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[Intervention Review]

Immersion in water during labour and birth

Elizabeth R Cluett[1], Ethel Burns[2], Anna Cuthbert[3]

[1]Faculty of Health Sciences, University of Southampton, Southampton, UK. [2]Department of Psychology, Social Work and Public Health, Faculty of Health and Life Sciences, Oxford Brookes University, Oxford, UK. [3]Cochrane Pregnancy and Childbirth Group, Department of Women's and Children's Health, The University of Liverpool, Liverpool, UK

Contact address: Elizabeth R Cluett, Faculty of Health Sciences, University of Southampton, Nightingale Building (67), Highfield, Southampton, Hants, SO17 1BJ, UK. e.cluett@soton.ac.uk, elizabeth.cluetr@outlook.com.

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ABSTRACT

Background

Water immersion during labour and birth is increasingly popular and is becoming widely accepted across many countries, and particularly in midwifery-led care settings. However, there are concerns around neonatal water inhalation, increased requirement for admission to neonatal intensive care unit (NICU), maternal and/or neonatal infection, and obstetric anal sphincter injuries (OASIS). This is an update of a review last published in 2011.

Objectives

To assess the effects of water immersion during labour and/or birth (first, second and third stage of labour) on women and their infants.

Search methods

We searched Cochrane Pregnancy and Childbirth's Trials Register, ClinicalTrials.gov and the WHO International Clinical Trials Registry Platform (ICTRP) (18 July 2017), and reference lists of retrieved trials.

Selection criteria

We included randomised controlled trials (RCTs) comparing water immersion with no immersion, or other non-pharmacological forms of pain management during labour and/or birth in healthy low-risk women at term gestation with a singleton fetus. Quasi-RCTs and cluster-RCTs were eligible for inclusion but none were identified. Cross-over trials were not eligible for inclusion.

Data collection and analysis

Two review authors independently assessed trials for inclusion and risk of bias, extracted data and checked them for accuracy. Two review authors assessed the quality of the evidence using the GRADE approach.

Main results

This review includes 15 trials conducted between 1990 and 2015 (3663 women): eight involved water immersion during the first stage of labour; two during the second stage only; four during the first and second stages of labour, and one comparing early versus late immersion during the first stage of labour. No trials evaluated different baths/pools, or third-stage labour management. All trials were undertaken in a hospital labour ward setting, with a varying degree of medical intervention considered as routine practice. No study was carried out in a midwifery-led care setting. Most trial authors did not specify the parity of women. Trials were subject to varying degrees of bias: the intervention could not be blinded and there was a lack of information about randomisation, and whether analyses were undertaken by intention-to-treat.

Immersion in water versus no immersion (first stage of labour)

There is probably little or no difference in spontaneous vaginal birth between immersion and no immersion (83% versus 82%; risk ratio (RR) 1.01, 95% confidence interval (CI) 0.97 to 1.04; 6 trials; 2559 women; moderate-quality evidence); instrumental vaginal birth (12% versus 14%; RR 0.86, 95% CI 0.70 to 1.05; 6 trials; 2559 women; low-quality evidence); and caesarean section (5% versus 4%; RR 1.27, 95% CI 0.91 to 1.79; 7 trials; 2652 women; low-quality evidence). There is insufficient evidence to determine the effect of immersion on estimated blood loss (mean difference (MD) -14.33 mL, 95% CI -63.03 to 34.37; 2 trials; 153 women; very low-quality evidence) and third- or fourth-degree tears (3% versus 3%; RR 1.36, 95% CI 0.85 to 2.18; 4 trials; 2341 women; moderate-quality evidence). There was a small reduction in the risk of using regional analgesia for women allocated to water immersion from 43% to 39% (RR 0.91, 95% CI 0.83 to 0.99; 5 trials; 2439 women; moderate-quality evidence). Perinatal deaths were not reported, and there is insufficient evidence to determine the impact on neonatal intensive care unit (NICU) admissions (6% versus 6%; average RR 1.30, 95% CI 0.42 to 3.97; 2 trials; 1511 infants; I^2 = 36%; low-quality evidence), or on neonatal infection rates (1% versus 1%; RR 2.00, 95% CI 0.50 to 7.94; 5 trials; 1295 infants; very low-quality evidence).

Immersion in water versus no immersion (second stage of labour)

There were no clear differences between groups for spontaneous vaginal birth (98% versus 97%; RR 1.02, 95% CI 0.96 to 1.08; 120 women; 1 trial; low-quality evidence); instrumental vaginal birth (2% versus 2%; RR 1.00, 95% CI 0.06 to 15.62; 1 trial; 120 women; very low-quality evidence); caesarean section (0% versus 2%; RR 0.33, 95% CI 0.01 to 8.02; 1 trial; 120 women; very low-quality evidence), and NICU admissions (8% versus 11%; RR 0.78, 95% CI 0.38 to 1.59; 2 trials; 291 women; very low-quality evidence). Use of regional analgesia was not relevant to the second stage of labour. Third- or fourth-degree tears, and estimated blood loss were not reported in either trial. No trial reported neonatal infection but did report neonatal temperature less than 36.2°C at birth (9% versus 9%; RR 0.98, 95% CI 0.30 to 3.20; 1 trial; 109 infants; very low-quality evidence), greater than 37.5°C at birth (15% versus 6%; RR 2.62, 95% CI 0.73 to 9.35; 1 trial; 109 infants; very low-quality evidence), and fever reported in first week (2% versus 5%; RR 0.53, 95% CI 0.10 to 2.82; 1 trial; 171 infants; very low-quality evidence), with no clear effect between groups being observed. One perinatal death occurred in the immersion group in one trial (RR 3.00, 95% CI 0.12 to 72.20; 1 trial; 120 infants; very low-quality evidence). The infant was born to a mother with HIV and the cause of death was deemed to be intrauterine infection.

There is no evidence of increased adverse effects to the baby or woman from either the first or second stage of labour.

Only one trial (200 women) compared early and late entry into the water and there were insufficient data to show any clear differences.

Authors' conclusions

In healthy women at low risk of complications there is moderate to low-quality evidence that water immersion during the first stage of labour probably has little effect on mode of birth or perineal trauma, but may reduce the use of regional analgesia. The evidence for immersion during the second stage of labour is limited and does not show clear differences on maternal or neonatal outcomes intensive care. There is no evidence of increased adverse effects to the fetus/neonate or woman from labouring or giving birth in water. Available evidence is limited by clinical variability and heterogeneity across trials, and no trial has been conducted in a midwifery-led setting.

PLAIN LANGUAGE SUMMARY

Immersion in water in labour and birth

What is the issue?

To assess the effects of water immersion (waterbirth) during labour and/or birth (first, second and third stage of labour) on women and their infants.

Why is this important?

Many women choose to labour and give birth in water (water immersion) and this practice is becoming more popular in many countries, particularly in midwifery-led units. Therefore, it is important to understand more about the benefits of water immersion in labour and birth for women and their newborns, along with any risks.

It is important to examine whether immersion in water during the first and/or the second stage of labour has the potential to maximise women's ability to manage labour pain, and to have a normal birth without increasing the risk of an adverse (harmful) event. Adverse events might be an increased risk of infection for women and/or their newborn; an increased likelihood of a serious tear to the perineum (the area between anus and vagina), and it may make estimating blood loss more difficult in the event of a haemorrhage. In assessing the benefits, we consider well-being to cover both physical and psychological health.

What evidence did we find?

We included 15 trials (3663 women). All the trials compared immersion in water with no immersion in water: eight during the first stage of labour, two during the second stage of labour (waterbirth) only, four during the first and second stages of labour, and one early versus

late immersion during the first stage of labour. The evidence was of moderate to very low quality. No trial compared immersion in water with other forms of pain management.

Water immersion during the first stage of labour probably results in fewer women having an epidural, but probably makes little or no difference to the number of women who have a normal vaginal birth, instrumental birth, caesarean section or a serious perineal tear. We are uncertain about the effect on the amount of blood loss after birth because the quality of the evidence was very low. Labouring in water also may make little or no difference to babies being admitted to neonatal intensive care unit (NICU) or developing infections. Stillbirths and baby deaths were not reported.

Two trials compared water immersion during the second stage (birth) with no immersion. We found that immersion may make little or no difference in numbers of women who have a normal vaginal birth. It is uncertain whether immersion makes any difference to instrumental vaginal births, caesarean sections, numbers of babies admitted to NICU, babies' temperatures at birth and fever in babies during the first week, because the quality of the evidence was found to be very low for all of these outcomes. Epidurals were not relevant to this stage of labour. Serious perineal tears and blood loss after birth were not reported in either trial.

Only one trial (200 women) compared women who got into the water early and late in their labour but there was not enough information to show any clear differences between the groups.

What does this mean?

Labouring in water may reduce the number of women having an epidural. Giving birth in water did not appear to affect mode of birth, or the number of women having a serious perineal tear. This review found no evidence that labouring in water increases the risk of an adverse outcome for women or their newborns. The trials varied in quality and further research is needed particularly for waterbirth and its use in birth settings outside hospital labour wards before we can be more certain of these effects. Research is also needed about women's and caregivers experiences of labour and birth in water.

SUMMARY OF FINDINGS

Summary of findings for the main comparison. Immersion in water compared to no immersion during first stage of labour in water during labour and birth

Immersion in water compared to no immersion during first stage of labour in water during labour and birth

Patient or population: women in labour
Setting: hospital-based maternity units in the following countries: UK, Canada, Iran, Finland, Australia, USA, Belgium, Brazil, Sweden, South Africa and China.
Intervention: immersion in water in the first stage of labour
Comparison: no immersion during first stage of labour

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Quality of the evidence (GRADE)	Comments
	Risk with no immersion during first stage of labour	Risk with immersion in water				
Mode of birth (spontaneous vaginal birth)	Study population		RR 1.01 (0.97 to 1.04)	2559 (6 RCTs)	⊕⊕⊕⊖ MODERATE [1]	
	822 per 1000	830 per 1000 (797 to 855)				
Mode of birth (instrumental vaginal birth)	Study population		RR 0.86 (0.70 to 1.05)	2559 (6 RCTs)	⊕⊕⊖⊖ LOW [1 2]	
	138 per 1000	119 per 1000 (97 to 1.05)				
Mode of birth (caesarean section)	Study population		RR 1.27 (0.91 to 1.79)	2652 (7 RCTs)	⊕⊕⊖⊖ LOW [2 3]	
	41 per 1000	52 per 1000 (38 to 74)				
Use of analgesia (regional)	Study population		RR 0.91 (0.83 to 0.99)	2439 (5 RCTs)	⊕⊕⊕⊖ MODERATE [1]	
	429 per 1000	390 per 1000 (356 to 424)				
Perineal trauma (third- or fourth-degree tears)	Study population		RR 1.36 (0.85 to 2.18)	2341 (4 RCTs)	⊕⊕⊕⊖ MODERATE [1]	
	25 per 1000	33 per 1000 (21 to 54)				

Perinatal death	Study population		-	-	-	No trial reported this outcome.
	see comment	see comment				
Admission to neonatal intensive care unit	Study population		Average RR 1.30 (0.42 to 3.97)	1511 (2 RCTs)	⊕⊕⊖⊖ LOW [2 4]	
	58 per 1000	75 per 1000 (24 to 229)				
Neonatal infection	Study population		RR 2.00 (0.50 to 7.94)	1295 (5 RCTs)	⊕⊖⊖⊖ VERY LOW [1 5]	
	5 per 1000	9 per 1000 (2 to 37)				
Estimated blood loss (mL)	The mean estimated blood loss with immersion was 265.5 mL	MD 14.33 mL lower without immersion (63.03 mL lower to 34.37 mL higher)	-	153 (2 RCTs)	⊕⊖⊖⊖ VERY LOW [6 7]	

*__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).

__CI:__ Confidence interval; __RR:__ Risk ratio

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

[1] All trials had design limitations: No trial was blinded, two trials did not randomise adequately, and three did not report all outcomes (-1)
[2] Wide confidence intervals that cross the line of no effect (-1)
[3] All trials had design limitations: No trial was blinded, two trials did not randomise adequately, one did not conceal allocation, and three did not report all outcomes (-1)
[4] Both trials have design limitations: Neither trial was blinded, one trial did not randomise adequately, and both did not report all outcomes (-1)
[5] Few events and wide confidence intervals crossing the line of no effect (-2)
[6] Both trials have design limitations: Neither trial was blinded, one trial did not randomise adequately (-1)
[7] Small sample size and wide confidence intervals crossing the line of no effect (-2)

Summary of findings 2. Immersion in water compared to no immersion during second stage of labour in water during labour and birth

Immersion in water compared to no immersion during second stage of labour in water during labour and birth

Patient or population: women in labour
Setting: hospital-based maternity units in the following countries: UK, Canada, Iran, Finland, Australia, USA, Belgium, Brazil, Sweden, South Africa and China
Intervention: immersion in water in the second stage of labour
Comparison: no immersion during second stage of labour

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Quality of the evidence (GRADE)	Comments
	Risk with no immersion during second stage of labour	Risk with immersion in water				
Mode of birth (spontaneous vaginal birth)	Study population		RR 1.02 (0.96 to 1.08)	120 (1 RCT)	⊕⊕⊖⊖ LOW [1,2]	
	967 per 1000	986 per 1000 (928 to 1000)				
Mode of birth (instrumental vaginal birth)	Study population		RR 1.00 (0.06 to 15.62)	120 (1 RCT)	⊕⊖⊖⊖ VERY LOW [1,3]	
	17 per 1000	17 per 1000 (1 to 260)				
Mode of birth (caesarean section)	Study population		RR 0.33 (0.01 to 8.02)	120 (1 RCT)	⊕⊖⊖⊖ VERY LOW [1,3]	
	17 per 1000	6 per 1000 (0 to 134)				
Use of analgesia (regional)	Study population		-	-	-	This outcome was not reported as it is not applicable to the second stage of labour.
	see comment	see comment				
Perineal trauma (third- or fourth-degree tears)	Study population		-	-	-	No trial reported this outcome
	see comment	see comment				
Perinatal death	Study population		RR 3.00 (0.12 to 72.20)	120 (1 RCT)	⊕⊖⊖⊖ VERY LOW [1,3]	1 death occurred in the immersion group in this trial. The infant was born alive to a woman with HIV who was treated 2 weeks previous to birth for vaginal infection. The infant died at 2.5 hours after birth. After investigation the cause of death was
	0 per 1000	0 per 1000 (0 to 0)				

						determined to be intrauterine infection.
Admission to neonatal intensive care unit	Study population		RR 0.78 (0.38 to 1.59)	291 (2 RCTs)	⊕⊖⊖⊖ VERY LOW [1 3]	
	108 per 1000	84 per 1000 (41 to 172)				
Neonatal infection, including markers of infection such as pyrexia and raised white cell count: Neonatal temperature less than 36.2ºC at birth	Study population		RR 0.98 (0.30 to 3.20)	109 (1 RCT)	⊕⊖⊖⊖ VERY LOW [1 3]	Number of neonatal infections was not reported, but temperature was included as a marker of infection.
	93 per 1000	91 per 1000 (28 to 296)				
Neonatal infection, including markers of infection such as pyrexia and raised white cell count: Neonatal temperature greater than 37.5ºC at birth	Study population		RR 2.62 (0.73 to 9.35)	109 (1 RCT)	⊕⊖⊖⊖ VERY LOW [1 3]	Number of neonatal infections was not reported, but temperature was included as a marker of infection.
	56 per 1000	146 per 1000 (41 to 519)				
Neonatal infection, including markers of infection such as pyrexia and raised white cell count: Fever reported in first week	Study population		RR 0.53 (0.10 to 2.82)	171 (1 RCT)	⊕⊖⊖⊖ VERY LOW [3 4]	Number of neonatal infections was not reported, but fever was included as a marker of infection.
	45 per 1000	24 per 1000 (5 to 128)				
Estimated blood loss (mL)	Study population		-	-	-	No trial reported this outcome
	see comment	see comment				

*__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).

CI: Confidence interval; **RR:** Risk ratio

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

[1] Data from one study with design limitations: trial was not blinded, and did not randomise adequately (-1)
[2] Small sample size (-1)
[3] Small sample size, few events, and wide confidence intervals crossing the line of no effect (-2)
[4] Data from one study with design limitations: trial was not blinded, did not report all outcomes, and was at unclear risk of bias in most domains (-1)

BACKGROUND

This review is one in a series of Cochrane Reviews examining pain management in labour. An earlier version of this review contributed to an overview of systematic reviews of pain management for women in labour (Jones 2012) and shared a generic protocol (Jones 2011).

A history of water immersion

The use of water immersion as a therapeutic medium is not new. Its exact origins are unknown, but there is evidence of immersion in water being used as a treatment for physical and psychological ill health by the Chinese, Egyptians, Japanese and Assyrians, as well as Greeks and Romans (Reid Campion 1990; Reid-Campion 1997). Warm water immersion during labour, including birth, used for relaxation and pain relief, has a long history in lay and clinical care (Garland 2000). Igor Tjarkovsky, a Russian boat builder, stimulated the foundation of a movement to promote waterbirth in Soviet Russia in the 1970s. He became convinced of the benefits of water immersion as a means of maximising physiological potential. Michel Odent subsequently popularised water immersion in other European countries (Odent 1983). Although considered a fad by some, the use of water during labour and birth appeals to both women and their carers, particularly those striving for a woman-centred, intervention-free, 'normal' experience. In 1995, the first international waterbirth conference was held in London, followed by many subsequent study events and international conferences.

In 1993, the use of water immersion during labour gained acceptance as a care option in the UK. A key report into maternity service provision, the Changing Childbirth publication recommended that a pool facility should be an option available to women in all UK maternity units (Department of Health 1993). Professional recognition of the use of water during labour and birth followed in 1994 when both the Royal College of Midwives and the United Kingdom Central Council for Nursing, Midwifery and Health Visiting published position statements, which incorporated water immersion during labour into the role of the midwife (RCM 1994; UKCC 1994). The use of water during labour/birth is now integrated in the UK Nursing and Midwifery Council's Midwifery Rules and Standards (NMC 2012), and clinical guidelines (NICE 2014).

Evidence indicates that labouring and giving birth in water is gaining in popularity internationally (Dahlen 2013; Geissbuehler 2004; Henderson 2014; New Zealand College of Midwives 2017), and is emerging as a means of facilitating women to have a greater sense of control and comfort during childbirth (Maude 2007; Richmond 2003). The buoyancy that labouring in water offers can reduce women's pain perception (Benfield 2010). The calmer and more in control a woman feels during labour reduces her likelihood of requiring interventions such as labour augmentation, and operative birth.

There is an association between birthing pool use during labour, particularly in midwifery-led settings (alongside/free-standing midwifery units) and fewer interventions during labour and birth for healthy pregnant women (Burns 2012). This is important in the context of increasing global concern about escalating caesarean section rates without evidence of a concomitant improvement in perinatal mortality (Gibbons 2010; Johanson 2002; McLachlan 2012; National Childbirth Trust 2011; Sufang 2007), and a national drive in the UK to promote midwifery settings as the optimal place of birth for healthy pregnant women (NICE 2014; RCOG 2011). A seminal national prospective study in the UK also found that healthy women who laboured and gave birth in midwifery settings experienced fewer interventions and fewer complications compared with similar women who planned to give birth in a hospital labour ward (Birthplace Collaboration 2011). Birthing pools are most commonly used in midwifery-led units. A birthing pool therefore offers midwives an opportunity to develop the skills required to provide woman-centred care, form a therapeutic rapport with women, facilitate their freedom and participation in decision making, and support them in having choice and control over their care (NMC 2012). Importantly, it may also facilitate them to increase the incidence of normal birth as defined in Normal Birth Consensus Statement (Burns 2012; Maternity Care Working Party 2007).

Description of the condition

This review is about care and management of women during labour and birth. It is one in a series of Cochrane reviews examining pain management in labour.

Labour is understood to be as defined by the woman or clinicians at the time, and includes regular painful uterine contractions, leading to full cervical dilation, expulsion of the fetus, and the placenta and membranes.

Description of the intervention

Throughout this review, 'water immersion' refers to the immersion in water by a pregnant woman during any stage of labour (first, second, third) where the woman's abdomen is completely submerged. 'Waterbirth' refers to where the neonate is born under the water. This implies the use of a receptacle that may be called a pool, tub or bath, and which is larger than a normal domestic bath. The period of immersion by the woman may be for one or more stages of labour, and for any duration. Labour is understood to be as defined by the woman or clinicians at the time, and includes regular painful uterine contractions, leading to full cervical dilation, expulsion of the fetus, and the placenta and membranes.

Water immersion during the first and second stage of labour

Prospective observational studies have shown an association between labouring in water and a greater likelihood of having a spontaneous vaginal birth, especially among nulliparous women (Burns 2012; Geissbuehler 2004; Henderson 2014; Lukasse 2014). Research involving women who laboured in water in midwifery-led units reported a low intrapartum transfer incidence, particularly from the community setting (Bovbjerg 2016, Burns 2012), and lower when compared with women who did not use water immersion (Lukasse 2014).

The UK is promoting water immersion during labour and waterbirth as a means of empowering women, and is consistent with the initiative to normalise birth and reduce inappropriate use of interventions (RCM 2016), which has been supported in evidence form cohort studies (Bovbjerg 2016; Burns 2012; Lukasse 2014). All maternity units are recommended to have at least one birthing pool, and there is a policy drive to encourage healthy pregnant women to give birth in midwifery-led settings (for example, alongside midwifery units situated inside the hospital, freestanding midwifery-led units located in the community), and home birth (NHS 2014; RCOG 2011), consistent with the view that non-medical

settings improve outcomes (Hodnett 2012). It is estimated that at least 60% of pregnant women in the UK are healthy and experience a straightforward pregnancy (Birthplace Collaboration 2011; RCOG 2011), and are therefore eligible to give birth in midwifery-led settings where a birthing pool use is an established, core care option.

'Normal birth' is a composite outcome defined as a spontaneous labour onset, no epidural, spontaneous vaginal birth with no episiotomy (Maternity Care Working Party 2007), has been identified as a care quality marker (Dodwell 2010). The largest prospective national cohort study showed that this outcome was more likely to occur in a midwifery-led setting (Birthplace Collaboration 2011); a finding echoed among women who used a birthing pool during labour and planned to give birth in the community (Burns 2012).

It has been suggested that waterbirth may reduce the uptake of pharmacological pain relief and increase the likelihood of an intact perineum (Burke 1995; Burns 2012; Garland 2010; Geissbuehler 2004; Henderson 2014; Otigbah 2000). There may also be increased maternal satisfaction with the birth experience (Hall 1998; Maude 2007). Waterbirth may facilitate healthy pregnant women to have a normal birth, and particularly nulliparous women who plan to give birth in the community setting (Burns 2012). Retrospective analysis suggested that waterbirth might predispose women to a greater risk of sustaining obstetric anal sphincter injury (OASIS) (Cortes 2011). However, a prospective study (N = 2745 women) that investigated risk factors for perineal trauma found no link to indicate that labouring in water might predispose women to have a perineal tear (Smith 2013), and two prospective studies found no evidence identifying waterbirth as a risk factor for OASIS (Burns 2012; Henderson 2014). Although historically concerns were raised that waterbirth may present a risk factor for maternal infection (Hawkins 1995; Rawal 1994; Rosevear 1993), there is no current evidence for this.

Concerns raised for the neonate born under water are fourfold. First, concerns have been raised by several authors (Deans 1995; Johnson 1996; Rosser 1994), for fetal (and hence neonatal) well-being if a woman becomes pyrexial due to immersion in water warmer than her own natural core temperature. Ensuring pool temperature remains below maternal temperature is often recommended to prevent this. Secondly, it has been suggested that fetal/neonatal infection may occur due to cross-contamination from the water and pool, and from the woman (Hawkins 1995; Rawal 1994). However, several trials, comparative studies, cohort studies, and audits report no increased risk of infection for the fetus/neonate (Alderdice 1995; Anderson 1996; Eriksson 1997; Otigbah 2000; Robertson 1998; Rush 1996; Zanetti-Daellenbach 2007). As with all maternity provision, it is incumbent upon practitioners to ensure they have appropriate cleaning protocols for labour and birthing pools, and employ universal precautions. Thirdly, there have been case reports of transient tachypnoea of the newborn (TTN) following waterbirth (Kassim 2005; Mammas 2009; Nguyen 2002; Schroeter 2004; Sotiridou 2012). There is some debate among paediatricians, but no evidence beyond case reports about whether waterbirth predisposes a newborn to a greater risk of TTN than land birth (Carpenter 2012; Pinette 2004). However, neither the largest observational studies for waterbirth (Bovbjerg 2016; Burns 2012; Geissbuehler 2004), the randomised controlled trials that involved waterbirths (Chaichian 2009; Gayiti 2015; Ghasemi 2013; Nikodem 1999; Torkamani 2010; Woodward 2004), or a systematic review (Taylor 2016) have reported cases of TTN. Finally, concerns have been raised about the dangers of umbilical cords at water births (Cro 2002; Gilbert 1999). Cords also snap in land births; there are however, no data for this. Cord snaps associated with waterbirth may be related to undue traction exerted on the cord as the baby is lifted out of the water (Burns 2012).

Third stage of labour

Limited data are available on the third stage of labour management during water immersion. Two prospective cohort studies, one involving a UK sample of women (Burns 2012), and the second, an Italian sample (Henderson 2014), reported on third-stage management and the incidence of postpartum haemorrhage (PPH) for women who used water immersion during labour and for women who had a waterbirth. Both studies found a low incidence of PPH, and a higher use of physiological third stage (no oxytocic drug injection prior to birth of the placenta) among women who had a waterbirth.

How the intervention might work

The positive physiological effects of hydrotherapy such as buoyancy, hydrostatic pressure, and associated thermal changes, are relevant to women labouring in water, where labour is defined as including the first, second (birth) and third stages. The buoyancy of water enables a woman to move more easily than on land (Edlich 1987). This can facilitate the neuro-hormonal interactions of labour, alleviating pain, and potentially optimising the progress of labour (Benfield 2010; Ginesi 1998a; Ginesi 1998b). Water immersion may be associated with improved uterine perfusion, less painful contractions, a shorter labour with fewer interventions (Aird 1997; Garland 2000; Geissbuehler 2004; Henderson 2014; Moneta 2001; Otigbah 2000; Thoeni 2005; Zanetti-Daellenbach 2007). In addition, the ease of mobility that water immersion offers women may optimise fetal position by encouraging flexion (Ohlsson 2001). Where water immersion reduces the use of any pharmacological analgesia, either completely or partly, then the fetus/neonate benefits from not being exposed to the side effects of such drugs.

Hydrotherapy has marked physiological effects on the cardiovascular system (Cefalo 1978). Shoulder-deep warm water immersion has been shown to reduce blood pressure due to vasodilatation of the peripheral vessels and redistribution of blood flow. It is suggested that water immersion during labour increases maternal satisfaction and sense of control (Hall 1998; Richmond 2003). A woman who feels in control during childbirth experiences greater emotional well-being postnatally (Green 1998; Green 2007; Maude 2007; Meyer 2012).

Why it is important to do this review

Evidence is growing on the benefits of water immersion during labour for the woman and fetus; and of the potential benefits during waterbirth. However, some controversy remains, particularly around the risk of severe perineal trauma and neonatal well-being. Importantly, most of the evidence on the use of water immersion during labour and waterbirth is based on observational studies (Burns 2012; Garland 2000; Garland 2006; Geissbuehler 2000; Geissbuehler 2004; Henderson 2014; Lukasse 2014; Ohlsson 2001; Thoeni 2005). Understanding the findings of the randomised controlled trials to date may help to elicit causal relationships

and/or greater confidence in results to date. This is particularly important given the current drive to normalise birth and reduce unnecessary intervention during labour and birth. This is an update of a review last published in 2011 (Cluett 2009).

OBJECTIVES

To assess the effects of water immersion during labour and/or birth (first, second and third stage of labour) on women and their infants.

METHODS

Criteria for considering studies for this review

Types of studies

We included randomised controlled trials (RCTs) that assessed the use of water immersion as a form of pain relief. Quasi-randomised and cluster-randomised trials were eligible for inclusion but none were identified. Cross-over trials were not eligible for inclusion because irrespective of maternal parity, the duration of the first and second stage of labour cannot be predicted with a high level of accuracy between women; a factor which would prevent being able to guarantee equitable cross-over and therefore data precision.

If trials had included randomised and non-randomised women and if the randomised data were presented separately, we planned to report this. We have included published, unpublished and ongoing studies with reported data. We included trial reports in abstract form.

Types of participants

Nulliparous or multiparous women in labour at term gestation (as defined by trial authors), with a singleton pregnancy, where the woman and her fetus were healthy, and at low risk of complications.

Types of interventions

The previous version of this review (Cluett 2009) contributed to an overview of systematic reviews of interventions for pain management in labour (Jones 2012), and shared a generic protocol (Jones 2011). To avoid duplication, the different methods of pain management were listed in a specific order, from one to 15. Individual reviews focusing on particular interventions included comparisons with only the intervention above it on the list. The list is as follows.

1. Placebo/no treatment
2. Hypnosis (Madden 2016)
3. Biofeedback (Barragán 2011)
4. Intracutaneous or subcutaneous sterile water injection (Derry 2012)
5. Immersion in water (this review)
6. Aromatherapy (Smith 2011a)
7. Relaxation techniques (yoga, music, audio) (Smith 2011b)
8. Acupuncture or acupressure (Smith 2011c)
9. Manual methods (massage, reflexology) (Smith 2012)
10. Transcutaneous electrical nerve stimulation (TENS) (Dowswell 2009)
11. Inhaled analgesia (Klomp 2012)
12. Opioids (Ullman 2010)
13. Non-opioid drugs (Othman 2011)
14. Local anaesthetic nerve blocks (Novikova 2011)
15. Epidural (including combined spinal epidural) (Anim-Somuah 2005; Simmons 2007)

Accordingly, this review includes comparisons of any kind of bath/tub/pool that enabled immersion during any stage of labour, regardless of care setting, compared with: 1. no treatment (no immersion); 2. hypnosis; 3. biofeedback; 4. intracutaneous or subcutaneous sterile water injection; and 5. immersion during a different stage of labour.

However, only trials of immersion versus no immersion have been identified to date.

Types of outcome measures

We chose primary outcomes that we thought would be the most clinically valuable in assessing safety and effectiveness for the woman, fetus/neonate and caregivers. In addition, we identified outcomes that were considered to be of interest from the perspective of the woman and her baby, primary caregivers and related service providers. We also included outcomes to be consistent with the overview of systematic reviews of interventions for pain management in labour (Jones 2012).

We then selected the most pertinent maternal and fetal/neonatal outcomes for water immersion as primary outcomes. These (list below) are analysed within the comparison groups:

1. immersion in water versus no immersion during the first stage of labour;
2. immersion in water versus no immersion during the second stage of labour;
3. immersion in water versus no immersion during any stage of labour;
4. immersion in water versus no immersion during the third stage of labour (no trial reported this comparison);
5. early (cervical dilation less than 5 cm) with late (cervical dilation more than 5 cm) immersion.

Primary outcomes

Maternal

1. Mode of birth (spontaneous vaginal birth, instrumental vaginal birth and caesarean section)
2. Use of analgesia (regional) during any stage of labour
3. Perineal trauma (third-degree or fourth-degree tear)

Fetal/Neonatal

1. Perinatal death (still birth, neonatal death)
2. Admission to neonatal intensive care unit
3. Neonatal infection, including markers of infection such as pyrexia and raised white cell count

Secondary outcomes

Maternal

1. Mortality

2. Labour
   a. Estimated blood loss
   b. Postpartum haemorrhage (> 500 mL)
   c. Use of analgesia (general anaesthesia, pharmacological analgesia, or other) during any stage of labour
   d. Infection during labour/postnatal period
   e. Augmentation of labour (artificial rupture of membranes and/or oxytocin administration)
   f. Use of non-pharmacological analgesia
   g. Duration of labour (first, second and third stage)
   h. Perineal trauma (none -intact, first-degree tear, second-degree tear, episiotomy)
   i. Pain experience/intensity as presented by authors
   j. Temperature (degrees Centigrade) (first and second stage)
   k. Pulse and blood pressure (first, second and third stage)
   l. Maternal self-esteem
   m. Preference for care in subsequent labour
   n. Satisfaction with childbirth experience (as defined by trialists)
   o. Satisfaction with pain relief (as defined by trialists)
   p. Sense of control in labour (as defined by trialists)
   q. Effect (negative) on mother/baby interaction
1. Long-term outcomes
   a. Postpartum depression
   b. Post-traumatic stress disorder

Fetal/Neonatal outcomes

1. Abnormal heart rate pattern
2. Meconium liquor
3. Apgar score less than seven at five minutes (or as presented by authors)
4. Cord pH immediately after birth (arterial and or venous cord blood)
5. Respiratory support (oxygen/ventilation required)
6. Lung hypoplasia
7. Neurological pathology, e.g. seizures, cerebral palsy
8. Snapped cord
9. Birth injury
10. Breastfeeding (at specified time points)
11. Poor infant outcomes at long-term follow-up (as defined by trialists)

Other

1. Cost as defined by trialists

Caregiver outcomes

1. Satisfaction
2. Injuries (any reported physical injury attributed to care of women in water)

Search methods for identification of studies

The following methods section of this review is based on a standard template used by Cochrane Pregnancy and Childbirth.

Electronic searches

For this update, we searched Cochrane Pregnancy and Childbirth's Trials Register by contacting their Information Specialist (18 July 2017).

The Register is a database containing over 24,000 reports of controlled trials in the field of pregnancy and childbirth. It represents over 30 years of searching. For full current search methods used to populate Pregnancy and Childbirth's Trials Register including the detailed search strategies for CENTRAL, MEDLINE, Embase and CINAHL; the list of handsearched journals and conference proceedings, and the list of journals reviewed via the current awareness service, please follow this link to the editorial information about the Cochrane Pregnancy and Childbirth in the Cochrane Library and select the '***Specialized Register***' section from the options on the left side of the screen.

Briefly, Cochrane Pregnancy and Childbirth's Trials Register is maintained by their Information Specialist and contains trials identified from:

1. monthly searches of the Cochrane Central Register of Controlled Trials (CENTRAL);
2. weekly searches of MEDLINE (Ovid);
3. weekly searches of Embase (Ovid);
4. monthly searches of CINAHL (EBSCO);
5. handsearches of 30 journals and the proceedings of major conferences;
6. weekly current awareness alerts for a further 44 journals plus monthly BioMed Central email alerts.

Search results are screened by two people and the full text of all relevant trial reports identified through the searching activities described above is reviewed. Based on the intervention described, each trial report is assigned a number that corresponds to a specific Pregnancy and Childbirth review topic (or topics), and is then added to the Register. The Information Specialist searches the Register for each review using this topic number rather than keywords. This results in a more specific search set that has been fully accounted for in the relevant review sections (Included studies; Excluded studies; Ongoing studies).

In addition, we searched ClinicalTrials.gov and the WHO International Clinical Trials Registry Platform (ICTRP) for unpublished, planned and ongoing trial reports (18 July 2017) using the terms given in Appendix 1

Searching other resources

We searched the reference lists of retrieved studies.

We did not apply any language or date restrictions.

Data collection and analysis

For methods used in the previous version of this review, *see* Cluett 2009.

For this update, we used the following methods for assessing the 14 reports that were identified as a result of the updated search.

The following methods section of this review is based on a standard template used by the Cochrane Pregnancy and Childbirth Review Group.

Selection of studies

Two review authors independently assessed for inclusion all the potential studies identified as a result of the search strategy. We resolved any disagreement through discussion.

Data extraction and management

We designed a form to extract data. For eligible studies, two review authors extracted the data using the agreed form. We resolved discrepancies through discussion. Data were entered into Review Manager software (RevMan 2014) by one review author (EC) and checked for accuracy by a second review author (EB).

When information regarding any of the above was unclear, we endeavoured to contact authors of the original reports to provide further details.

We decided to present the data by stage of labour, first, second and third stage. Where a trial involved immersion in labour during first and second stages, we decided to present data in both subgroups. This was because the key outcomes of interest to practitioners and women are presented in clinical practice as ultimate birth outcome regardless of management strategies adopted.

Assessment of risk of bias in included studies

Two review authors independently assessed risk of bias for each study using the criteria outlined in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). Any disagreement was resolved by discussion.

(1) Random sequence generation (checking for possible selection bias)

We described for each included study the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups.

We assessed the method as:

- low risk of bias (any truly random process, e.g. random number table; computer random number generator);
- high risk of bias (any non-random process, e.g. odd or even date of birth; hospital or clinic record number); or;
- unclear risk of bias.

(2) Allocation concealment (checking for possible selection bias)

We described for each included study the method used to conceal allocation to interventions prior to assignment and assessed whether intervention allocation could have been foreseen in advance of, or during recruitment, or changed after assignment.

We assessed the methods as:

- low risk of bias (e.g. telephone or central randomisation; consecutively numbered sealed opaque envelopes);
- high risk of bias (open random allocation; unsealed or non-opaque envelopes, alternation; date of birth);
- unclear risk of bias.

(3.1) Blinding of participants and personnel (checking for possible performance bias)

Due to the nature of the intervention women, carers' and researchers cannot be blind to group allocation after randomisation and so all studies are considered to be at high risk of bias for this domain.

(3.2) Blinding of outcome assessment (checking for possible detection bias)

No study included in this review reported any blinding of outcome assessment. However most outcomes were recorded by the professional providing data for example method of birth, duration of labour which are routine outcomes, so are unlikely to be biased.

As a consequence we have assessed methods used to blind outcome assessment as:

- unclear risk of bias.

(4) Incomplete outcome data (checking for possible attrition bias due to the amount, nature and handling of incomplete outcome data)

We described for each included study, and for each outcome or class of outcomes, the completeness of data including attrition and exclusions from the analysis. We stated whether attrition and exclusions were reported and the numbers included in the analysis at each stage (compared with the total randomised participants), reasons for attrition or exclusion where reported, and whether missing data were balanced across groups or were related to outcomes.

We assessed methods as:

- low risk of bias (e.g. no missing outcome data; missing outcome data balanced across groups, less than 20% loss);
- high risk of bias (e.g. numbers or reasons for missing data imbalanced across groups; ‘as treated” analysis done with substantial departure of intervention received from that assigned at randomisation);
- unclear risk of bias.

(5) Selective reporting (checking for reporting bias)

We described for each included study how we investigated the possibility of selective outcome reporting bias and what we found.

We assessed the methods as:

- low risk of bias (where it is clear that all of the study’s pre-specified outcomes and all expected outcomes of interest to the review have been reported);
- high risk of bias (where not all the study’s pre-specified outcomes have been reported; one or more reported primary outcomes were not pre-specified; outcomes of interest are reported incompletely and so cannot be used; study fails to include results of a key outcome that would have been expected to have been reported);
- unclear risk of bias.

