risk of bias in the item related to the measurement of results were excluded from the scope of this study.

2.6 | Determining robustness of evidence

The GRADE approach recommended by the Cochrane working group was employed for evaluating the certainty of evidence for the critical outcomes of the study (Ryan & Hill, 2016; Schünemann et al., 2013). In the creation of the GRADE profile tables, the research design and the relevant outcome variables reported were taken into account.

2.7 | Data synthesis and analysis

The meta-analysis was performed using Review Manager 5.3 (The Nordic Cochrane Centre, Copenhagen, Denmark). Effect size was calculated by meta-analysis for each outcome variable reported in more than one study. The odds ratio (OR) was calculated for categorical variables, and mean difference (MD) or standardized mean difference (SMD) was calculated for continuous variables. Heterogeneity between studies was assessed using Cochran's Q test and Higgins' I^2, with I^2 greater than 50% considered to indicate significant heterogeneity (Deeks et al., 2021). Accordingly, when $I^{2\prime}$ was greater than 50%, the random effect results were taken into account, and if the value was less, the fixed effect results were considered. In addition, subgroup analysis was examined in order to take into account the heterogeneity that may result from study designs. All tests were calculated from two-tailed tests, and a p value of less than 0.05 was considered statistically significant.

3 | RESULTS

3.1 | Study selection

A total of 10 902 records were pooled. After screening the titles and abstracts and removing duplicated articles, 43 articles was reached for full-text review. From the review of the full texts, 20 articles were selected for the meta-analysis (Figure 1). Studies that were found not to include data that were suitable for our analysis were removed at the data extraction and analysis stages.

3.2 | Study characteristics

Eight of the articles were randomized controlled experimental studies (Abo-Romia & El-Adham, 2014; Darsareh et al., 2018; Lee et al., 2013; Maddady et al., 2018; Sert et al., 2020; Solt Kirca & Kanza Gul, 2022; Taghavi et al., 2015; Taşkın & Ergin, 2022), three were quasi-experimental with controls (Grymel-Kulesza et al., 2021; Liu et al., 2014; Tuncay et al., 2017), five were retrospective cohort studies (Büyük et al., 2019, 2020; Lewis et al., 2018; Neiman et al., 2020; Sidebottom et al., 2020), three were prospective cohort studies (Barry et al., 2020; Lanier et al., 2021; Seed et al., 2023), and one was a case–control study (Zhao et al., 2017).

In 14 of the studies included in this review, hydrotherapy was applied by immersion in water (Barry et al., 2020; Büyük et al., 2019, 2020; Darsareh et al., 2018; Grymel-Kulesza et al., 2021; Lanier et al., 2021; Lewis et al., 2018; Liu et al., 2014; Neiman et al., 2020; Seed et al., 2023; Sert et al., 2020; Sidebottom et al., 2020; Tuncay et al., 2017; Zhao et al., 2017); in five, warm showers were used (Abo-Romia & El-Adham, 2014; Lee et al., 2013; Solt Kırca & Kanza Gul, 2022; Taghavi et al., 2015; Taşkın & Ergin, 2022); and in one, a hot shower (Maddady et al., 2018) was applied. It was reported in the studies that the hydrotherapy water temperature varied in the range of 34–38°C (Table 1).

The total sample size of the studies included in this systematic review and meta-analysis amounted to $n = 8254$ (hydrotherapy: $n = 2953$, control: $n = 5301$). The age range among the women in the studies was 20–35 years in the hydrotherapy groups and 19–38 years in the control groups (Table 1). Apart from routine intrapartum care, there was no hydrotherapy intervention in the control group.

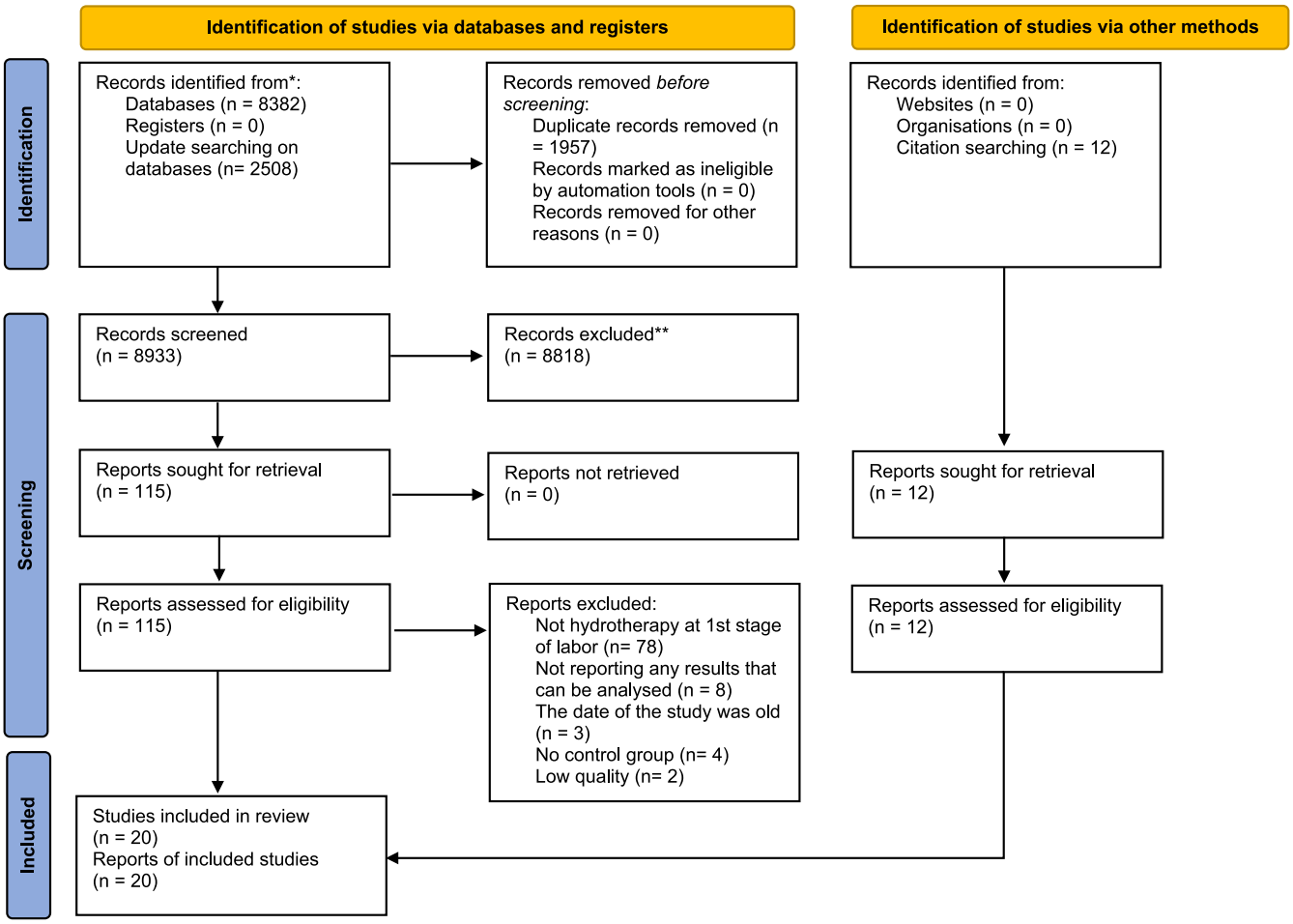


FIGURE 1 PRISMA flow diagram of the study.

TABLE 1 The characteristics and main findings of the studies included in the systematic review and meta-analysis.

Authors Year/country	Study design/data sources	Collection year	Sample size	Hydrotherapy type	Mean age	Maternal outcomes	Neonatal outcomes
Abo-Romia and El-Adham (2014) Egypt	RCT	2014	H: 50 C: 50	Warm shower in active labour (contracting at least every 5 min), with constant hot water to last 30 min with encouragement of participant sitting or changing positions for comfort	H: 28.4 ± 5.7 C: 26.6 ± 6.2	Pain intensity after intervention	—
Barry et al. (2020) Ireland	Prospective observational study	2016–2019	H: 190 C: 190	A pool wide enough for the woman to take different positions and deep enough so that the water level covers her abdomen when she sits down	H: >35 years 23.2% C: >35 years 14.7%	Vaginal birth, PPH > 500 mL	NICU admission
Büyük et al. (2020) Turkey	Retrospective observational study	2017–2019	H: 104 C: 104	Water immersion in a birth cabin with 4–10 cm dilatation	H: 29.8 ± 5.0 C: 30.9 ± 4.7	Use of oxytocin	NICU admission
Büyük et al. (2019) Turkey	Retrospective observational study	2017–2018	H: 84 C: 84	Water immersion; water between 34 and 37.5°C.	H: 29.8 ± 4.8 C: 30.1 ± 4.9	Postpartum Hb (g/dL) and Hct (%)	—
Darsareh et al. (2018) Iran	RCT	2015	H: 90 C: 90	Water immersion in a tub with constant water between 37 and 37.5°C and applied from 4 to 10 cm dilatation	H: 23.0 ± 2.09 C: 22.0 ± 2.87	Length of labour 2nd stage (min), use of augmentation, vaginal birth, vacuum-assisted birth, intact perineum, episiotomy, first-degree laceration	1st and 5th min APGAR scores, NICU admission
Grymel-Kulesza et al. (2021) Poland	Quasi-experimental study	2010–2012	H: 38 C: 32	Women entered the bath tub for delivery at 3–9 cm cervical dilation (average 6 cm). A single stay in the bath tub lasted approx. 60 min The water level was up to the primipara's umbilicus and the water temperature was 37°C	H: 20–34 (25) C: 19–38 (28)	Pain intensity	—
Lanier et al. (2021) USA	Prospective observational study	2015–2019	H: 730 C: 458	Water immersion during the first stage of labour in a water birth tub	H: 29.37 (29.0–29.7) C: 29.8 (29.3–30.2)	Vaginal birth	NICU admission, neonatal infectious
Lee et al. (2013) Taiwan	RCT	2010–2011	H: 41 C: 39	Warm shower application with constant hot water at 37°C in any region of the body	H: 31.44 ± 3.85 C: 31.83 ± 4.62	Pain intensity during and after intervention, use of induction and amniotomy	—
Lewis et al. (2018) Australia	Retrospective observational study	2015–2016	H: 303 C: 199	Water immersion in the pool from the participant's axilla to vulva/perineum	Not reported	Intact perineum, third/fourth-degree tear, estimated blood loss (mL), vaginal birth, assisted vaginal birth	NICU admission
Liu et al. (2014) China	Quasi-experimental study		H: 38 C: 70	Water immersion. Water temperature: 35–38°C, rest for	H: 28.66 ± 3.08 C: 27.89 ± 2.99	Vaginal birth, duration of first and second stage of labour	NICU admission, positive bacterial culture

(Continues)

TABLE 1 (Continued)

Authors Year/country	Study design/data sources	Collection year	Sample size	Hydrotherapy type	Mean age	Maternal outcomes	Neonatal outcomes
				30 min after every 2 h of water immersion			
Maddady et al. (2018) Iran	RCT	2015–2016	H: 55 C: 54	Total 20-min hot shower application with constant water at 37°C starting with washing body or waist wash for 5 min and continued with full body	H: 22.6 ± 3.8 C: 24.5 ± 4.14	Pain intensity after intervention (VAS), duration of first stage of labour	—
Neiman et al. (2020) USA	Retrospective observational study	2013–2014	H: 58 C: 108	Water immersion during the first stage of labour in a tub	H: 29.2 ± 4.7 C: 28.9 ± 4.2	Intact perineum, episiotomy, vaginal birth, postpartum Hb, Hct and estimated blood loss	Neonatal sepsis.
Seed et al. (2023) Australia	Prospective observational study	2019–2020	H: 157 C: 1265	Warm water immersion during the first stage of labour in a water birth tub	H: 31(27.34) C: 31 (27.35)	Vaginal birth, forceps or vacuum, episiotomy, third/fourth degree, estimated blood loss, use of pain medication	NICU admission, positive neonatal bacterial culture
Sert et al. (2020) Turkey	RCT	2018–2019	H: 34 C: 30	Water immersion in the active phase of labour (6 cm cervical dilatation) in an ovoid bath filled 2/3 full with filtered water at a temperature of 34–36°C	H: 27 ± 2.1 C: 27 ± 2.5	—	First and fifth min APGAR scores
Sidebottom et al. (2020) USA	Retrospective observational study	2014–2018	H:199 C:199	Water immersion during the first stage of labour in a water birth tub	H: 29.6 ± 4.7 C: 29.7 ± 5.2	Use of augmentation and pain medication, intact perineum, severe laceration (3rd, 4th)	NICU admission
Solt Kırca and Kanza Gul (2022) Turkey	RCT	2019–2020	H: 40 C: 40	Warm shower application for 30 min with water 32 and 37°C	H: 28.7 ± 3.1 C: 28.3 ± 3.2	PPCQ	—
Taghavi et al. (2015) Iran	RCT	2010–2013	H: 50 C: 50	Warm shower application for 30 min with 37°C water	H: 25.6 ± 4.3 C: 26.1 ± 3.9	Length of first and second stage of labour (min), pain intensity (NRS)	—
Taşkın and Ergin (2022) Turkey	RCT	2019	H: 52 C: 52	Warm shower application 3 times at 4 cm, 5–7 cm and 8–10 cm dilatation, standing or sitting position (patient's preference) with constant hot water at 37°C	H: 23.40 ± 3.49 C: 24.17 ± 4.43	VAS score after intervention, childbirth comfort, vaginal birth, assisted vaginal birth, episiotomy, first-degree laceration	First and fifth min APGAR scores
Tuncay et al. (2017) Turkey	Quasi-experimental study	2015–2016	H: 40 C: 40	Hydrotherapy at 5 cm cervical dilation, in a hydrotherapy tub with 37° C water temperature, up to 10 cm dilation	H: 24.42 ± 4.33 C: 23.88 ± 4.05	Duration of first and second stages of labour (min), VAS score during and after intervention	—
Zhao et al. (2017) China	Case–control study	2013–2014	H: 600	Water immersion at cervix dilation 3 cm or more, in the birthing pool	H: 27.56 ± 2.67 C: 27.82 ± 3.01	Episiotomy, assisted vaginal birth	

TABLE 1 (Continued)

Authors Year/country	Study design/data sources	Collection year	Sample size	Hydrotherapy type	Mean age	Maternal outcomes	Neonatal outcomes
			C: 2147	at 35–38° C, 1–6 h use until 10 cm dilation			

Abbreviations: C, control; H, hydrotherapy; NICU, neonatal intensive care unit; NRS, Numeric Pain Rating Scale; PPCQ, Postpartum Comfort Questionnaire; RCT, randomized controlled trial; VAS, Visual Analogue Scale.

3.3 | Methodological quality

All of the randomized controlled trials indicated a high risk of bias (Abo-Romia & El-Adham, 2014; Darsareh et al., 2018; Lee et al., 2013; Maddady et al., 2018; Sert et al., 2020; Solt Kırca & Kanza Gul, 2022; Taghavi et al., 2015; Taşkın & Ergin, 2022). Among the observational studies included in the review, six reported low (Büyük et al., 2019, 2020; Lewis et al., 2018; Neiman et al., 2020;Seed et al., 2023; Sidebottom et al., 2020), four indicated moderate (Barry et al., 2020; Grymel-Kulesza et al., 2021; Tuncay et al., 2017; Zhao et al., 2017), and two reported serious (Lanier et al., 2021; Liu et al., 2014) risk of bias (Figures 2 and 3). The quality evaluation resulted in the exclusion of one randomized controlled study and a quasi-experimental study that carried a serious risk of bias, especially in the outcomes (Stark, 2017; Tosun, 2019).