(6) Other bias (checking for bias due to problems not covered by (1) to (5) above)

We described for each included study any important concerns we had about other possible sources of bias.

We assessed whether each study was free of other problems that could put it at risk of bias:

- low risk of other bias;
- high risk of other bias;
- unclear whether there is risk of other bias.

(7) Overall risk of bias

We made explicit judgements about whether studies were at high risk of bias, according to the criteria given in the *Handbook* (Higgins 2011). With reference to (1) to (6) above, we assessed the likely magnitude and direction of the bias and considered the likely impact on the findings.

Assessment of the quality of the evidence using the GRADE approach

For this update, we assessed the quality of the evidence using the GRADE approach as outlined in the GRADE handbook in order to assess the quality of the body of evidence relating to the following outcomes.

1. Mode of birth (spontaneous vaginal birth, instrumental vaginal birth, and caesarean section)
2. Use of analgesia (regional) during any stage of labour
3. Perineal trauma (third- or fourth-degree tear)
4. Perinatal mortality
5. Admission to special care baby unit/neonatal intensive care unit
6. Neonatal infection, including markers of infection such as pyrexia and raised white cell count
7. Estimated blood loss

We assessed the evidence for the main comparisons: immersion in water versus no immersion during first stage of labour; and immersion in water versus no immersion during second stage of labour.

We used the GRADEpro Guideline Development Tool to import data from Review Manager 5.3 (RevMan 2014) in order to create 'Summary of findings' tables. A summary of the intervention effect and a measure of quality for each of the above outcomes was produced using the GRADE approach. The GRADE approach uses five considerations (study limitations, consistency of effect, imprecision, indirectness and publication bias) to assess the quality of the body of evidence for each outcome. The evidence can be downgraded from 'high quality' by one level for serious (or by two levels for very serious) limitations, depending on assessments for risk of bias, indirectness of evidence, serious inconsistency, imprecision of effect estimates or potential publication bias.

Measures of treatment effect

Dichotomous data

For dichotomous data, we presented results as summary risk ratio with 95% confidence intervals.

Continuous data

We used the mean difference if outcomes were measured in the same way between trials. We planned to use the standardised mean difference to combine trials that measured the same outcome, but used different methods.

Unit of analysis issues

Cluster-randomised trials

We planned to include cluster-randomised trials, however none were identified. In future updates, if cluster-randomised trials are included, we will include cluster-randomised trials in the analyses along with individually-randomised trials. We will adjust their sample size using the methods described in Section 16.3.4 of the *Handbook* (Higgins 2011) using an estimate of the intracluster correlation co-efficient (ICC) derived from the trial (if possible), from a similar trial or from a study of a similar population. If we use ICCs from other sources, we will report this and conduct sensitivity analyses to investigate the effect of variation in the ICC. If we identify both cluster-randomised trials and individually-randomised trials, we plan to synthesise the relevant information. We will consider it reasonable to combine the results from both if there is little heterogeneity between the study designs and the interaction between the effect of intervention and the choice of randomisation unit is considered to be unlikely.

We will also acknowledge heterogeneity in the randomisation unit and perform a sensitivity analysis to investigate the effects of the randomisation unit.

Cross-over trials would not be a feasible or valid design for this topic and were therefore not eligible for inclusion. No other unit of analysis issues were identified.

Dealing with missing data

We analysed data on all participants with available data in the group to which they were allocated, regardless of whether or not they received the allocated intervention, and irrespective of whether they used additional interventions. If, in the original reports, participants were not analysed in the group to which they were randomised, and there was sufficient information in the trial report, we have attempted to restore them to the correct group.

For included studies we noted levels of attrition.

Where data were not reported for some outcomes or groups, we attempted to contact the study authors.

Assessment of heterogeneity

We assessed statistical heterogeneity in each meta-analysis using the Tau^2, I^2 and Chi^2 statistics. We regarded heterogeneity as substantial if an I^2 was greater than 30% and either a Tau^2 was greater than zero, or there was a low P value (less than 0.10) in the Chi^2 test for heterogeneity. Had we identified substantial heterogeneity (above 30%), we planned to explore it by pre-specified subgroup analysis.

Assessment of reporting biases

If there were 10 or more studies in any meta-analysis, we planned to investigate reporting biases (such as publication bias) using funnel plots. There was a single meta-analysis with 10 studies.

We assessed funnel plot asymmetry visually in this single meta-analysis.

Data synthesis

We carried out statistical analysis using the Review Manager software (RevMan 2014). We used fixed-effect meta-analysis for combining data where it was reasonable to assume that studies were estimating the same underlying treatment effect: i.e. where trials were examining the same intervention, and the trials' populations and methods were judged sufficiently similar.

If there was clinical heterogeneity sufficient to expect that the underlying treatment effects differed between trials, or if substantial statistical heterogeneity was detected, we used random-effects meta-analysis to produce an overall summary, if an average treatment effect across trials was considered clinically meaningful. The random-effects summary was treated as the average range of possible treatment effects and we discussed the clinical implications of treatment effects differing between trials. If the average treatment effect was not clinically meaningful, we did not combine trials. Where we used random-effects analyses, we presented the results as the average treatment effect with 95% confidence intervals, and the estimates of Tau^2 and I^2.

Subgroup analysis and investigation of heterogeneity

If we had identified substantial heterogeneity, we planned to investigate it using subgroup analyses and sensitivity analyses. We would have considered whether an overall summary was meaningful, and if it was, used a random-effects analysis to produce it.

For the primary outcomes, where data were available, we planned the following subgroup analyses.

1. Spontaneous labour versus induced labour.
2. Primiparous versus multiparous.
3. Continuous support in labour versus no continuous support.

We were unable to perform any of the planned subgroup analyses due to lack of data relating to subgroups.

In future updates, if subgroup analyses are performed, we will assess subgroup differences by interaction tests available within RevMan (RevMan 2014). We will report the results of subgroup analyses quoting the Chi^2 statistic and P value, and the interaction test I^2 value.

Sensitivity analysis

We carried out sensitivity analyses to explore the effect of trial quality assessed by concealment of allocation, high attrition rates, or both. We excluded trials assessed to be at high risk of selection bias (allocation concealment), attrition bias, or both from the analyses in order to assess whether this made any difference to the overall results of the review's primary outcomes.

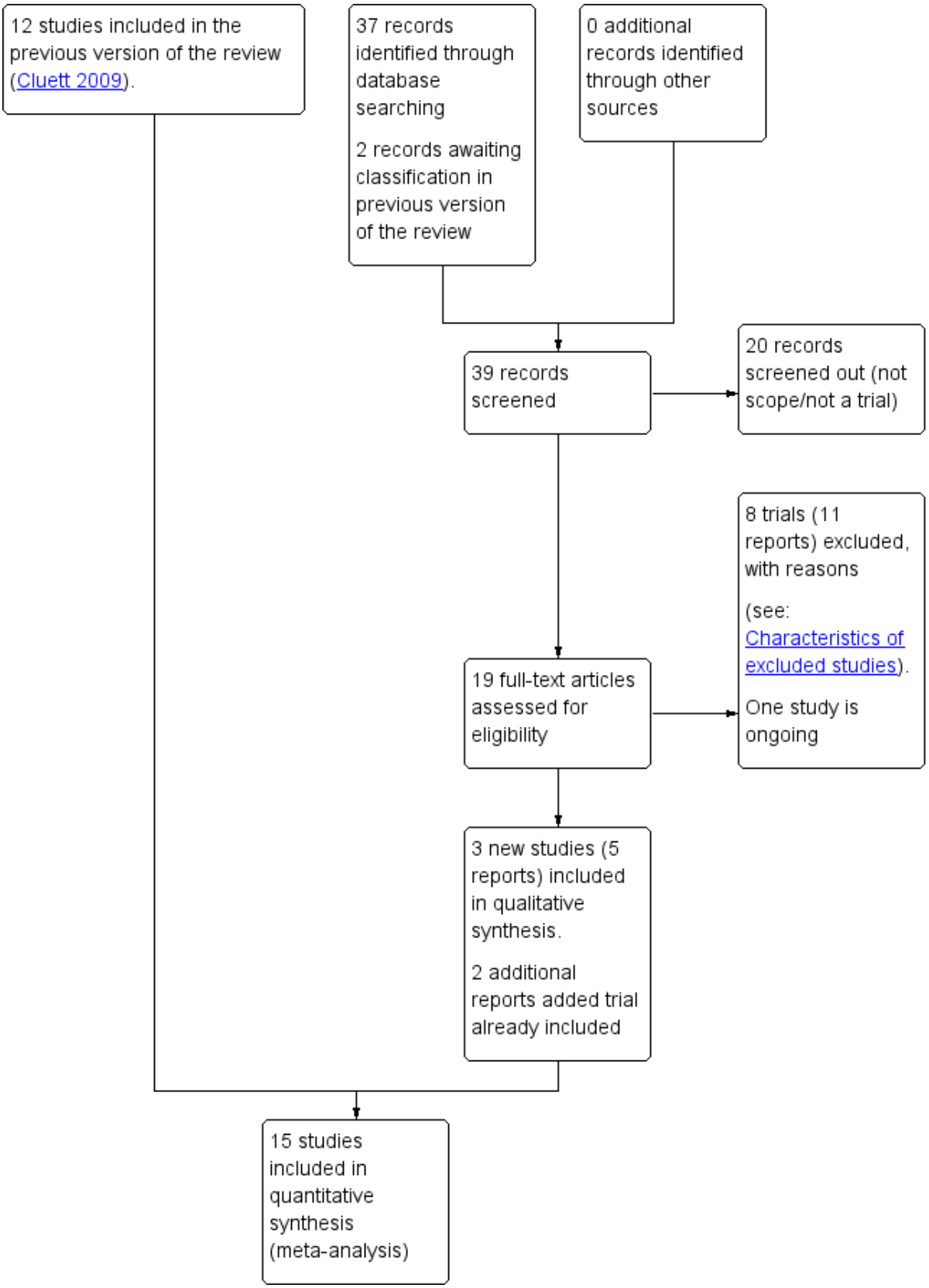
RESULTS

Description of studies

Results of the search

See: Figure 1

Figure 1. Study flow diagram.



For this update, we retrieved 17 relevant trial reports and we also reassessed the two trial reports (Malarewicz 2005; Torkamani 2010) that were awaiting further classification in the previous version of the review (Cluett 2009). Of these, we included three trials (five reports) (Gayiti 2015; Ghasemi 2013; Torkamani 2010), and added an additional report each to Rush 1996 and Woodward 2004. One trial is ongoing, for which we have requested information on completion (Dabiri 2016), and we excluded eight trials (11 reports). We have now included 15 trials (Cammu 1994; Chaichian 2009; Da Silva 2006; Eckert 2001; Eriksson 1997; Gayiti 2015; Ghasemi 2013; Kuusela 1998; Nikodem 1999; Ohlsson 2001; Rush 1996; Schorn 1993; Taha 2000; Torkamani 2010; Woodward 2004).

Included studies

Design

All included trials are randomised controlled trials (Cammu 1994; Chaichian 2009; Da Silva 2006; Eckert 2001; Eriksson 1997; Gayiti 2015; Ghasemi 2013; Kuusela 1998; Nikodem 1999; Ohlsson 2001; Rush 1996; Schorn 1993; Taha 2000; Torkamani 2010; Woodward 2004).

Sample sizes

Sample size ranged from 33 (Kuusela 1998) to 800 (Rush 1996).

Setting and dates of trials

The trials were conducted across a wide range of countries: Belgium (Cammu 1994), Iran (Chaichian 2009; Ghasemi 2013; Torkamani 2010), Brazil (Da Silva 2006), Australia (Eckert 2001), Sweden (Eriksson 1997; Ohlsson 2001), China (Gayiti 2015), Finland (Kuusela 1998), South Africa (Nikodem 1999; Taha 2000), Canada (Rush 1996), the USA (Schorn 1993), and the UK (Woodward 2004).

All trials were undertaken in a hospital labour ward setting, with varying degree of medical intervention considered as routine practice, for example the use of enemas and shaves (Gayiti 2015), intravenous access and postpartum oxytocin (Ghasemi 2013), other trials did not indicate the underpinning approach to care. In particular, one-to-one care in labour is known to affect labour outcomes (Hodnett 2013), and this was clearly documented in only four trials (Cammu 1994; Da Silva 2006; Nikodem 1999; Taha 2000). Where it was stated that normal/routine/standard care was provided, this was understood to mean that the practitioners who normally provided intrapartum care to women in labour in the study centre provided care for the study participants (Da Silva 2006; Eckert 2001; Eriksson 1997; Ghasemi 2013; Nikodem 1999; Rush 1996; Schorn 1993; Woodward 2004). Cammu 1994 indicated that care was supervised by obstetric staff.

Of the trials that reported trial dates, six trials took place between 1990 and 2000 (Eckert 2001 1995 to 1998; Kuusela 1998 1997 to 1998; Nikodem 1999 1999; Ohlsson 2001 1992 to 1995; Rush 1996 1998; Schorn 1993 1990 to 1991), and four took place between 2005 and 2015 (Chaichian 2009 2006 to 2007; Gayiti 2015 2012 to 2013; Ghasemi 2013 2008 to 2009; Torkamani 2010 2006 to 2007).

Participants

Most trial authors did not specify the parity of included women. Three trials only included nulliparous women (Cammu 1994; Da Silva 2006; Gayiti 2015), and one included both multiparous and nulliparous (Woodward 2004).

Interventions and comparisons

Of the 15 trials included in this review, eight related to the first stage of labour only (Cammu 1994; Da Silva 2006; Eckert 2001; Kuusela 1998; Ohlsson 2001; Rush 1996; Schorn 1993; Taha 2000); one related to early versus late immersion in the first stage of labour (Eriksson 1997); four involved immersion during the first and second stages of labour (Chaichian 2009; Gayiti 2015; Torkamani 2010; Woodward 2004); and two involved women in the second stage of labour only (Ghasemi 2013; Nikodem 1999). There were no studies evaluating the use of different types of baths/pools at any stage of labour or the effects of water immersion on the third stage of labour.

Water temperature, which is known to be important in the care of women using water immersion during labour, also differed between trials. Reporting varied across trials, with some using a temperature up to 37°C (Cammu 1994; Eckert 2001; Gayiti 2015; Kuusela 1998); others up to 38°C (Da Silva 2006; Eriksson 1997; Taha 2000); and others not stated (Chaichian 2009; Ghasemi 2013; Nikodem 1999; Ohlsson 2001; Schorn 1993; Torkamani 2010; Woodward 2004). Rush 1996 referred to a temperature of 38°C to 39°C. Higher temperatures may affect outcomes, but there are no studies comparing outcomes for the use of different water temperatures.

The variation in practices between study centres and data presentation restricted comparison across studies, resulting in the predominance of one study's findings for several variables particularly in relation to the immersion in water during the second stage of labour, and for all of the outcomes for early versus late immersion, which was compared by Eriksson 1997 only.

There were no trials that compared water immersion with other forms of pain relief as described in Types of interventions.

Outcomes

A wide range of data were collected, and there was wide variation regarding specific outcome measures and their presentation. For example, some studies did not consider neonatal well-being. Apgar scores were reported differently: some used them as continuous data, others as dichotomous. There were also differences in reporting maternal data, for example labour duration was presented as an overall total or only provided for individual stages of labour.

For further details, *see* Characteristics of included studies.

Funding sources

Woodward 2004 was partly funded by Getting Started in Research Grant from Northampton General Hospital NHS Trust. All the remaining trials did not disclose funding sources.

Declarations of interest

One trial (Gayiti 2015) reported that the authors had no conflicts of interest. All the remaining trials did not mention conflicts of interest.

Excluded studies

We excluded 14 studies.

Bastide 1990 was excluded as the description of the intervention was whirlpool bath and was inadequate to confirm if immersion of the pregnant abdomen was possible. We had only unpublished data, and the authors did not provide additional information.

Benfield 2001 was excluded because the intervention was not water immersion, as the water depth was limited as women lay on a raft and the focus was on psychophysical measures of anxiety in early labour only, and it was not an randomised controlled trial (RCT) and had no comparator - it was a pre-test, post-test trial.

One pilot study (Calvert 2000), was excluded because its objective was to compare the effect of essential oil of ginger with the essential oil of lemon grass added to a birthing pool, not the water immersion itself.

In two studies by Cluett (Cluett 2001; Cluett 2004), the women were not at low risk of complications as all had been diagnosed as having labour dystocia. These two studies addressed water immersion as a mechanism for addressing dystocia in labour for nullipara.

The trials by Kashanian 2013 and Irion 2011 related to antenatal use of water immersion, and therefore not the intervention being considered in this review.

Labrecque 1999 was excluded because the water group included whirlpool, back massage and 'liberal mobilisation' negating the possibility of assessing the effect of water immersion.

We excluded the following studies because they involved inappropriate interventions, using comparisons between women using a shower versus other comparators and therefore they did not immerse in a bath or birthing pool (Henrique 2015; Irion 2011; Khadijeh 2015; Lee 2013).

We excluded Malarewicz 2005 as there was inadequate description of the pool to confirm immersion, and the report only provided data on cervical dilation between two time points, which is a subjective measurement by the caregiver, of a non linear outcome. No data were provided on length of labour which is the outcome used within this review. No other outcome was provided despite direct request to the authors for non published data.

Two studies were excluded as they were not randomised trials (Cai 2005; Zou 2008).

Risk of bias in included studies

See details under Characteristics of included studies, Figure 2; Figure 3.

Figure 2. 'Risk of bias' graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

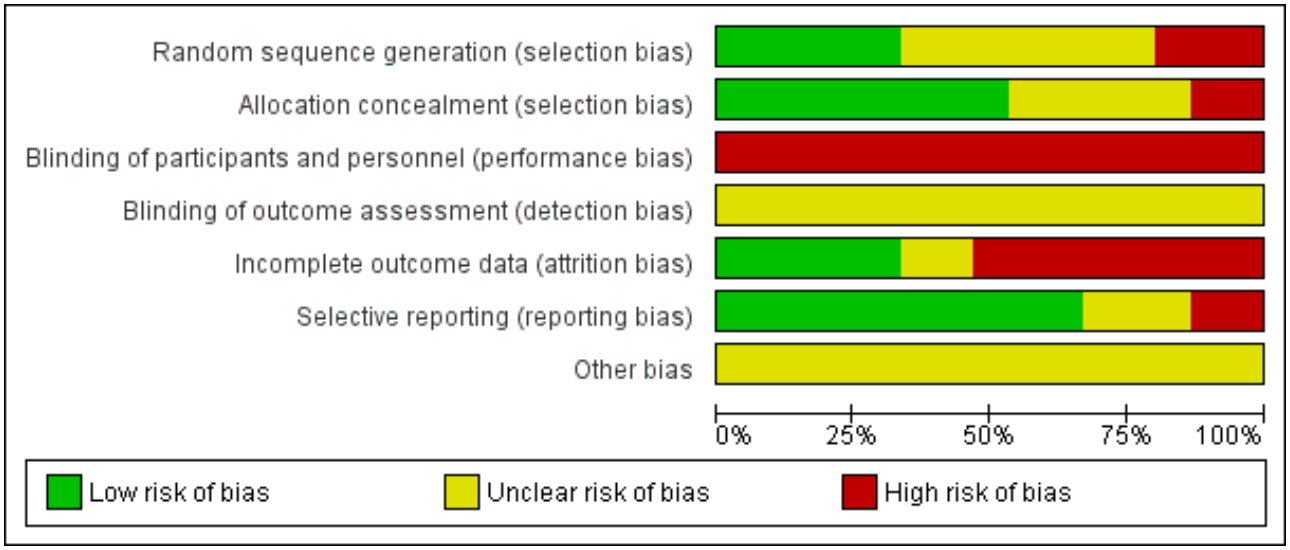
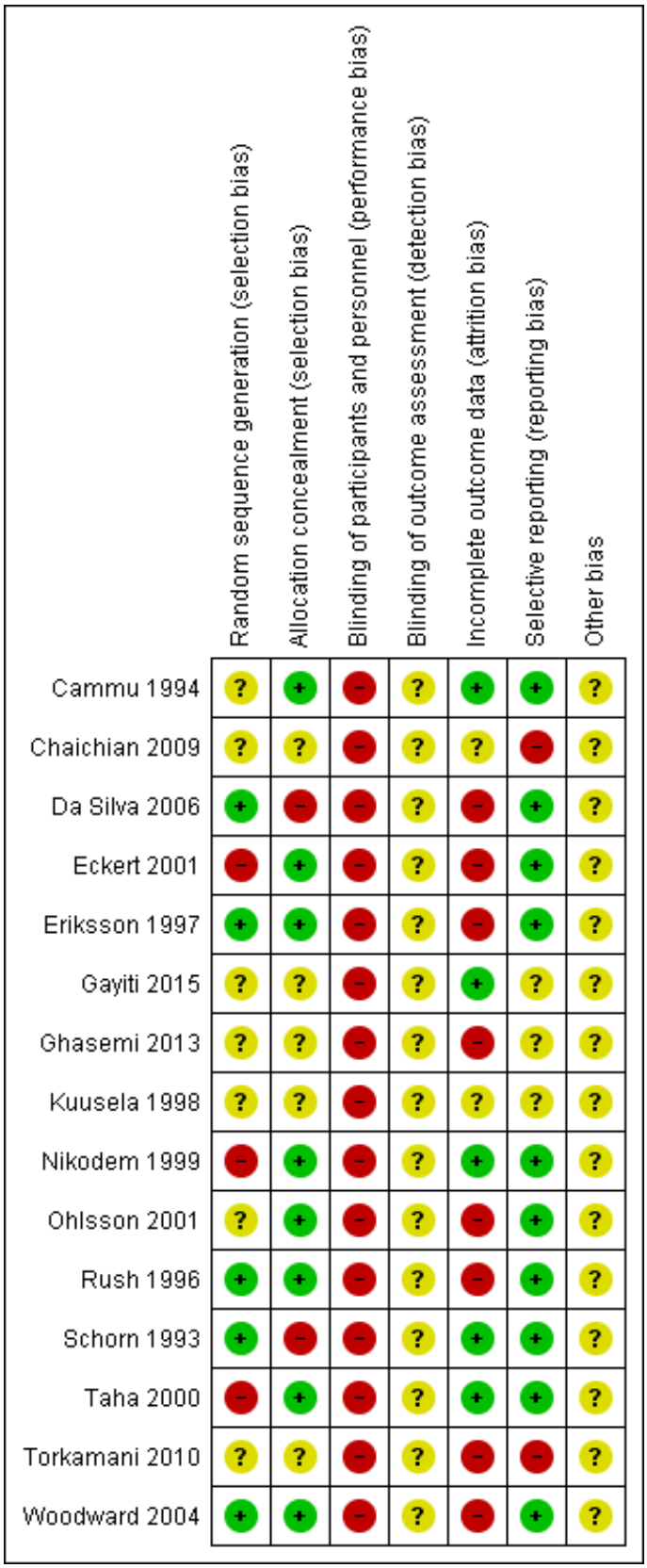


Figure 3. 'Risk of bias' summary: review authors' judgements about each risk of bias item for each included study.



Allocation

We considered random sequence generation to be at low risk of bias for five trials (Da Silva 2006; Eriksson 1997; Rush 1996; Schorn 1993; Woodward 2004) as they used a computer-generated random number table to generate the random sequence. Three trials were at high risk of bias (Eckert 2001; Nikodem 1999; Taha 2000) because they used blocks for randomisation, with potential for breaking concealment. The remaining seven trials were at unclear risk of bias for random sequence generation because they did not report clearly the method for randomisation.

Similarly for allocation concealment, we judged eight trials to be at low risk of bias as they all reported using sequentially numbered, opaque sealed envelopes (Cammu 1994; Eckert 2001; Eriksson 1997; Nikodem 1999; Ohlsson 2001; Rush 1996; Taha 2000; Woodward 2004). Two were at high risk of bias: Da Silva 2006 only used 'tabs' to cover allocation; and in Schorn 1993, the midwife knew the allocation. The remaining five trials were at unclear risk of bias (Chaichian 2009; Gayiti 2015; Ghasemi 2013; Kuusela 1998; Torkamani 2010) because they did not clearly describe the method for allocation concealment (refer to Figure 2; Figure 3).

Blinding

None of the trials cite any blinding of participants and personnel, and this is likely to be difficult to achieve, as use of water during labour is usually clearly documented in case records, so we have assessed them all as high risk of bias.

As an intervention, it is not possible to blind participants or carers to water immersion. Not all participants and/or carers will be in a state of equipoise between immersion or non-immersion, that is being equally comfortable and confident about water immersion. This may positively or negatively influence outcomes such as pain perception and hence subsequent analgesia use, maternal satisfaction, self-esteem and postpartum depression. An example of this is Woodward 2004, which reported that some midwives were apparently not supportive of women using water, suggesting a positive bias within the women, and in this case a negative bias within the midwives. Conversely, Rush 1996 reported practitioners as maintaining an interest in low-intervention labour practice, suggesting a positive bias towards water immersion. Water immersion, however, is as much a psychological choice as a physical pain-management strategy, and as such pragmatic clinical trials are assessing the effect of the whole package.

None of the trials cite any blinding of outcome assessment, and while, due to the nature of the intervention which is documented on care records, it is difficult to achieve, it is in theory possible. However, this was not described and so we have assessed all as being at unclear risk of bias.

Incomplete outcome data

We considered compliance with trial allocation to be variable across the trials. We classified eight trials as being at high risk of attrition bias, (Da Silva 2006; Eckert 2001; Eriksson 1997; Ghasemi 2013; Ohlsson 2001; Rush 1996; Torkamani 2010; Woodward 2004), as a known or unknown number of participants did not receive the allocated intervention. Of the trials that involved water immersion in the first stage of labour, Rush 1996 reported that 46% of women allocated to water immersion did not actually enter the water. Woodward 2004 planned a 2:1 ratio allocation to water anticipating that about 50% of women would not use water, but of the 40 allocated to use water, only 24 used the pool. Four (of 58) women in Da Silva 2006 did not receive the water intervention due to medical/obstetric reasons. Another three trials (Eckert 2001; Eriksson 1997; Ohlsson 2001) reported some cross-over between groups. Analysis of the Torkamani 2010 outcome data in percentages, indicated attrition, as the numbers are not consistent, although this is not explained in the translated trial description available. Ghasemi 2013 data imply attrition of 17 of 100 in the water group and 12 in the traditional care group, but did not provide details. Five studies indicated no attrition (Cammu 1994; Gayiti 2015; Nikodem 1999; Schorn 1993; Taha 2000). Chaichian 2009 and Kuusela 1998 did not provide information on this.

Selective reporting

We judged 10 trials to be at low risk of bias as they appear to have reported all of the data (Cammu 1994; Da Silva 2006; Eckert 2001; Eriksson 1997; Nikodem 1999; Ohlsson 2001; Rush 1996; Schorn 1993; Taha 2000; Woodward 2004). We considered two trials(Chaichian 2009; Torkamani 2010) to be at high risk of bias as it was clear that not all the data were reported; in Torkamani 2010, women who required a caesarean section after apparently consenting and entering the trial were excluded indicating analysis was not by intention-to-treat and there were no data on the number of such women in each group. Chaichian 2009 only reported key outcomes, and stated that the rest were not significant. We judged selective reporting bias in three studies as unclear from the available translations (Gayiti 2015; Ghasemi 2013; Kuusela 1998).

Other potential sources of bias

Weclassified all the trials as unclear for other bias as the trials adopted a variety of definitions for water immersion, with different size baths/pools containing different volumes of water. To date, there is no evidence as to whether different degrees of immersion, or the amount of mobility possible within the bath/pool, affect outcomes. Schorn 1993 referred to a tub with a moulded seat, which may restrict mobility and the freedom to adopt different positions while immersed. Likewise, Rush 1996 used a pool where the woman could not change position. Schorn 1993 and Rush 1996 used a whirlpool (hot tub with jets) and the effect of moving water during immersion may be different to the effect of still water. Kuusela 1998 referred to a tub that was 70 cm deep and held 730 litres; Da Silva 2006 indicated tub volume as 194 litres; Eckert 2001 and Eriksson 1997 cite tub depths of 54 cm and 40 cm, respectively. Other trials did not provide a description of the pool used. Differences as to what constitutes water immersion makes comparisons of outcomes across trials difficult.

The duration of immersion in water was very variable. For trials related to the first stage of labour, this ranged from restrictions on length of time in the water of between 30 to 60 minutes (Da Silva 2006; Kuusela 1998, Schorn 1993), to Taha 2000 who indicated women could only be out of the water for a maximum of 30 minutes at any one time during labour. Cammu 1994 and Eckert 2001 specifically indicated there was no restriction, while the other trials did not comment on this.

Women in three trials did not receive the intervention despite being randomised to immersion groups: Rush 1996 reported that 46% of women allocated to water immersion did not enter the water, Woodward 2004 reported that of the 40 allocated to use water, only 24 used the pool, four (of 58) women in Da Silva 2006 did not receive

the water intervention due to medical/obstetric reasons. It is not clear if these studies used intention-to-treat analysis.

All trials were in hospital-based settings and had varying degrees of medical models of care, and it was not possible to judge the impact of these on level of bias.

These factors limited comparison across trials and the reliability and validity of the trial findings.

Effects of interventions

See: **Summary of findings for the main comparison** Immersion in water compared to no immersion during first stage of labour in water during labour and birth; **Summary of findings 2** Immersion in water compared to no immersion during second stage of labour in water during labour and birth

This section considers the results from the included trials and overall conclusions.

1. Immersion versus no immersion in the first stage of labour

We included eight trials in this comparison (Cammu 1994; Da Silva 2006; Eckert 2001; Kuusela 1998; Ohlsson 2001; Rush 1996; Schorn 1993; Taha 2000). As indicated above, many outcomes were not defined, defined differently or not reported across all trials. See Summary of findings for the main comparison.

Primary outcomes

Maternal

Mode of birth (spontaneous birth, assisted vaginal birth and caesarean section)

Seven trials (Cammu 1994; Eckert 2001; Kuusela 1998; Ohlsson 2001; Rush 1996; Taha 2000; Woodward 2004) provided data on mode of birth.

Six trials presenting data on spontaneous vaginal birth rate did not find any clear difference between the groups (risk ratio (RR) 1.01, 95% confidence interval (CI) 0.97 to 1.04; 2559 women; 6 trials; moderate-quality evidence; Analysis 1.1). There is no clear effect on instrumental vaginal births (RR 0.86, 95% CI 0.70 to 1.05; 2559 women; 6 trials; low-quality evidence; Analysis 1.2), or caesarean sections (RR 1.27, 95% CI 0.91 to 1.79; 2652 women; 7 trials; low-quality evidence; Analysis 1.3).

Use of analgesia (regional) during any stage of labour

Five trials (Cammu 1994; Eckert 2001; Kuusela 1998; Ohlsson 2001; Rush 1996) provided data on epidural/spinal analgesia/anaesthesia use and there was a reduction in the incidence of epidural/spinal/paracervical analgesia/anaesthesia amongst women allocated to immersion in water during the first stage of labour compared to controls (RR 0.91, 95% CI 0.83 to 0.99; 2439 women; 5 trials; moderate-quality evidence, Analysis 1.4). Of these trials, Rush 1996 reported women were allocated to water immersion but did not use water; 183 (46%) of the water group did not immerse, but none of the control group immersed.

Perineal trauma (third-degree and fourth-degree perineal tears)

Four trials (Eckert 2001; Ohlsson 2001; Rush 1996; Taha 2000) reported on third- and fourth-degree tears, and it is unclear whether there is a difference in the risk of tears in the groups (RR 1.36, 95% CI 0.85 to 2.18; 2341 women; 4 trials; moderate-quality evidence, Analysis 1.5).

Perinatal mortality

No trial investigating water immersion during the first stage of labour reported any incidence of perinatal mortality. Considering the importance of this outcome, particularly in relation to water immersion, it is highly likely that this can be interpreted as no cases of mortality, rather than a failure to report the outcomes.

Admission to neonatal intensive care unit

Two trials (Eckert 2001; Ohlsson 2001) reported admissions to the neonatal intensive care unit. There was no clear difference between groups for this outcome (average RR 1.30, 95% CI 0.42 to 3.97, low-quality evidence, Analysis 1.6). There was some heterogeneity between these studies and the results should be interpreted with caution (heterogeneity: I^2 = 36%; Tau^2 = 0.36; Chi^2 test for heterogeneity (P = 0.21)).

Neonatal infection, including markers of infection such as pyrexia and raised white cell count

Five trials (Cammu 1994; Eckert 2001; Kuusela 1998; Rush 1996; Schorn 1993) reported infection rates and did not find any clear difference between the groups (RR 2.00, 95% CI 0.50 to 7.94, 1295 infants; very low-quality evidence, Analysis 1.7). Furthermore, both the groups reported few infection rates. Three trials (Cammu 1994; Kuusela 1998; Schorn 1993) reported no infections in either group, which is expected in trials with small sample sizes involving low-risk women. One trial (Eckert 2001) reported temperature greater than 37.8°C as an indicator of infection but did not find any clear difference between the groups (RR 1.00, 95% CI 0.06 to 15.83, Analysis 1.8).

Sensitivity analysis

Removing Eckert 2001, Ohlsson 2001, Rush 1996, and Schorn 1993 as per review methodology, widened confidence intervals but did not alter overall results for modes of birth, use of regional analgesia, and perineal trauma (third- or fourth-degree tears). For use of analgesia (regional), removing Eckert 2001, Ohlsson 2001, and Rush 1996 removed the favourable immersion results leaving no clear difference between groups. Only Eckert 2001 and Ohlsson 2001 contributed data to admission to neonatal intensive care unit so a sensitivity analysis was not attempted. Eckert 2001 and Rush 1996 were the only trials that contributed events to neonatal infection.

Secondary outcomes

Maternal

The following outcomes were not reported in any of the included studies: maternal mortality; post-traumatic stress disorder; temperature; satisfaction with childbirth experience; maternal self-esteem; satisfaction with pain relief; sense of control in labour; and effect on mother/baby interaction.

Mortality

No trial reported any maternal mortality. Given the magnitude of a maternal death, it is reasonable to assume this was because there was none.

Estimated blood loss during labour (first, second, third stage, and immediate postnatal period)

Two trials (Kuusela 1998; Taha 2000) reported on the mean blood loss (mL) in each group but did not find any clear difference between the groups (mean difference (MD) (MD -14.33, 95% CI -63.03 to 34.37; 153 women; 2 trials; very low-quality evidence, Analysis 1.9).

Postpartum haemorrhage

One trial (Eckert 2001) reported on the postpartum haemorrhage rate in each group. There was no clear difference between the groups (RR 1.58, 95% CI 0.80 to 3.13; 274 women, Analysis 1.10). Eckert 2001 did not define postpartum haemorrhage so this outcome is unclear.

Use of analgesia (general anaesthesia, or pharmacological analgesia) during any stage of labour

Narcotic/pethidine use was reported by three trials (Eckert 2001; Rush 1996; Taha 2000) and there was no clear difference between the groups (average RR 1.08, 95% CI 0.59 to 1.96; 1180 women; 3 trials; I^2 = 37%; Analysis 1.11). However, heterogeneity was detected (heterogeneity: I^2 = 37%, Tau^2 = 0.12, Chi^2 test for heterogeneity P = 0.20); and so we used a random-effects analysis. Consideration of those trials (Eckert 2001; Schorn 1993; Taha 2000) that reported 'any analgesia', also did not find any clear difference between the groups (RR 0.99, 95% CI 0.88 to 1.12, 3 trials; 487 women; Analysis 1.12). Two trials reported on 'any pharmacological analgesia' (Eckert 2001; Taha 2000) also did not find any clear difference between the groups (RR 1.05, 95% CI 0.80 to 1.39, 394 women; Analysis 1.13). Due to the lack of definitions of what was classified by authors for pharmacological analgesia, it was not possible to combine these various outcomes.

Maternal infection during labour/postnatal period (perineal, systemic, uterine or increase in temperature)

The incidence of maternal infection reported by five trials (Cammu 1994; Eckert 2001; Kuusela 1998; Rush 1996; Schorn 1993) did not find any clear difference between the groups (RR 0.99, 95% CI 0.50 to 1.96, 1295 women, Analysis 1.14).

Augmentation of labour (artificial rupture of membranes and/or oxytocin infusion administration)

There has been some concern that water immersion may slow labour, therefore we analysed data on augmentation: three trials (Da Silva 2006; Kuusela 1998; Rush 1996) that reported on the incidence of amniotomy did not find any clear difference between the groups (RR 1.02, 95% CI 0.90 to 1.16, 3 trials, 926 women, Analysis 1.15). Pooled analysis from four trials (Da Silva 2006; Kuusela 1998; Rush 1996; Schorn 1993) found no clear difference in the use of oxytocin infusion (RR 0.91, 95% CI 0.72 to 1.15, 4 trials, 1019 women, Analysis 1.16).

Use of non-pharmacological analgesia

One trial (Rush 1996) provided data on the use of transcutaneous nerve stimulation (TENS) and found no clear difference between groups (RR 1.25, 95% CI 0.34 to 4.61; 785 women, Analysis 1.17).

Duration of labour (first, second and third stage) (minutes)

Five trials (Cammu 1994; Eckert 2001; Kuusela 1998; Rush 1996; Schorn 1993) provided data on duration of the first stage of labour. They showed no clear difference between the groups (MD -11.53, 95% CI -45.42 to 22.36; 1295 women, Analysis 1.18).

Six trials (Cammu 1994; Da Silva 2006; Eckert 2001; Kuusela 1998; Rush 1996; Schorn 1993) reported on the duration of the second stage of labour, which showed no clear difference between the groups (MD 1.12, 95% CI -5.23 to 7.48; random-effects; 1403 women; I^2 = 38%, Analysis 1.19). There was evidence of heterogeneity for this outcome (heterogeneity: Tau^2 = 18.67; Chi^2 test for heterogeneity P = 0.17; I^2 = 38%).

Two trials (Eckert 2001; Rush 1996) reported on the duration of the third stage of labour (MD 0.25, 95% CI -1.10 to 1.60; 1059 women, Analysis 1.20). One trial (Taha 2000) that provided only the duration of total labour did not find any clear difference between the groups (MD -27.50, 95% CI -133.05 to 78.05; 120 women, Analysis 1.21).

Perineal trauma (none/intact, first degree, second degree, episiotomy)

Four trial reported these outcomes (Da Silva 2006; Eckert 2001; Rush 1996; Taha 2000). Slightly more women in the immersion group had an intact perineum following the birth than in the no immersion group (RR 1.17, 95% CI 1.01 to 1.37; 1277 women; Analysis 1.22). There was no clear differences between the numbers of women with second-degree tears (RR 0.94, 95% CI 0.74 to 1.20; 1212 women; Analysis 1.23) or women with episiotomies (RR 0.94, 95% CI 0.80 to 1.09; 1212 women; Analysis 1.24).