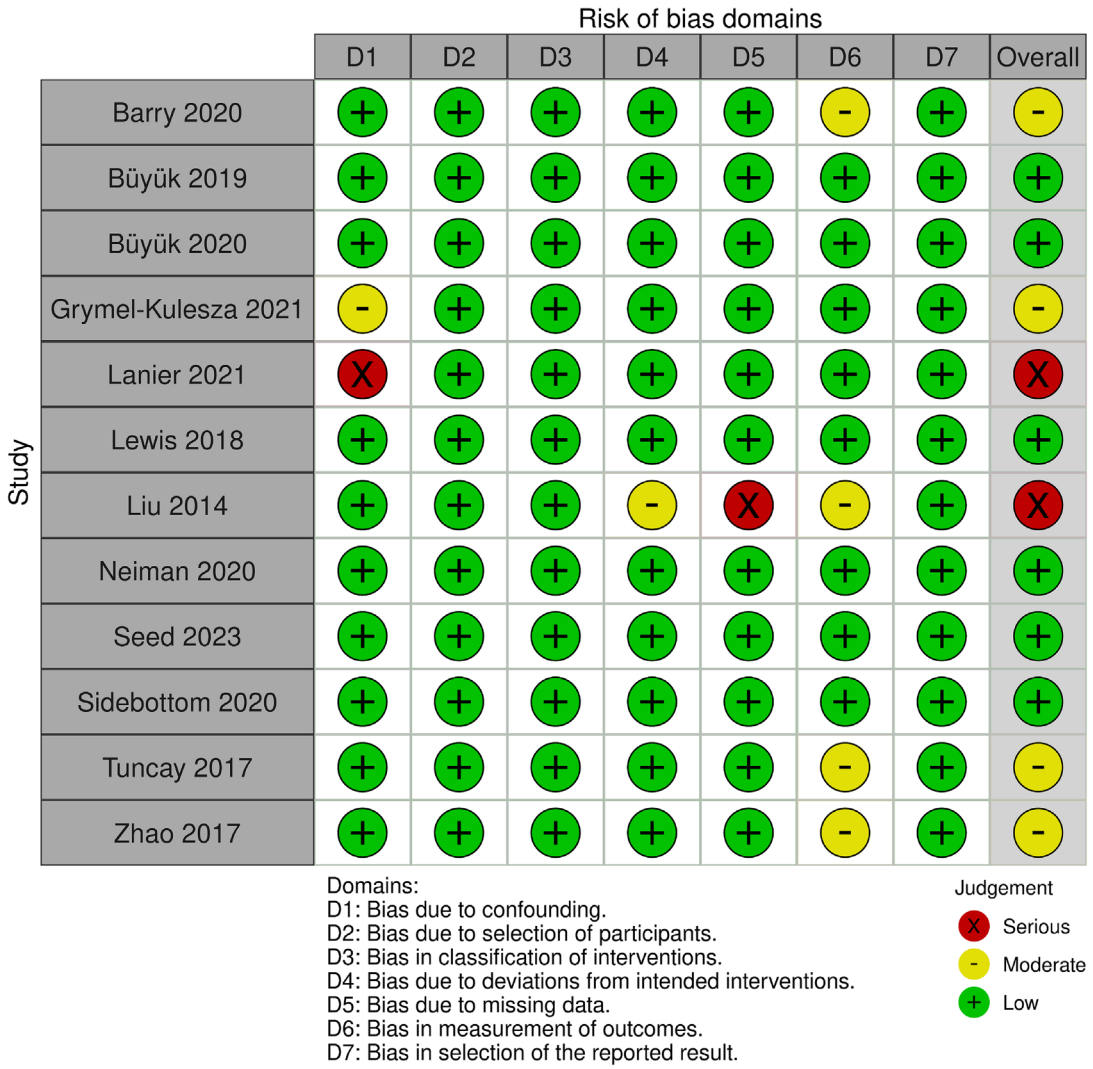
3.4 | Meta-analysis results related to the effects of hydrotherapy on maternal health outcomes

In five studies (Darsareh et al., 2018; Liu et al., 2014; Maddady et al., 2018; Taghavi et al., 2015; Tuncay et al., 2017), the duration of the first stage of labour in the hydrotherapy groups was shorter than in the control groups. However, this result was not statistically significant ($Z = 0.76$, $p = 0.450$). Another four studies (Darsareh et al., 2018; Liu et al., 2014; Taghavi et al., 2015; Tuncay et al., 2017) showed that there was no significant difference between the hydrotherapy and control groups in the duration of the second stage of labour ($Z = 0.90$, $p = 0.370$; Figure 4).

Seven studies reported outcomes related to the intensity of pain after hydrotherapy (Abo-Romia & El-Adham, 2014; Grymel-Kulesza et al., 2021; Lee et al., 2013; Maddady et al., 2018; Taghavi et al., 2015; Taşkın & Ergin, 2022; Tuncay et al., 2017). Two studies had evaluated the severity of pain during the application of hydrotherapy (Lee et al., 2013; Tuncay et al., 2017). These studies showed that in the hydrotherapy group, the intensity of pain during intervention and after the application was significantly lower than in the control group (respectively, $Z = 4.39$, $p < 0.001$; $Z = 5.06$, $p < 0.001$; Figure 5a and b).

Two studies (Seed et al., 2023; Sidebottom et al., 2020) showed no significant difference between the hydrotherapy and control groups in terms of the use of pain medication ($Z = 0.21$, $p = 0.840$). Another two studies (Solt Kırca & Kanza Gul, 2022; Taşkın & Ergin, 2022) reported that comfort during labour and postpartum was significantly higher in the hydrotherapy group ($Z = 4.42$, $p < 0.001$; Figure 5c,d).

Eight studies (Barry et al., 2020; Darsareh et al., 2018; Lanier et al., 2021; Lewis et al., 2018; Liu et al., 2014; Neiman et al., 2020; Seed et al., 2023; Taşkın & Ergin, 2022) revealed that hydrotherapy applied in the first stage of labour increased the likelihood of vaginal birth by 2.26 times ($Z = 4.19$, $p < 0.001$). This significant effect was associated with quasi-experimental and observational studies.



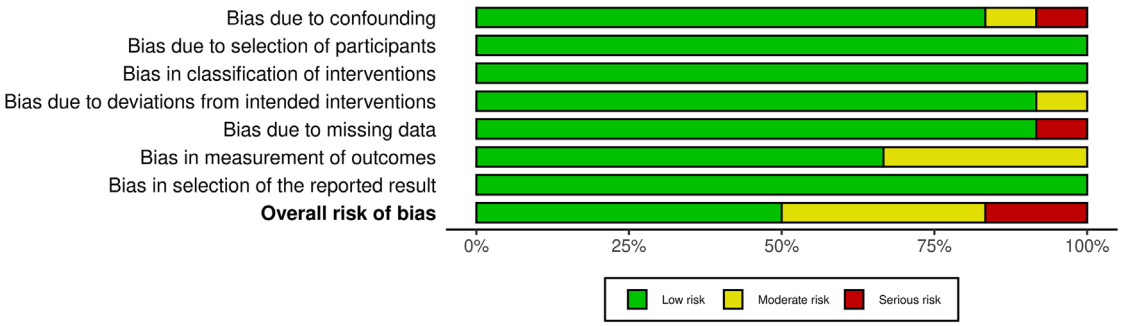
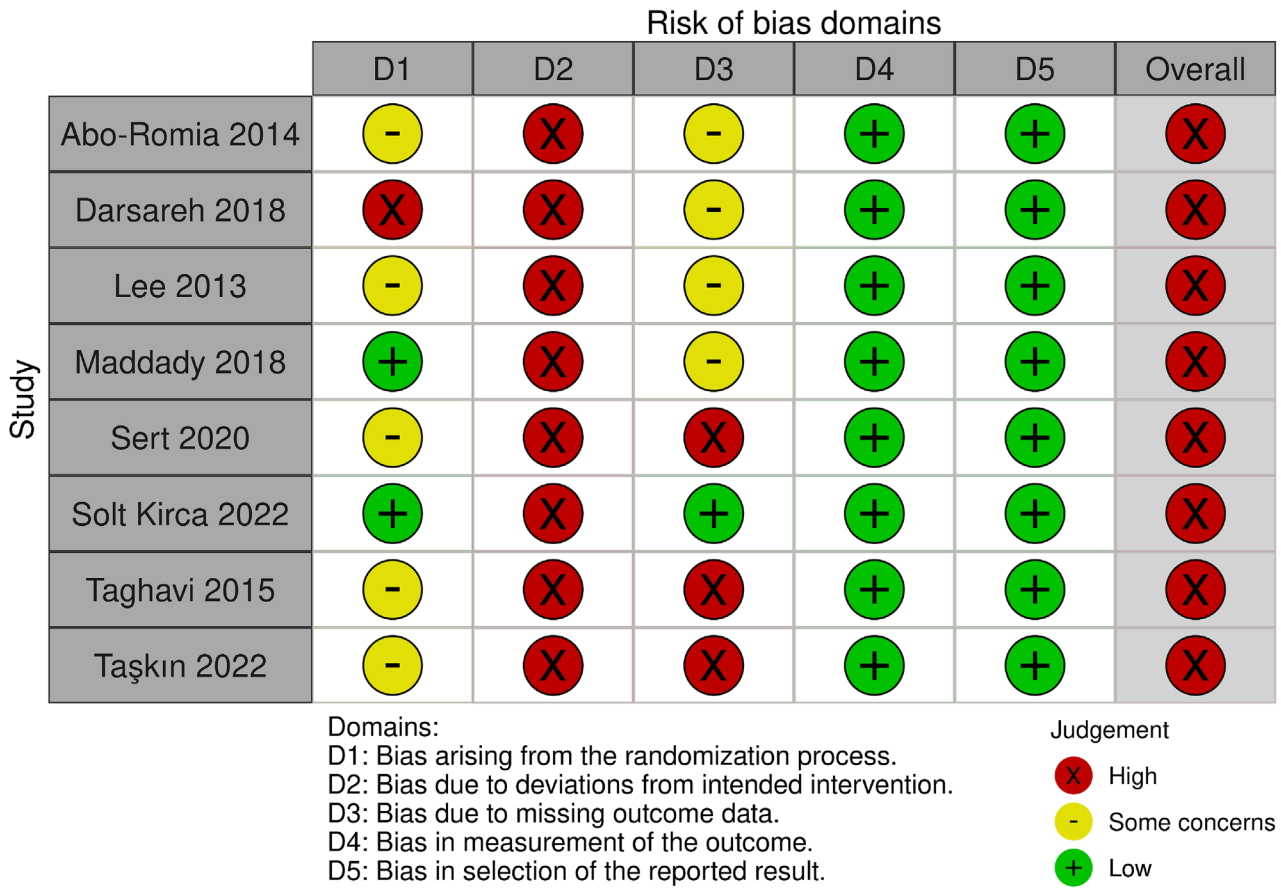


FIGURE 2 Risk of bias domains: ROBINS-I.