Pain experience/intensity as presented by the authors

Three trials (Da Silva 2006; Kuusela 1998; Taha 2000) reported on pain. Two trials (Da Silva 2006: Kuusela 1998) reported mean visual analogue pain scores (VAS) at the start of assessment and then up to 60 minutes later. At the start of assessment there was no apparent difference between groups (two trials; 72/69, MD 0.15, 95% CI -0.79 to 1.08; random-effects) (heterogeneity: Tau^2 = 0.26, Chi^2 = 2.07, df = 1, (P = 0.15); I^2 = 52%, Analysis 1.25) with the trials reporting effects in opposite directions. Moreover, a considerable amount of heterogeneity was detected among studies reporting pain scores at the start of the assessment. There was, however, evidence to suggest that women in the immersion group experienced less pain when assessed up to an hour later compared to the women in the no immersion group (two trials; 72/69, MD -0.81, 95% CI -1.34 to -0.28, Analysis 1.25).

One trial (Taha 2000) assessed pain using three ordinal scales: pain reported on a VAS scale, where 1 is no pain and 10 is worst pain imaginable; feelings indicated by means of faces on a scale of 0 to 5; description in words the pain experienced, from no pain at all to unbearable pain. They did not use the McGill Pain Questionnaire. The data were reported at six different time points (before randomisation and then 30 minutes, one hour, two hours, three hours and 24 hours after randomisation) and was dichotomised giving the proportion of patients at different points on the scales. We have included these data as information on pain is pertinent to this review and it is possible that future trials may add to the data set, as well as for completeness we only presented the data after randomisation in the analysis (Analysis 1.26). Moderate to severe pain according to all three ordinal scales was less in those labouring in water than those not labouring in water when assessed 30 minutes after randomisation (RR 0.75, 95% CI 0.62 to 0.91; RR 0.72, 95% CI 0.58 to 0.90; RR 0.67, 95% CI 0.51 to 0.90), and 24 hours after randomisation (RR 0.64, 95% CI 0.50 to 0.82; RR 0.62, 95% CI 0.49 to 0.80; RR 0.69, 95% CI 0.54 to 0.87). It was less when assessed

at one hour and two hours after randomisation for two out of the three ordinal scales (one hour RR 0.76, 95% CI 0.63 to 0.91; RR 0.68, 95% CI 0.53 to 0.86) (two hours RR 0.76, 95% CI 0.59 to 0.98; RR 0.72, 95% CI 0.52 to 0.98). Data were also assessed between those labouring in water and those not labouring in water using the VAS 1 to 10 ordinal scale at one or two hours after randomisation (one hour, RR 1.21, 95% CI 0.69 to 2.11; two hours, RR 0.83, 95% CI 0.66 to 1.05), and at three hours after randomisation on any of the three ordinal scales (RR 0.69, 95% CI 0.39 to 1.23) (Analysis 1.26).

Pulse and blood pressure (first, second and third stage)

Only one trial (Taha 2000) reported the biophysiological effect of immersion in water on the effect of blood pressure changes. There was reduction in all the outcomes among women in the immersion group compared to those in the non-immersion group: systolic (mean 120.3 mmHg versus 127.5 mmHg; MD -7.20, 95% CI -13.12 to -1.28; Analysis 1.27); diastolic (mean 62.8 mmHg versus 73 mmHg; MD -10.20, 95% CI -13.70 to -6.70; Analysis 1.28); and mean arterial pressure (mean 83.7 versus 94.2; MD -10.50, 95% CI -14.68 to -6.32; Analysis 1.29).

Preference for care in subsequent labour (does not wish to use bath with next labour/birth)

One trial (Taha 2000) reported this outcome. There was no clear difference between the groups (RR 0.38, 95% CI 0.14 to 0.98; 119 women; Analysis 1.30).

Postpartum depression (EPDS more than 11)

Two trials (Eckert 2001; Taha 2000) that reported postpartum depression did not find any clear difference between the groups (RR 1.38, 95% CI 0.85 to 2.24; 370 women; Analysis 1.31).

Fetal/neonatal outcomes

The following neonatal outcomes were not reported in the trials: respiratory support (oxygen/ventilation required); lung hypoplasia; neurological pathology, e.g. seizures, cerebral palsy; snapped cord; birth injury; poor infant outcomes at long-term follow-up (as defined by trialists).

Abnormal heart rate pattern

Three trials (Eckert 2001; Schorn 1993; Taha 2000) that reported abnormal fetal heart rate patterns did not find any clear difference between the groups (average RR 0.75, 95% CI 0.34 to 1.67, 487 women; Analysis 1.32). Substantial heterogeneity was detected among the studies (heterogeneity: $I^2 = 57\%$, $Tau^2 = 0.22$, Chi^2 test for heterogeneity P = 0.13), and so we used a random-effects analysis.

Presence of meconium-stained liquor

Four trials (Da Silva 2006; Eckert 2001; Kuusela 1998; Rush 1996) provided data on the presence of meconium-stained liquor but did not find any clear difference between the groups (average RR 0.92, 95% CI 0.64 to 1.33; 1200 women; Analysis 1.33). Heterogeneity was detected among the studies (heterogeneity: $I^2 = 35\%$; $Tau^2 = 0.05$; Chi^2 test for heterogeneity P = 0.20) therefore we used random-effect analysis.

Apgar score (as presented by authors)

Five trials (Cammu 1994; Eckert 2001; Ohlsson 2001; Schorn 1993; Taha 2000) that reported data on the proportion of children with an Apgar score of less than seven at five minutes did not find any clear difference between the groups (RR 1.58, 95% CI 0.63 to 3.93; 1834 infants; Analysis 1.34). Similarly, there was no clear difference between the groups in the two trials (Da Silva 2006; Rush 1996) that provided mean Apgar score at five minutes (MD -0.03, 95% CI -0.11 to 0.06; 893 infants; Analysis 1.35).

Cord pH immediately after birth (arterial and or venous cord blood)

One trial (Cammu 1994) that reported umbilical artery pH less than 7.20 did not find any clear difference between the groups (RR 5.18, 95% CI 0.25 to 105.51;110 infants; Analysis 1.36).

Breastfeeding (at specified time points)

Two trials (Eckert 2001; Taha 2000) reported on the number of women not breastfeeding six weeks post birth and did not find any clear difference between the groups (RR 1.17, 95% CI 0.64 to 2.15; 363 women; Analysis 1.37).

Other outcomes

No trial describes the costs associated with immersion in water in labour and birth.

Caregiver outcomes

No trial described any injuries or satisfaction outcomes for caregivers.

2. Immersion versus no immersion in the second stage of labour

We included two trials evaluating immersion during the second stage of labour (Ghasemi 2013; Nikodem 1999). See Summary of findings 2.

Primary outcomes

Maternal

Mode of birth (spontaneous birth, instrumental vaginal births and caesarean sections)

One trial (Nikodem 1999) reported on spontaneous vaginal birth (RR 1.02, 95% CI 0.96 to 1.08; 120 women, low-quality evidence; Analysis 2.1), instrumental vaginal birth (RR 1.00, 95% CI 0.06 to 15.62; 120 women; very low-quality evidence; Analysis 2.2), and caesarean section rate (RR 0.33, 95% CI 0.01 to 8.02; 120 women; very low-quality evidence; Analysis 2.3), but did not find any clear difference between the groups.

Use of analgesia (regional) during any stage of labour

Regional analgesia was not reported as it is not applicable to the second stage of labour as it would be an exclusion criterion for water immersion.

Third- and fourth-degree tears were not reported under this comparison.

Neonatal

Perinatal death

There was one perinatal death in the immersion group of one trial (Nikodem 1999), although there was no clear difference between the groups (RR 3.00, 95% CI 0.12 to 72.20, very low-quality evidence; Analysis 2.4). Further, the infant was born to an HIV mother and the cause of death was deemed to be intrauterine infection. Low-risk women only were included in this study but the HIV status of the

women was not known. The woman who was HIV positive found out following the birth.

Admission to neonatal intensive care unit

Two trials (Ghasemi 2013; Nikodem 1999) reported admissions to the neonatal intensive care unit, which did not find any clear difference between the groups (RR 0.78, 95% CI 0.38 to 1.59; 291 infants; very low-quality evidence; Analysis 2.5).

Neonatal Infection (including markers of infection such as pyrexia and raised white cell count)

No trial report confirmed neonatal infection.

There was no clear difference between the groups in the trial (Nikodem 1999) that reported the incidence of raised neonatal temperature at birth greater than 37.5°C (RR 2.62; 95% CI 0.73 to 9.35, 109 infants; very low-quality evidence; Analysis 2.6) or of a temperature less than 36.2°C at birth (RR 0.98, 95% CI 0.30 to 3.20; 109 infants;very low-quality evidence; Analysis 2.6). Ghasemi 2013 reported the incidence of fever during the first week of life but again found no clear difference between the groups (RR 0.53, 95% CI 0.10 to 2.82, 171 infants, very low-quality evidence; Analysis 2.7).

Sensitivity analysis

There was not a sufficient number of trials to perform sensitivity analysis under this comparison.

Secondary outcomes

No trial reported any maternal mortality and given the rarity of this outcome, it is reasonable to assume there was no maternal mortality. No trial reported augmentation of labour in the second stage; temperature; pulse and blood pressure; maternal self esteem; satisfaction with pain relief; or sense of control in labour.

Maternal

Estimated blood loss during labour (first, second, third stage, and immediate postnatal period)

Neither trial reported estimated blood loss.

Postpartum haemorrhage

One trial (Nikodem 1999) reported no clear difference between the groups for postpartum haemorrhage rate (RR 0.14, 95% CI 0.01 to 2.71, 120 women, Analysis 2.8).

Use of analgesia (general anaesthesia, or pharmacological analgesia) during any stage of labour

No other type of analgesia was reported.

Duration of labour (first, second and third stage)

Two trials (Ghasemi 2013; Nikodem 1999) that reported on the duration of the second stage of labour did not find any clear difference between the groups (MD -1.83, 95% CI -8.18 to 4.52; 291 women; Analysis 2.9).

Perineal trauma (intact, first- or second-degree tears, episiotomy)

One trial (Nikodem 1999) reported perineal trauma. There was no clear difference between group for incidence of episiotomy (RR 0.74, 95% CI 0.17 to 3.15; 119 women; Analysis 2.10), or for second-degree tears (RR 1.16, 95% CI 0.57 to 2.38; 119 women; Analysis 2.11).

Pain experience/intensity as defined by authors

One trial (Nikodem 1999) reported on the proportion of women experiencing moderate to severe pain, and found no clear difference between groups (RR 1.06, 95% CI 0.73 to 1.53; 117 women, Analysis 2.12).

Preference for care in subsequent labour (does not wish to use bath with next labour/birth)

One trial (Nikodem 1999) reported the number of women who would not wish to use immersion during labour with a subsequent labour and birth but there was no clear difference between the groups (RR 0.57, 95% CI 0.22 to 1.47; 117 women; Analysis 2.13).

Satisfaction with childbirth experience (as defined by trialists)

Nikodem 1999 demonstrated a higher level of satisfaction with the birth experience (one trial; 3/60 versus 12/57, RR 0.24, 95% CI 0.07 to 0.80; Analysis 2.14), with fewer women in the immersion group feeling that they did not cope satisfactorily with their pushing efforts (3/60 versus 12/57).

Fetal

Only one fetal outcome was reported in these trials.

Meconium liquor

One trial (Nikodem 1999) provided data on the presence of meconium-stained liquor but there was no clear difference between the groups (RR 1.40, 95% CI 0.47 to 4.17; 120 women; Analysis 2.15).

Neonatal outcomes

The following neonatal outcomes were not reported in the trials: respiratory support (oxygen/ventilation required); lung hypoplasia; neurological pathology, e.g. seizures, cerebral palsy; snapped cord; birth injury; poor infant outcomes at long-term follow-up (as defined by trialists).

Apgar score (as described by authors)

Two trials (Ghasemi 2013; Nikodem 1999) reported on Apgar score although each used different parameters.

Ghasemi 2013 reported on mean Apgar at five minutes and there was no clear difference between the groups (MD -0.10, 95% CI -0.22 to 0.02; 171 infants, Analysis 2.17). Similarly, there was no clear difference between the groups in the trial (Nikodem 1999) that reported incidence of an Apgar score less than seven at five minutes (RR 4.92, 95% CI 0.24 to 100.31; 119 infants, Analysis 2.16).

Cord pH immediately after birth (arterial and or venous cord blood)

Nikodem 1999 cited the incidence of an arterial umbilical cord sample pH being below 7.20 (RR 0.89, 95% CI 0.45 to 1.75, 116 infants, Analysis 2.18).

Other outcomes

None of the included trials reported the costs associated with immersion in water in labour and birth.

Caregiver outcomes

None of the included trials reported any injuries or satisfaction outcomes for caregivers.

3. Immersion in water versus no immersion during any stage of labour

We 14 trials in this overall comparison of immersion versus no immersion in any stage of labour. All trials, with the exception of Eriksson 1997, which compares early versus late immersion, are included in this comparison.

We entered all available data for these trials in both the first- and second-stage sections of this review, although it should be noted that in Woodward 2004 only 10 (25%) of the 40 women allocated to birth in water actually received the intervention. All the women received their allocated intervention in two trials (Chaichian 2009; Gayiti 2015), while it was unclear in one trial (Torkamani 2010).

Primary outcomes

Maternal

Mode of birth (spontaneous vaginal birth, instrumental vaginal birth and caesarean section)

Trials contributing to these outcomes included women using immersion in first stage only, second stage only, and both first and second stages.

There is no clear effect on incidence of spontaneous vaginal birth (average RR 1.03, 95% CI 0.99 to 1.09; 2845 women; 9 trials; I^2 = 51%, Analysis 3.1). Random-effects analysis was used due to the substantial heterogeneity present between these trials (heterogeneity: Tau^2 = 0.00; Chi^2 test for subgroup difference P = 0.04; I^2 = 51%).

There also appears to be no clear effect on instrumental vaginal births (RR 0.86, 95% CI 0.70 to 1.04; 2739 women; 8 trials, Analysis 3.2), or caesarean section rates (RR 1.19, 95% CI 0.86 to 1.65; 2832 women; 9 trials, Analysis 3.3).

Use of analgesia (regional) during any stage of labour

Trials contributing to these outcomes included women using immersion in first stage only, and both first and second stages.

Women using immersion received less regional analgesia (RR 0.90, 95% CI 0.82 to 0.98; 2499 women; 6 trials, Analysis 3.4).

Perineal trauma (third-degree or fourth-degree tear)

Trials contributing to this outcome included women using immersion in first stage only (Eckert 2001; Ohlsson 2001; Rush 1996; Taha 2000), and both first and second stages (Woodward 2004).

There is no clear effect on incidence of third- or fourth-degree tears (RR 1.37, 95% CI 0.86 to 2.17; 2401 women; 5 trials, Analysis 3.5).

Fetal/neonatal

Perinatal death (still birth, neonatal death)

There was one perinatal death in one trial looking at immersion in second stage only (Nikodem 1999), although there was no clear difference between the groups (RR 3.00, 95% CI 0.12 to 72.20; 1 trial; 120 infants; Analysis 3.6). Further, the infant was born to a mother with HIV and the cause of death was deemed to be intrauterine infection. Low-risk women only were included in this study but the HIV status of the women was not known. The woman who was HIV positive found out following the birth. No other trials reported this outcome.

Admission to neonatal intensive care unit

Trials contributing to this outcome included women using immersion in first stage only (Eckert 2001; Ohlsson 2001), second stage only (Ghasemi 2013; Nikodem 1999), and both first and second stage (Woodward 2004).

There was no clear difference between groups for this outcome (RR 0.99, 95% CI 0.70 to 1.39; 1862 infants; 5 trials, Analysis 3.7).

Neonatal infection, including markers of infection such as pyrexia and raised white cell count

Trials contributing to this outcomes included women using immersion in first stage only (Cammu 1994; Eckert 2001; Kuusela 1998; Rush 1996; Schorn 1993). There was no clear difference between groups for this outcome (RR 2.00, 95% CI 0.50 to 7.94; 1295 infants; 5 trials, Analysis 3.8).

Chaichian 2009 stated there was no "statistically significant difference" between groups but did not provide data.

Two trials, Eckert 2001 (first stage only) and Nikodem 1999 (second stage only), reported no difference between groups for different specified neonatal temperatures: greater than 37.8°C as an indicator for infection (RR 1.00, 95% CI 0.06 to 15.83; 274 infants; 1 trial), less than 36.2°C at birth (RR 0.98, 95% CI 0.30 to 3.20; 109 infants; 1 trial), and greater than 37.5°C at birth (RR 2.62, 95% CI 0.73 to 9.35; 109 infants; 1 trial) (Analysis 3.9).

One trial from the second stage of labour only (Ghasemi 2013) reported no clear difference between groups for fever in the first week (RR 0.53, 95% CI 0.10 to 2.82; 171 infants; 1 trial, Analysis 3.10).

There was no clear difference between the groups in the trial (Woodward 2004) that reported the administration of antibiotics to neonates (RR 1.50, 95% CI 0.17 to 13.52; 60 infants, Analysis 3.11). The same trial reported the incidence of positive neonatal swabs of ear, mouth or umbilicus. Babies born in water appeared to have more positive mouth, ear, and umbilical swabs, however the denominators for these outcomes do not add up and it is not clear how babies were counted if they had more than one positive swab so the data could not be extracted.

Sensitivity analysis

Removing Eckert 2001, Ghasemi 2013, Ohlsson 2001, Rush 1996, Schorn 1993, and Woodward 2004 as per review methodology, widened confidence intervals but did not alter overall results for modes of birth. For use of analgesia (regional), removing Eckert 2001, Ohlsson 2001, Rush 1996, and Woodward 2004 removed the favourable immersion results leaving no clear difference between groups. For perineal trauma (third- and fourth-degree tears), perinatal deaths, admission to neonatal intensive care unit, and neonatal infection, sensitivity analysis was not possible due to a small number of trials left in the analysis, single trials contributing data to the analysis, or the only trials contributing events being removed from the analysis.

Secondary outcomes

Maternal

The following outcomes were not reported by any trial: maternal self-esteem, satisfaction with pain relief (as defined by trialists),

sense of control in labour (as defined by trialists), effect (negative) on mother/baby interaction, post-traumatic stress disorder.

Estimated blood loss (mL) (not pre-specified)

Trials contributing to this outcome included women using immersion in first stage only (Kuusela 1998; Taha 2000), and both first and second stages (Gayiti 2015). There was no clear difference between the groups due to wide confidence intervals crossing the line of no effect (MD -6.28, 95% CI -13.67 to 1.11; 273 women; 3 trials, Analysis 3.12).

Postpartum haemorrhage (PPH)

There was no clear difference between groups in numbers of women who experienced a PPH (average RR 0.73, 95% CI 0.08 to 6.90; 394 women; 2 trials; I^2 = 61%, Analysis 3.13). There was substantial heterogeneity in this outcome (heterogeneity: Tau^2 = 1.82; Chi^2 test for heterogeneity P = 0.11; I^2 = 61%) and the results should be interpreted with caution.

Use of analgesia (general anaesthesia, or pharmacological analgesia) during any stage of labour

Immersion or no immersion made no clear difference to women receiving pethidine/narcotics (average RR 0.85, 95% CI 0.46 to 1.56; 1240 women; 4 trials; I^2 = 58%; Tau^2 = 0.20; Chi^2 test for subgroup differences P = 0.07, Analysis 3.14), or any pharmacological analgesia (RR 1.05, 95% CI 0.80 to 1.39; 394 women; 2 trials (first stage of labour only), Analysis 3.15). There was no clear difference between groups for using any analgesia (average RR 0.72, 95% CI 0.46 to 1.12; 653 women; 5 trials; I^2 = 93%; Tau^2 = 0.19; Chi^2 test for subgroup differences P < 0.001; Analysis 3.16).

Maternal infection during labour/postnatal period (perineal, systemic, uterine or increase in temperature)

All five trials contributing to this outcome used immersion in the first stage only (Cammu 1994; Eckert 2001; Kuusela 1998; Rush 1996; Schorn 1993). There was no clear difference between the groups (RR 0.99, 95% CI 0.50 to 1.96, 1295 women, 5 trials, Analysis 3.17). This analysis uses the same data as Analysis 1.14.

Augmentation of labour (artificial rupture of membranes and/or oxytoxic administration)

Three trials using immersion or no immersion in the first stage only reported artificial rupture of membranes (Da Silva 2006; Kuusela 1998; Rush 1996). There was no clear difference between the groups (RR 1.02, 95% CI 0.90 to 1.16; 926 women; 3 trials, Analysis 3.18). This analysis uses the same data as Analysis 1.15,

Five trials contributed data to use of oxytocin for augmentation. One trial used immersion in first and second stage of labour (Chaichian 2009) and four were only in first stage (Da Silva 2006; Kuusela 1998; Rush 1996; Schorn 1993). There was no clear difference between groups (average RR 0.64, 95% CI 0.32 to 1.28; 1125 women; 5 trials; I^2 = 79%, Analysis 3.19). There was substantial heterogeneity (heterogeneity: Tau^2 = 0.41; Chi^2 test for heterogeneity P = 0.0008; I^2 = 79%) in this outcome due to the large number of women in the no immersion group receiving oxytocin in Chaichian 2009.

Use of non-pharmacological analgesia (TENS)

Trials contributing to this outcome included women using immersion in first stage only (Rush 1996), and both first and second stages (Woodward 2004). There was no clear difference between the groups (RR 1.05, 95% CI 0.37 to 2.94; 845 women; 2 trials, Analysis 3.20).

Duration of labour (first, second and third stage) (minutes)

Trials contributing to this outcome included women using immersion in first stage only (Cammu 1994; Eckert 2001; Kuusela 1998; Rush 1996; Schorn 1993), and both first and second stages (Chaichian 2009; Torkamani 2010; Woodward 2004). Women in the immersion in water groups experienced shorter first stages of labour than those who did not use immersion (MD -42.21, 95% CI -80.93 to -3.49; 1561 women; random-effects; eight trials; I^2 = 67%, Analysis 3.21). There was substantial heterogeneity between studies for this outcome (heterogeneity: Tau^2 = 1600.24; Chi^2 test for heterogeneity P = 0.004; I^2 = 67%).

Eleven trials contributed to duration of the second stage of labour: six trials with immersion in first stage (Cammu 1994; Da Silva 2006; Eckert 2001; Kuusela 1998; Rush 1996; Schorn 1993), two trials with immersion in second stage (Ghasemi 2013; Nikodem 1999), and three in both stages (Chaichian 2009; Torkamani 2010; Woodward 2004). There was no clear difference between the groups (MD -2.85, 95% CI -8.85 to 3.16; random-effects; 1960 women; 11 trials; I^2 = 68%, Analysis 3.22). Again, there was a substantial amount of heterogeneity for this outcome (heterogeneity: Tau^2 = 55.15; Chi^2 test for heterogeneity P = 0.0009; I^2 = 68%) and the results should be interpreted with caution.

Three trials (Chaichian 2009; Eckert 2001; Rush 1996) reported on the duration of the third stage of labour. There was no clear difference between the groups (MD -0.52, 95% CI -1.84 to 0.79; random-effects; 1165 women; 3 trials; I^2 = 41%; Tau^2 = 0.54; Chi^2 test for heterogeneity P = 0.18, Analysis 3.23).

Two trials contributing data the duration of total labour included women using immersion in first stage only (Taha 2000), and both first and second stages (Gayiti 2015). There was no clear difference between the groups (MD -40.83, 95% CI -87.09 to 5.43; 240 women; 2 trials).

Perineal trauma (intact, first-degree tear, second-degree tear, episiotomy)

Four trials contributing data were using immersion in first stage (Da Silva 2006; Eckert 2001; Rush 1996; Taha 2000) and one trial used immersion in both stages (Woodward 2004). Women using immersion in any stage of their labour appeared to experience more intact perineums than those with no immersion, however the wide confidence intervals just cross the line of no effect (RR 1.16, 95% CI 0.99 to 1.35; 1337 women; 5 trials, Analysis 3.25).

There was no clear difference in second-degree tears (RR 0.89, 95% CI 0.71 to 1.10; 1525 women; 7 trials, Analysis 3.26). First-degree tears were not reported by any trial.

There was no clear difference between groups in episiotomy (average RR 0.88, 95% CI 0.67 to 1.17; 1511 women; 7 trials; I^2 = 41%, Analysis 3.27) however there was substantial heterogeneity between trials (heterogeneity: Tau^2 = 0.05; Chi^2 test for heterogeneity P = 0.12; I^2 = 41%) and this should be interpreted with caution.

Pain experience/intensity as presented by authors

Pain was presented in different ways so that meta-analyses were not possible. The results for this outcome is identical to that presented in Comparisons 1 and 2.

Torkamani 2010 used immersion in first and second stage and reported much lower pain scores in the immersion group when measured following the birth (MD -3.43, 95% CI -3.95 to -2.91; 100 women, Analysis 3.28).

Temperature (ºC) (first and second stage)

One trial looking at immersion in first and second stages (Woodward 2004), reported maternal mean temperature and found there was no clear difference between groups (MD 0.20, 95% CI -0.18 to 0.58; 60 women; Analysis 3.30). It is not clear when this temperature was taken.

Pulse and blood pressure (first, second and third stage)

One trial of 120 women (Taha 2000) found that systolic (MD -7.20, 95% CI -13.12 to -1.28, Analysis 3.31), diastolic (MD -10.20, 95% CI -13.70 to -6.70, Analysis 3.32), and mean arterial blood pressures (MD -10.50, 95% CI -14.68 to -6.32, Analysis 3.33) were all lower in the women in the immersion group compared with the no immersion group. The data used for these outcomes are the same as that used for Analysis 1.27, Analysis 1.28, and Analysis 1.29, respectively.

Pulse was not reported in any trial.

Preference for care in subsequent labour

More women in the immersion group reported to want to use immersion again in a subsequent labour compared to those in the no immersion group (RR 0.46, 95% CI 0.24 to 0.90; 236 women; 2 trials, Analysis 3.34).

Satisfaction with childbirth experience (as defined by trialists)

One trial (Nikodem 1999) from the second stage of labour only found that fewer women in the immersion group reported little or no satisfaction in coping in labour (RR 0.24, 95% CI 0.07 to 0.80; 117 women; 1 trial, Analysis 3.35).

However, another trial (Woodward 2004), which measured satisfaction with labour and birth on a scale of 0 to 6 where 0 is not at all satisfied, considered that both groups were 'reasonably satisfied' and there was no clear difference between the groups (MD 0.03, 95% CI -0.64 to 0.70; 60 women; Analysis 3.36).

Postpartum depression

Two trials (Eckert 2001; Taha 2000) that reported postpartum depression did not find any clear difference between the groups (RR 1.38, 95% CI 0.85 to 2.24; 370 women, Analysis 3.37). This analysis used the same data as Analysis 1.31.

Fetal/neonatal outcomes

The following outcomes were not reported in any trial: respiratory support (oxygen/ventilation required), lung hypoplasia, neurological pathology (e.g. seizures, cerebral palsy), snapped cord, birth injury, poor infant outcomes at long-term follow-up (as defined by trialists).

Abnormal heart rate pattern

There was no clear difference between group in abnormal fetal heart rate patterns (average RR 0.75, 95% CI 0.34 to 1.67; 487 women; 3 trials; I^2 = 57%, Analysis 3.38). There was substantial heterogeneity between these trials (heterogeneity: Tau^2 = 0.22; Chi^2 test for heterogeneity P = 0.13; I^2 = 57%) and the results should be interpreted with caution. These data are the same used for Analysis 1.32.

Presence of meconium-stained liquor

Da Silva 2006, Eckert 2001, Kuusela 1998, Nikodem 1999, Rush 1996, and Woodward 2004 found no clear difference between group in presence of meconium liquor (RR 0.97, 95% CI 0.78 to 1.21; 1380 women; 6 trials, Analysis 3.39).

Apgar score less than seven at five minutes (or as presented by authors)

It appears that fewer babies have an Apgar score of less than seven at five minutes in the no immersion group (12/967 versus 6/986) but there are very wide confidence intervals that cross the line of no effect for this analysis (RR 1.79, 95% CI 0.76 to 4.25; 1953 infants; 6 trials, Analysis 3.40).

Similarly, four trials reported mean Apgar score at five minutes and found very slightly higher mean scores in the no immersion group, however wide confidence intervals again crossed the line of no effect (MD -0.04, 95% CI -0.11 to 0.02; 1184 infants; 4 trials, Analysis 3.41).

Woodward 2004 reported one baby having an Apgar score of less than eight at five minutes in the immersion group (data not shown).

Cord pH immediately after birth (arterial and or venous cord blood)

There was no clear difference between groups in infants born with umbilical artery pH less than 7.20 (RR 1.04, 95% CI 0.54 to 1.98; 226 infants; 2 trials, Analysis 3.42).

Breastfeeding (at specified time points)

Woodward 2004 reported no clear difference between groups on the number of women breastfeeding at birth (RR 0.86, 95% CI 0.69 to 1.08; 60 women; 1 trial, Analysis 3.43).

Two trials (Eckert 2001; Taha 2000) reported on the number of women not breastfeeding six weeks post birth and did not find any clear difference between the groups (RR 1.17; 95% CI 0.64 to 2.15; 363 women; Analysis 3.44). These same data were used for Analysis 1.37.

Other outcomes

Cost as defined by trialists was not reported in any trial.

Caregiver outcomes

Satisfaction, and injuries (any reported physical injury attributed to care of women in water) were not reported in any trial.

4. Early versus late immersion

We included one trial (Eriksson 1997) comparing early versus late immersion during the first stage of labour.

Primary outcomes

Maternal

The single trial (Eriksson 1997) did not report on mode of birth, or perineal trauma. Fewer women used regional analgesia if they had late immersion (RR 2.21, 95% CI 1.39 to 3.52; 1 trial; 200 women, Analysis 4.1).

Fetal/neonatal outcomes

Perinatal death (still birth, neonatal death), and admission to neonatal intensive care unit were not reported.

Neonatal infection

Eriksson 1997 reported on neonatal infection rate but there was no clear difference between the groups (RR 3.00; 95% CI 0.12 to 72.77; 200 infants, Analysis 4.2).

Sensitivity analysis

Eriksson 1997 was the only trial contributing data to this comparison although this trial was assessed to be at high risk of attrition bias.

Secondary outcomes

Maternal outcomes

The following maternal outcomes were not reported in the trials: mortality; use of analgesia (general analgesia, or pharmacological), use of non-pharmacological analgesia; duration of labour (first, second and third stage); temperature (first and second stage); pulse and blood pressure (first, second and third stage); maternal self-esteem; preference for care in subsequent labour.

Augmentation of labour (artificial rupture of membranes and/or oxytocic administration)

Eriksson 1997 found an increased incidence of augmentation of labour in the early group (57/100 versus 30/100; RR 1.90; 95% CI 1.35 to 2.68; 200 women, Analysis 4.3).

Fetal/neonatal outcomes

Abnormal fetal heart rate pattern

The single trial (Eriksson 1997) reported that none of the fetus experienced abnormal fetal heart rate pattern, which might be expected in a group of woman/fetal dyads at low risk of complications, where all women entered the water and any abnormality would exclude immersion (Analysis 4.4).

Apgar score less than seven at one minute

There was no neonate with an Apgar lower than seven in either group, which was expected among women/neonate dyads with low risk of complications (Analysis 4.5).

The following fetal/neonatal outcomes were not reported in the trials: meconium liquor; cord pH immediately after birth (arterial and or venous cord blood); admission to special care baby unit/neonatal intensive care unit; respiratory support (oxygen/ ventilation required); lung hypoplasia; neurological pathology, e.g. seizures, cerebral palsy; snapped cord; birth injury; poor infant outcomes at long-term follow-up (as defined by trialists); well-being markers; breastfeeding (at specified time points).

Other outcomes

None of the included trials reported the costs associated with immersion in water in labour and birth.

Caregiver outcomes

None of the included trials reported any injuries or satisfaction outcomes for caregivers.

DISCUSSION

Summary of main results

The objective of this review was to assess the effects of water immersion during labour and/or birth (first, second and third stage of labour) on labour interventions and birth, maternal, fetal/neonatal, and caregiver well-being outcomes. Fifteen trials assessing the effects of water immersion in first and/or second stages of labour were identified. Outcomes that were reported varied across the studies. Risk of bias varied across the trials; no trial blinded participants or staff. We assessed the evidence for our pre-specified GRADE outcomes for immersion versus no immersion in the first stage of labour and immersion versus no immersion in the second stage. Evidence was downgraded for trial design limitations and imprecision in effect estimates (Summary of findings for the main comparison; Summary of findings 2).

Immersion in water compared with no immersion during the first stage of labour

Eight trials reported on this comparison (Cammu 1994; Da Silva 2006; Eckert 2001; Kuusela 1998; Ohlsson 2001; Rush 1996; Schorn 1993; Taha 2000). For the primary outcomes, there were no clear differences between groups for spontaneous vaginal birth (moderate-quality evidence), instrumental vaginal births (low-quality evidence), caesarean sections (low-quality evidence), or third- or fourth-degree tears (moderate-quality evidence). Fewer women in the immersion group received an epidural compared with those in the no immersion group (moderate-quality evidence) but there was no clear difference in numbers of women receiving narcotic/pethidine, 'any analgesia', or any pharmacological analgesia. There was no clear difference in neonatal admission to neonatal intensive care (low-quality evidence), and neonatal infection (very low-quality evidence). Perinatal death was not reported. For most secondary outcomes, including estimated blood loss (very low-quality evidence), immersion or no immersion made very little clear differences to outcomes.

Immersion in water compared with no immersion during the second stage of labour

Two trials evaluated this comparison (Ghasemi 2013; Nikodem 1999). For the primary outcomes there was no clear difference between groups for spontaneous vaginal birth (low-quality evidence), instrumental birth (very low-quality evidence), or caesarean section (very low-quality evidence). Use of analgesia, and third- and fourth- degree tears were not reported. There was one perinatal death in the immersion group (very low-quality evidence). There was no clear evidence to show a difference between groups for admission to neonatal intensive care unit (very low-quality evidence), neonatal temperature of below 36.2° (very low-quality evidence), or greater than 37.5°C at birth (very low-quality evidence), or incidence of fever in the first week (very low-quality evidence). Most secondary outcomes showed no

clear difference between the groups. In one trial (Nikodem 1999), the women in the immersion group reported a higher level of satisfaction with their childbirth experience.

Immersion in water compared with no immersion during any stage of labour

In this overall comparison, 14 trials contributed (Cammu 1994; Chaichian 2009; Da Silva 2006; Eckert 2001; Gayiti 2015; Ghasemi 2013; Kuusela 1998; Nikodem 1999; Ohlsson 2001; Rush 1996; Schorn 1993; Taha 2000; Torkamani 2010; Woodward 2004). Heterogeneity was generally high between trials in the comparison and the results should be interpreted with caution. Immersion during any stage did not have a clear effect on the incidence of spontaneous vaginal births, instrumental births, caesarean sections, or third- and fourth- degree tears. Perinatal death, admission to neonatal intensive care, neonatal infection (including neonatal temperature), showed no clear differences between groups. Fewer women in the immersion group had an epidural. The evidence was less clear for estimated blood loss.

Early versus late immersion

One trial (Eriksson 1997) compared early versus late immersion during the first stage of labour. This trial did not report on mode of birth, or perineal trauma. Fewer women used regional analgesia if they had late immersion. Perinatal death and admission to neonatal intensive care unit were not reported. There was no clear difference between groups in terms of neonatal infection rates. Estimated blood loss was not reported.

In summary

It was not possible to conclude whether the differences identified for primary and secondary outcomes, and particularly the reduction in epidural/spinal analgesia, are due to water alone, or the water/pool environment. Across all trials, in addition to an overall lack of a description of the bath or pool in which the women immersed and what ‘standard care’ incorporated, there was insufficient information about the model of care that women received in either the water immersion or control groups.

Overall completeness and applicability of evidence

Water immersion is a care package, which includes the actual water and associated environment, together with the interactions between the woman and her caregivers. It may be that this last factor, linking midwives/caregivers to proactively support women to optimise their physiological capacity to labour and give birth, to work towards reducing the likelihood of obstetric intervention requirement and to ensure they are comfortable facilitating water immersion during labour and waterbirth, is the most important component. This would be consistent with the evidence on continuous support during labour (Bohren 2017). It could be argued that, if water immersion facilitates the adoption of a woman-centred approach to care, facilitating normalisation of labour and birth, as many now seek (Maternity Care Working Party 2007; RCM 2016; RCOG 2011), then immersion in water during labour and waterbirth should be promoted for healthy women with a singleton fetus who experience a straightforward pregnancy.

Presentation of findings in all but a couple of the trials indicate a high level of group allocation integrity. However, Rush 1996 and Woodward 2004 reported respectively that 46% (n = 183) and 40% (n = 16) of women allocated to water immersion did not actually use water, although in the case of Woodward 2004, this was expected and a recruitment ratio of 2:1 was adopted. In both studies, analysis was by intention-to-treat, although they did not report outcomes by actual use. Subgroup analysis excluding women who did not use the water might have increased the difference between water users and non-users, in favour of less epidural analgesia for those who used water immersion. This would be consistent with the study by Chaichian 2009. This is pertinent, as the authors reported that the main reasons for non-use of the water included early request for epidural, identification of complication precluding water use, non-availability of the pool and change of mind (numbers for each are provided by Woodward 2004, but not by Rush 1996).

Only one trial investigated early (before a cervical dilatation of 5 cm) versus late (after a cervical dilatation of 5 cm) immersion in water during the first stage of labour, which suggested a higher rate of augmentation and use of pharmacological analgesia in the early immersion group (Eriksson 1997). The main issue arising from this trial is whether or not women in the trial were actually in active labour, and could therefore be reasonably expected to progress spontaneously. It is not possible to preclude that some women may have entered a birthing pool in the latent phase of labour, which could predispose them requiring augmentation. The trial did not consider this possibility.

The trials that described the immersion pool reported using different sized pools (only five trials provide information on bath/pool size (Cammu 1994; Da Silva 2006; Eckert 2001; Eriksson 1997; Kuusela 1998), various durations in the water; and still or moving water, each of which may have had an impact on the outcomes. These factors limit the applicability of the findings.

Another confounding factor is that the gestational age at which water immersion was permissible varies across the trials; from greater than 34 weeks' gestation (Eriksson 1997) through 35 weeks (Ohlsson 2001), and 36 weeks (Schorn 1993; Taha 2000; Woodward 2004), to greater than 37 weeks (Cammu 1994; Chaichian 2009; Da Silva 2006; Eckert 2001; Gayiti 2015; Ghasemi 2013; Kuusela 1998; Rush 1996; Torkamani 2010). This is due to variations in the definition of 'preterm' adopted by different countries. However, the baseline characteristics of participants in the included studies showed no differences.

Although all the trials involved women defined as 'in labour', this was interpreted differently, from trials including all women with contractions, or about to have labour induced with a cervical dilatation of as little as 1 cm (Eckert 2001), to trials including only women in active labour with a cervical dilatation of greater than 6 cm (Da Silva 2006). This variability makes comparisons across trials problematic. Another variation is that the length of the first stage of labour for women in the trial by (Cammu 1994) was shorter (mean of 244 minutes) and less variable (small standard deviation of 139 minutes), compared to a first stage length of 846 minutes (standard deviation 432 minutes) in the trial by Schorn 1993. This suggests that participants may have met different inclusion criteria or experienced a different management protocol during labour, although this was not explicit in the papers. The length of the second stage of labour for the women in the immersion group is much longer than might be expected in the trial by Schorn 1993, which involved only nulliparae, compared to Kuusela 1998 and Chaichian 2009 where the second-stage duration was reported as 21 and 20 minutes, respectively. This may again relate to different management strategies, for example, definition of the onset of the

second stage and the use or not of directed pushing, but again this is not detailed in the papers.

All participants across the included trials were considered at low risk of complications and trials were excluded where this was not so (Cluett 2001; Cluett 2004). However, Eckert 2001 reported the inclusion of women whose labour was induced, while Gayiti 2015 reported pre-birth preparation of enema, shave and rupture of membranes, which may have affected labour duration and maternal pain perception. Rush 1996 indicated that 41 women who did not meet the inclusion criteria had been randomised. When these women were removed from the analysis the P value for epidural analgesia use changes to 0.044 from 0.069, whilst that for instrumental vaginal birth changes to 0.011 from 0.055. Therefore, when ineligible women are excluded the results indicate that, for women at low risk of complications, labouring in water reduced the likelihood of epidural/narcotic use and of needing an instrumental vaginal birth (Rush 1996). The definitions adopted for 'labour' were varied and may have influenced outcomes. In particular, Cammu 1994 required that the amniotic membranes were ruptured, although there is no indication as to whether this occurred spontaneously or artificially. In contrast, the membranes were intact in all participants in the trial by Schorn 1993. Participants in other trials had a mixture of intact and ruptured membranes (Ohlsson 2001; Rush 1996; Taha 2000; Woodward 2004). These differences may affect pain perception, and hence influence analgesia uptake, maternal satisfaction, and possibly labour progress, which makes comparison across trials difficult. Maternal parity is another factor that can affect pain perception and the duration of labour, yet no trials that involved women of mixed parity accounted for this confounder in their analysis. There is little or no information about the presence of one-to-one care or not in the trials evaluating first stage of labour outcomes, although Rush 1996 indicated that caregivers tended to be more continuously present with the water immersion participants. As continuous support during labour is known to affect outcomes (Bohren 2017), if this was not balanced across trial arms, it presents a confounding factor.

Overall, while there is good evidence for the use of water immersion during labour for women at low risk of complications, there is a need to explore its wider adoption into practice, and the care culture-related factors that affect birthing pool use, particularly in the hospital setting (Russell 2011). In line with the policy drive to promote normality and the use of midwifery-led units for healthy pregnant women who have an uncomplicated pregnancy (NICE 2014; RCM 2016; RCOG 2011), settings where water immersion during labour and waterbirth are common events, an economic evaluation should be undertaken.

Quality of the evidence

Risk of bias varied across the trials. All the trials were assessed to be at high risk of performance bias and most had at least one other domain at high risk of bias. The conclusions need to be considered in the context of small sample sizes (range 33 to 1237); only two trials (Ohlsson 2001; Rush 1996) achieved a total sample size of greater than 300, both trials being during the first stage of labour only. Blinding to the intervention was not possible, and many outcomes were only considered in one or two trials. These factors limit the interpretation of the results.

The GRADE analysis highlighted that the data are of moderate to very low quality. For the comparison of immersion versus no immersion in the first stage of labour, evidence for spontaneous vaginal birth, regional analgesia, and third- or fourth-degree tear was assessed as moderate quality; instrumental vaginal birth, caesarean section, and admission to neonatal intensive care unit assessed as low quality; and neonatal infection and estimated blood loss as very low quality. Perinatal death was not reported. For the comparison of immersion versus no immersion in the second stage of labour, evidence for spontaneous vaginal birth was assessed as low quality; instrumental vaginal birth, caesarean section, perinatal death, and admission to neonatal intensive care was very low quality. Neonatal infection rates were not reported but markers of infection such as neonatal temperature greater than 37.5ºC at birth, neonatal temperature less than 36.2ºC at birth, and fever reported in the first week were all assessed to be very low quality. Use of regional analgesia, third- and fourth-degree tears, and estimated blood loss were not reported under this comparison. For both comparisons, evidence was downgraded for design limitations and imprecision in effect estimates.

Potential biases in the review process

We aimed to minimise bias during all stages of the review process. Two review authors independently assessed trials and extracted data. A comprehensive search of literature was performed to minimise publication bias. Both review authors are authors of research related to water immersion, although no trials undertaken by them were included within the review. Some papers were not in English and the review authors were reliant on the quality of the translated information provided.

Agreements and disagreements with other studies or reviews

The results of these trials show beneficial effects of water immersion during labour and waterbirth, with reduced use of epidural/spinal analgesia and episiotomy, and women voicing increased satisfaction with their labour experience. They found no indication that labouring or giving birth in water presents an added risk for the neonate. Such findings are consistent with prospectively conducted observational studies (Bovbjerg 2016; Burns 2012; Geissbuehler 2004; Henderson 2014; Thoeni 2005) and a systematic review (Taylor 2016). Observational and case studies have reported a low incidence of umbilical cord snapping in waterbirth (Burns 2012; Cro 2002; Henderson 2014); a complication which can also occur on land, but is rarely reported.

AUTHORS' CONCLUSIONS

Implications for practice

Evidence suggests that women who are at low risk of complications who use water immersion during labour are probably no more or less likely to experience vaginal delivery and may be less likely to have to use regional analgesia, particularly when immersion occurs during the first stage of labour. There was a lack of data on effects during the second stage of labour. There is no evidence of increased adverse effects to the neonate in terms of admissions to neonatal intensive care unit and infection rates. Available evidence is limited by clinical variability and heterogeneity across trials, and no trial has been conducted in a midwifery-led setting.

Implications for research

There is evidence that immersion in water during the first stage of labour may reduce the need for analgesia, but the limited reliability and validity of the studies means that this would benefit from further research, in particular from a study of an appropriate size to assess equivalence. However, the popularity of using a birthing pool during labour and giving birth in water among pregnant women could constrain the potential for conducting a well-powered trial. It is therefore essential to have women's views and ideas about a trial design. It is equally important to have midwives views because of their clinical expertise with water immersion during labour and waterbirth, and also their capacity to influence maternal choice.

Were it to prove impossible to undertake a large, multi-centre trial, large prospective comparative studies should be undertaken.

There is a lack of clarity as to what constitutes water immersion, and further evaluation of the relative merits of different shaped/sized pools is required, and of still versus moving water, and the relative merits of water immersion during early labour (latent phase). There is insufficient information to support or not to support the use of immersion during the second stage (waterbirth), or during the third stage of labour. The safety regarding infection and neonatal outcomes are not fully addressed, and large collaborative trials are needed to answer these critical issues. It has been suggested that maternal satisfaction increases with water immersion, although there is a need for a large trial to evaluate this.

There is also a need to research what happens to women who use a birthing pool during labour and those who give birth in water across all care settings.

There are no data on caregiver outcomes or costs and these warrant investigation, particularly across the midwifery-led settings where most women labour in water and many have a waterbirth.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Cammu 1994

Methods	Randomisation by sealed opaque envelopes containing method indicator card **Methodological qualities:** 1. selection bias: low risk: adequate concealment at time of randomisation; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: moderate risk of bias: 57 were randomly allocated to bath, 3 refused to bathe and their results were not included in analyses; 4. bias conclusion: moderate bias: 1 or more criteria partially met. May raise some doubt about the results.
Participants	Study group: n = 54. Control group: n = 56 **Inclusion criteria:** 1. gestation > 36 weeks; 2. low risk; 3. nulliparous; 4. singleton; 5. cephalic presentation; 6. active labour between 4 cm to 5 cm cervical dilatation; 7. ruptured membranes with clear liquor on entry; 8. scalp electrodes used for all participants; 9. ambulation and analgesics were allowed.
Interventions	Immersion in labour during the first stage of labour Pool described as an oval-shaped hot tub. Bath temperature not exceeding 37 degrees celsius. No chemicals added Control group: no water immersion during labour Women in both groups received 'personalised' care but it is not clear if this was 1-to-1 care or not, although care overseen by obstetricians and all births conducted by house officers (doctors).
Outcomes	**Maternal outcomes:** 1. *use of analgesia/anaesthesia; 2. *augmentation of labour;

Cammu 1994 *(Continued)*

	3. cervical dilatation; 4. *duration of labour and birth; 5. *mode of delivery; 6. *maternal infection. **Fetal outcomes:** 1. abnormal FHR patterns needing intervention; 2. neonatal outcomes: 3. *neonatal condition; 4. *admittance to NICU or high dependency care unit; 5. *neonatal infection rates.
Notes	Academic hospital, Brussels, Belgium Dates of trial: not clear Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No indication of how random sequence was generated
Allocation concealment (selection bias)	Low risk	Sealed opaque envelopes containing method indicator card
Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Information available on number of participants asked (water -57/control -56) to number who gave consent (water -53/control -56) to outcome data - no attrition
Selective reporting (reporting bias)	Low risk	All outcome detailed in methods are reported on
Other bias	Unclear risk	It is not clear if women had 1-to-1 care, which is known to affect outcomes, but is common for water immersion care

Chaichian 2009

Methods	Randomised control trial; no information on how randomisation was achieved
Participants	Water group - n = 53; control group - n = 53 **Inclusion criteria:**

Chaichian 2009 *(Continued)*

1. gestational age 37-42 weeks;
2. no previous CS;
3. intact membranes;
4. no malpresentations;
5. no placenta abruption or praevia;
6. well fetus.

Interventions	Immersion in water during first and second stage of labour Information given to women in pregnancy, then randomised to experimental or control group in labour. Water group labour and birth in warm water pool, but no description of pool size or care protocol given. Control group conventional care at the hospital, but not detailed
Outcomes	Data provided on baseline characteristics or age, gravida, parity, previous abortion, and prolonged rupture of membranes Data provided on outcomes, *normal birth rate, *duration of labour, *use of oxytocin and *analgesia (not stated what type) Data collected on *episiotomy/perineal trauma, *neonatal weight, *Apgar score, gender and breastfeeding initiation but data not given
Notes	Study undertaken in Iranian hospital affiliated to Iran University of Medical Sciences, between June 2006 and September 2007 Authors contacted twice for further information but no reply Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information given on randomisation processes
Allocation concealment (selection bias)	Unclear risk	No information given on randomisation processes
Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	No indication of women who withdrew from study, or that data were lost/incomplete
Selective reporting (reporting bias)	High risk	Outcomes not detailed on perineal trauma, neonatal weight, Apgar scores, gender and breastfeeding initiation although data collected and described as not significantly different
Other bias	Unclear risk	It is surprising that all the women who went to water gave birth in the water. Normally one would expect some who laboured in water to choose to get out

Chaichian 2009 *(Continued)*

	for birth, but no evidence of this as number in each group is the same. This calls into question if all who got into the pool are included in study or just those who remained in for birth as well.

Da Silva 2006

Methods	Randomisation was computer-generated, and then recorded on a list (paper copy), where the next allocation was concealed from the research until the next woman had provided consent, was recruited and thus being allocated. **Methodological qualities:** 1. selection bias: none apparent; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: low risk of bias 4 of 58 in water group did not get water as required CS prior to immersion, and 2 of 56 in control group also required CS prior to reaching cervical dilation of 6 cm Analysed according to ITT; 4. bias conclusion: high risk of bias, where 1 or more criteria are not met may cause plausible bias that seriously weakens confidence in the results.
Participants	Power calculation undertaken Water n = 58 Control n = 56 Full term, nulliparous, live, cephalic presentation, no complications, cervical dilation of 6 cm or less in established labour
Interventions	Immersion in water during first stage of labour Control group received standard care, including cardiotocography on admission, ambulation, amniotomy and oxytocin augmentation if now cervical progress over 3 hours, intermittent auscultation during labour Intervention group as above with immersion in water when cervix had reached 6 cm to 7 cm dilated, for 60 minutes First stage of labour study, all women received 1-to-1 care from the researcher Pool was 194 litres, equipped with a heater. Water temperature ranged from 27 to 38 degrees Celsius.
Outcomes	Pain score on 5-point behavioural scale and numerical pain score from 0 to 10, at 6 cm to 7 cm dilated and again 1 hour later. In addition, the following data were collected: use of augmentation, amniotic liquor conditions, duration of labour, perineal condition, gestational age, Apgar score at 1 and 5 minutes, maternal and water temperature.
Notes	Study done in Sao Paulo, Brazil Dates of trial: not reported Funding: not reported Declaration of interest: not reported
Risk of bias	

Da Silva 2006 *(Continued)*

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated random list
Allocation concealment (selection bias)	High risk	Each allocation on the list was covered with a tab, which was removed by the researcher after consent form signed by next participant. This description suggests the process could be open to tampering.
Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not blind to group allocation after randomisation due to the nature of the intervention.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	High risk	Flow chart detailed participants from eligibility to completion; no attrition after instigation of allocated care, however not all women received the allocated intervention.
Selective reporting (reporting bias)	Low risk	All the data mentioned in the methods, and that would reasonably be expected of this study are reported.
Other bias	Unclear risk	All women had 1-to-1 care, which is known to affect outcomes, but is common for water immersion care. In this study the care was from the researcher, regardless of group.

Eckert 2001

Methods	Randomisation by sealed opaque, sequentially numbered envelopes that were kept in the admission ward. Prepared in random blocks of 10, stratified for parity. **Methodological qualities:** 1. selection bias: none; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: high risk of bias 37/134 of women allocated to bath group did not bathe and 34/134 of women allocated to the control group did bathe. Analysed according to ITT; 4. bias conclusion: high risk of bias, where 1 or more criteria are not met may cause plausible bias that seriously weakens confidence in the results.
Participants	Study group n = 137. Control group n = 137 **Inclusion criteria:** 1. gestation > 36 weeks; 2. low risk; 3. singleton; 4. cephalic presentation. **Exclusion criteria:** 1. planned CS; history of Group B streptococcal infection; epidural anaesthesia; continuous FHR monitoring needed.

Eckert 2001 *(Continued)*

Interventions	Immersion in water during first stage of labour. Women were allocated to a delivery suite with a bath or to a general delivery suite without a bath. The bath group was allowed to use the bath as long as each woman wished, but they had to get out during second stage of labour (first stage only). The bath tub was 120 cm x 160 cm x 54 cm and the maximum water temperature was 37 degrees Celsius. Control group was allowed to use a shower. First stage only study women received care from same midwives but no mention of 1-to-1 second care or not.
Outcomes	**Maternal outcomes:** 1. *maternal experience and satisfaction of labour; 2. *use of analgesia/anaesthesia; 3. *augmentation of labour; 4. *presence of meconium-stained liquor; 5. *duration of labour and birth; 6. *mode of delivery; 7. *trauma to the birth canal requiring suturing; 8. *blood loss - only as percentage of whole; group no event data by group; 9. *postpartum depression; 10. breastfeeding. **Fetal outcomes:** 1. *abnormal FHR patterns, needing intervention. **Neonatal outcomes:** 1. *neonatal condition; 2. *admittance to NICU or high-dependency care unit; 3. * temperature at birth; 4. *neonatal infection rates.
Notes	Tertiary referral hospital in Adelaide, Australia. May 1995-Sept 1998 Some of the results are not in an appropriate format. Further information needed Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Random table of numbers, using variable blocks of 10, by a clerk independent of the study. Stratification was by place of birth, hospital or midwifery birth centre.
Allocation concealment (selection bias)	Low risk	On recruitment, midwife telephoned an independent clerk for allocation.

Eckert 2001 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	High risk	Data analysed on ITT basis. Flow chart reports on participants from eligibility to completion. From randomisation similar numbers (water 58 (42%)/control 53 (39%)) became ineligible or did not use the allocated care option as might be expected in a study of this size which respected women's right to choice care options; however, this is a high percentage.
Selective reporting (reporting bias)	Low risk	All the data mentioned in the methods and that would reasonably be expected of this study are reported.
Other bias	Unclear risk	No mention of 1-to-1 care or not, but no other issue apparent.

Eriksson 1997

Methods	Randomisation by sealed opaque, sequentially numbered envelopes containing the code. **Methodological qualities:** 1. selection bias: none; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: low risk of bias as only 8/200 did not enter bath. Analysed according to ITT; 4. bias conclusion: moderate bias. 1 or more criteria partially met. May raise some doubt about the results.
Participants	Group 1: n = 100: the "early bath group". Group 2: n = 100: the "late bath group" Regional referral hospital in the west of Sweden. **Inclusion criteria:** 1. gestation > 34 weeks; 2. low risk; 3. singleton; 4. cephalic presentation; 5. spontaneous labour; contractions 3/10 minutes and/or ruptured membranes with cervical dilatation less than 3 cm; 6. normal FHR pattern; 7. ambulation and analgesics were allowed.
Interventions	Early versus late Immersion in water during first stage of labour Group 1: the "early bath group" had a cervical dilatation of less than 5 cm when immersed in water. Group 2: the "late bath group" had a cervical dilation of 5 cm or more when immersed in water. All women used an oval tub that was 1.5 m long and 40 cm deep. It contained 300 L of waters at a temperature not more than 38 degrees Celsius. No mention of 1-to-1 care or not.

Eriksson 1997 *(Continued)*

Outcomes	**Maternal outcomes:** 1. *use of analgesia/anaesthesia; 2. *augmentation of labour; 3. duration of labour and birth; 4. *mode of delivery; 5. *maternal infection; 6. *abnormal FHR patterns needing intervention; 7. *neonatal condition; 8. *admittance to NICU or high-dependency care unit; 9. *neonatal infection rates (studies that describe additional outcomes that may be of importance will be mentioned in the text); 10. parity; 11. maternal age; 12. birthweight; 13. Bishop score before randomisation
Notes	Duration of labour not in acceptable format. Early group 9.80 hours and late group 8.48 hours P < 0.004. Primipara: 72/100 in early group and 60/100 in late group Maternal mean age: 26.3 early group; 27.2 late group Mean birthweight: 3550 g early group; 3616 g late group Performance bias: caregivers were not blind to group allocation. Not recorded if results were analysed blind Exclusion bias: *women did not enter bath - groups not mentioned Thus moderate rate of bias may be present. Regional referral hospital, Sweden Dates of trial: not reported Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated
Allocation concealment (selection bias)	Low risk	Sealed opaque envelopes containing allocation
Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention.
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	High risk	1 woman in early bath group did not use water, compared to 7 in late bath group; however, this might be expected as a result of different degrees of progression in labour.

Eriksson 1997 *(Continued)*

Selective reporting (reporting bias)	Low risk	All outcomes identified in methods are reported.
Other bias	Unclear risk	Percentage of primigravida higher in early group, but likely to be due to chance. No mention of 1-to-1 care or not.

Gayiti 2015

Methods	Random assignment to water or traditional birth.
Participants	Primiparous, singleton fetus, cephalic presentation, term pregnancy (37-42 weeks).
Interventions	Immersion in water during first and second stages of labour. 120 women. Traditional delivery group received, enema, shave, artificial rupture of membranes, fetal monitoring and parenteral nutrition, education on breathing and pushing. Water delivery group; enema and shower before 3 cm cervical dilation, vaginal examination to confirm dilation of 4 cm, entered water bath, maintained at 35-37 degrees Celsius, free to adopt any position in water, fetus monitored every 15 minutes.
Outcomes	Pain intensity on scale 1-3 Total duration of labour Blood loss in 24 hours Perineal condition Apgar score
Notes	No mention of 1:1 care Medical model of care evident No description of 'bath' size or shape but refers to free movement Undertaken in 1 unit in China Dates of trial: June 2012 - July 2013 Funding: not reported Declaration of interest: the authors declare that there are no conflicts of interest

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No indication of how randomisation achieved
Allocation concealment (selection bias)	Unclear risk	No information about concealment

Gayiti 2015 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Not possible
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants accounted for, no attrition
Selective reporting (reporting bias)	Unclear risk	Delivery data limited, but all intended outcomes reported on, but no differentiation by stages of labour
Other bias	Unclear risk	Medical module of care within study unit. No description of water bath intervention

Ghasemi 2013

Methods	Participants randomly allocated to water birth or conventional birth groups
Participants	200 pregnant women,100 allocated to water birth, 100 to conventional (land) birth
Interventions	Immersion in water during second stage of labour Women in water were able to move about freely but pool not described Conventional care conducted on bed, no further information about care provided
Outcomes	Duration of labour; mode of delivery, Apgar at 1and 5 mins. No raw data provided - only P values for outcomes.
Notes	Mean duration of first stage P < 0.344. mean duration of second stage P = 0.372; mean duration of third stage P = 0.523. caesarean section rate significantly higher in land group P = 0.018. Apgar scores were significantly higher for water birth group at 1 min P = 0.026, at 5 mins P ≤ 0.001. No difference found for other variables Omolbanin hospital, Mashhad, Iran Dates of trial: 2008 and 2009 Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Full paper in Iranian, so data based on English abstracts only, which did not provide this information
Allocation concealment (selection bias)	Unclear risk	Full paper in Iranian, so data based on English abstracts only, which did not provide this information

Ghasemi 2013 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	Blinding of participants and carers not possible due to nature of intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	High risk	Data implies attrition of 17 of 100 in the water group and 12 in the traditional care group but translation did not provide details
Selective reporting (reporting bias)	Unclear risk	Full paper in Iranian, so data based on English abstracts only, which did not provide this information
Other bias	Unclear risk	Full paper in Iranian, so data based on English abstracts only, which did not provide this information

Kuusela 1998

Methods	Randomisation stated but only described as 'by lots'. **Methodological qualities:** 1. selection bias: no information; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: low risk of bias as no dropouts reported; 4. bias conclusion: moderate bias. 1 or more criteria partially met. May raise some doubt about the results.
Participants	33 women, 18 water, 15 control In labour (cervix 4 cm dilated) Low risk - term, 1 fetus, no complications in current or any previous pregnancy/birth
Interventions	Immersion in water during first stage of labour Intervention was use of bath for max of 60 minutes. Bath was thermally insulted, oval, size 150 cm by 110 cm, by 70 cm deep. Volume was 730 litres. Water temperature 37 degree Celsius No pharmacological analgesia available to either control or intervention group during study hour. After use of bath labour care as normal and could access 'usual' pain relief methods, positions. No mention of 1-to-1 care or not.
Outcomes	Duration of first and second stage of labour Pain relief used, pain score before and after study period (1 hour), own assessment in postnatal questionnaire on day 2 postpartum Blood loss, perineal trauma, Apgars

Kuusela 1998 *(Continued)*

	Maternal pulse, temperature, blood pressure
Notes	Undertaken in Finland - 1 hospital Dates of trial: April 1997 - March 1998 Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Randomised 'by lots' in translation so very unclear what this means
Allocation concealment (selection bias)	Unclear risk	Described as randomised but translation does not indicate how concealed
Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	Not reported
Selective reporting (reporting bias)	Unclear risk	Unable to assess this from translation
Other bias	Unclear risk	Full translation not available, just extracts as requested on Cochrane Pregnancy and Childbirth Group translation sheet

Nikodem 1999

Methods	Randomisation by sealed opaque, sequentially numbered envelopes containing the code. Prepared in random blocks of 10, stratified for parity. **Methodological qualities:** 1. selection bias: none; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: low risk of bias as all women received their allocated treatment. Analysed according to ITT. 1 lost to follow-up; 4. bias conclusion: moderate bias. 1 or more criteria partially met. May raise some doubt about the results. Women were randomised at full dilatation of bearing down efforts.
Participants	Study group: n = 60.

Nikodem 1999 *(Continued)*

	Control group: n = 60. Academic teaching hospital, Johannesburg, South Africa. **Inclusion criteria:** 1. gestation > 36 weeks; 2. low risk; 3. singleton; 4. cephalic presentation; 5. active phase of labour; 6. normal FHR pattern; 7. ambulation and analgesics were allowed; 8. able to read and understand English. No immersion of water was used during the first stage of labour.
Interventions	Immersion in water during second stage of labour. Study group: allocated to oval bath tub which contained about 220 L of water. Temperature 34-38 degrees Celsius. Women were allowed to use different postures in the bath. Control group: care the same as study group but they were not allowed to use a bath for birth. All care was the same. Consent obtained early in labour but randomisation took place at full second stage. Same main caregivers for all women.
Outcomes	**Maternal outcomes:** 1. *maternal experience and satisfaction of labour; 2. *pain; 3. *use of analgesia/anaesthesia; 4. *augmentation of labour; 5. *blood pressure; 6. *pulse; 7. *duration of labour and birth; 8. *mode of delivery; 9. *trauma to the birth canal requiring suturing; 10.*blood loss; 11.maternal infection; 12.*postpartum depression. **Fetal outcomes:** 1. *abnormal FHR patterns needing intervention. **Neonatal outcomes:** 1. *neonatal condition; 2. *admittance to NICU or high dependency care unit; 3. *temperature at birth; 4. *perinatal deaths; 5. delivered in OP position; 6. gestational age; 7. birthweight.
Notes	Done in South Africa. 1999 Funding: not reported Declaration of interest: not reported

Nikodem 1999 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Blocks of 10, stratified for parity. Blocks of 10 have potential for breaking concealment for at least participant in each block
Allocation concealment (selection bias)	Low risk	Sealed opaque, sequentially numbered envelopes containing the code
Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	Information from approach to women (133) to allocation (60 + 60); all women completed trial but 3 in control group did not complete follow-up questionnaire
Selective reporting (reporting bias)	Low risk	All outcomes identified in methods are reported. Thesis made available with very detailed reporting
Other bias	Unclear risk	All women regardless of group had 1-to-1 care from researcher

Ohlsson 2001

Methods	Randomised when regular contractions and eligible. Sealed opaque envelopes. **Methodological qualities:** 1. selection bias: low risk; adequate concealment at time of randomisation; 2. performance bias: high risk of bias; could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: moderate risk of bias; 46 were excluded and 11.1% (KH) and 4.4% (LH) did not use tub; 4. bias conclusion: moderate bias; 1 or more criteria partially met. May raise some doubt about the results.
Participants	Study group: KH: n = 364. OH: n = 95; LH: n = 153; total = 612. Control group: KH: n = 376; OH: n = 97; LH: n = 152; total = 625. **Inclusion criteria:** 1. gestation term defined as greater than 35 weeks; 2. in active labour, defined as a cervical dilatation of 3 cm or more; 3. ruptured membranes on entry also eligible; 4. ambulation, analgesics and anaesthesia were allowed.
Interventions	Immersion in water during first stage of labour. Study group: warm bath; no information on management of care for either group; no information on water temperature or bath size.

Ohlsson 2001 *(Continued)*

	Control group: shower allowed. Water use in first stage, no mention of 1-to-1 second care or not.
Outcomes	**Maternal outcomes:** 1. *use of analgesia/anaesthesia; 2. *mode of delivery; 3. *trauma to the birth canal requiring suturing. **Neonatal outcomes:** 1. *neonatal condition; 2. *admittance to NICU or high dependency care unit. **Additional outcomes:** 1. secondary arrest and delivered in OP position.
Notes	3 obstetric units in Sweden - 1992-1995 Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	Not indicated
Allocation concealment (selection bias)	Low risk	Sealed opaque envelopes
Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	High risk	From a total of 1279 women, 42 were excluded across both groups and all centres for obstetric reasons
Selective reporting (reporting bias)	Low risk	All outcomes mentioned in methods are reported
Other bias	Unclear risk	Study was started in 1 unit then after 2 years 2 further obstetric units were involved to achieve the required sample size

Rush 1996

Methods	Randomisation by consecutively numbered, computer-generated random allocation in sealed opaque envelopes.

Rush 1996 *(Continued)*

	Methodological qualities: 1. selection bias: low risk; adequate concealment at time of randomisation; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: high risk of bias; 4. bias conclusion: high risk of bias. Where 1 or more criteria are not met may cause plausible bias that seriously weakens confidence in the results.
Participants	Academic hospital, Ontario, Canada. **Inclusion criteria:** 1. term pregnancy defined as gestation greater than 37 weeks; 2. previous CS included (VBAC); 3. in active labour defined as a cervical dilatation of 3 cm or more; 4. ruptured membranes on entry also eligible; 5. ambulation, analgesics and anaesthesia were allowed. 800 women were randomised, 15 were withdrawn 8 from study group and 7 from control group. Nearly half (46%) of the women in the study group did NOT use the bath but were still considered experimental participants with the ITT. 41 of the women did not meet eligibility criteria but were still included and results were analysed. Study group: n = 393- stated but Experimental group adds up to 394. Control group: n = 392
Interventions	Immersion in water during first stage of labour. The use of a Parker whirlpool hot tub with jets during labour. Bath temperature between 38-39 degrees celsius. Mean total time in tub was 54 minutes. No births in tub. No water immersion during labour. Refer to care being provided by assigned nurse, and all had be trained to care for women using immersion, but not clear if this is 1-to-1 second care. First stage only.
Outcomes	**Maternal outcomes:** 1. *use of analgesia/anaesthesia; 2. *augmentation of labour; 3. *presence of meconium-stained liquor; 4. *duration of labour and birth; 5. *mode of delivery. **Additional outcomes:** 1. maternal age; 2. gravida; 3. cervical dilatation; 4. duration in tub; 5. VBAC.
Notes	Data table 1 incorrect. No response from authors Dates of trial: February-September 1998 Funding: not reported Declaration of interest: not reported

Rush 1996 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated
Allocation concealment (selection bias)	Low risk	Consecutively numbered sealed opaque envelopes
Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	High risk	All participants are accounted for, and 15 withdraws were detailed, as were 41 who did not meet criteria but were recruited
Selective reporting (reporting bias)	Low risk	All outcomes mentioned in methods are reported, and seem appropriate for the study and topic
Other bias	Unclear risk	No information on this

Schorn 1993

Methods	Randomisation by packets containing random computer-generated codes. **Methodological qualities:** 1. selection bias: high risk - the researcher knew group allocation before obtaining informed consent; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: low risk of bias - no exclusions. Main outcome not stated. Determine safety and effect of water immersion on women in labour. Most women stayed in the tub for 30-45 minutes. Bias conclusion: moderate bias. 1 or more criteria partially met. May raise some doubt about the results.
Participants	Study group: n = 45 Control group: n = 48 **Inclusion criteria:** 1. gestation between 36-41 weeks; 2. no major obstetric or medical complication; 3. active labour between 4-7 cm cervical dilatation; 4. intact membranes on entry; 5. normal FHR patterns; 6. ambulation and analgesics were allowed.
Interventions	Immersion in water during first stage of labour.

Schorn 1993 *(Continued)*

	Study group: the use of a hot tub with air jets and with a moulded seat during labour. Bath temperature between 32-41 degrees Celsius. Control group: no water immersion during labour. Showers were allowed. First stage of labour
Outcomes	**Maternal outcomes:** 1. Maternal age; 2. gestational age; 3. ethnicity; 4. parity; 5. water temperature; 6. duration in bath; 7. *use of analgesia; 8. *augmentation; 9. cervical dilatation; 10.*duration of first stage of labour; 11.*duration of second stage of labour; 12.duration of admission to delivery; 13.duration of ruptured membranes; 14.blood pressure; 15.pulse; 16.maternal temperature; 17.*method of delivery; **Fetal outcomes:** 1. *FHR patterns; 2. Apgar score at 1 minute; 3. *Apgar score at 5 minutes; 4. neonatal weight;. **Additional outcomes:** 1. *postnatal maternal infections; 2. re-admissions to hospital.
Notes	Academic hospital, Houston, Texas, USA. December 1990 to December 1991 Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated code
Allocation concealment (selection bias)	High risk	Midwife know the allocation at the time of recruitment, and risk of bias acknowledged but women apparently would not be recruited if they did not know which allocation they had
Blinding of participants and personnel (performance bias)	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention

Schorn 1993 *(Continued)*

All outcomes		
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants are accounted for throughout study with no withdrawals
Selective reporting (reporting bias)	Low risk	All outcomes mentioned in method are reported, and seem appropriate for the study and topic
Other bias	Unclear risk	There were significantly more primigravid women in water group, which could affect outcomes, and is a confounding variable

Taha 2000

Methods	Randomisation into sequentially numbered sealed opaque envelopes containing the code. Prepared in variable random blocks stratified for parity. Randomised when in active birth labour and met inclusion and exclusion criteria. **Methodological qualities:** 1. selection bias: none; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: low risk of bias all women received their allocated treatment. Analysed according to ITT. 1 lost to follow-up; 4. bias conclusion: moderate bias. 1 or more criteria partially met. May raise some doubt about the results.
Participants	Study group: n = 59 Control group: n = 61 **Inclusion criteria:** 1. in active labour; 2. primiparous women with cervical dilatation of 4 cm to 7 cm; 3. multiparous women with cervical dilatation of 4 cm to 6 cm; 4. low-risk women; 5. read/understand English. **Exclusion criteria** 1. poor obstetric history; 2. previous CS; 3. medical disorders; 4. pre-eclampsia; 5. multiple pregnancy; 6. intrauterine growth impairment; 7. < 36 weeks and > 42 weeks; 8. pyrexia; 9. meconium-stained liquor; 10. prolonged ruptured of membranes.
Interventions	Immersion in water during first stage of labour.

Taha 2000 *(Continued)*

	Study group: labour in water; water temperature 34-38 degrees Celsius; analgesia as required; exit for second stage; not out of the water for more than 30 minutes. Control group: encouraged ambulation; if lie down use side analgesia as required. Same midwife for all women (so 1-to-1 second stage care assumed) also same observer/assessor of pain for all. First stage study
Outcomes	**Outcomes reported:** **Maternal outcomes:** 1. *pain; 2. *use of analgesia/anaesthesia; 3. *augmentation of labour; 4. *blood pressure; 5. *pulse; 6. *duration of labour and birth; 7. *mode of delivery; 8. *trauma to the birth canal requiring suturing; 9. *blood loss; 10. *postpartum depression; 11. *breastfeeding; **Fetal outcomes:** 1. *abnormal FHR patterns needing intervention. **Additional outcomes:** 1. studies which describe additional outcomes that may be of importance will be mentioned in the text; 2. gestational age; 3. maternal age; 4. gravida; 5. parity; 6. cervical dilatation; 7. duration in tub; 8. meconium-stained liquor.
Notes	Academic hospital, South Africa Dates of trial: not reported Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	High risk	Random list compiled in different block size of 6 and 8 but not clear how this was achieved or by whom
Allocation concealment (selection bias)	Low risk	Sequentially-numbered sealed opaque envelopes containing the allocation

Taha 2000 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	Low risk	All participants are accounted for throughout study with no withdrawals
Selective reporting (reporting bias)	Low risk	All outcomes mentioned in method are reports, and seem appropriate for the study and topic
Other bias	Unclear risk	Researcher recruited and cared for all women and provided 1-to-1 care

Torkamani 2010

Methods	Clinical trial with women equally divided into 2 groups. Information available understood to be random allocation.
Participants	Women 16-28 years of age gravida 1 or 2 gestational age 38-42 week
Interventions	Immersion in water during first and second stage of labour (100 women) Control group described as 'normal delivery' Active management of labour was undertaken, with use of oxytocin use for ineffective contractions or lack of cervical progress in 2 hours. Promethazine available analgesia with no indication if this resulted in exit from the pool, as the use of this drug would exclude water use in many locations. No indication of 1:1 care.
Outcomes	Duration of first stage of labour Duration of second stage of labour pain score percentage who used analgesia percentage who received oxytocin percentage who had episiotomy percentage who had normal birth percentage who had Apgar score lower than 8 percentage of Woman's satisfied with mode of delivery

Torkamani 2010 *(Continued)*

Notes	Conducted in Asalian Gynaecological hospital in Iran. The full name of the lead author paper that was initially labelled as by author Akbari 2008 - is Soheila Akbari Torkamani and has be renamed according. This is 1 trial with 2 publications. Dates of trial: February 2006 to February 2007 Funding: not reported Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	No information provided
Allocation concealment (selection bias)	Unclear risk	No information provided
Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias because women and carers could not be blind to group allocation after randomisation due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	High risk	No attrition data provided,however most of outcome data are provided as percentages (see above) and on trying to convert this data to numbers it is evident that data are missing, appears to have different data missing for different outcomes and therefore could not be converted to numbers for analysis
Selective reporting (reporting bias)	High risk	Women who required a caesarean section after apparently consenting and entering the trial were excluded indicating analysis was not by ITT. There are no data on the number of such women in each group
Other bias	Unclear risk	No information on type of pool used

Woodward 2004

Methods	Randomisation schedule provided by National Perinatal Epidemiology Unit, Oxford. A person unconnected to study prepared by consecutively numbered, computer-generated random allocation in sealed opaque envelopes. **Methodological qualities:** 1. selection bias: low risk; adequate concealment at time of randomisation; 2. performance bias: high risk of bias could have been introduced because researcher could not be blind to group allocation after randomisation; 3. exclusion bias: moderate risk as, although expected and 2:1 randomisation undertaken, 16 of 40 women in water arm and 2 of 20 in control arm did not receive their allocated treatment. Analysed according to ITT. 1 woman withdrew; 4. bias conclusion: moderate risk of bias. Where 1 or more criteria are not met may cause plausible bias that seriously weakens confidence in the results.