Five studies (Darsareh et al., 2018; Lewis et al., 2018; Seed et al., 2023; Taşkın & Ergin, 2022; Zhao et al., 2017) showed that compared to the control group, the likelihood of assisted vaginal birth was lower in the hydrotherapy group ($Z = 5.65$, $p < 0.001$). This significant effect was associated with observational studies.

Four studies (Büyük et al., 2020; Darsareh et al., 2018; Lee et al., 2013; Sidebottom et al., 2020) revealed that there was no significant difference between the groups in terms of the need for augmentation of labour ($Z = 0.05$, $p = 0.960$; Figure 6). This result was similar for all study designs.



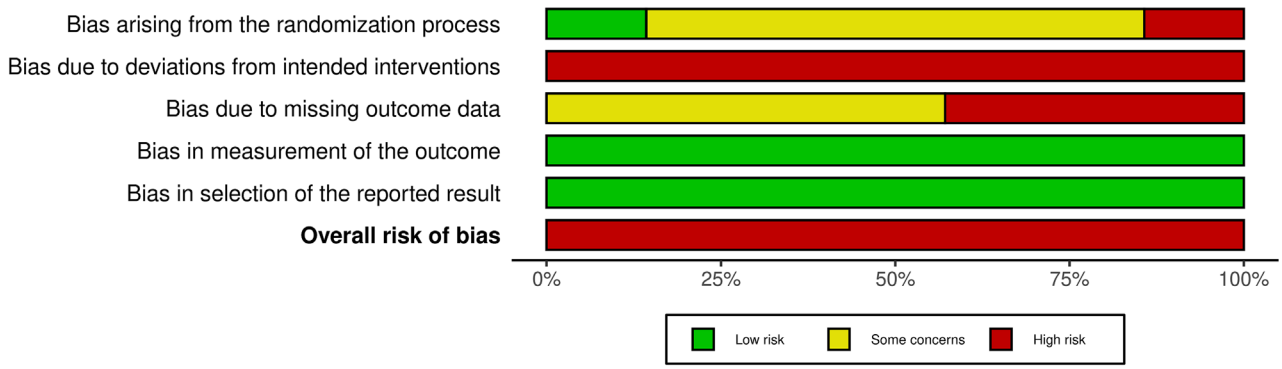


FIGURE 3 Risk of bias' domains: RoB-2.

Four studies revealed the effects of hydrotherapy on the frequency with which the perineum remained intact (Darsareh et al., 2018; Lewis et al., 2018; Neiman et al., 2020; Sidebottom et al., 2020), with two studies reporting its effects in relation to incidence of first-degree lacerations (Darsareh et al., 2018; Taşkın & Ergin, 2022) and three reporting the incidence of third/fourth-degree lacerations (Lewis et al., 2018; Seed et al., 2023; Sidebottom et al., 2020). The pooled results failed to show any significant differences between the groups with respect to these variables. Five studies (Darsareh et al., 2018; Neiman et al., 2020; Seed et al., 2023; Taşkın & Ergin, 2022; Zhao et al., 2017) revealed that the use of hydrotherapy in the first stage of labour did not affect the rate of episiotomy (Figure 7).

In four studies (Barry et al., 2020; Lewis et al., 2018; Neiman et al., 2020; Seed et al., 2023), the groups were similar in terms of the incidence of intrapartum blood loss. Another two studies (Büyük

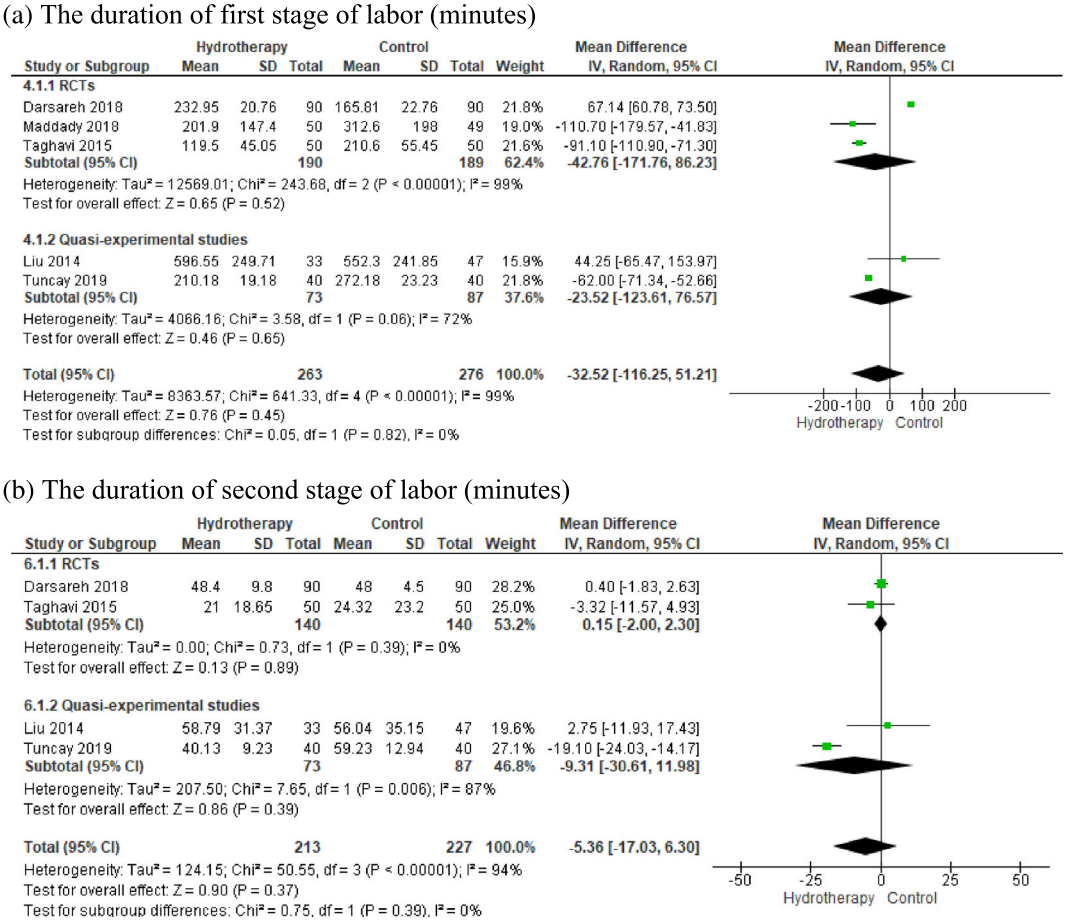


FIGURE 4 Duration of first and second stage of labour.

et al., 2020; Neiman et al., 2020) showed that there was no significant difference between the hydrotherapy and control groups in terms of postpartum Hb and Hct levels (Figure 8).

3.5 | Meta-analysis results related to the effects of hydrotherapy on neonatal health outcomes

Three studies reported mean APGAR scores at the first and fifth minutes (Darsareh et al., 2018; Sert et al., 2020; Taşkın & Ergin, 2022). The meta-analysis showed that mean APGAR scores in the first minute were statistically significantly lower in the hydrotherapy group but were similar at the fifth minute.

Eight studies that reported admittance of the newborn into the neonatal intensive unit (Barry et al., 2020; Büyük et al., 2020; Darsareh et al., 2018; Lanier et al., 2021; Lewis et al., 2018; Liu et al., 2014; Seed et al., 2023; Sidebottom et al., 2020) indicated no difference between the groups. Four studies reported the effect of hydrotherapy on neonatal sepsis or positive neonatal bacterial cultures (Lanier et al., 2021; Liu et al., 2014; Neiman et al., 2020; Seed et al., 2023). The analysis determined that there was no significant difference between the groups (Figure 9).

3.6 | Overall evidence

The certainty of evidence assessed with GRADE for all the critical outcomes are presented in Table 2. The certainty of evidence was low in six outcomes, moderate in 10 outcomes and high for four outcomes.

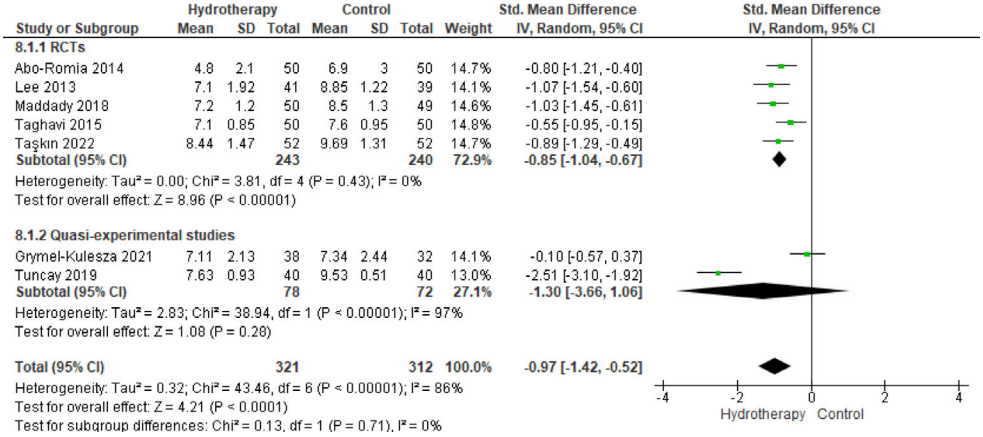
4 | DISCUSSION

4.1 | The effect of hydrotherapy on maternal health outcomes

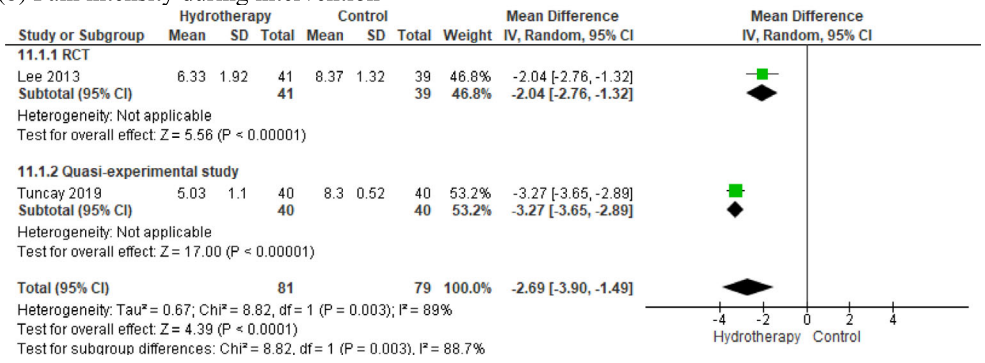
This study showed that the use of hydrotherapy in the first stage of labour effectively reduces the intensity of pain. Similar results were reported in previous studies (Burns et al., 2022; Cluett et al., 2018; Cowan et al., 2017). It has been asserted in the literature that by reducing the level of vasopression, hydrotherapy increases uterine perfusion, thereby facilitating neurohormonal interactions and resulting in less pain (Henrique et al., 2018; Mascarenhas et al., 2019). Based on these findings, it can be said that hydrotherapy applied in the first stage of labour can have an impact on the sensation of pain and can reduce its perceived severity.

FIGURE 5 Pain intensity after and during intervention, use of pain medication and comfort.

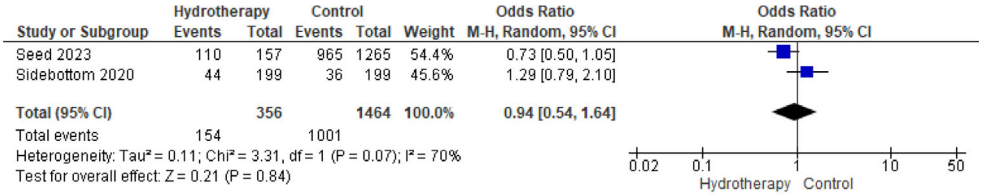
(a) Pain intensity after intervention



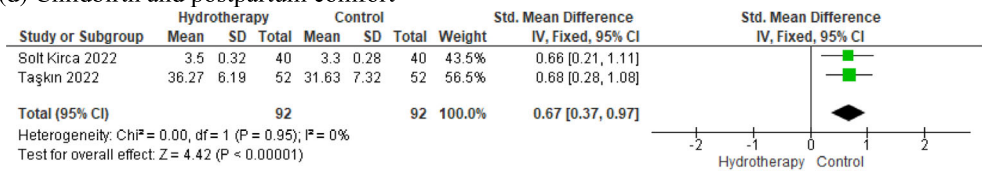
(b) Pain intensity during intervention



(c) Use of pain medication



(d) Childbirth and postpartum comfort

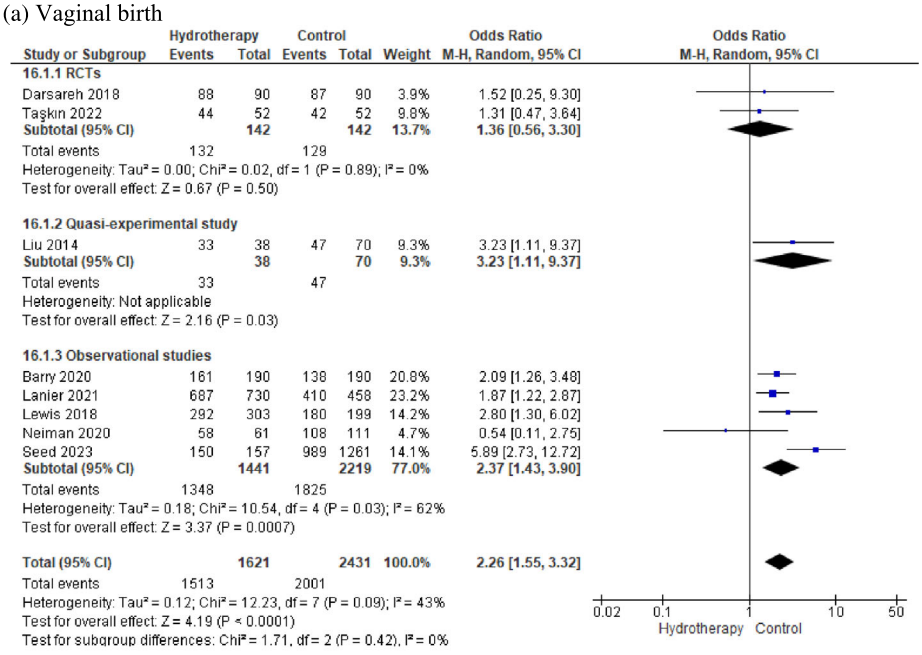


This study observed that women undergoing hydrotherapy experienced about a 33-min shorter first stage of labour, compared with the control group. This finding was consistent with the literature (Cowan et al., 2017; Zhang & Yang, 2022). One study reported that a longer duration of labour may be associated with increase in interventions (Barber et al., 2011). It might then be said that the shortening of labour is an important outcome in terms of reducing maternal risks and protecting maternal and neonatal health.

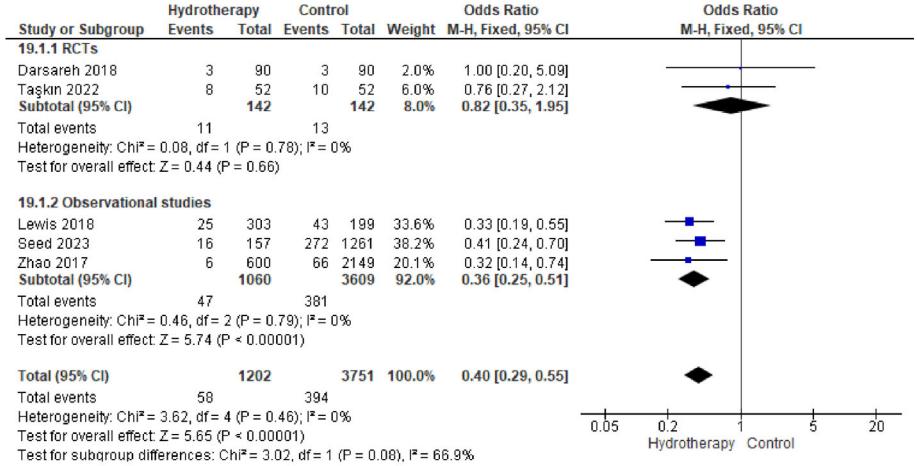
This study revealed that hydrotherapy did not have an impact on the duration of the second stage of labour. This finding is consistent with the literature (Cluett et al., 2018). It is seen in some studies in the literature, however, that the use of hydrotherapy increases the secretion of oxytocin, reduces stress hormones that obstruct the progress of labour and diminishes the level of catecholamines (Jones et al., 2012; Kolivand et al., 2014; Mollamahmutoğlu et al., 2012).