Woodward 2004 *(Continued)*

Participants	2 groups in RCT part of study. Water n = 40 Land n = 20 (2:1 ratio as about local experience was 50% of women choose not to use water). Women recruited through community midwife, posters in clinics, and media promotions and interested women contacted researcher or gave permission to own midwife to pass on information. Aged 18-50 Low risk
Interventions	Immersion in water during first and second stages of labour. Results do not distinguish which of the women allocated to pool, did not use pool (16 of 40 women), used pool for first stage only (13 of 40 women), used pool in second stage but not for birth (1 woman), or gave birth in the pool (10 women) (no subgroup analysis). Data entered into both 'immersion in water versus no immersion during first stage of labour ' AND 'immersion in water versus no immersion during second stage of labour' DATA and ANALYSIS section. Waterbirth pool - dimensions/volume not described, temperature described as recorded but data not provided. No mention of 1-to-1 care or not.
Outcomes	ITT analysis done. Maternal: age, social history, pulse, temperature, maternal satisfaction on scale of 0-6 immediately post birth and in 6 week postal questionnaire. Labour: length of first, second stages; analgesia used; augmentation; mode of birth. Fetus/neonate: cord arterial and venous gases, Apgar score at 1, 5 and 10 mins, time to first respiration, rectal temperature at birth, ear swabs, method of feeding, date and time of first feed, admission to neonatal unit (plus any interventions needed) infection, any mortality/morbidity. Water; duration in water, water temperature, microbiological analysis at end of labour/use.
Notes	Non-randomised, preference arm data not included although additional 20 participants in this part of study. 16 (40%) of water women did not use water. UK study. Dates of trial: not reported Funding: partly funded by Getting Started in Research Grant from Northampton General Hospital NHS Trust. Declaration of interest: not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	Computer-generated independent of study
Allocation concealment (selection bias)	Low risk	Consecutively numbered in sealed opaque envelopes

Woodward 2004 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	High risk of bias could have been introduced because women, carers and researcher could not be blind to group allocation after randomisation due to the nature of the intervention
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	No information provided
Incomplete outcome data (attrition bias) All outcomes	High risk	All participants are accounted for throughout study with no withdrawals, however many did not receive the allocated intervention
Selective reporting (reporting bias)	Low risk	All outcomes mentioned in method are reported, and seem appropriate for the study and topic
Other bias	Unclear risk	40% or water group did not use water, which is consistent with choice and other papers on this topic

*: prespecified outcomes
CS: caesarean section
FHR: fetal heart rate
ITT: intention-to-treat
KH: Karlskrona Hospital
LH: Lund hospital
NICU: neonatal intensive care unit
OH: Osterund Hospital
OP: Occipito posterior
VBAC: vaginal birth after caesarean section

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Bastide 1990	Unpublished data from 1990 available only. Intervention was whirlpool bath and was inadequate to confirm immersion of the pregnant abdomen was possible. We contacted the author for further information, but nothing was provided.
Benfield 2001	The intervention was not consistent with immersion of the pregnancy abdomen, as women were in a limited depth of water; were asked to adopt semi-recumbent positions on a partially inflated air raft with attached head pillow (authors description) for 1 hour, and had cannulation to facilitate repeat blood samples. All of which limits mobility and is not consistent with water immersion in labour.
Cai 2005	Cases drawn from existing records, not randomised design.
Calvert 2000	The intervention was inappropriate as the study was to compare the effect of the essential oil of ginger compared to essential oil of lemon grass rather than water immersion.
Cluett 2001	Women had all been diagnosed as having dystocia in the first stage of labour (less than 1 cm/hr progress after established labour), and therefore at increased risk of complications and this does not meet participant inclusion criteria.
Cluett 2004	Women had all been diagnosed as having dystocia in the first stage of labour (less than 1 cm/hr progress after established labour), and therefore at increased risk of complications and this does not meet participant inclusion criteria.

Study	Reason for exclusion
Henrique 2015	The intervention is hot water spray, or shower, and not immersion in water and hence is not the intervention of this review.
Irion 2011	Antenatal women standing in water versus antenatal women sat in water with legs elevated and peripheral oedema assessed. Not immersion and not labour or birth.
Kashanian 2013	The participants are antenatal women, not in labour or during birth.
Khadijeh 2015	The intervention is warm water shower, and not immersion in water and hence is not the intervention of this review as the physiological impact of a shower is considered to be different to immersion.
Labrecque 1999	The Intervention does not meet the inclusion criteria for this review, as 3 interventions were compared (1) ISWs, (2) transcutaneous electrical nerve stimulation and (3) standard care that included back massage, and all has access to a whirlpool bath and liberal mobilisation, and therefore is not specifically about water immersion.
Lee 2013	The intervention is inappropriate being a 20-minute shower, not immersion in water during first stage of labour.
Malarewicz 2005	Inadequate description of the pool to confirm immersion. The only outcome provided is cervical dilation between 2 time points, which is a subjective measurement by the caregiver, of a non linear outcome. No data were provided on length of labour, which is outcome used within this review. No other outcome was provided, despite direct request for non published data to authors.
Zou 2008	The design description indicated this as a cohort study not a randomised trial.

ISW: intracutaneous sterile water injection

Characteristics of ongoing studies *[ordered by study ID]*

Dabiri 2016

Trial name or title	Effect of water immersion during the first stage of labour on pain and the outcome of labour of primipara women attending to Khaleej-e- fars hospital in Bandar Abbas
Methods	Clinical trial with 2 arms
Participants	Nulliparous women; age 35-18 years; height over 150 cm; BMI 18.5-24.9; singleton pregnancy; gestational age 37-40; participation in preparation for childbirth classes; vertex presentation; alive fetus; not having risk factors (abnormal vital signs of mother- of mother underlying disease- prolonged rupture of membrane- vaginal bleeding, oligo- or polyhydramnios- placenta previa- placental abruption- meconium-stained- intrauterine growth restriction- fetal macrosomia- abnormal fetus- history of infertility); regular uterine contractions; 4 cm cervical dilatation; Normal NST
Interventions	Immersion during the active phase of first stage of labour in a tub full of water at the appropriate temperature, for all of the first stage of labour
Outcomes	Labour pian intensity, duration of first stage of labour, duration of second stage of labour, perineal status, newborn Apgar score
Starting date	November 2015
Contact information	Fatemeh Dabiri, Shahid Beheshti University of Medical Sciences Shahid Beheshti Nursing & Midwifery collage,Vali-Asr Avenue,Cross of Vali Asr and Neiaiesh Highway, Tehran Iran, Islamic Republic of Iran

Dabiri 2016 *(Continued)*

Notes	No outcome data published or provided at time of this review

BMI: body mass index
NST: non-stress test

DATA AND ANALYSES

Comparison 1. Immersion in water versus no immersion during first stage of labour

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mode of birth (spontaneous vaginal birth)	6	2559	Risk Ratio (M-H, Fixed, 95% CI)	1.01 [0.97, 1.04]
2 Mode of birth (instrumental vaginal births)	6	2559	Risk Ratio (M-H, Fixed, 95% CI)	0.86 [0.70, 1.05]
3 Mode of birth (caesarean section)	7	2652	Risk Ratio (M-H, Fixed, 95% CI)	1.27 [0.91, 1.79]
4 Use of analgesia (regional)	5	2439	Risk Ratio (M-H, Fixed, 95% CI)	0.91 [0.83, 0.99]
5 Perineal trauma (third- or fourth-degree tears)	4	2341	Risk Ratio (M-H, Fixed, 95% CI)	1.36 [0.85, 2.18]
6 Admission to neonatal intensive care unit	2	1511	Risk Ratio (M-H, Random, 95% CI)	1.30 [0.42, 3.97]
7 Neonatal infection	5	1295	Risk Ratio (M-H, Fixed, 95% CI)	2.00 [0.50, 7.94]
8 Neonate temperature	1		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
8.1 Temperature greater than 37.8 degrees C as an indicator for infection	1	274	Risk Ratio (M-H, Fixed, 95% CI)	1.0 [0.06, 15.83]
9 Estimated blood loss (mL)	2	153	Mean Difference (IV, Fixed, 95% CI)	-14.33 [-63.03, 34.37]
10 Postpartum haemorrhage	1	274	Risk Ratio (M-H, Fixed, 95% CI)	1.58 [0.80, 3.13]
11 Use of analgesia (pharmacological - pethidine/narcotic)	3	1180	Risk Ratio (M-H, Random, 95% CI)	1.08 [0.59, 1.96]
12 Use of any analgesia	3	487	Risk Ratio (M-H, Fixed, 95% CI)	0.99 [0.88, 1.12]
13 Use of analgesia (pharmacological - any)	2	394	Risk Ratio (M-H, Fixed, 95% CI)	1.05 [0.80, 1.39]

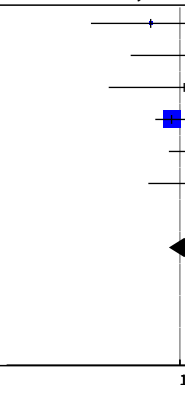
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
14 Maternal infection during labour/postnatal period (perineal, systemic, uterine or increase in temperature)	5	1295	Risk Ratio (M-H, Fixed, 95% CI)	0.99 [0.50, 1.96]
15 Artificial rupture of membranes	3	926	Risk Ratio (M-H, Fixed, 95% CI)	1.02 [0.90, 1.16]
16 Use of oxytocin for augmentation of labour	4	1019	Risk Ratio (M-H, Fixed, 95% CI)	0.91 [0.72, 1.15]
17 Use of non-pharmacological analgesia (transcutaneous nerve stimulation (TENS)	1	785	Risk Ratio (M-H, Fixed, 95% CI)	1.25 [0.34, 4.61]
18 Duration of first stage (minutes)	5	1295	Mean Difference (IV, Fixed, 95% CI)	-11.53 [-45.42, 22.36]
19 Duration of second stage (minutes)	6	1403	Mean Difference (IV, Random, 95% CI)	1.12 [-5.23, 7.48]
20 Duration of third stage (minutes)	2	1059	Mean Difference (IV, Fixed, 95% CI)	0.25 [-1.10, 1.60]
21 Duration of total labour (all three stages minutes)	1	120	Mean Difference (IV, Fixed, 95% CI)	-27.5 [-133.05, 78.05]
22 Perineal trauma (intact)	4	1277	Risk Ratio (M-H, Fixed, 95% CI)	1.17 [1.01, 1.37]
23 Perineal trauma (second-degree tears)	4	1212	Risk Ratio (M-H, Fixed, 95% CI)	0.94 [0.74, 1.20]
24 Perineal trauma (episiotomy)	4	1212	Risk Ratio (M-H, Fixed, 95% CI)	0.94 [0.80, 1.09]
25 Self reports pain score on visual analogue scale of 0-10	2		Mean Difference (IV, Random, 95% CI)	Subtotals only
25.1 Pain score at start of assessment period (time zero)	2	141	Mean Difference (IV, Random, 95% CI)	0.15 [-0.79, 1.08]
25.2 Pain score up to 60 minutes later	2	141	Mean Difference (IV, Random, 95% CI)	-0.81 [-1.34, -0.28]
26 Pain intensity (experience of moderate to severe pain)	1		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
26.1 Ordinal description as moderate to severe, 30 mins after randomisation	1	120	Risk Ratio (M-H, Fixed, 95% CI)	0.75 [0.62, 0.91]
26.2 VAS scale 8 to 10, 30 mins after randomisation	1	120	Risk Ratio (M-H, Fixed, 95% CI)	0.72 [0.58, 0.90]
26.3 Ordinal scale pain faces 4 to 5, 30 mins after randomisation	1	120	Risk Ratio (M-H, Fixed, 95% CI)	0.67 [0.51, 0.90]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
26.4 Ordinal description as moderate to severe, 1 hr after randomisation	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.76 [0.63, 0.91]
26.5 VAS scale 8 to 10, 1 hr after randomisation	1	117	Risk Ratio (M-H, Fixed, 95% CI)	1.21 [0.69, 2.11]
26.6 Ordinal scale pain faces 4 to 5, 1 hr after randomisation	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.68 [0.53, 0.86]
26.7 Ordinal description as moderate to severe, 2 hrs after randomisation	1	57	Risk Ratio (M-H, Fixed, 95% CI)	0.76 [0.59, 0.98]
26.8 VAS scale 8 to 10, 2 hrs after randomisation	1	57	Risk Ratio (M-H, Fixed, 95% CI)	0.83 [0.66, 1.05]
26.9 Ordinal scale pain faces 4 to 5, 2 hrs after randomisation	1	57	Risk Ratio (M-H, Fixed, 95% CI)	0.72 [0.52, 0.98]
26.10 Ordinal description as moderate to severe, 3 hrs after randomisation	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.52 [0.23, 1.16]
26.11 VAS scale 8 to 10, 3 hrs after randomisation	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.69 [0.39, 1.23]
26.12 Ordinal scale pain faces 4 to 5, 3 hrs after randomisation	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.57 [0.25, 1.27]
26.13 Ordinal description as moderate to severe, 24 hrs after randomisation	1	119	Risk Ratio (M-H, Fixed, 95% CI)	0.64 [0.50, 0.82]
26.14 VAS scale 8 to 10, 24 hrs after randomisation	1	119	Risk Ratio (M-H, Fixed, 95% CI)	0.62 [0.49, 0.80]
26.15 Ordinal scale pain faces 4 to 5, 24 hrs after randomisation	1	119	Risk Ratio (M-H, Fixed, 95% CI)	0.69 [0.54, 0.87]
27 Systolic blood pressure	1	120	Mean Difference (IV, Fixed, 95% CI)	-7.20 [-13.12, -1.28]
28 Diastolic blood pressure	1	120	Mean Difference (IV, Fixed, 95% CI)	-10.20 [-13.70, -6.70]
29 Mean arterial blood pressure	1	120	Mean Difference (IV, Fixed, 95% CI)	-10.5 [-14.68, -6.32]
30 Preference for care in subsequent labour (Does not wish to use bath with next labour/birth)	1	119	Risk Ratio (M-H, Fixed, 95% CI)	0.38 [0.14, 0.98]
31 Postpartum depression (EPDS more than 11)	2	370	Risk Ratio (M-H, Fixed, 95% CI)	1.38 [0.85, 2.24]
32 Abnormal fetal heart rate patterns	3	487	Risk Ratio (M-H, Random, 95% CI)	0.75 [0.34, 1.67]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
33 Presence of meconium-stained liquor	4	1200	Risk Ratio (M-H, Random, 95% CI)	0.92 [0.64, 1.33]
34 Apgar score less than seven at five minutes	5	1834	Risk Ratio (M-H, Fixed, 95% CI)	1.58 [0.63, 3.93]
35 Apgar score at five minutes	2	893	Mean Difference (IV, Fixed, 95% CI)	-0.03 [-0.11, 0.06]
36 Umbilical artery pH less than 7.20	1	110	Risk Ratio (M-H, Fixed, 95% CI)	5.18 [0.25, 105.51]
37 Breastfeeding - not breastfeeding after six weeks post birth	2	363	Risk Ratio (M-H, Fixed, 95% CI)	1.17 [0.64, 2.15]

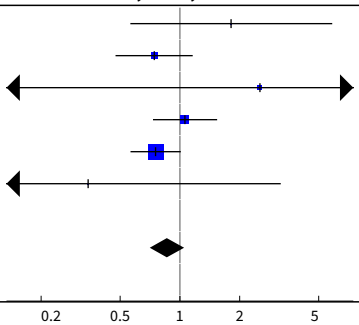
Analysis 1.1. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 1 Mode of birth (spontaneous vaginal birth).

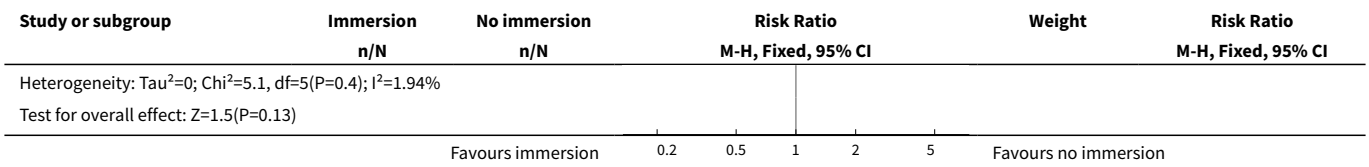
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Cammu 1994	46/54	51/56		4.76%	0.94[0.81,1.07]
Eckert 2001	102/137	99/137		9.42%	1.03[0.89,1.19]
Kuusela 1998	17/18	14/15		1.45%	1.01[0.85,1.21]
Ohlsson 2001	543/612	565/625		53.2%	0.98[0.94,1.02]
Rush 1996	293/393	275/392		26.2%	1.06[0.97,1.16]
Taha 2000	54/59	53/61		4.96%	1.05[0.93,1.19]
Total (95% CI)	**1273**	**1286**		**100%**	**1.01[0.97,1.04]**
Total events: 1055 (Immersion), 1057 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=5.12, df=5(P=0.4); I^2=2.31%					
Test for overall effect: Z=0.51(P=0.61)					



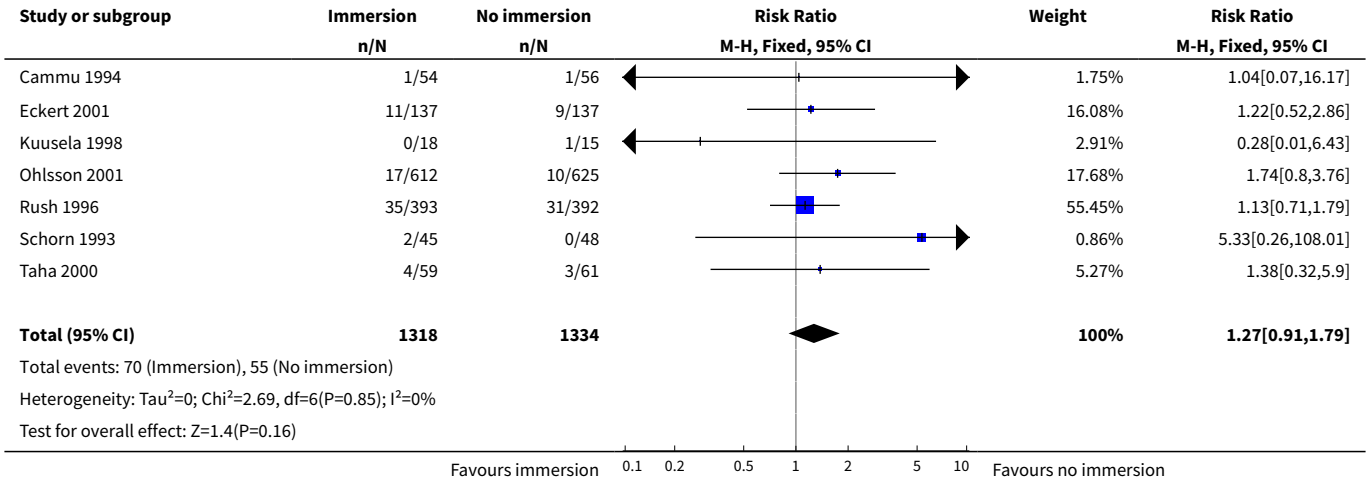
Analysis 1.2. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 2 Mode of birth (instrumental vaginal births).

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Cammu 1994	7/54	4/56		2.21%	1.81[0.56,5.85]
Eckert 2001	26/137	35/137		19.66%	0.74[0.47,1.16]
Kuusela 1998	1/18	0/15		0.3%	2.53[0.11,57.83]
Ohlsson 2001	52/612	50/625		27.79%	1.06[0.73,1.54]
Rush 1996	65/393	86/392		48.38%	0.75[0.56,1.01]
Taha 2000	1/59	3/61		1.66%	0.34[0.04,3.22]
Total (95% CI)	**1273**	**1286**		**100%**	**0.86[0.7,1.05]**
Total events: 152 (Immersion), 178 (No immersion)					

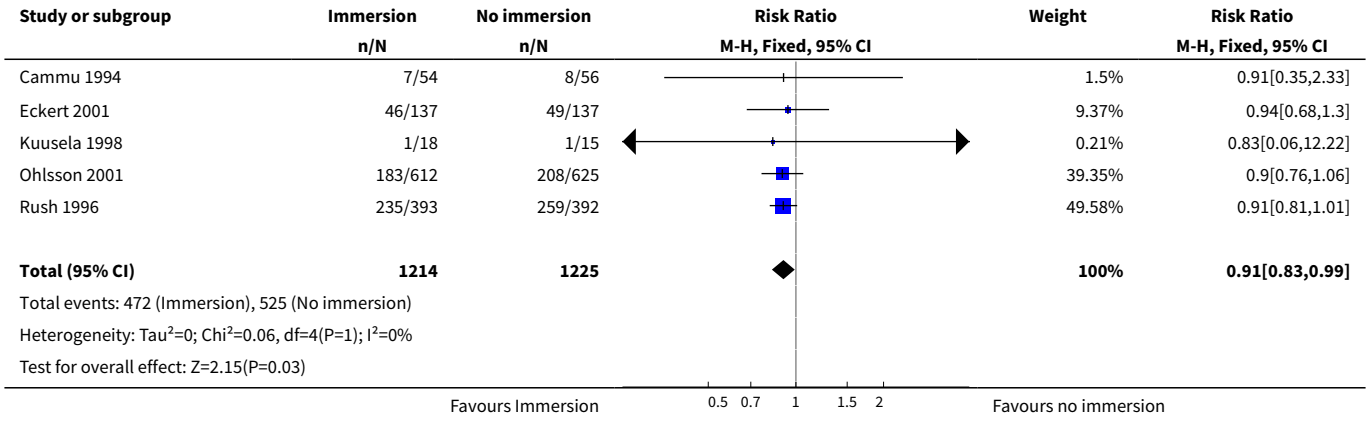




Analysis 1.3. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 3 Mode of birth (caesarean section).

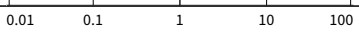


Analysis 1.4. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 4 Use of analgesia (regional).



Analysis 1.5. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 5 Perineal trauma (third- or fourth-degree tears).

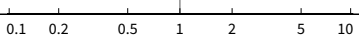
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Eckert 2001	5/137	2/137		6.84%	2.5[0.49,12.67]
Ohlsson 2001	28/612	22/625		74.45%	1.3[0.75,2.25]
Rush 1996	6/358	4/361		13.62%	1.51[0.43,5.31]
Taha 2000	0/55	1/56		5.08%	0.34[0.01,8.15]
Total (95% CI)	**1162**	**1179**		**100%**	**1.36[0.85,2.18]**
Total events: 39 (Immersion), 29 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=1.33, df=3(P=0.72); I^2=0%					
Test for overall effect: Z=1.29(P=0.2)					



Favours immersion — Favours no immersion

Analysis 1.6. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 6 Admission to neonatal intensive care unit.

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Eckert 2001	4/137	1/137		20.35%	4[0.45,35.33]
Ohlsson 2001	41/612	43/625		79.65%	0.97[0.64,1.47]
Total (95% CI)	**749**	**762**		**100%**	**1.3[0.42,3.97]**
Total events: 45 (Immersion), 44 (No immersion)					
Heterogeneity: Tau^2=0.36; Chi^2=1.57, df=1(P=0.21); I^2=36.27%					
Test for overall effect: Z=0.46(P=0.65)					



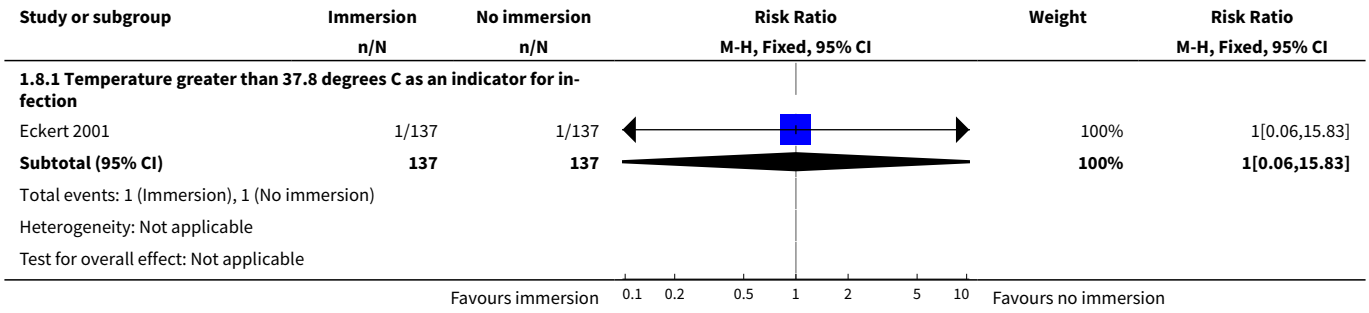
Favours immersion — Favours no immersion

Analysis 1.7. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 7 Neonatal infection.

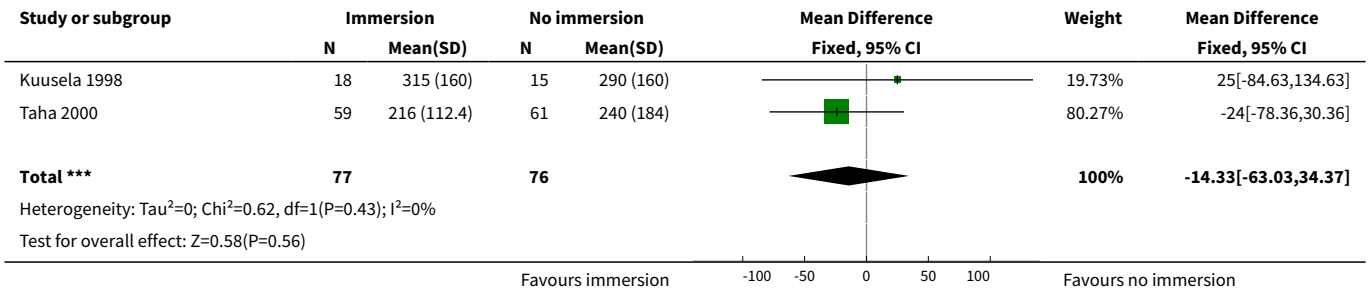
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Cammu 1994	0/54	0/56			Not estimable
Eckert 2001	1/137	1/137		33.31%	1[0.06,15.83]
Kuusela 1998	0/18	0/15			Not estimable
Rush 1996	5/393	2/392		66.69%	2.49[0.49,12.78]
Schorn 1993	0/45	0/48			Not estimable
Total (95% CI)	**647**	**648**		**100%**	**2[0.5,7.94]**
Total events: 6 (Immersion), 3 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=0.31, df=1(P=0.58); I^2=0%					
Test for overall effect: Z=0.98(P=0.33)					

Favours immersion — Favours no immersion

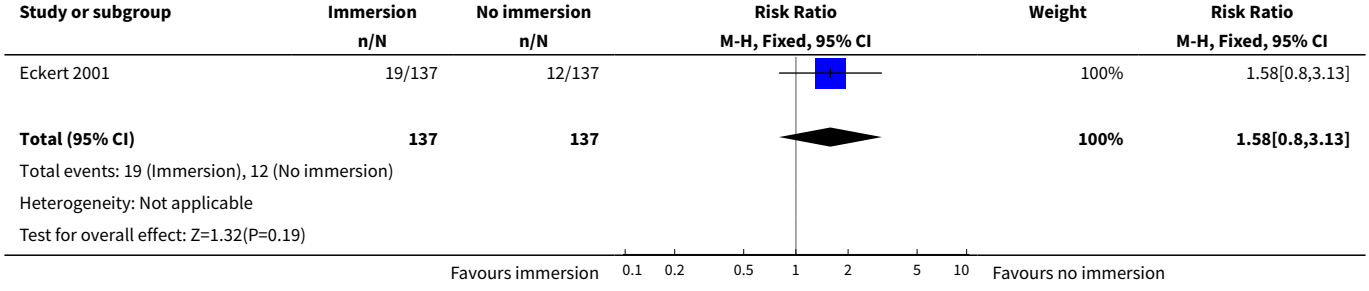
Analysis 1.8. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 8 Neonate temperature.



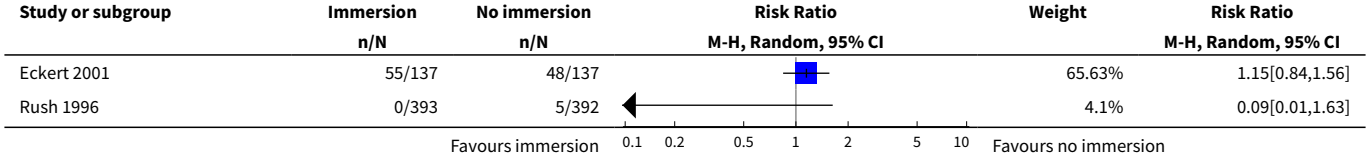
Analysis 1.9. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 9 Estimated blood loss (mL).

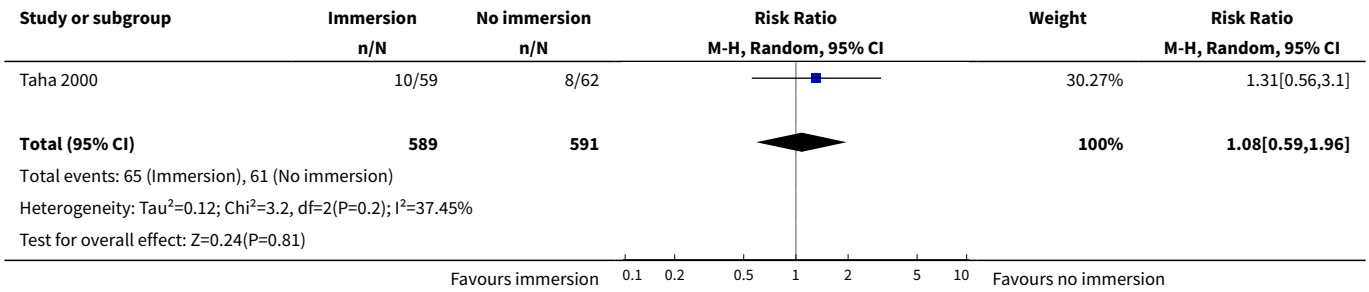


Analysis 1.10. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 10 Postpartum haemorrhage.

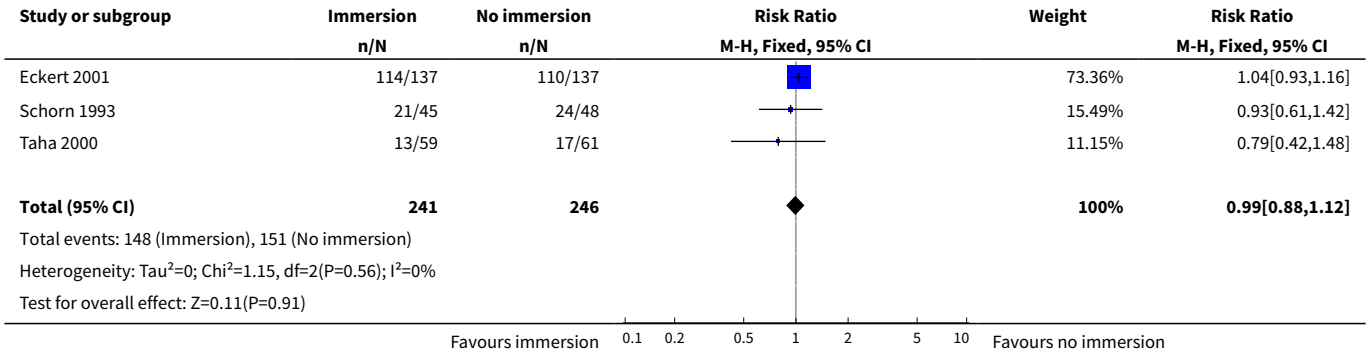


Analysis 1.11. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 11 Use of analgesia (pharmacological - pethidine/narcotic).

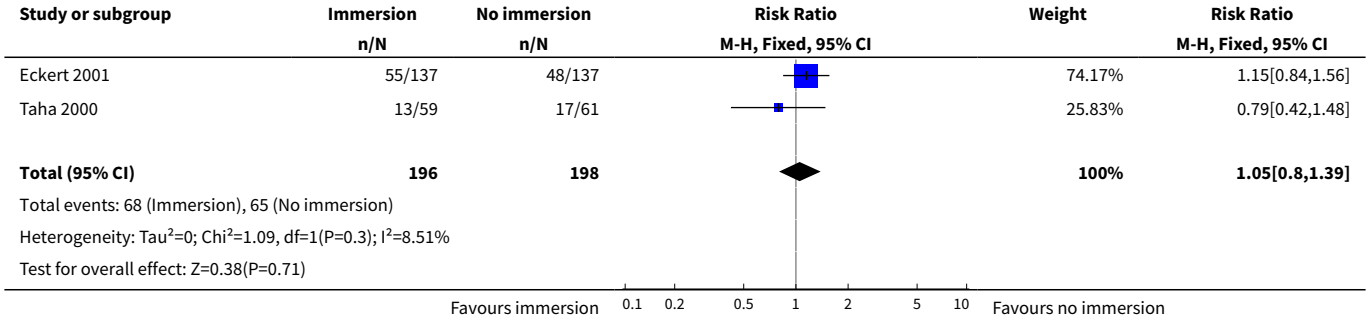




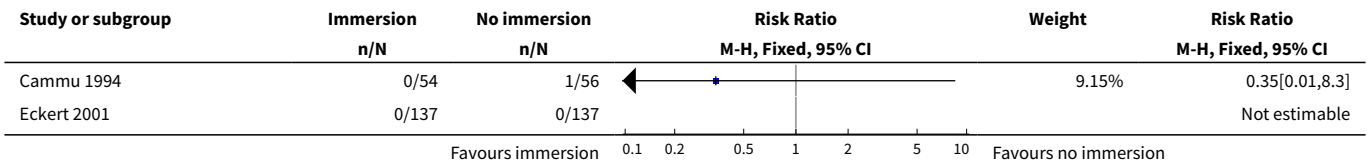
Analysis 1.12. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 12 Use of any analgesia.

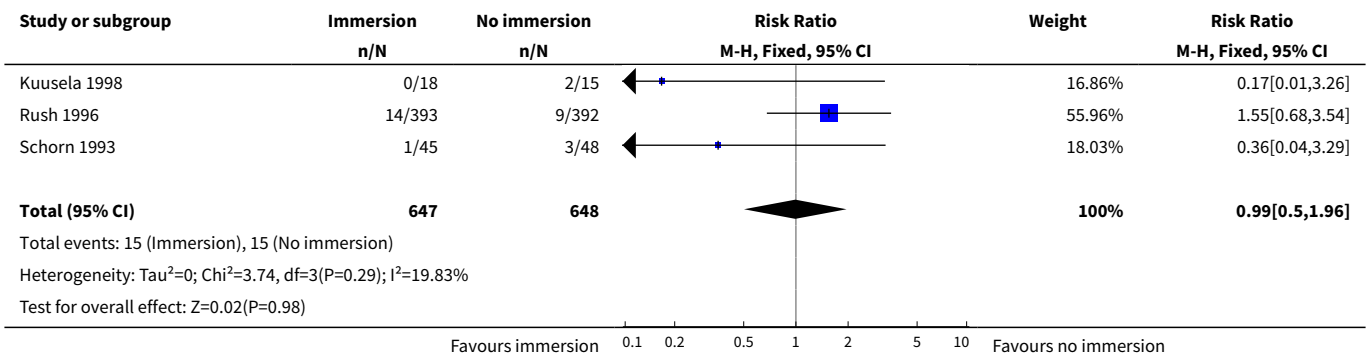


Analysis 1.13. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 13 Use of analgesia (pharmacological - any).

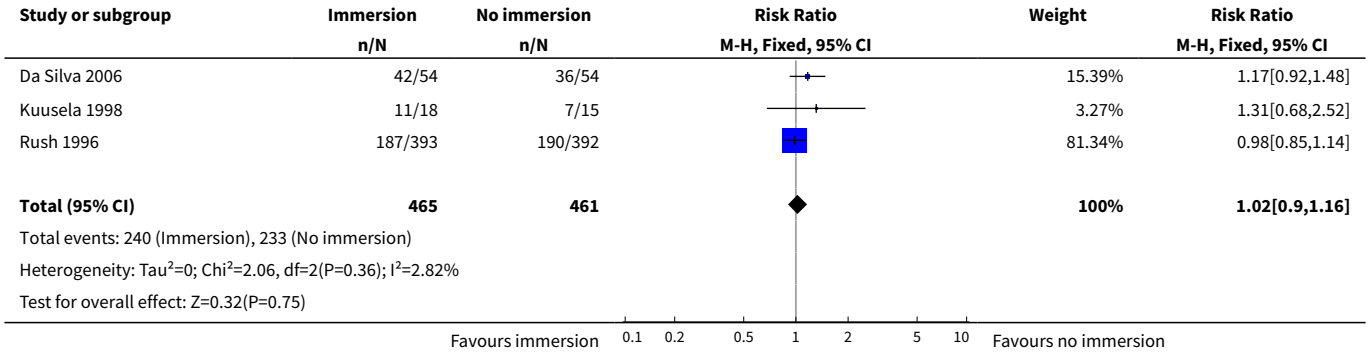


Analysis 1.14. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 14 Maternal infection during labour/postnatal period (perineal, systemic, uterine or increase in temperature).

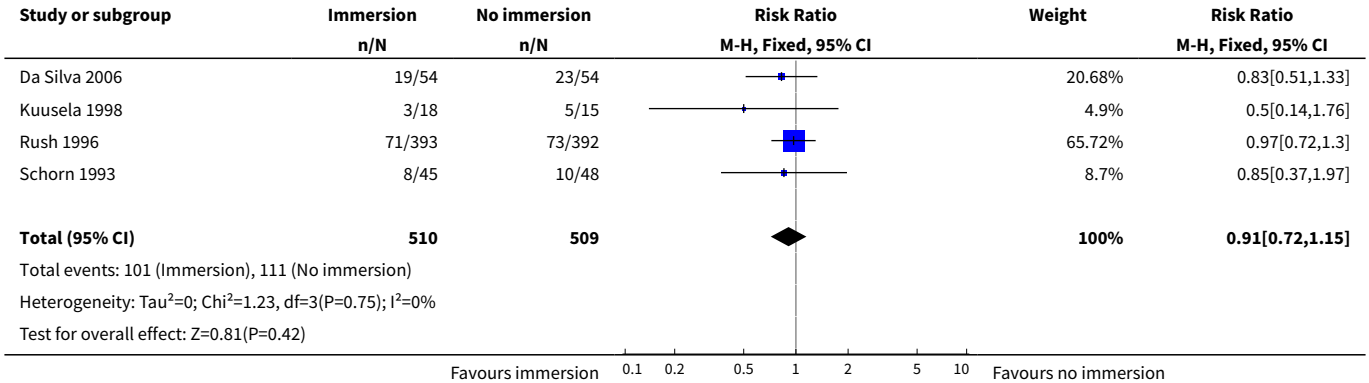




Analysis 1.15. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 15 Artificial rupture of membranes.



Analysis 1.16. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 16 Use of oxytocin for augmentation of labour.

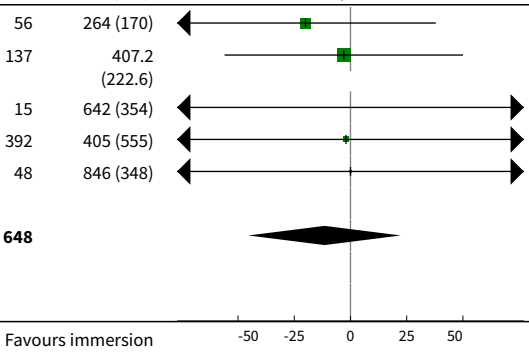


Analysis 1.17. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 17 Use of non-pharmacological analgesia (transcutaneous nerve stimulation (TENS).

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Rush 1996	5/393	4/392		100%	1.25[0.34,4.61]
Total (95% CI)	**393**	**392**		**100%**	**1.25[0.34,4.61]**
Total events: 5 (Immersion), 4 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.33(P=0.74)					

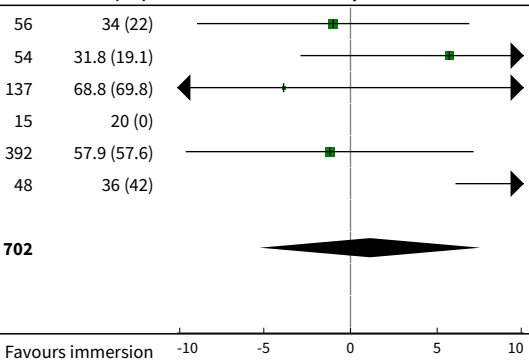
Analysis 1.18. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 18 Duration of first stage (minutes).

Study or subgroup	Immersion N	Immersion Mean(SD)	No immersion N	No immersion Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Cammu 1994	54	244 (139)	56	264 (170)		34.22%	-20[-77.94,37.94]
Eckert 2001	137	404.2 (225.2)	137	407.2 (222.6)		40.86%	-2.98[-56,50.04]
Kuusela 1998	18	528 (216)	15	642 (354)		2.73%	-114[-319.06,91.06]
Rush 1996	393	403 (596)	392	405 (555)		17.7%	-2[-82.56,78.56]
Schorn 1993	45	846 (432)	48	846 (348)		4.48%	0[-160.07,160.07]
Total ***	**647**		**648**			**100%**	**-11.53[-45.42,22.36]**
Heterogeneity: Tau^2=0; Chi^2=1.21, df=4(P=0.88); I^2=0%							
Test for overall effect: Z=0.67(P=0.5)							



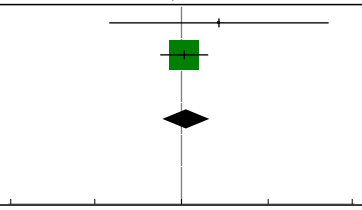
Analysis 1.19. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 19 Duration of second stage (minutes).

Study or subgroup	Immersion N	Immersion Mean(SD)	No immersion N	No immersion Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Cammu 1994	54	33 (20)	56	34 (22)		30.32%	-1[-8.85,6.85]
Da Silva 2006	54	37.5 (25.9)	54	31.8 (19.1)		27.81%	5.7[-2.88,14.28]
Eckert 2001	137	64.9 (66.3)	137	68.8 (69.8)		12.2%	-3.86[-19.97,12.25]
Kuusela 1998	18	21 (0)	15	20 (0)			Not estimable
Rush 1996	393	56.7 (61)	392	57.9 (57.6)		28.76%	-1.2[-9.5,7.1]
Schorn 1993	45	108 (222)	48	36 (42)		0.91%	72[6.06,137.94]
Total ***	**701**		**702**			**100%**	**1.12[-5.23,7.48]**
Heterogeneity: Tau^2=18.67; Chi^2=6.47, df=4(P=0.17); I^2=38.21%							
Test for overall effect: Z=0.35(P=0.73)							



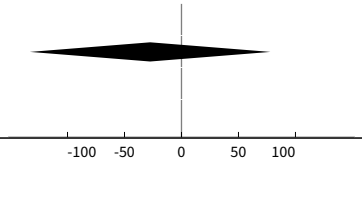
Analysis 1.20. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 20 Duration of third stage (minutes).

Study or subgroup	Immersion N	Immersion Mean(SD)	No immersion N	No immersion Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Eckert 2001	137	15.6 (33.4)	137	13.4 (17.7)		4.56%	2.16[-4.17,8.49]
Rush 1996	393	8.3 (8.7)	392	8.1 (10.9)		95.44%	0.16[-1.22,1.54]
Total ***	**530**		**529**			**100%**	**0.25[-1.1,1.6]**
Heterogeneity: Tau²=0; Chi²=0.37, df=1(P=0.54); I²=0%							
Test for overall effect: Z=0.36(P=0.72)							



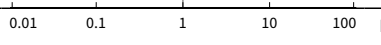
Analysis 1.21. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 21 Duration of total labour (all three stages minutes).

Study or subgroup	Immersion N	Immersion Mean(SD)	No immersion N	No immersion Mean(SD)	Mean Difference Fixed, 95% CI	Weight	Mean Difference Fixed, 95% CI
Taha 2000	59	558.4 (287.9)	61	585.9 (302)		100%	-27.5[-133.05,78.05]
Total ***	**59**		**61**			**100%**	**-27.5[-133.05,78.05]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.51(P=0.61)							



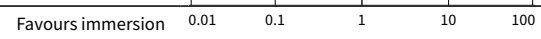
Analysis 1.22. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 22 Perineal trauma (intact).

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Da Silva 2006	13/54	11/54		5.68%	1.18[0.58,2.4]
Eckert 2001	53/137	54/137		27.9%	0.98[0.73,1.32]
Rush 1996	129/393	99/392		51.21%	1.3[1.04,1.62]
Taha 2000	32/54	30/56		15.22%	1.11[0.8,1.54]
Total (95% CI)	**638**	**639**		**100%**	**1.17[1.01,1.37]**
Total events: 227 (Immersion), 194 (No immersion)					
Heterogeneity: Tau²=0; Chi²=2.35, df=3(P=0.5); I²=0%					
Test for overall effect: Z=2.04(P=0.04)					



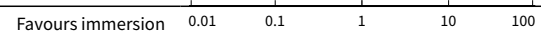
Analysis 1.23. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 23 Perineal trauma (second-degree tears).

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Da Silva 2006	7/54	5/54		4.6%	1.4[0.47,4.14]
Eckert 2001	32/137	43/137		39.55%	0.74[0.5,1.1]
Rush 1996	58/358	56/361		51.29%	1.04[0.75,1.46]
Taha 2000	5/55	5/56		4.56%	1.02[0.31,3.32]
Total (95% CI)	**604**	**608**		**100%**	**0.94[0.74,1.2]**
Total events: 102 (Immersion), 109 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=2.28, df=3(P=0.52); I^2=0%					
Test for overall effect: Z=0.49(P=0.62)					



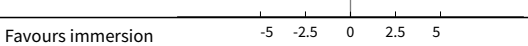
Analysis 1.24. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 24 Perineal trauma (episiotomy).

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Da Silva 2006	27/54	27/54		12.72%	1[0.69,1.46]
Eckert 2001	35/137	32/137		15.07%	1.09[0.72,1.66]
Rush 1996	135/358	147/361		68.95%	0.93[0.77,1.11]
Taha 2000	1/55	7/56		3.27%	0.15[0.02,1.14]
Total (95% CI)	**604**	**608**		**100%**	**0.94[0.8,1.09]**
Total events: 198 (Immersion), 213 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=3.8, df=3(P=0.28); I^2=21.12%					
Test for overall effect: Z=0.86(P=0.39)					



Analysis 1.25. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 25 Self reports pain score on visual analogue scale of 0-10.

Study or subgroup	Immersion N	Immersion Mean(SD)	No Immersion N	No Immersion Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
1.25.1 Pain score at start of assessment period (time zero)							
Da Silva 2006	54	8.5 (1.4)	54	8.7 (1.7)		65.17%	-0.2[-0.79,0.39]
Kuusela 1998	18	6.2 (1.9)	15	5.4 (1.7)		34.83%	0.8[-0.43,2.03]
Subtotal ***	**72**		**69**			**100%**	**0.15[-0.79,1.08]**
Heterogeneity: Tau^2=0.26; Chi^2=2.07, df=1(P=0.15); I^2=51.7%							
Test for overall effect: Z=0.31(P=0.76)							
1.25.2 Pain score up to 60 minutes later							
Da Silva 2006	54	8.5 (1.6)	54	9.3 (1.4)		88.06%	-0.8[-1.37,-0.23]
Kuusela 1998	18	6.3 (1.9)	15	7.2 (2.5)		11.94%	-0.9[-2.44,0.64]
Subtotal ***	**72**		**69**			**100%**	**-0.81[-1.34,-0.28]**
Heterogeneity: Tau^2=0; Chi^2=0.01, df=1(P=0.9); I^2=0%							



Study or subgroup	Immersion N	Immersion Mean(SD)	No Immersion N	No Immersion Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Test for overall effect: Z=2.99(P=0)							

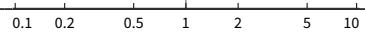
Favours immersion -5 -2.5 0 2.5 5 Favours no immersion

Analysis 1.26. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 26 Pain intensity (experience of moderate to severe pain).

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
1.26.1 Ordinal description as moderate to severe, 30 mins after randomisation					
Taha 2000	40/59	55/61		100%	0.75[0.62,0.91]
Subtotal (95% CI)	**59**	**61**		**100%**	**0.75[0.62,0.91]**
Total events: 40 (Immersion), 55 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.87(P=0)					
1.26.2 VAS scale 8 to 10, 30 mins after randomisation					
Taha 2000	37/59	53/61		100%	0.72[0.58,0.9]
Subtotal (95% CI)	**59**	**61**		**100%**	**0.72[0.58,0.9]**
Total events: 37 (Immersion), 53 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.91(P=0)					
1.26.3 Ordinal scale pain faces 4 to 5, 30 mins after randomisation					
Taha 2000	30/59	46/61		100%	0.67[0.51,0.9]
Subtotal (95% CI)	**59**	**61**		**100%**	**0.67[0.51,0.9]**
Total events: 30 (Immersion), 46 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.67(P=0.01)					
1.26.4 Ordinal description as moderate to severe, 1 hr after randomisation					
Taha 2000	41/58	55/59		100%	0.76[0.63,0.91]
Subtotal (95% CI)	**58**	**59**		**100%**	**0.76[0.63,0.91]**
Total events: 41 (Immersion), 55 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=3.02(P=0)					
1.26.5 VAS scale 8 to 10, 1 hr after randomisation					
Taha 2000	19/58	16/59		100%	1.21[0.69,2.11]
Subtotal (95% CI)	**58**	**59**		**100%**	**1.21[0.69,2.11]**
Total events: 19 (Immersion), 16 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.66(P=0.51)					
1.26.6 Ordinal scale pain faces 4 to 5, 1 hr after randomisation					
Taha 2000	34/58	51/59		100%	0.68[0.53,0.86]
Subtotal (95% CI)	**58**	**59**		**100%**	**0.68[0.53,0.86]**
Total events: 34 (Immersion), 51 (No immersion)					
Heterogeneity: $Tau^2=0$; $Chi^2=0$, df=0(P<0.0001); $I^2=100\%$					

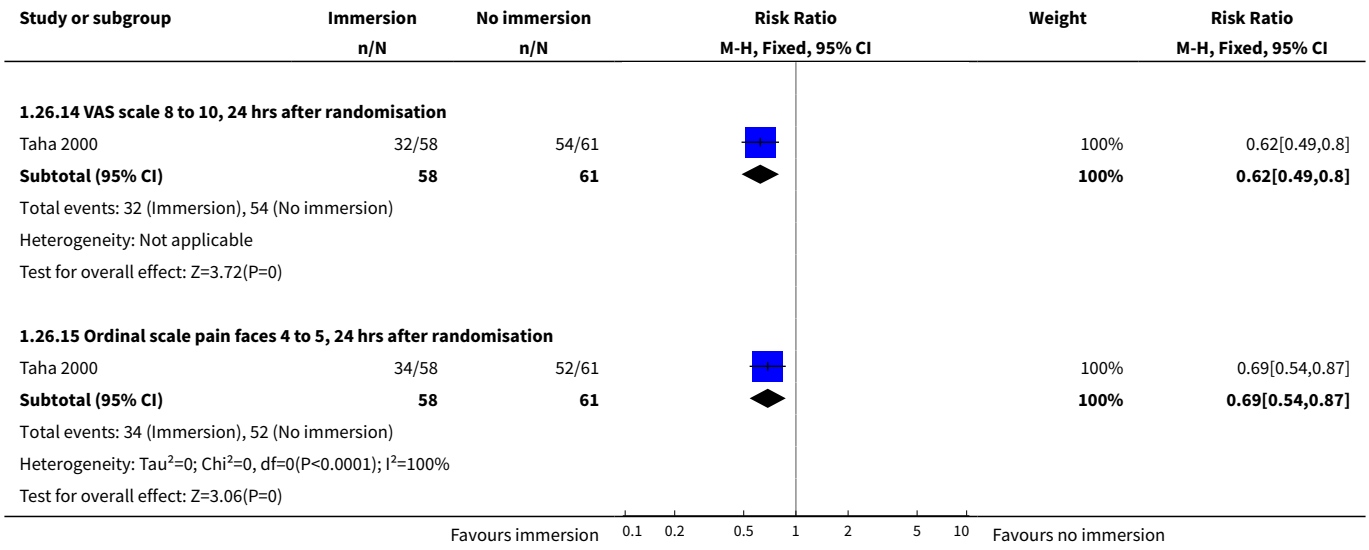
Favours immersion 0.1 0.2 0.5 1 2 5 10 Favours no immersion

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Test for overall effect: Z=3.19(P=0)					
1.26.7 Ordinal description as moderate to severe, 2 hrs after randomisation					
Taha 2000	17/23	33/34		100%	0.76[0.59,0.98]
Subtotal (95% CI)	**23**	**34**		**100%**	**0.76[0.59,0.98]**
Total events: 17 (Immersion), 33 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%					
Test for overall effect: Z=2.14(P=0.03)					
1.26.8 VAS scale 8 to 10, 2 hrs after randomisation					
Taha 2000	18/23	32/34		100%	0.83[0.66,1.05]
Subtotal (95% CI)	**23**	**34**		**100%**	**0.83[0.66,1.05]**
Total events: 18 (Immersion), 32 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.56(P=0.12)					
1.26.9 Ordinal scale pain faces 4 to 5, 2 hrs after randomisation					
Taha 2000	15/23	31/34		100%	0.72[0.52,0.98]
Subtotal (95% CI)	**23**	**34**		**100%**	**0.72[0.52,0.98]**
Total events: 15 (Immersion), 31 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.08(P=0.04)					
1.26.10 Ordinal description as moderate to severe, 3 hrs after randomisation					
Taha 2000	3/6	25/26		100%	0.52[0.23,1.16]
Subtotal (95% CI)	**6**	**26**		**100%**	**0.52[0.23,1.16]**
Total events: 3 (Immersion), 25 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.59(P=0.11)					
1.26.11 VAS scale 8 to 10, 3 hrs after randomisation					
Taha 2000	4/6	25/26		100%	0.69[0.39,1.23]
Subtotal (95% CI)	**6**	**26**		**100%**	**0.69[0.39,1.23]**
Total events: 4 (Immersion), 25 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.26(P=0.21)					
1.26.12 Ordinal scale pain faces 4 to 5, 3 hrs after randomisation					
Taha 2000	3/6	23/26		100%	0.57[0.25,1.27]
Subtotal (95% CI)	**6**	**26**		**100%**	**0.57[0.25,1.27]**
Total events: 3 (Immersion), 23 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.38(P=0.17)					
1.26.13 Ordinal description as moderate to severe, 24 hrs after randomisation					
Taha 2000	33/58	54/61		100%	0.64[0.5,0.82]
Subtotal (95% CI)	**58**	**61**		**100%**	**0.64[0.5,0.82]**
Total events: 33 (Immersion), 54 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%					
Test for overall effect: Z=3.59(P=0)					

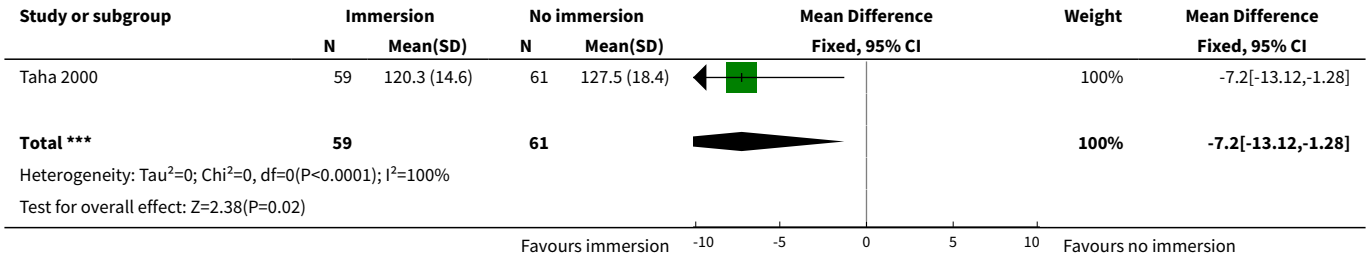


Favours immersion

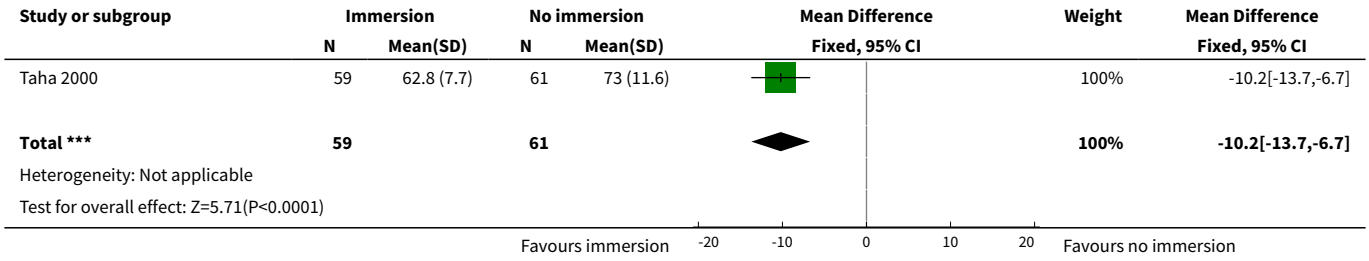
Favours no immersion



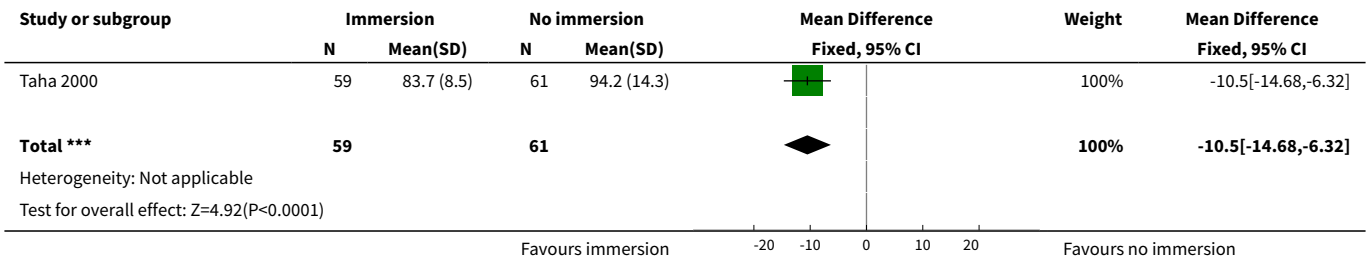
Analysis 1.27. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 27 Systolic blood pressure.



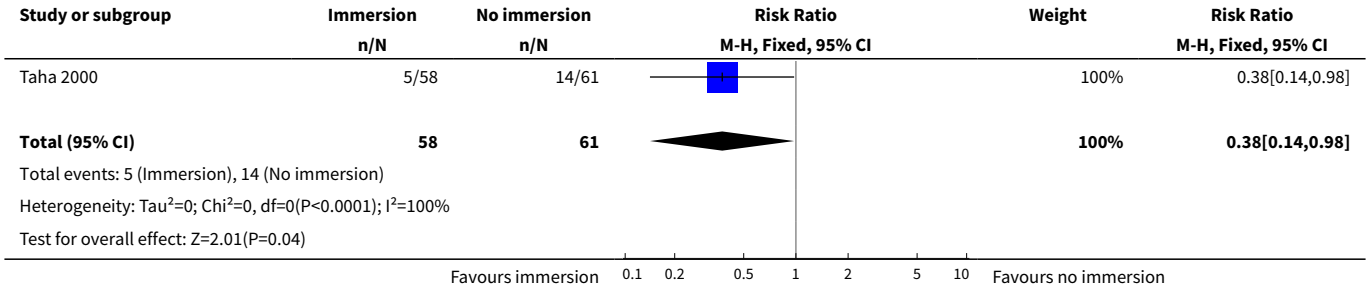
Analysis 1.28. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 28 Diastolic blood pressure.



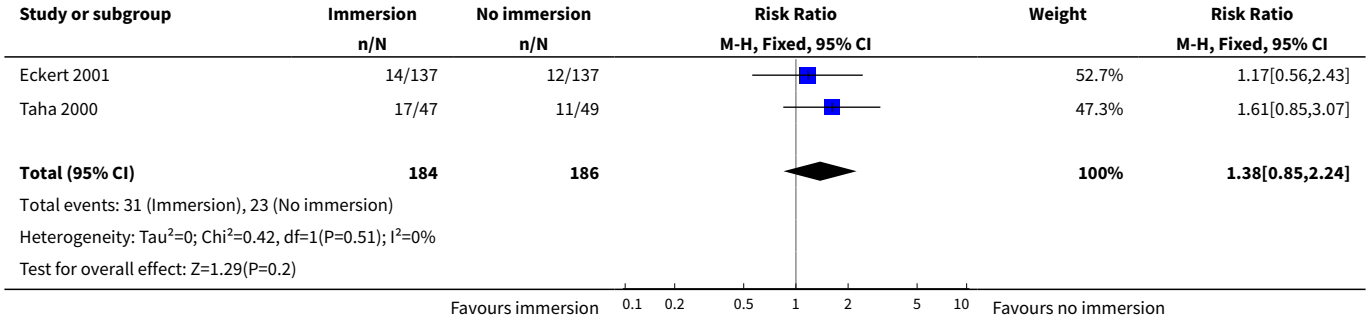
Analysis 1.29. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 29 Mean arterial blood pressure.



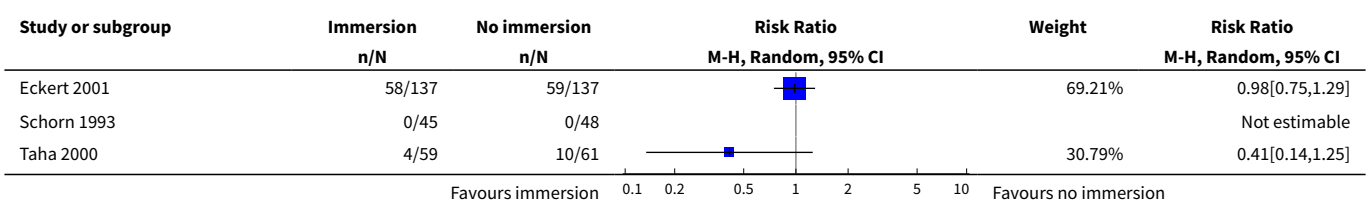
Analysis 1.30. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 30 Preference for care in subsequent labour (Does not wish to use bath with next labour/birth).

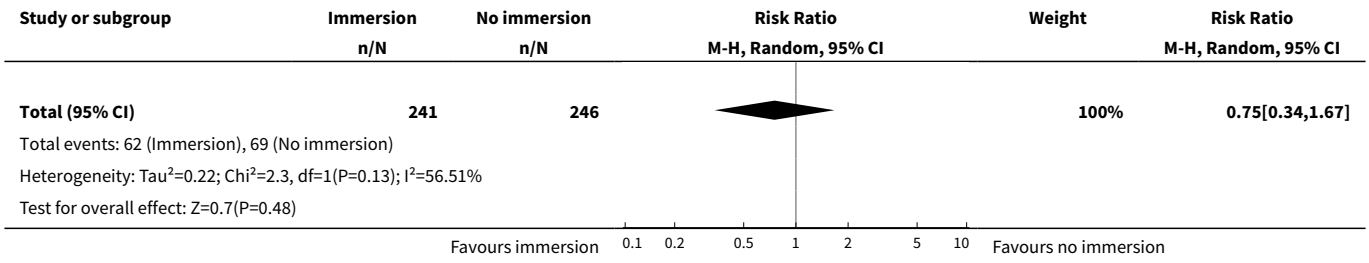


Analysis 1.31. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 31 Postpartum depression (EPDS more than 11).

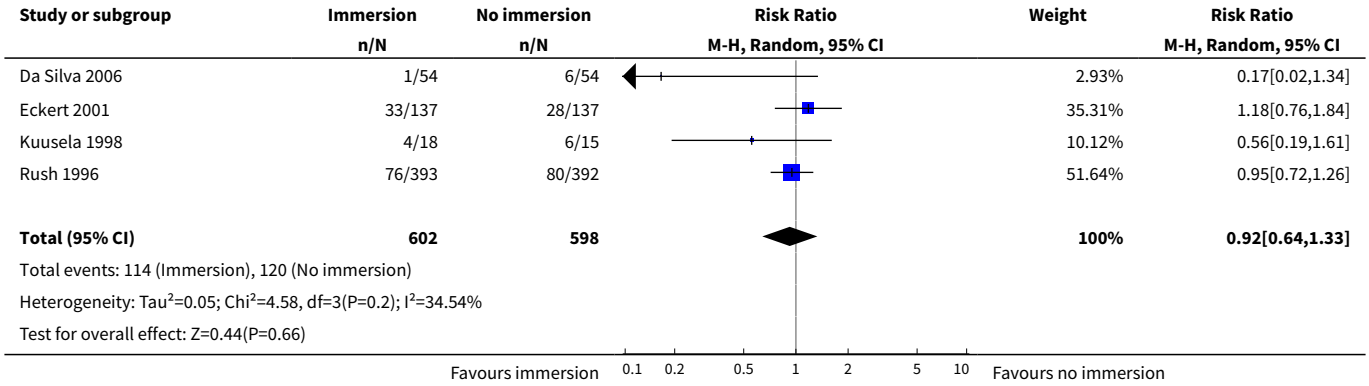


Analysis 1.32. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 32 Abnormal fetal heart rate patterns.

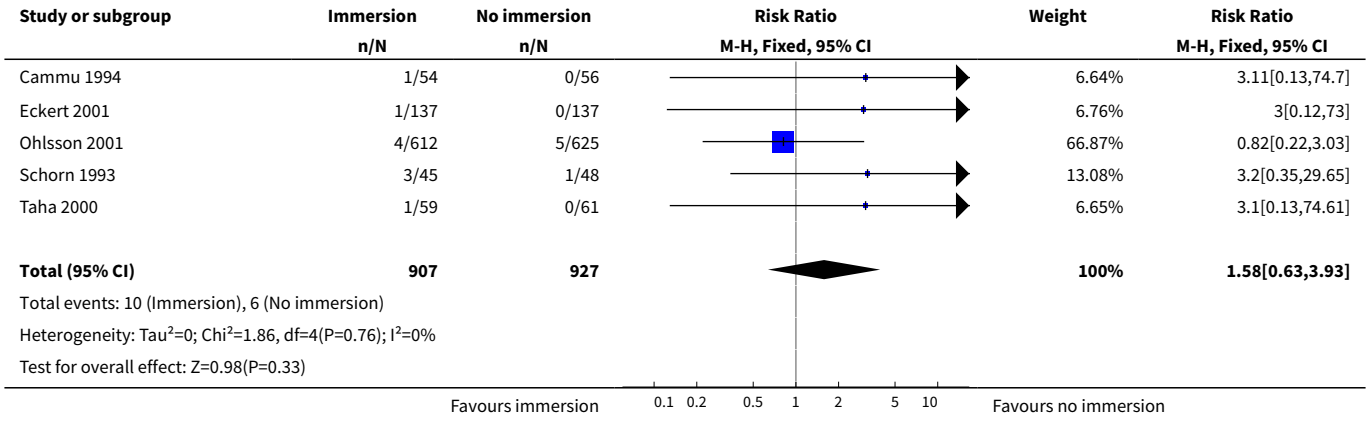




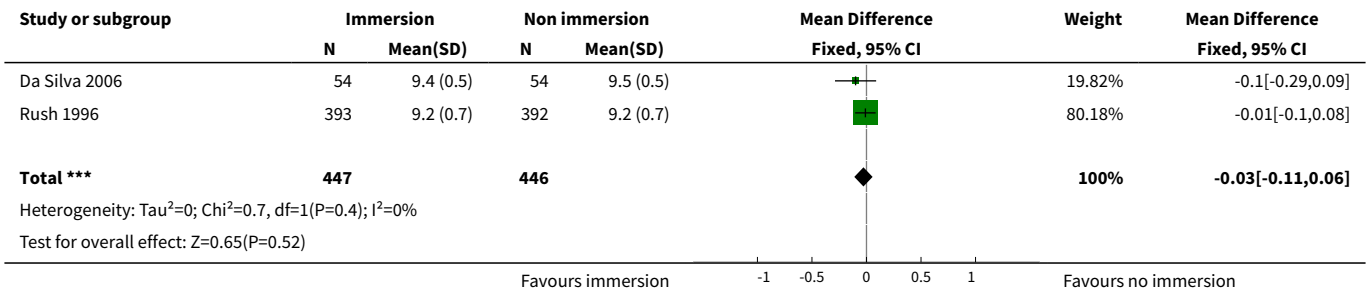
Analysis 1.33. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 33 Presence of meconium-stained liquor.



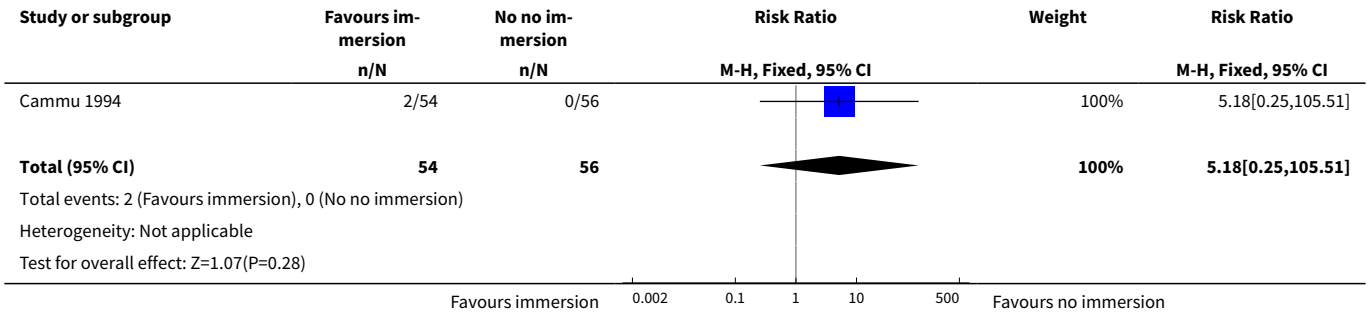
Analysis 1.34. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 34 Apgar score less than seven at five minutes.



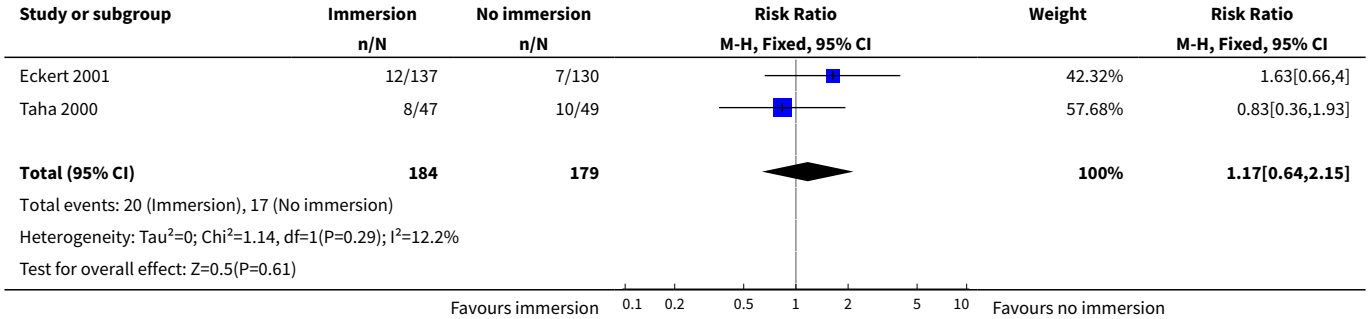
Analysis 1.35. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 35 Apgar score at five minutes.



Analysis 1.36. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 36 Umbilical artery pH less than 7.20.



Analysis 1.37. Comparison 1 Immersion in water versus no immersion during first stage of labour, Outcome 37 Breastfeeding - not breastfeeding after six weeks post birth.



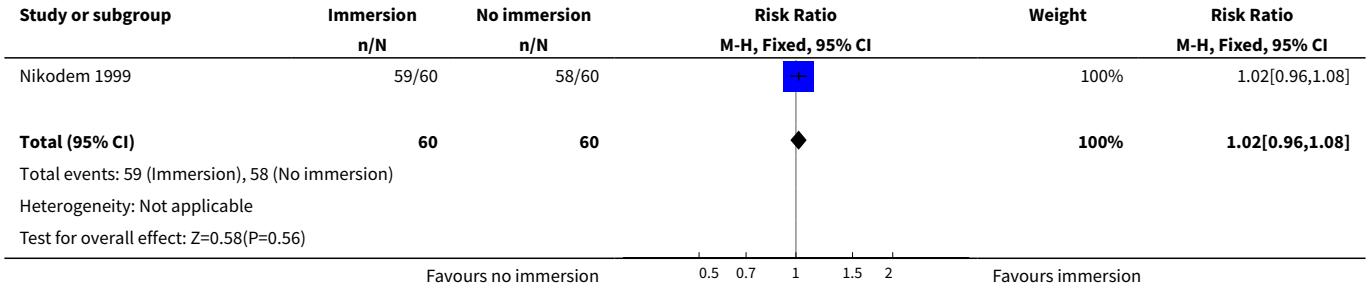
Comparison 2. Immersion in water versus no immersion during second stage of labour

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mode of birth (spontaneous vaginal birth)	1	120	Risk Ratio (M-H, Fixed, 95% CI)	1.02 [0.96, 1.08]

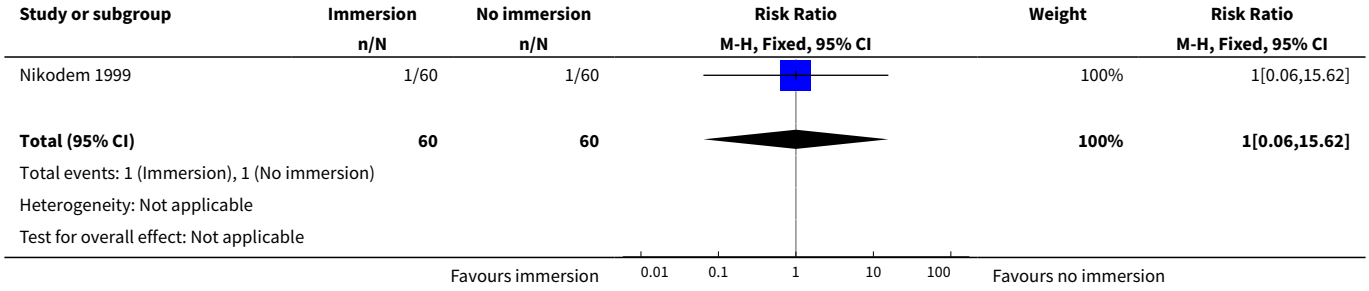
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2 Mode of birth (instrumental vaginal births)	1	120	Risk Ratio (M-H, Fixed, 95% CI)	1.0 [0.06, 15.62]
3 Mode of birth (caesarean section)	1	120	Risk Ratio (M-H, Fixed, 95% CI)	0.33 [0.01, 8.02]
4 Perinatal deaths	1	120	Risk Ratio (M-H, Fixed, 95% CI)	3.0 [0.12, 72.20]
5 Admission to neonatal intensive care unit	2	291	Risk Ratio (M-H, Fixed, 95% CI)	0.78 [0.38, 1.59]
6 Neonate temperature	1		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
6.1 Temperature less than 36.2 degrees C at birth	1	109	Risk Ratio (M-H, Fixed, 95% CI)	0.98 [0.30, 3.20]
6.2 Temperature greater than 37.5 degrees C at birth	1	109	Risk Ratio (M-H, Fixed, 95% CI)	2.62 [0.73, 9.35]
7 Fever reported in first week	1	171	Risk Ratio (M-H, Fixed, 95% CI)	0.53 [0.10, 2.82]
8 Postpartum haemorrhage more than 500 mL	1	120	Risk Ratio (M-H, Fixed, 95% CI)	0.14 [0.01, 2.71]
9 Duration of second stage (minutes)	2	291	Mean Difference (IV, Fixed, 95% CI)	-1.83 [-8.18, 4.52]
10 Perineal trauma (episiotomy)	1	119	Risk Ratio (M-H, Fixed, 95% CI)	0.74 [0.17, 3.15]
11 Perineal trauma (second degree tear)	1	119	Risk Ratio (M-H, Fixed, 95% CI)	1.16 [0.57, 2.38]
12 Experience of moderate to severe pain	1	117	Risk Ratio (M-H, Fixed, 95% CI)	1.06 [0.73, 1.53]
12.1 Ordinal description as moderate to severe	1	117	Risk Ratio (M-H, Fixed, 95% CI)	1.06 [0.73, 1.53]
13 Preference for care in subsequent labour (Does not wish to use bath next birth)	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.57 [0.22, 1.47]
14 Satisfied with labour	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.24 [0.07, 0.80]
14.1 Little or not satisfied with coping experience	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.24 [0.07, 0.80]
15 Presence of meconium-stained liquor	1	120	Risk Ratio (M-H, Fixed, 95% CI)	1.4 [0.47, 4.17]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
16 Apgar score less than seven (five minutes)	1	119	Risk Ratio (M-H, Fixed, 95% CI)	4.92 [0.24, 100.31]
17 Mean Apgar at five minutes	1	171	Mean Difference (IV, Fixed, 95% CI)	-0.10 [-0.22, 0.02]
18 Umbilical artery pH less than 7.20	1	116	Risk Ratio (M-H, Fixed, 95% CI)	0.89 [0.45, 1.75]

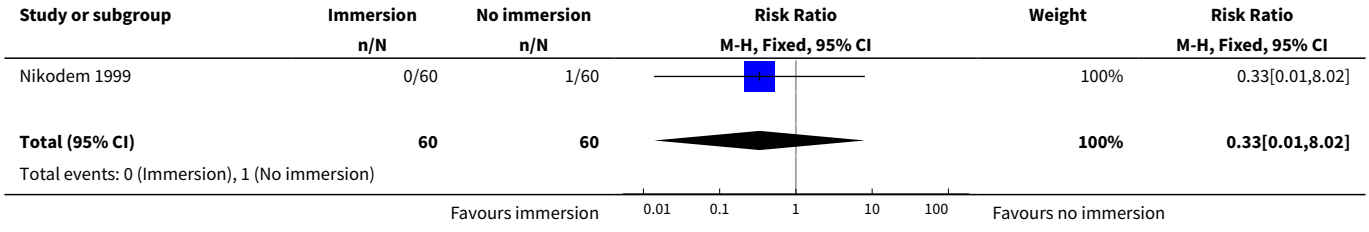
Analysis 2.1. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 1 Mode of birth (spontaneous vaginal birth).