This study demonstrated that hydrotherapy applied in the first stage of labour increases comfort but that the use of analgesics does not change. Other studies indicated that hot showering during labour increased satisfaction and postpartum comfort levels (Burns et al., 2022; Shaw-Battista, 2017; Stark, 2013). Our meta-analysis results are similar to reports in the literature, but only one study could be detected that addressed the use of analgesics (Sidebottom et al., 2020). It would be appropriate to evaluate the results related to this factor with larger sample groups.

(a) Vaginal birth



(b) Assisted vaginal birth (forceps or vacuum-assisted birth)



(c) Use of augmentation (oxytocin or amniotomy)

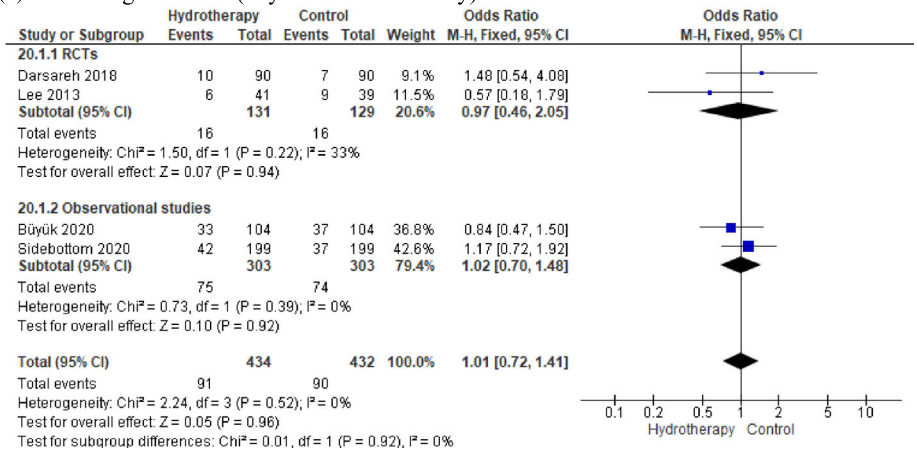
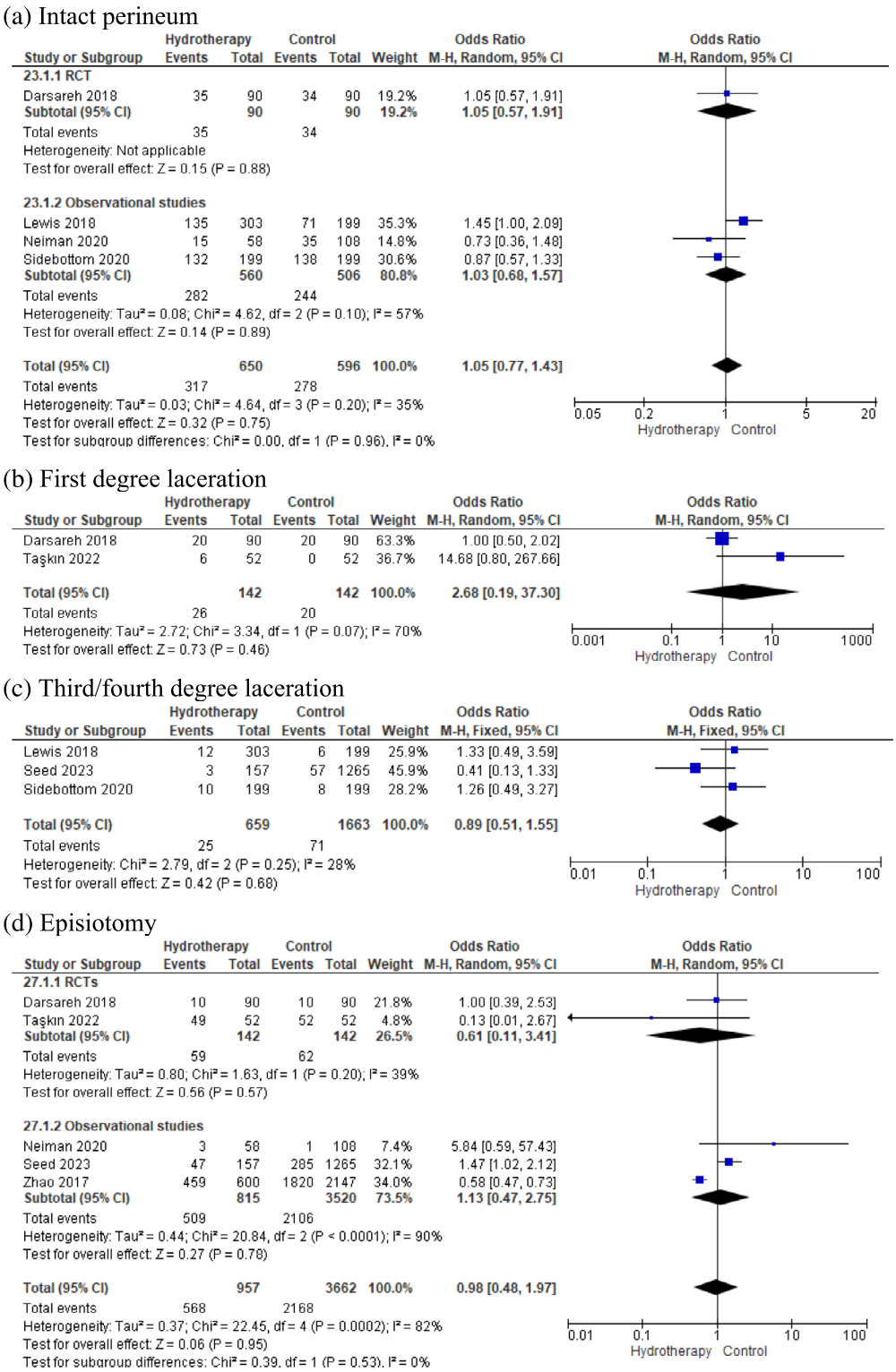


FIGURE 6 Vaginal birth, assisted vaginal birth and augmentation need.

This study demonstrated that the use of hydrotherapy in the first stage of labour increased spontaneous vaginal delivery 2.26-fold, decreased the incidence of assisted vaginal birth, but did not change the need for augmentation. These findings are similar to the results of the study conducted by Russell et al. (2014). Another systematic review performed in 2018 in parallel to this reported that

FIGURE 7 Perineal outcomes.



hydrotherapy did not make any change in the need for augmentation. The same study also asserted that hydrotherapy did not have a significant impact on assisted vaginal birth and caesarean birth rates (Cluett et al., 2018). This difference may be due to the difference in the years covered by the two meta-analyses, different studies and differences in studies included.

This study found that hydrotherapy does not affect the development of first-, third- or fourth-degree lacerations or episiotomy rates. Unlike these findings, previous systematic reviews reported that the rate of episiomy was lower in the hydrotherapy group (Burns et al., 2022; Zhang & Yang, 2022). Cristina et al. (2022) reported that there was no significant difference in the rate of third- and