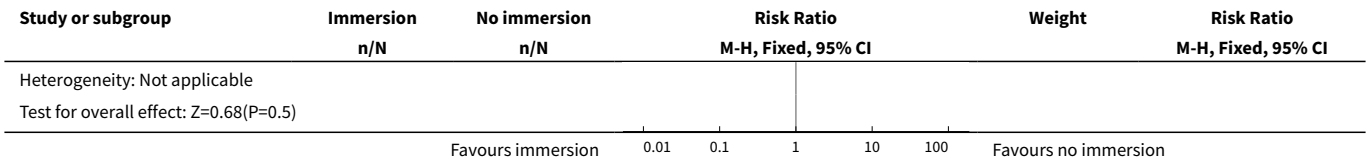


Analysis 2.2. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 2 Mode of birth (instrumental vaginal births).

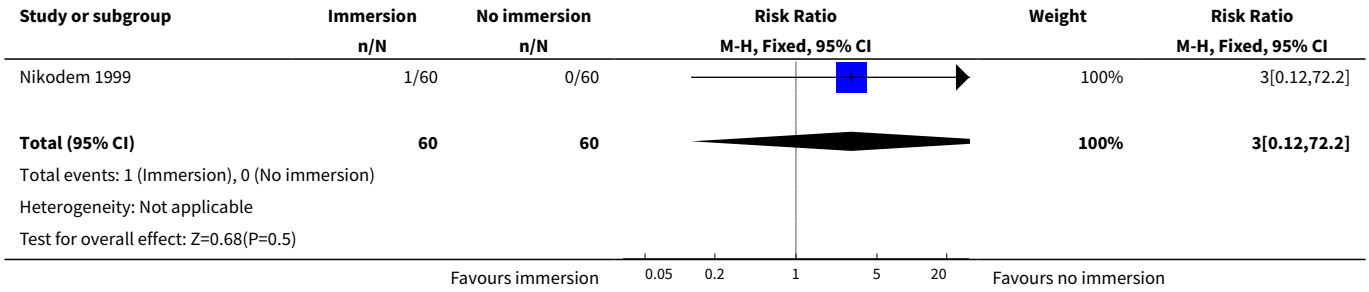


Analysis 2.3. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 3 Mode of birth (caesarean section).

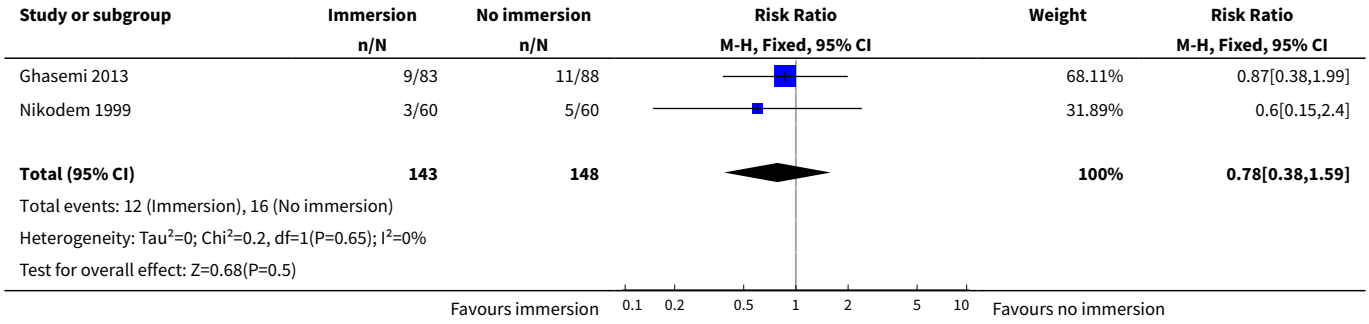




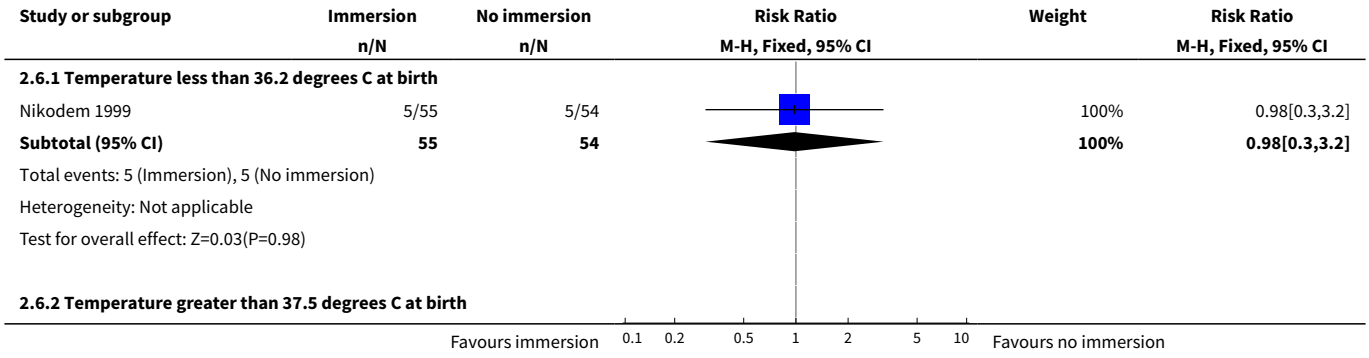
Analysis 2.4. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 4 Perinatal deaths.

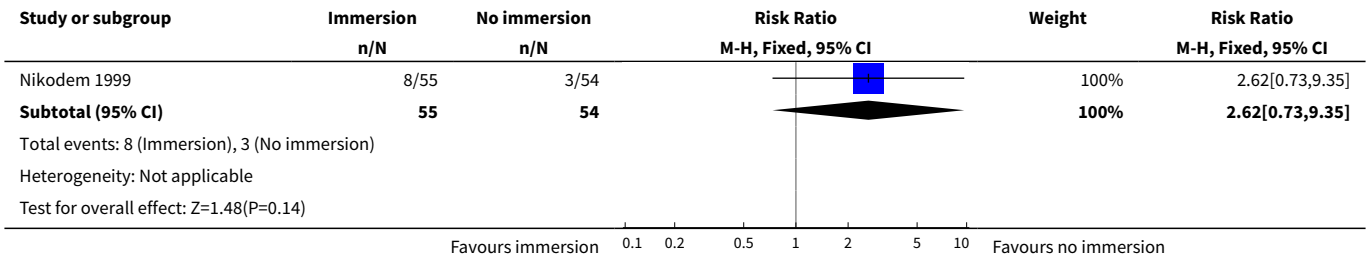


Analysis 2.5. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 5 Admission to neonatal intensive care unit.

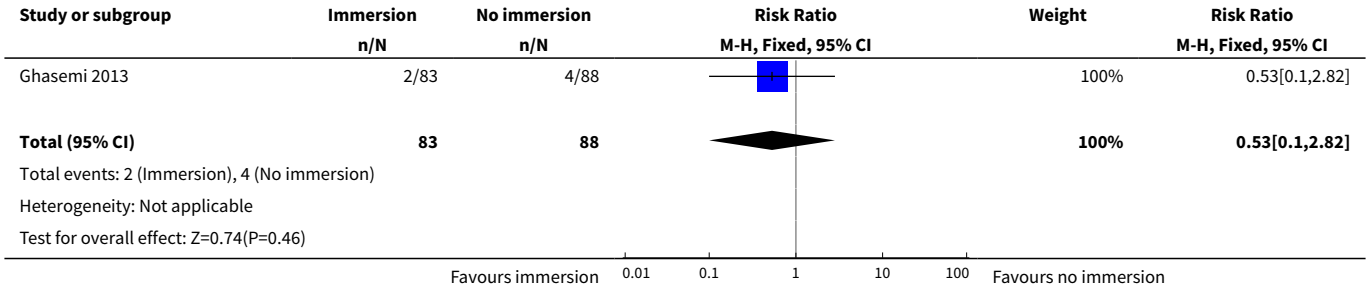


Analysis 2.6. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 6 Neonate temperature.

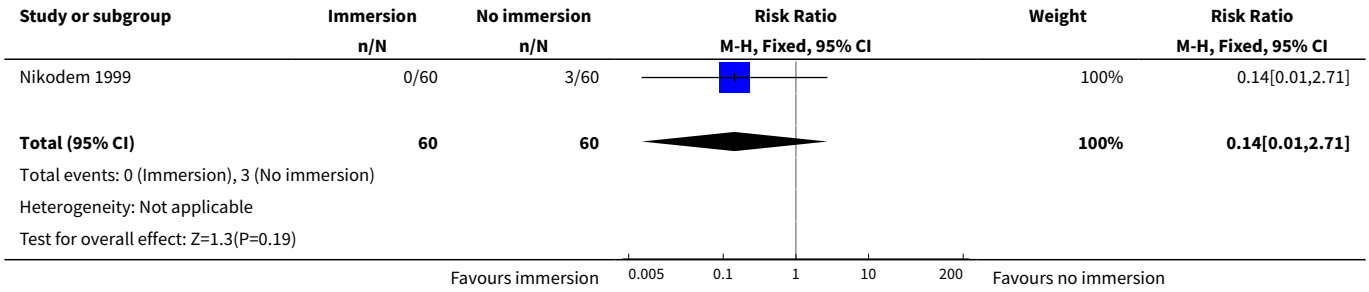




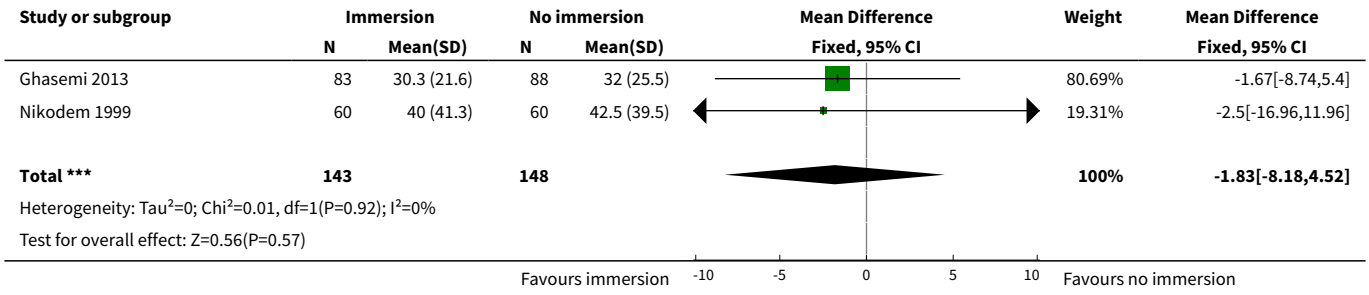
Analysis 2.7. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 7 Fever reported in first week.



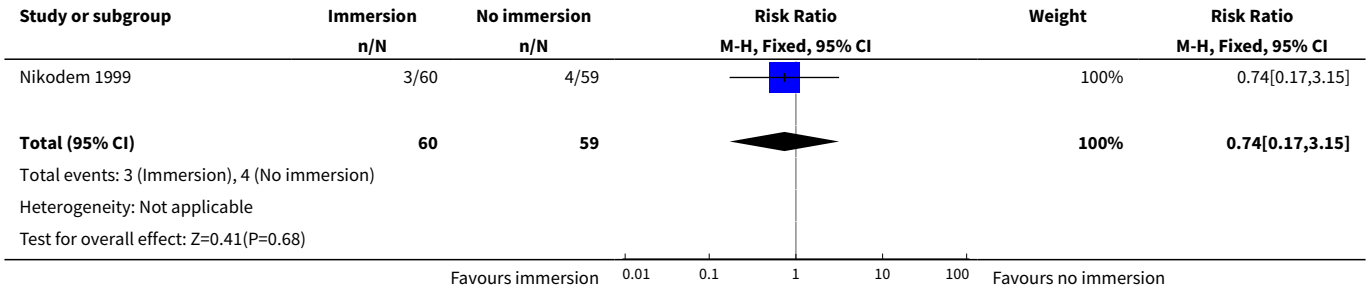
Analysis 2.8. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 8 Postpartum haemorrhage more than 500 mL.



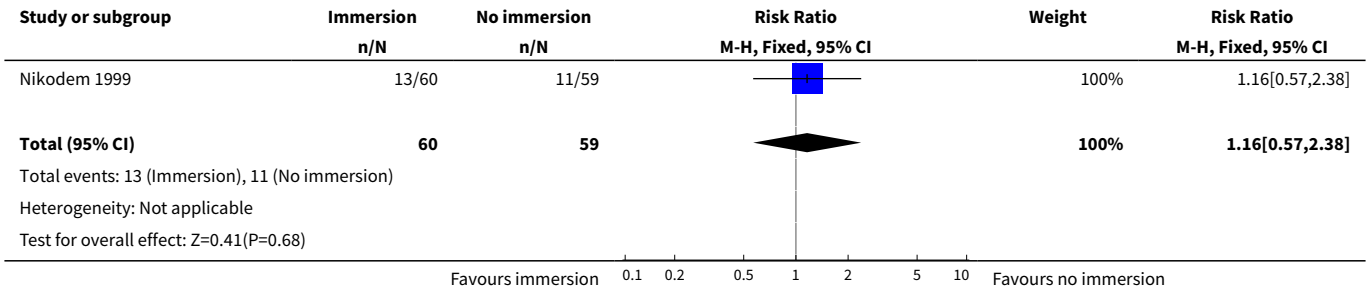
Analysis 2.9. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 9 Duration of second stage (minutes).



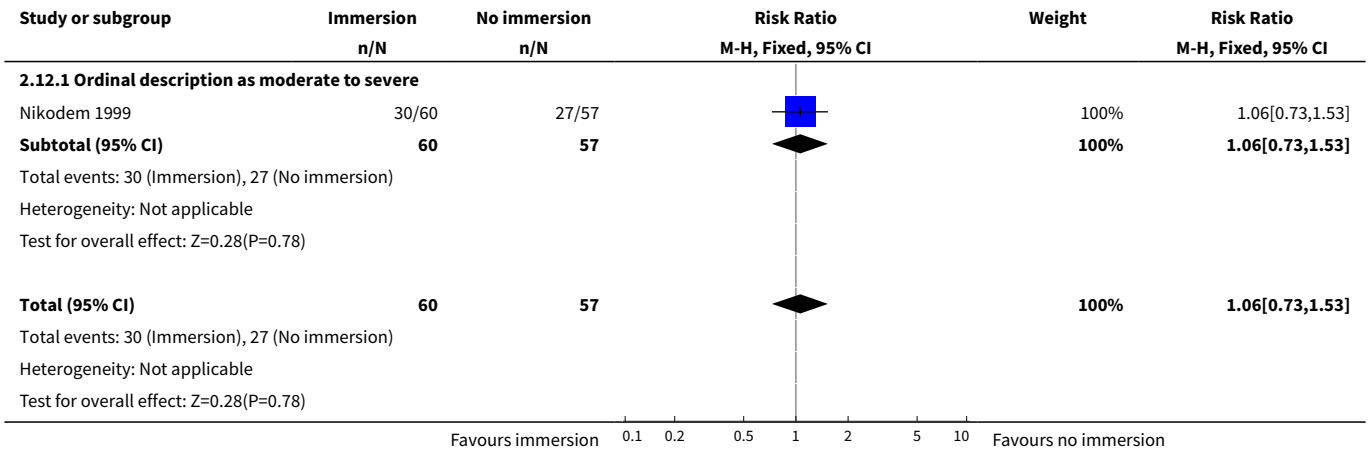
Analysis 2.10. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 10 Perineal trauma (episiotomy).



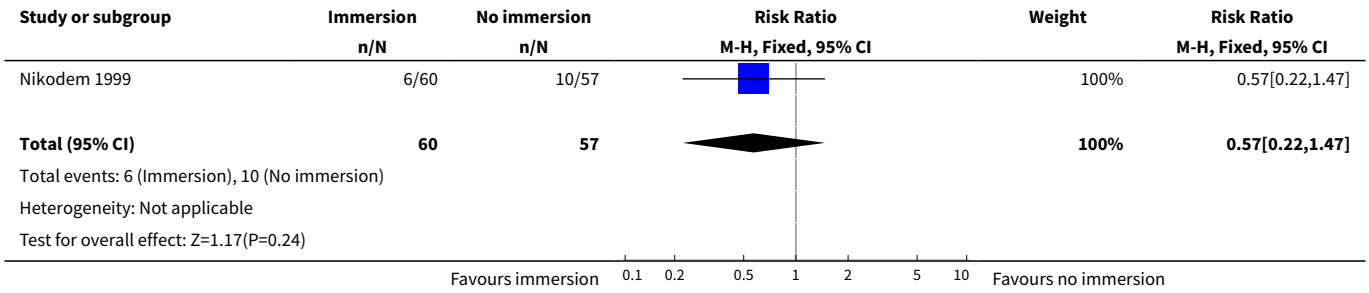
Analysis 2.11. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 11 Perineal trauma (second degree tear).



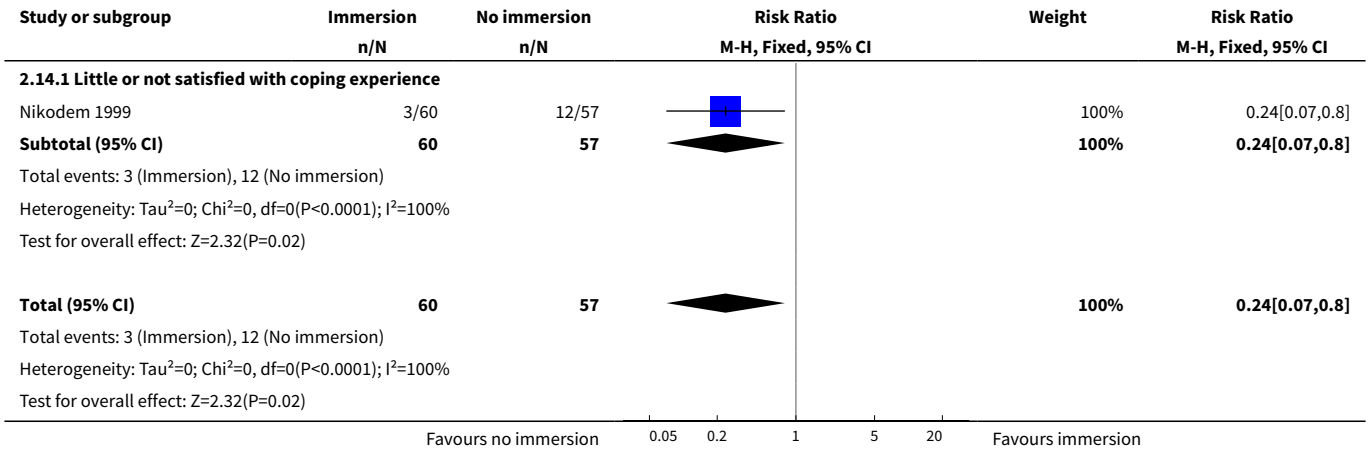
Analysis 2.12. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 12 Experience of moderate to severe pain.



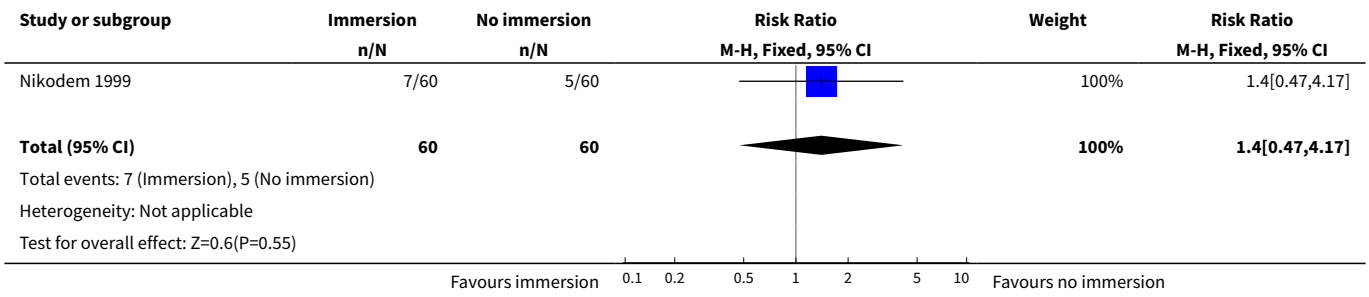
Analysis 2.13. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 13 Preference for care in subsequent labour (Does not wish to use bath next birth).



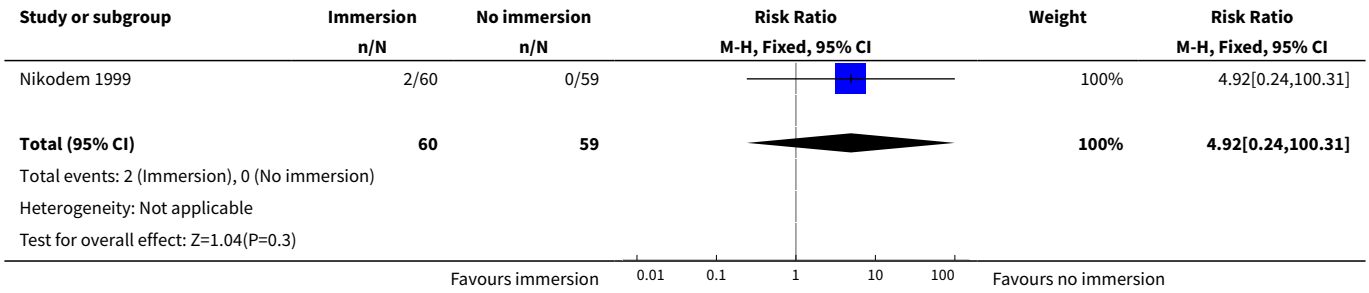
Analysis 2.14. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 14 Satisfied with labour.



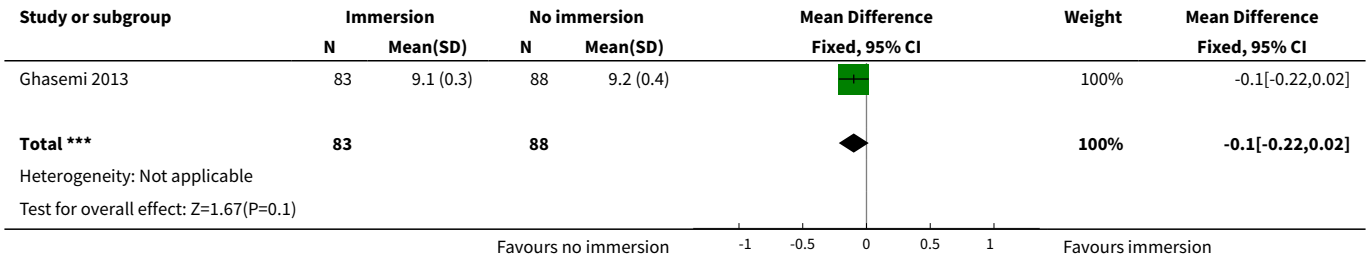
Analysis 2.15. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 15 Presence of meconium-stained liquor.



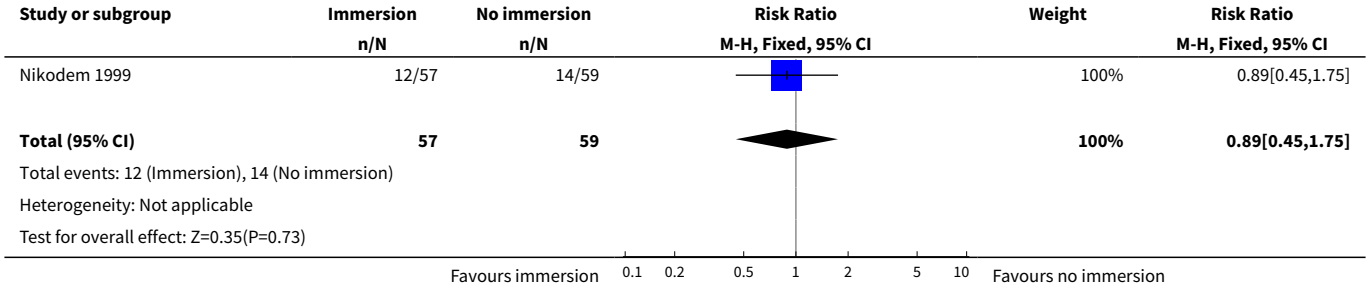
Analysis 2.16. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 16 Apgar score less than seven (five minutes).



Analysis 2.17. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 17 Mean Apgar at five minutes.



Analysis 2.18. Comparison 2 Immersion in water versus no immersion during second stage of labour, Outcome 18 Umbilical artery pH less than 7.20.



Comparison 3. Immersion in water versus no immersion during any stage of labour

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Mode of birth (spontaneous vaginal birth)	9	2845	Risk Ratio (M-H, Random, 95% CI)	1.03 [0.99, 1.09]
2 Mode of birth (instrumental vaginal births)	8	2739	Risk Ratio (M-H, Fixed, 95% CI)	0.86 [0.70, 1.04]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
3 Mode of birth (caesarean section)	9	2832	Risk Ratio (M-H, Fixed, 95% CI)	1.19 [0.86, 1.65]
4 Use of analgesia (regional)	6	2499	Risk Ratio (M-H, Fixed, 95% CI)	0.90 [0.82, 0.98]
5 Perineal trauma (third- or fourth-degree tears)	5	2401	Risk Ratio (M-H, Fixed, 95% CI)	1.37 [0.86, 2.17]
6 Perinatal deaths	1	120	Risk Ratio (M-H, Fixed, 95% CI)	3.0 [0.12, 72.20]
7 Admission to neonatal intensive care unit	5	1862	Risk Ratio (M-H, Fixed, 95% CI)	0.99 [0.70, 1.39]
8 Neonatal infection	5	1295	Risk Ratio (M-H, Fixed, 95% CI)	2.00 [0.50, 7.94]
9 Neonate temperature	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
9.1 Temperature greater than 37.8 degrees C as an indicator for infection	1	274	Risk Ratio (M-H, Fixed, 95% CI)	1.0 [0.06, 15.83]
9.2 Temperature less than 36.2 degrees C at birth	1	109	Risk Ratio (M-H, Fixed, 95% CI)	0.98 [0.30, 3.20]
9.3 Temperature greater than 37.5 degrees C at birth	1	109	Risk Ratio (M-H, Fixed, 95% CI)	2.62 [0.73, 9.35]
10 Fever reported in first week	1	171	Risk Ratio (M-H, Fixed, 95% CI)	0.53 [0.10, 2.82]
11 Antibiotics given to neonate	1	60	Risk Ratio (M-H, Fixed, 95% CI)	1.5 [0.17, 13.52]
12 Estimated blood loss (mL)	3	273	Mean Difference (IV, Fixed, 95% CI)	-6.28 [-13.67, 1.11]
13 Postpartum haemorrhage	2	394	Risk Ratio (M-H, Random, 95% CI)	0.73 [0.08, 6.90]
14 Use of analgesia (pharmacological - pethidine/narcotic)	4	1240	Risk Ratio (M-H, Random, 95% CI)	0.85 [0.46, 1.56]
15 Use of analgesia (pharmacological - any)	2	394	Risk Ratio (M-H, Fixed, 95% CI)	1.05 [0.80, 1.39]
16 Use of any analgesia	5	653	Risk Ratio (M-H, Random, 95% CI)	0.72 [0.46, 1.12]
17 Maternal infection during labour/postnatal period (perineal, systemic, uterine or increase in temperature)	5	1295	Risk Ratio (M-H, Fixed, 95% CI)	0.99 [0.50, 1.96]

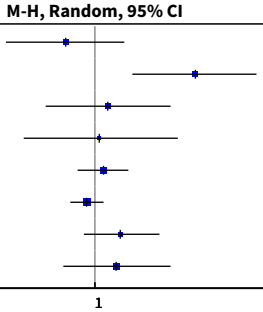
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
18 Artificial rupture of membranes	3	926	Risk Ratio (M-H, Fixed, 95% CI)	1.02 [0.90, 1.16]
19 Use of oxytocin for augmentation of labour	5	1125	Risk Ratio (M-H, Random, 95% CI)	0.64 [0.32, 1.28]
20 Use of non-pharmacological analgesia (transcutaneous nerve stimulation (TENS))	2	845	Risk Ratio (M-H, Fixed, 95% CI)	1.05 [0.37, 2.94]
21 Duration of first stage (minutes)	8	1561	Mean Difference (IV, Random, 95% CI)	-42.21 [-80.93, -3.49]
22 Duration of second stage (minutes)	11	1960	Mean Difference (IV, Random, 95% CI)	-2.85 [-8.85, 3.16]
23 Duration of third stage (minutes)	3	1165	Mean Difference (IV, Random, 95% CI)	-0.52 [-1.84, 0.79]
24 Duration of total labour (all three stages)	2	240	Mean Difference (IV, Fixed, 95% CI)	-40.83 [-87.09, 5.43]
25 Perineal trauma (none- intact)	5	1337	Risk Ratio (M-H, Fixed, 95% CI)	1.16 [0.99, 1.35]
26 Perineal trauma (first- and second-degree tears)	7		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
26.1 Second-degree tear	7	1525	Risk Ratio (M-H, Fixed, 95% CI)	0.89 [0.71, 1.10]
27 Perineal trauma (episiotomy)	7	1511	Risk Ratio (M-H, Random, 95% CI)	0.88 [0.67, 1.17]
28 Self reports pain score on visual analogue scale of 0-10	3		Mean Difference (IV, Random, 95% CI)	Subtotals only
28.1 Pain score at start of assessment period (time zero)	2	141	Mean Difference (IV, Random, 95% CI)	0.15 [-0.79, 1.08]
28.2 Pain score up to 60 minutes later	2	141	Mean Difference (IV, Random, 95% CI)	-0.81 [-1.34, -0.28]
28.3 overall pain score (assessed once post labour)	1	100	Mean Difference (IV, Random, 95% CI)	-3.43 [-3.95, -2.91]
29 Pain intensity (experience of moderate to severe pain)	2		Risk Ratio (M-H, Fixed, 95% CI)	Subtotals only
29.1 Ordinal description as moderate to severe, 30 mins after randomisation	1	120	Risk Ratio (M-H, Fixed, 95% CI)	0.75 [0.62, 0.91]
29.2 VAS scale 8 to 10, 30 mins after randomisation	1	120	Risk Ratio (M-H, Fixed, 95% CI)	0.72 [0.58, 0.90]

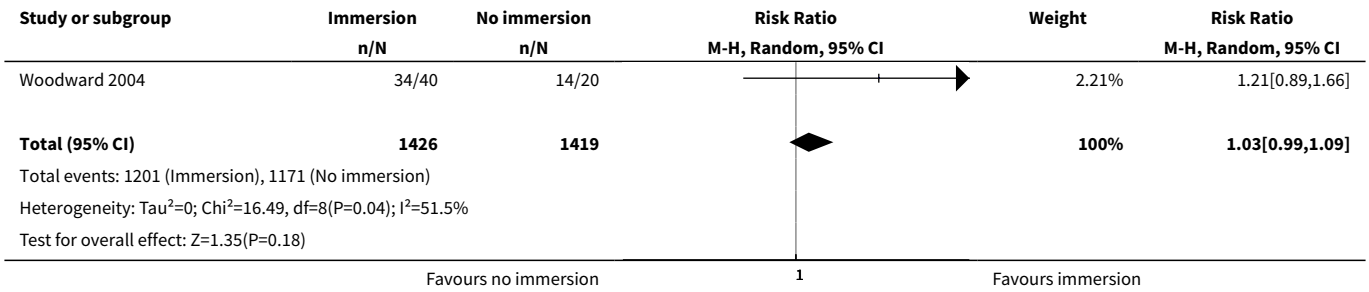
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
29.3 Ordinal scale pain faces 4 to 5, 30 mins after randomisation	1	120	Risk Ratio (M-H, Fixed, 95% CI)	0.67 [0.51, 0.90]
29.4 Ordinal description as moderate to severe, 1 hr after randomisation	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.76 [0.63, 0.91]
29.5 VAS scale 8 to 10, 1 hr after randomisation	1	117	Risk Ratio (M-H, Fixed, 95% CI)	1.21 [0.69, 2.11]
29.6 Ordinal scale pain faces 4 to 5, 1 hr after randomisation	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.68 [0.53, 0.86]
29.7 Ordinal description as moderate to severe, 2 hrs after randomisation	1	57	Risk Ratio (M-H, Fixed, 95% CI)	0.76 [0.59, 0.98]
29.8 VAS scale 8 to 10, 2 hrs after randomisation	1	57	Risk Ratio (M-H, Fixed, 95% CI)	0.83 [0.66, 1.05]
29.9 Ordinal scale pain faces 4 to 5, 2 hrs after randomisation	1	57	Risk Ratio (M-H, Fixed, 95% CI)	0.72 [0.52, 0.98]
29.10 Ordinal description as moderate to severe, 3 hrs after randomisation	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.52 [0.23, 1.16]
29.11 VAS scale 8 to 10, 3 hrs after randomisation	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.69 [0.39, 1.23]
29.12 Ordinal scale pain faces 4 to 5, 3 hrs after randomisation	1	32	Risk Ratio (M-H, Fixed, 95% CI)	0.57 [0.25, 1.27]
29.13 Ordinal description as moderate to severe, 24 hrs after randomisation	1	119	Risk Ratio (M-H, Fixed, 95% CI)	0.64 [0.50, 0.82]
29.14 VAS scale 8 to 10, 24 hrs after randomisation	1	119	Risk Ratio (M-H, Fixed, 95% CI)	0.62 [0.49, 0.80]
29.15 Ordinal scale pain faces 4 to 5, 24 hrs after randomisation	1	119	Risk Ratio (M-H, Fixed, 95% CI)	0.69 [0.54, 0.87]
29.16 Ordinal description as moderate to severe	1	117	Risk Ratio (M-H, Fixed, 95% CI)	1.06 [0.73, 1.53]
30 Maternal temperature	1	60	Mean Difference (IV, Fixed, 95% CI)	0.20 [-0.18, 0.58]
31 Systolic blood pressure	1	120	Mean Difference (IV, Fixed, 95% CI)	-7.20 [-13.12, -1.28]
32 Diastolic blood pressure	1	120	Mean Difference (IV, Fixed, 95% CI)	-10.20 [-13.70, -6.70]
33 Mean arterial blood pressure	1	120	Mean Difference (IV, Fixed, 95% CI)	-10.5 [-14.68, -6.32]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
34 Preference for care in subsequent labour (Does not wish to use bath with next labour/birth)	2	236	Risk Ratio (M-H, Fixed, 95% CI)	0.46 [0.24, 0.90]
35 Satisfied with labour	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.24 [0.07, 0.80]
35.1 Little or not satisfied with coping experience	1	117	Risk Ratio (M-H, Fixed, 95% CI)	0.24 [0.07, 0.80]
36 Satisfied with labour on scale	1	60	Mean Difference (IV, Fixed, 95% CI)	0.03 [-0.64, 0.70]
37 Postpartum depression (EPDS more than 11)	2	370	Risk Ratio (M-H, Fixed, 95% CI)	1.38 [0.85, 2.24]
38 Abnormal fetal heart rate patterns	3	487	Risk Ratio (M-H, Random, 95% CI)	0.75 [0.34, 1.67]
39 Presence of meconium-stained liquor	6	1380	Risk Ratio (M-H, Fixed, 95% CI)	0.97 [0.78, 1.21]
40 Apgar score less than seven at five minutes	6	1953	Risk Ratio (M-H, Fixed, 95% CI)	1.79 [0.76, 4.25]
41 Apgar score at five minutes	4	1184	Mean Difference (IV, Fixed, 95% CI)	-0.04 [-0.11, 0.02]
42 Umbilical artery pH less than 7.20	2	226	Risk Ratio (M-H, Fixed, 95% CI)	1.04 [0.54, 1.98]
43 Breastfeeding	1	60	Risk Ratio (M-H, Fixed, 95% CI)	0.86 [0.69, 1.08]
44 Not breastfeeding after six weeks post birth	2	363	Risk Ratio (M-H, Fixed, 95% CI)	1.17 [0.64, 2.15]

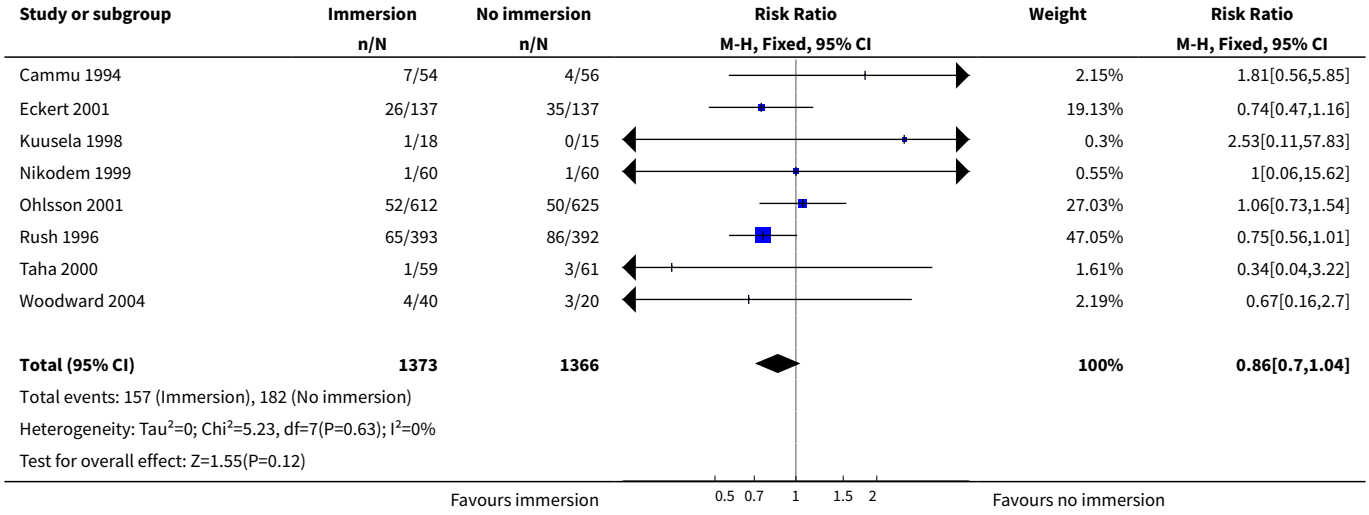
Analysis 3.1. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 1 Mode of birth (spontaneous vaginal birth).