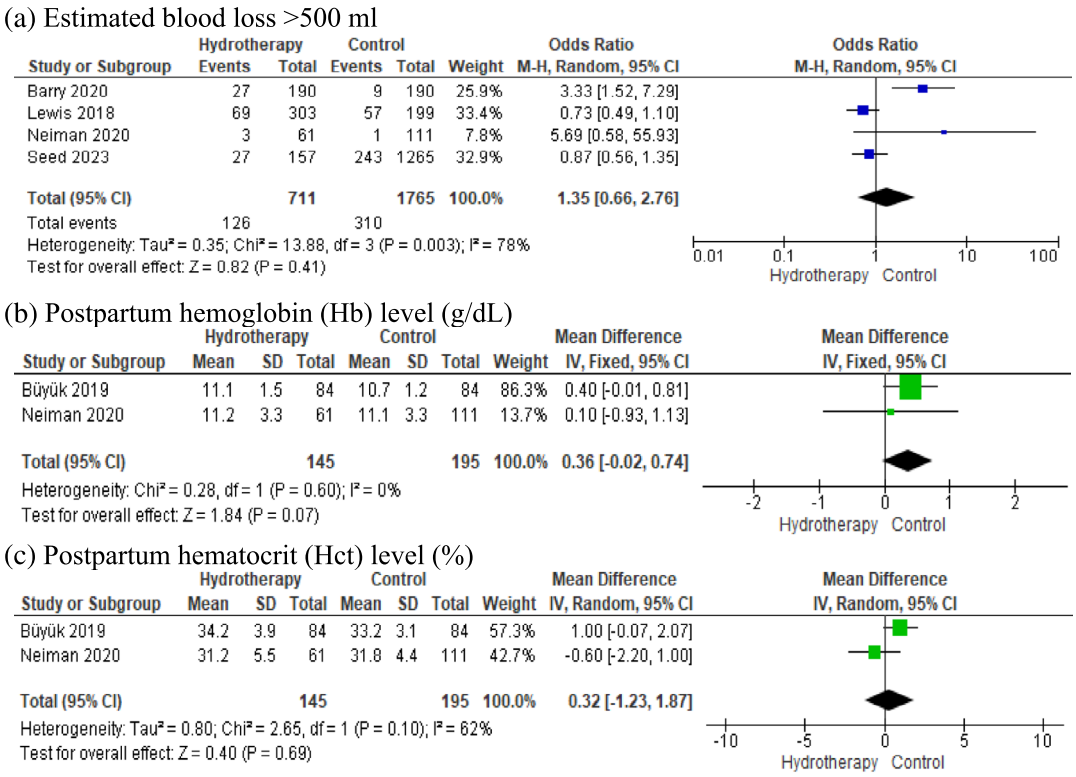


FIGURE 8 Postpartum blood loss and levels of Hb and Hct.

fourth-degree lacerations between water and land birth groups while increasing the rate of first- and second-degree tears. There are however various other studies with contrary reports (Dahlen et al., 2013; Gautham & Devi, 2020). These inconsistent results for the effect of hydrotherapy on perineal outcomes may be related to differences in study samples' age, parity, intrapartum care and the follow-up methods used.

This study observed that no difference was seen between the hydrotherapy and control groups in terms of blood loss amounts and postpartum Hb and Hct levels. These findings are similar to the results of the studies by Gautham and Devi (2020) and Zhang and Yang (2022). Contrary to our study, two studies found that water immersion was effective in reducing postpartum haemorrhage (Burns et al., 2022; Cristina et al., 2022). That these results did not indicate that hydrotherapy had a negative effect on postpartum haemorrhage, considered a major cause of maternal death, implies that the practice can be used as a safe option in intrapartum care.

4.2 | The effect of hydrotherapy on neonatal health outcomes

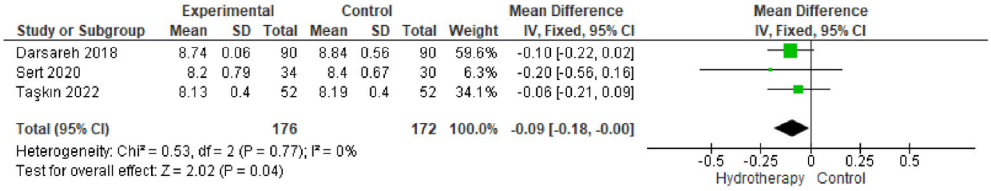
In this study, while hydrotherapy was effective in reducing the APGAR score at the first minute, it did not have a significant effect on the APGAR score at the fifth minute, NICU admission and neonatal sepsis or positive bacterial culture. These findings were consistent with previous studies (Gayiti et al., 2015; Mallen-Perez et al., 2018; Vanderlaan et al., 2018). Zhang and Yang (2022) reported that it decreased the risk of APGAR score <7 at the fifth minute and NICU admission in the water birth group. Cluett et al. (2018) concluded there was insufficient evidence to determine the impact on NICU admissions and on neonatal infection rates. The finding that there is no identified contraindication for hydrotherapy in terms of neonatal health is important since this means that the application can be safely used during labour.

4.3 | Strengths and limitations of the study

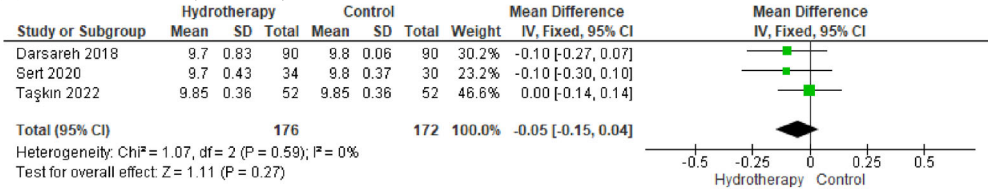
The strengths of this study included that a comprehensive search strategy was used, an ample number of pregnant women were involved and the review encompassed an expansive geography (e.g. America, Asia and Australia) and brought into focus current results. The use of reliable methods in reaching the results of the analysis and the assessment of each result in terms of the quality of evidence are other strengths that reinforced our study's conclusions. A limitation, however, was that the review and analysis was carried out using only articles published in Turkish and English. Furthermore, the low homogeneity in a large portion of the studies evaluated in the meta-analysis may have weakened the strength of the evidence. To control for this heterogeneity, the random effect model was preferred in analyses in which the extent of heterogeneity was high.

FIGURE 9 Neonatal outcomes.

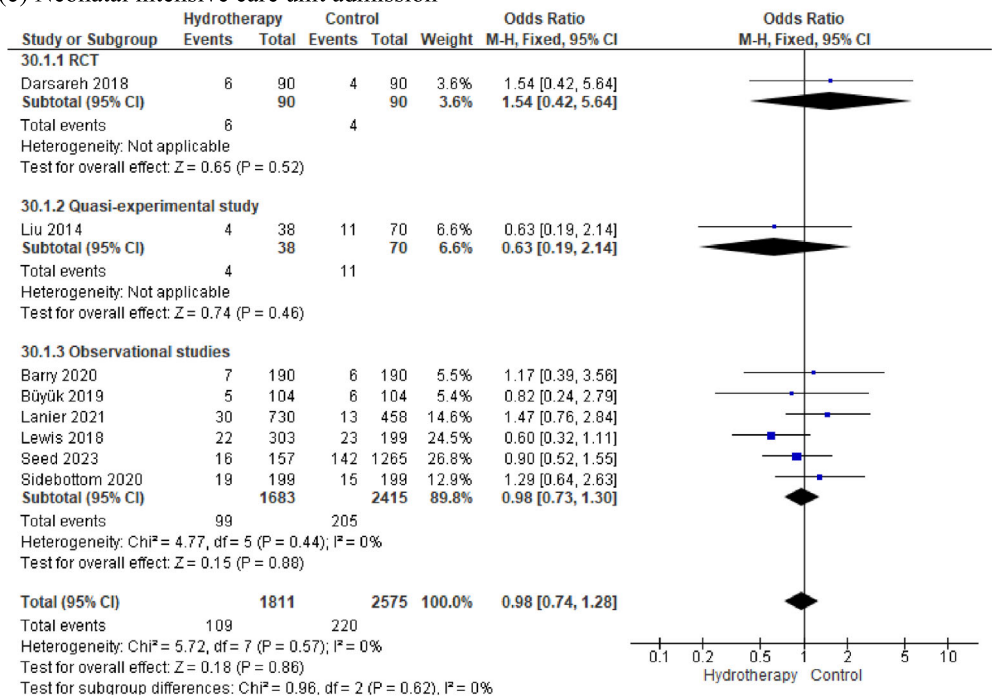
(a) APGAR score (at 1 min)



(b) APGAR score (at 5 min)



(c) Neonatal intensive care unit admission



(d) Positive neonatal bacterial culture or neonatal sepsis

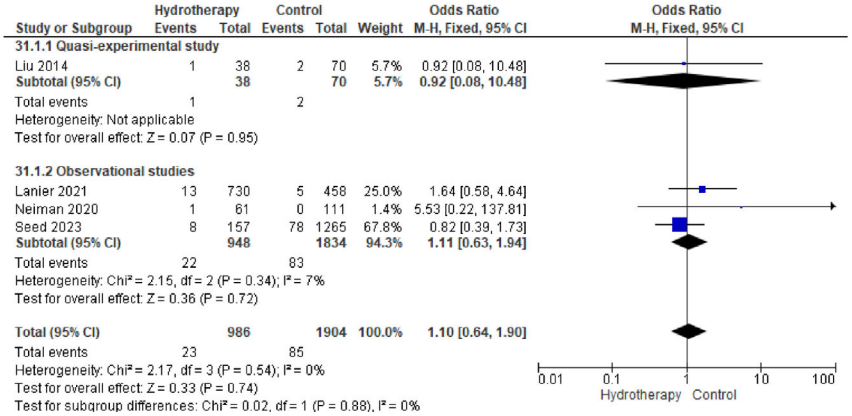


TABLE 2 GRADE summary of findings for hydrotherapy intervention versus control groups for maternal, foetal/neonatal and obstetric outcomes.

Outcomes	Anticipated absolute effects[a] (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of evidence (GRADE)	Comments
	Risk with control	Risk with hydrotherapy				
The duration of first stage of labour	Mean duration of first stage of labour = **0**	MD **32.52 lower**(116.25 lower to 51.21 higher)	—	539(5 RCTs)	⨁⨁◯◯ Low[b,c]	The evidence suggests hydrotherapy reduces the duration of first stage of labour slightly
The duration of second stage of labour	Mean duration of second stage of labour = **0**	MD **5.36 lower**(17.03 lower to 6.3 higher)	—	440(4 RCTs)	⨁⨁◯◯ Low[b,c]	The evidence suggests hydrotherapy reduces the duration of second stage of labour slightly
Pain intensity after intervention	—	SMD **0.97 lower**(1.42 lower to 0.52 lower)	—	633(7 RCTs)	⨁⨁◯◯ Low[d]	The evidence suggests hydrotherapy reduces pain intensity after intervention slightly
Pain intensity during intervention	Mean pain intensity during intervention = **0**	MD **2.69 lower**(3.9 lower to 1.49 lower)	—	160(2 RCTs)	⨁⨁⨁◯ Moderate[b]	Hydrotherapy probably reduces pain intensity during intervention
Use of pain medication	684 per 1.000	**670 per 1.000**(539–780)	**OR 0.94** (0.54–1.64)	1820(2 observational studies)	⨁⨁⨁⨁ High	Hydrotherapy results in large reduction in use of pain medication
Childbirth and postpartum comfort	—	SMD **0.67 higher**(0.37 higher to 0.97 higher)	—	184(2 RCTs)	⨁⨁⨁◯ Moderate[b]	Hydrotherapy probably increases childbirth and postpartum comfort
Vaginal birth	823 per 1.000	**919 per 1.000**(898–936)	**OR 2.43** (1.90–3.13)	4052(8 observational studies)	⨁⨁◯◯ Low[b,c]	The evidence suggests hydrotherapy increases incidence of vaginal birth slightly
Assisted vaginal birth	105 per 1.000	**45 per 1.000**(33–61)	**OR 0.40** (0.29–0.55)	4953(5 observational studies)	⨁⨁⨁◯ Moderate[b]	Hydrotherapy probably reduces assisted vaginal birth
Use of augmentation	208 per 1.000	**210 per 1.000**(159–271)	**OR 1.01** (0.72–1.41)	866(4 RCTs)	⨁⨁⨁◯ Moderate[b]	Hydrotherapy probably increases use of augmentation
Intact perineum	466 per 1.000	**488 per 1.000**(429–545)	**OR 1.09** (0.86–1.37)	1246(4 observational studies)	⨁⨁⨁◯ Moderate[b]	Hydrotherapy probably increases intact perineum
First-degree laceration	141 per 1.000	**305 per 1.000**(30–859)	**OR 2.68** (0.19–37.30)	284(2 RCTs)	⨁⨁⨁◯ Moderate[b]	Hydrotherapy probably increases first-degree laceration
Third/fourth-degree laceration	43 per 1.000	**38 per 1.000**(22–65)	**OR 0.89** (0.51–1.55)	2322(3 observational studies)	⨁⨁⨁⨁ High	Hydrotherapy results in large reduction in third/fourth-degree laceration
Episiotomy	592 per 1.000	**587 per 1.000**(411–741)	**OR 0.98**(0.48 to 1.97)	4619(5 observational studies)	⨁⨁⨁◯ Moderate[e]	Hydrotherapy probably reduces episiotomy
Estimated blood loss >500 mL	176 per 1.000	**223 per 1.000**(123–370)	**OR 1.35** (0.66–2.76)		⨁⨁⨁◯ Moderate[f]	Hydrotherapy probably increases estimated blood loss >500 mL

TABLE 2 (Continued)

Outcomes	Anticipated absolute effects[a] (95% CI)		Relative effect (95% CI)	No. of participants (studies)	Certainty of evidence (GRADE)	Comments
	Risk with control	Risk with hydrotherapy				
				2476(4 observational studies)		
Postpartum haemoglobin (Hb) level (g/dL)Hb (g/dL)	Mean postpartum haemoglobin (Hb) level (g/dL), Hb (g/dL) = **0**	MD **0.36 higher**(0.02 lower to 0.74 higher)	—	340(2 observational studies)	⨁⨁⨁⨁ High	Hydrotherapy results in large increase in postpartum haemoglobin (Hb) level (g/dL) Hb (g/dL)
Postpartum haematocrit (Hct) level (%)	Mean postpartum haematocrit (Hct) level (%) = **0**	MD **0.32 higher**(1.23 lower to 1.87 higher)	—	340(2 observational studies)	⨁⨁⨁⨁ High	Hydrotherapy results in large increase in postpartum haematocrit (Hct) level (%)
Apgar score (@ 1 min)	Mean APGAR score (@ 1 min) = **0**	MD **0.09 lower**(0.18 lower to 0)	—	348(3 RCTs)	⨁⨁⨁◯ Moderate[b]	Hydrotherapy probably reduces APGAR score (@ 1 min)
Apgar score (@ 5 min)	Mean APGAR score (@ 5 min) = **0**	MD **0.05 lower**(0.15 lower to 0.04 higher)	—	348(3 RCTs)	⨁⨁⨁◯ Moderate[b]	Hydrotherapy probably reduces APGAR score (@ 5 min)
NICU admission	85 per 1.000	**84 per 1.000**(65–107)	**OR 0.98** (0.74–1.28)	4386(8 observational studies)	⨁⨁◯◯ Low[b,c]	The evidence suggests hydrotherapy reduces NICU admission slightly
Positive neonatal bacterial culture or neonatal sepsis	45 per 1.000	**49 per 1.000**(29–82)	**OR 1.10** (0.64–1.90)	2890(4 observational studies)	⨁⨁◯◯ Low[c,g]	The evidence suggests hydrotherapy increases positive neonatal bacterial culture or neonatal sepsis slightly

Note: GRADE Working Group grades of evidence: High certainty: we are very confident that the true effect lies close to that of the estimate of the effect. Moderate certainty: we are moderately confident in the effect estimate: the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different. Low certainty: our confidence in the effect estimate is limited: the true effect may be substantially different from the estimate of the effect. Very low certainty: we have very little confidence in the effect estimate: the true effect is likely to be substantially different from the estimate of effect.

Abbreviations: CI, confidence interval; MD, mean difference; OR, odds ratio; SMD, standardized mean difference.

[a]**The risk in the intervention group** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

[b]We downgraded by one level due to risk of bias arising from the randomization process and unclear risk of bias due to missing outcome data.

[c]We downgraded by one level due to indirectness as the study had unclear bias due to important co-interventions balanced across intervention groups.

[d]We downgraded by two levels due to risk of bias arising from the randomization process and indirectness as the study had potential for confounding of the effect of intervention.

[e]We downgraded by one level due to risk of bias arising from the randomization process, unclear risk of bias due to missing outcome data and measurement of outcomes.

[f]We downgraded by one level due to bias in measurement of outcomes.

[g]We downgraded by one level due to bias in measurement of outcomes, confounding and missing data.

5 | CONCLUSIONS

This study showed that the use of hydrotherapy in the first stage of labour is an effective intervention that reduces the duration of labour and the severity of pain, and this process does not affect newborns' health. Midwives and nurses can be recommended to include hydrotherapy in their practice to a greater extent in order to increase opportunities for a positive birthing experience and to support and encourage vaginal birth. Another recommendation is to conduct more observational and, particularly, experimental studies on the effects of hydrotherapy for women living in different environments and cultures. In future, these studies and those defining standardization for the stages of labour and the frequency and techniques of hydrotherapy will make the results more reliable.

AUTHORSHIP STATEMENT

All listed authors meet the authorship criteria. Ayla Ergin, Zekiye Karaçam, Meltem Demirgöz Bal and Özlem Aşci designed the study. Meltem Demirgöz Bal, Özlem Aşci and Ayla Ergin collected the data. Özlem Aşci, Gizem Güneş Öztürk and Zekiye Karaçam analysed the data and prepared the manuscript. All authors critically revised the manuscript for important intellectual content and approved the final version for submission.

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CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest to disclose.

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