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Cammu 1994	46/54	51/56		8.52%	0.94[0.81,1.07]
Chaichian 2009	53/53	42/53		8.28%	1.26[1.09,1.45]
Eckert 2001	102/137	99/137		8.14%	1.03[0.89,1.19]
Kuusela 1998	17/18	14/15		6%	1.01[0.85,1.21]
Nikodem 1999	59/60	58/60		19.55%	1.02[0.96,1.08]
Ohlsson 2001	543/612	565/625		23.02%	0.98[0.94,1.02]
Rush 1996	293/393	275/392		14.53%	1.06[0.97,1.16]
Taha 2000	54/59	53/61		9.76%	1.05[0.93,1.19]

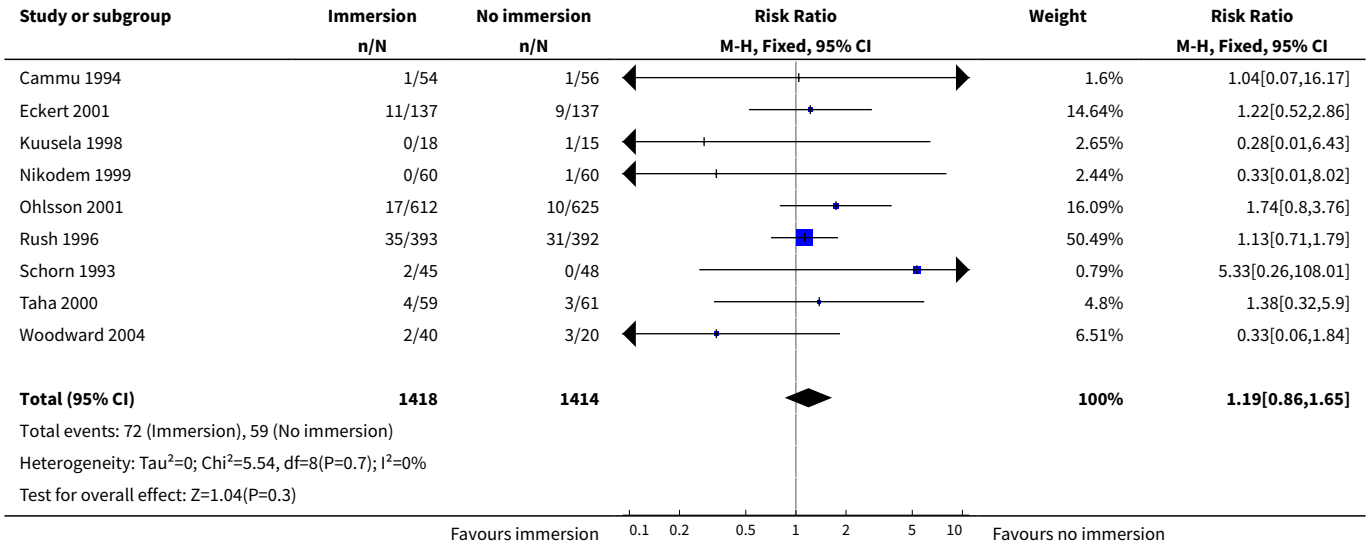




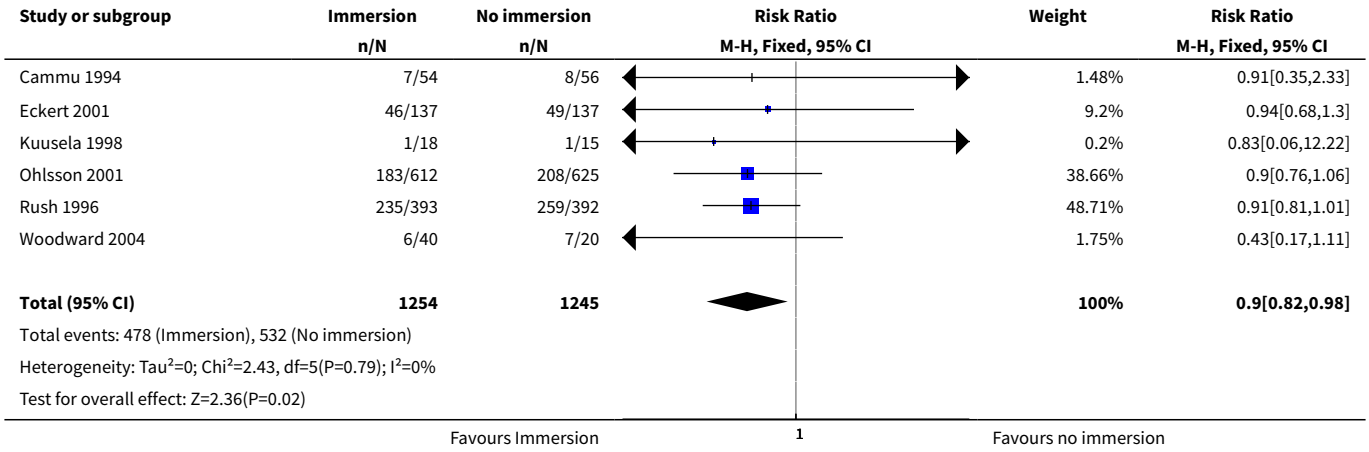
Analysis 3.2. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 2 Mode of birth (instrumental vaginal births).



Analysis 3.3. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 3 Mode of birth (caesarean section).

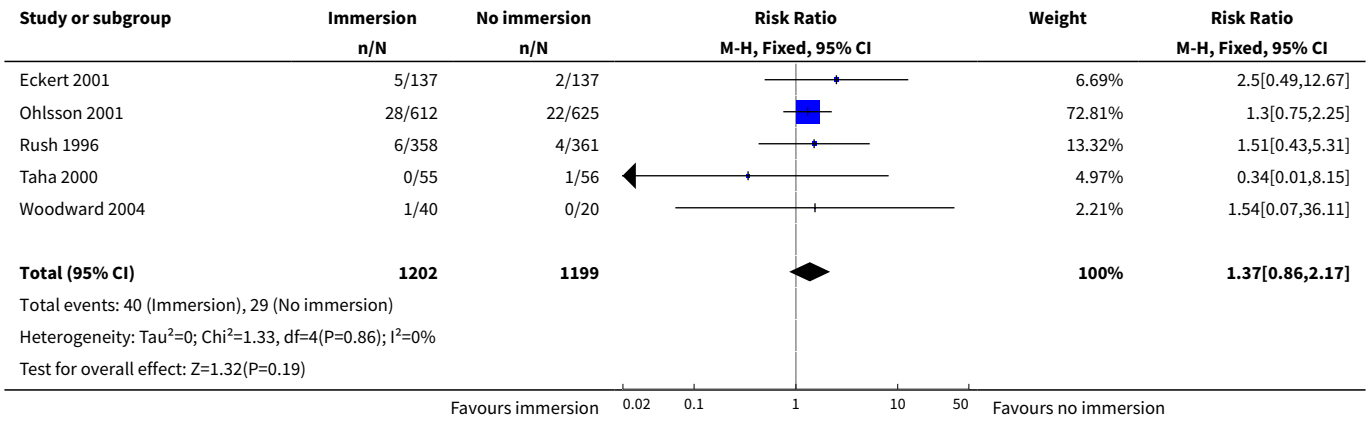


Analysis 3.4. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 4 Use of analgesia (regional).



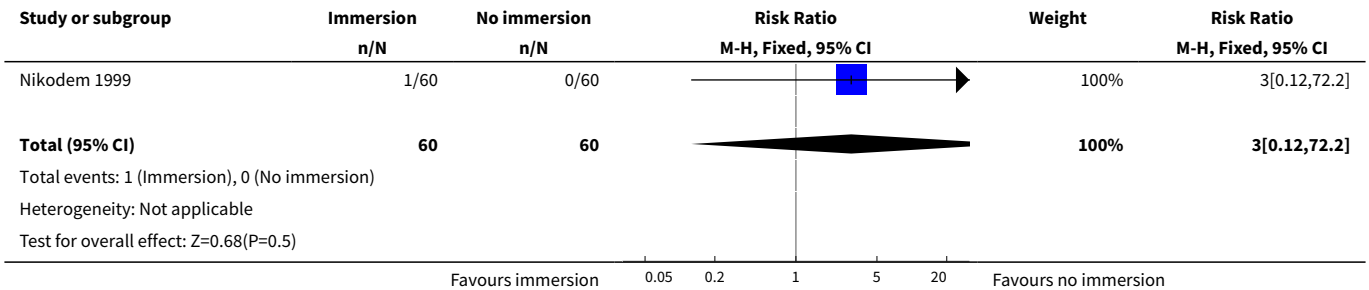
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Cammu 1994	7/54	8/56		1.48%	0.91[0.35,2.33]
Eckert 2001	46/137	49/137		9.2%	0.94[0.68,1.3]
Kuusela 1998	1/18	1/15		0.2%	0.83[0.06,12.22]
Ohlsson 2001	183/612	208/625		38.66%	0.9[0.76,1.06]
Rush 1996	235/393	259/392		48.71%	0.91[0.81,1.01]
Woodward 2004	6/40	7/20		1.75%	0.43[0.17,1.11]
Total (95% CI)	**1254**	**1245**		**100%**	**0.9[0.82,0.98]**
Total events: 478 (Immersion), 532 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=2.43, df=5(P=0.79); I^2=0%					
Test for overall effect: Z=2.36(P=0.02)					

Analysis 3.5. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 5 Perineal trauma (third- or fourth-degree tears).



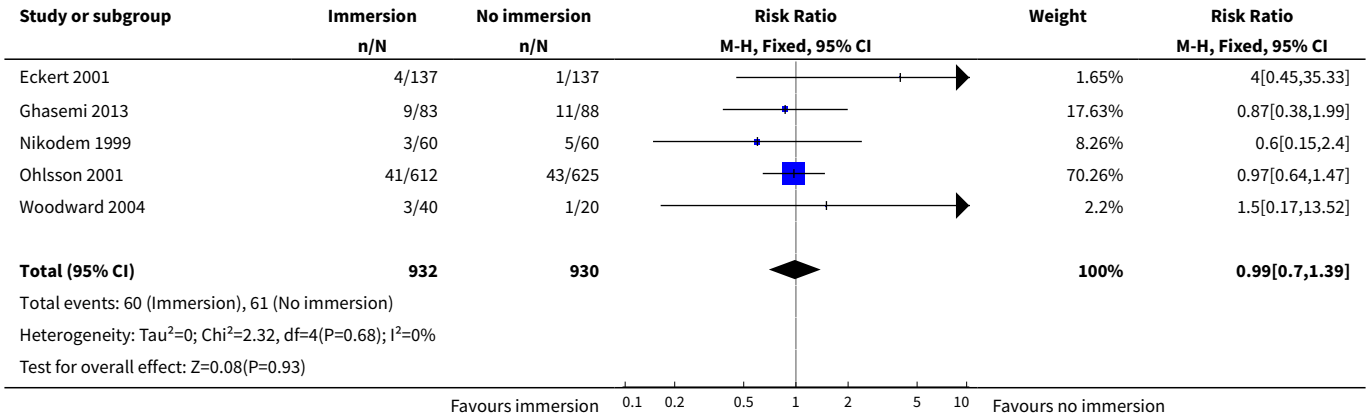
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Eckert 2001	5/137	2/137		6.69%	2.5[0.49,12.67]
Ohlsson 2001	28/612	22/625		72.81%	1.3[0.75,2.25]
Rush 1996	6/358	4/361		13.32%	1.51[0.43,5.31]
Taha 2000	0/55	1/56		4.97%	0.34[0.01,8.15]
Woodward 2004	1/40	0/20		2.21%	1.54[0.07,36.11]
Total (95% CI)	**1202**	**1199**		**100%**	**1.37[0.86,2.17]**
Total events: 40 (Immersion), 29 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=1.33, df=4(P=0.86); I^2=0%					
Test for overall effect: Z=1.32(P=0.19)					

Analysis 3.6. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 6 Perinatal deaths.

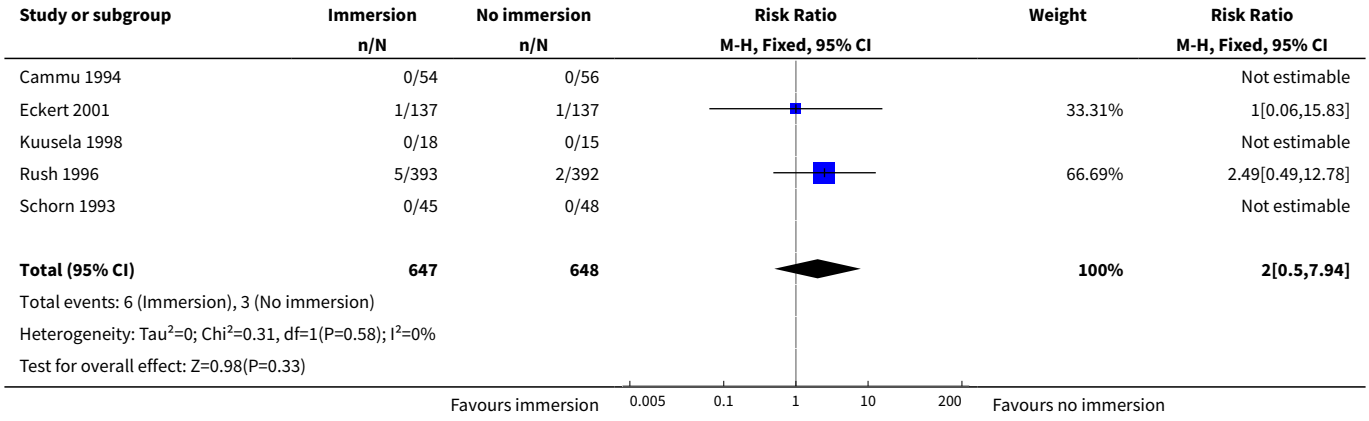


Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Nikodem 1999	1/60	0/60		100%	3[0.12,72.2]
Total (95% CI)	**60**	**60**		**100%**	**3[0.12,72.2]**
Total events: 1 (Immersion), 0 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.68(P=0.5)					

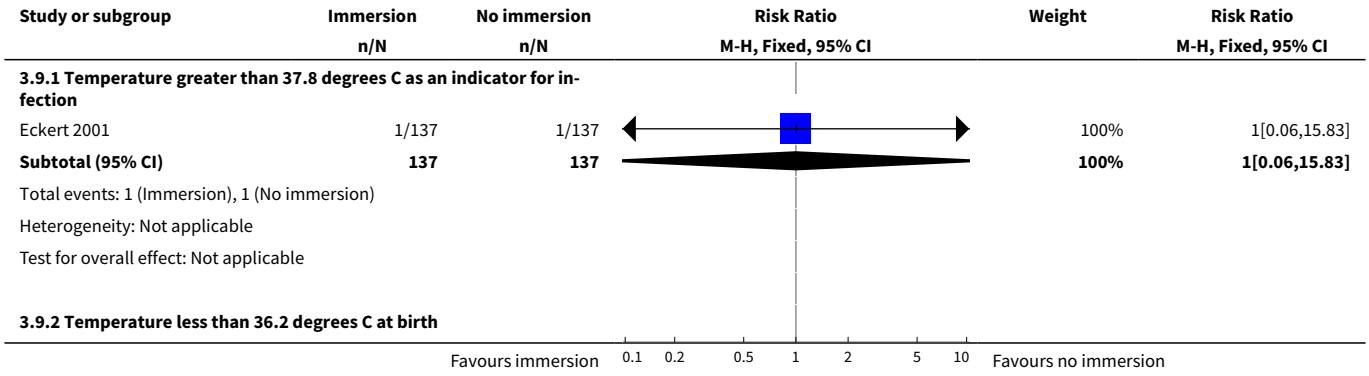
Analysis 3.7. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 7 Admission to neonatal intensive care unit.

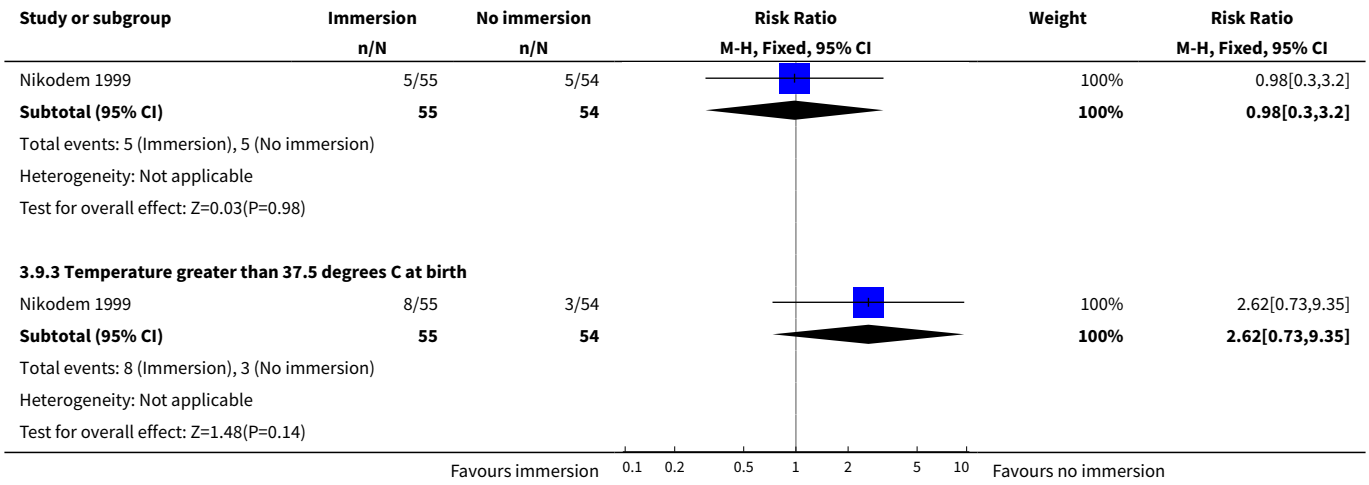


Analysis 3.8. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 8 Neonatal infection.

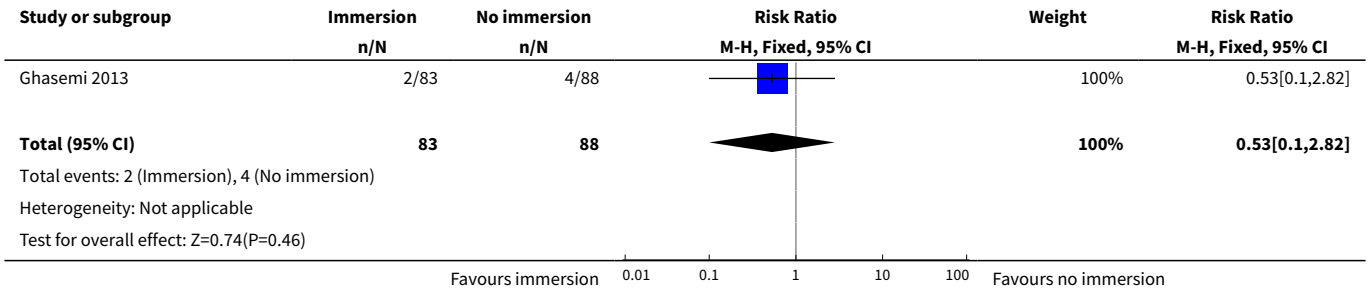


Analysis 3.9. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 9 Neonate temperature.

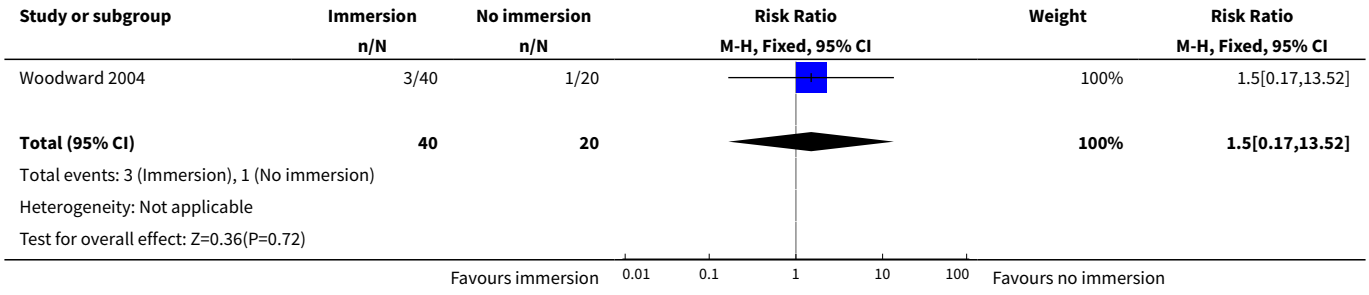




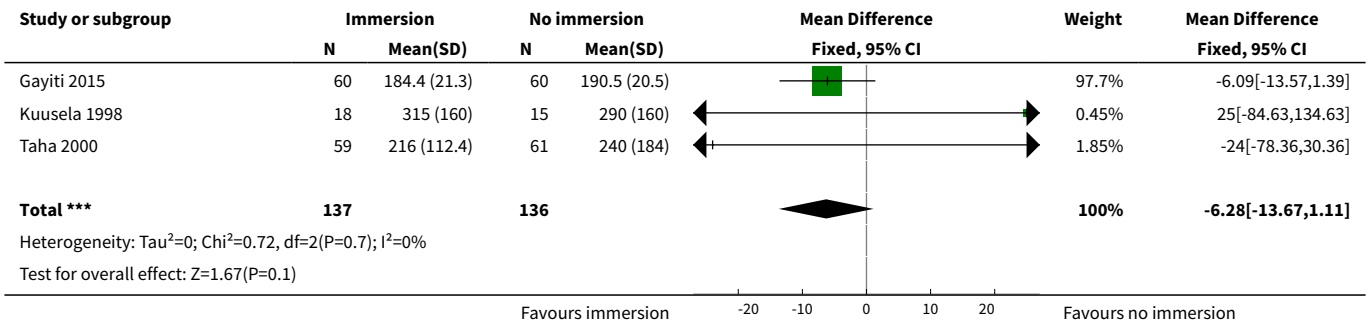
Analysis 3.10. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 10 Fever reported in first week.



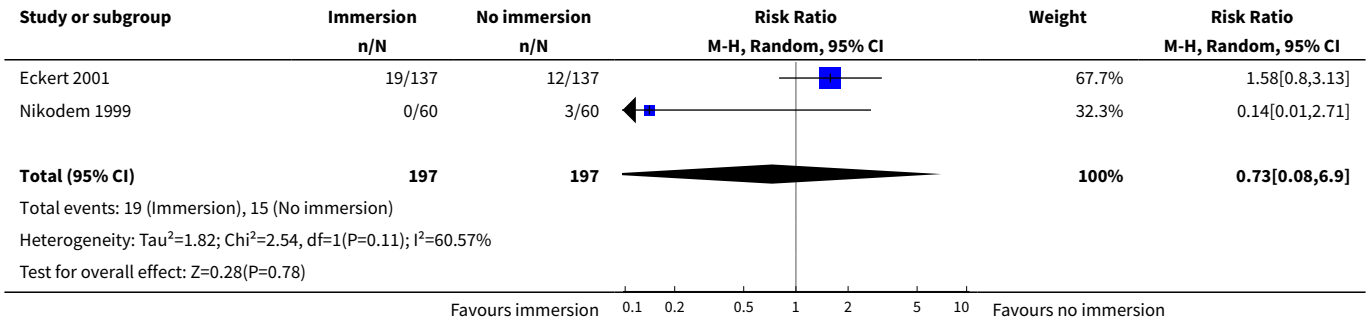
Analysis 3.11. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 11 Antibiotics given to neonate.



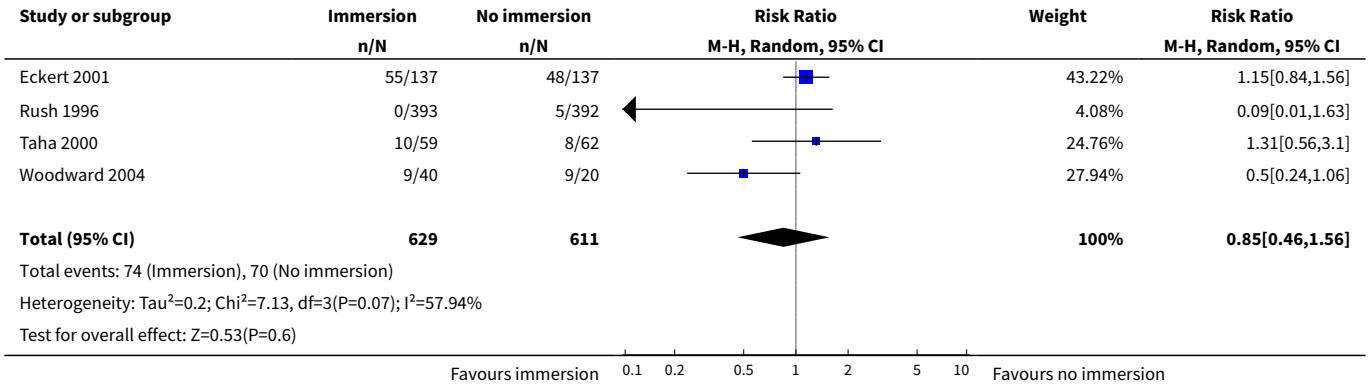
Analysis 3.12. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 12 Estimated blood loss (mL).



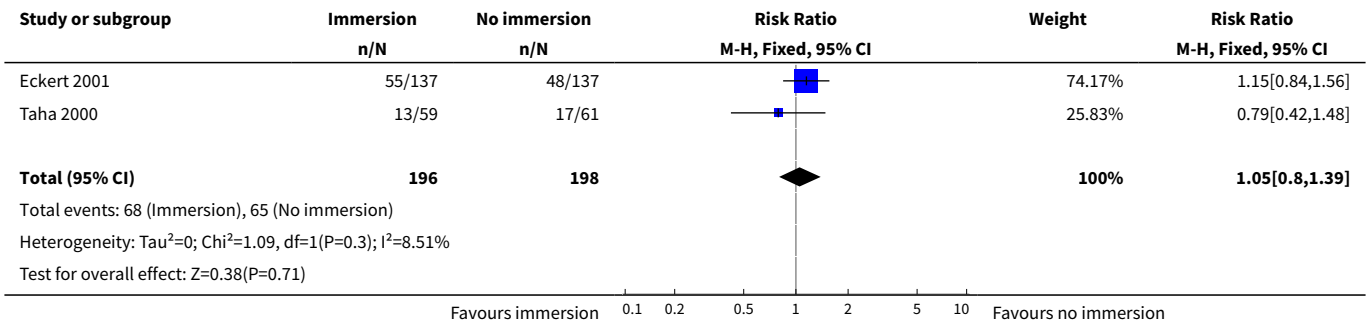
Analysis 3.13. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 13 Postpartum haemorrhage.



Analysis 3.14. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 14 Use of analgesia (pharmacological - pethidine/narcotic).

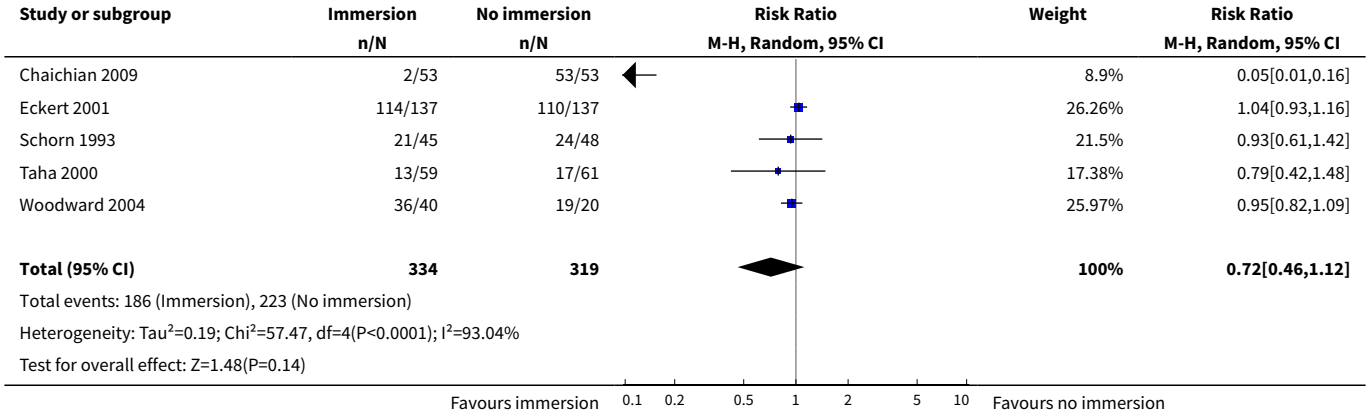


Analysis 3.15. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 15 Use of analgesia (pharmacological - any).



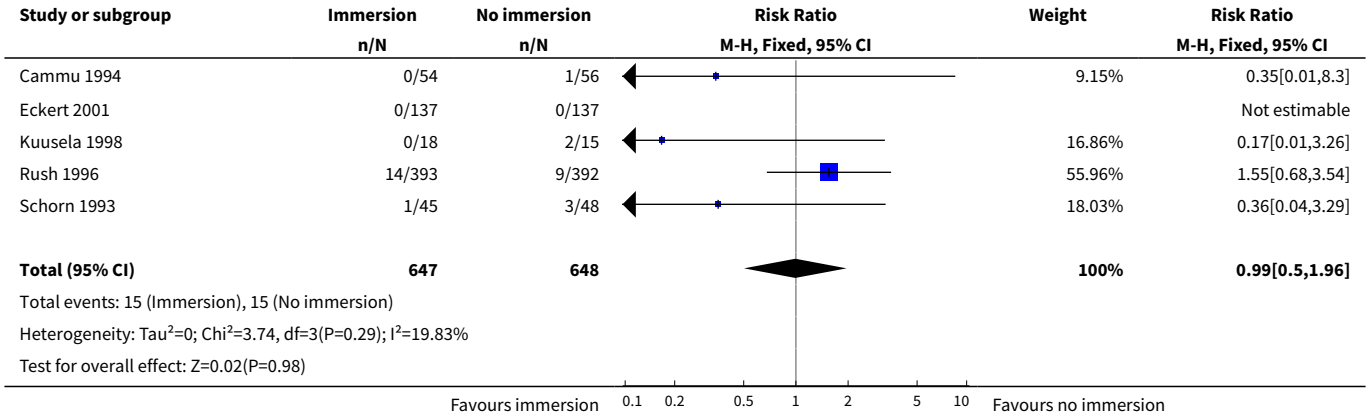
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Eckert 2001	55/137	48/137		74.17%	1.15[0.84,1.56]
Taha 2000	13/59	17/61		25.83%	0.79[0.42,1.48]
Total (95% CI)	**196**	**198**		**100%**	**1.05[0.8,1.39]**
Total events: 68 (Immersion), 65 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=1.09, df=1(P=0.3); I^2=8.51%					
Test for overall effect: Z=0.38(P=0.71)					

Analysis 3.16. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 16 Use of any analgesia.



Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Chaichian 2009	2/53	53/53		8.9%	0.05[0.01,0.16]
Eckert 2001	114/137	110/137		26.26%	1.04[0.93,1.16]
Schorn 1993	21/45	24/48		21.5%	0.93[0.61,1.42]
Taha 2000	13/59	17/61		17.38%	0.79[0.42,1.48]
Woodward 2004	36/40	19/20		25.97%	0.95[0.82,1.09]
Total (95% CI)	**334**	**319**		**100%**	**0.72[0.46,1.12]**
Total events: 186 (Immersion), 223 (No immersion)					
Heterogeneity: Tau^2=0.19; Chi^2=57.47, df=4(P<0.0001); I^2=93.04%					
Test for overall effect: Z=1.48(P=0.14)					

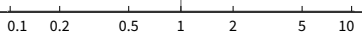
Analysis 3.17. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 17 Maternal infection during labour/postnatal period (perineal, systemic, uterine or increase in temperature).



Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Cammu 1994	0/54	1/56		9.15%	0.35[0.01,8.3]
Eckert 2001	0/137	0/137			Not estimable
Kuusela 1998	0/18	2/15		16.86%	0.17[0.01,3.26]
Rush 1996	14/393	9/392		55.96%	1.55[0.68,3.54]
Schorn 1993	1/45	3/48		18.03%	0.36[0.04,3.29]
Total (95% CI)	**647**	**648**		**100%**	**0.99[0.5,1.96]**
Total events: 15 (Immersion), 15 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=3.74, df=3(P=0.29); I^2=19.83%					
Test for overall effect: Z=0.02(P=0.98)					

Analysis 3.18. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 18 Artificial rupture of membranes.

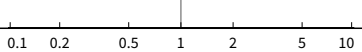
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Da Silva 2006	42/54	36/54		15.39%	1.17[0.92,1.48]
Kuusela 1998	11/18	7/15		3.27%	1.31[0.68,2.52]
Rush 1996	187/393	190/392		81.34%	0.98[0.85,1.14]
Total (95% CI)	**465**	**461**		**100%**	**1.02[0.9,1.16]**
Total events: 240 (Immersion), 233 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=2.06, df=2(P=0.36); I^2=2.82%					
Test for overall effect: Z=0.32(P=0.75)					



Favours immersion — Favours no immersion

Analysis 3.19. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 19 Use of oxytocin for augmentation of labour.

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Chaichian 2009	0/53	50/53		5.36%	0.01[0,0.16]
Da Silva 2006	19/54	23/54		27.46%	0.83[0.51,1.33]
Kuusela 1998	3/18	5/15		15.66%	0.5[0.14,1.76]
Rush 1996	71/393	73/392		29.78%	0.97[0.72,1.3]
Schorn 1993	8/45	10/48		21.74%	0.85[0.37,1.97]
Total (95% CI)	**563**	**562**		**100%**	**0.64[0.32,1.28]**
Total events: 101 (Immersion), 161 (No immersion)					
Heterogeneity: Tau^2=0.41; Chi^2=19.01, df=4(P=0); I^2=78.96%					
Test for overall effect: Z=1.26(P=0.21)					



Favours immersion — Favours no immersion

Analysis 3.20. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 20 Use of non-pharmacological analgesia (transcutaneous nerve stimulation (TENS)).

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Rush 1996	5/393	4/392		60.03%	1.25[0.34,4.61]
Woodward 2004	3/40	2/20		39.97%	0.75[0.14,4.13]
Total (95% CI)	**433**	**412**		**100%**	**1.05[0.37,2.94]**
Total events: 8 (Immersion), 6 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=0.22, df=1(P=0.64); I^2=0%					
Test for overall effect: Z=0.09(P=0.93)					

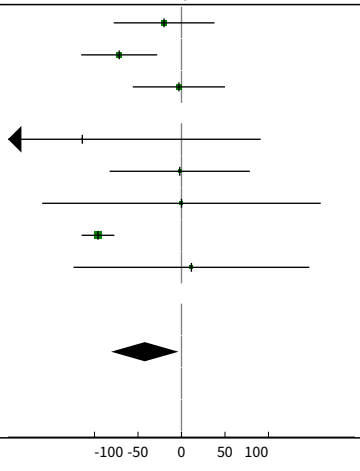
Favours immersion — Favours no immersion

Analysis 3.21. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 21 Duration of first stage (minutes).

Study or subgroup	Immersion N	Immersion Mean(SD)	No immersion N	No immersion Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Cammu 1994	54	244 (139)	56	264 (170)		15.78%	-20[-77.94,37.94]
Chaichian 2009	53	114.4 (93.6)	53	186 (132.5)		18.61%	-71.6[-115.27,-27.93]
Eckert 2001	137	404.2 (225.2)	137	407.2 (222.6)		16.74%	-2.98[-56,50.04]
Kuusela 1998	18	528 (216)	15	642 (354)		3.11%	-114[-319.06,91.06]
Rush 1996	393	403 (596)	392	405 (555)		11.86%	-2[-82.56,78.56]
Schorn 1993	45	846 (432)	48	846 (348)		4.72%	0[-160.07,160.07]
Torkamani 2010	50	186 (48)	50	282 (48)		23.06%	-96[-114.82,-77.18]
Woodward 2004	40	420.8 (225.4)	20	409.4 (265)		6.12%	11.4[-124.13,146.93]
Total ***	**790**		**771**			**100%**	**-42.21[-80.93,-3.49]**

Heterogeneity: Tau^2=1600.24; Chi^2=21.05, df=7(P=0); I^2=66.75%

Test for overall effect: Z=2.14(P=0.03)

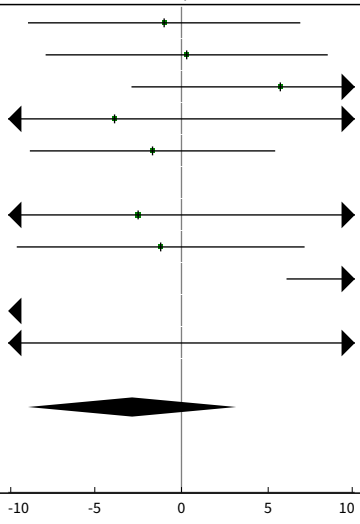


Analysis 3.22. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 22 Duration of second stage (minutes).

Study or subgroup	Immersion N	Immersion Mean(SD)	No immersion N	No immersion Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Cammu 1994	54	33 (20)	56	34 (22)		13.19%	-1[-8.85,6.85]
Chaichian 2009	53	20.9 (20.5)	53	20.6 (22.2)		12.97%	0.3[-7.84,8.44]
Da Silva 2006	54	37.5 (25.9)	54	31.8 (19.1)		12.63%	5.7[-2.88,14.28]
Eckert 2001	137	64.9 (66.3)	137	68.8 (69.8)		7.65%	-3.86[-19.97,12.25]
Ghasemi 2013	83	30.3 (21.6)	88	32 (25.5)		13.77%	-1.67[-8.74,5.4]
Kuusela 1998	18	21 (0)	15	20 (0)			Not estimable
Nikodem 1999	60	40 (41.3)	60	42.5 (39.5)		8.57%	-2.5[-16.96,11.96]
Rush 1996	393	56.7 (61)	392	57.9 (57.6)		12.85%	-1.2[-9.5,7.1]
Schorn 1993	45	108 (222)	48	36 (42)		0.79%	72[6.06,137.94]
Torkamani 2010	50	31.8 (13.2)	50	52 (25.8)		13.05%	-20.2[-28.23,-12.17]
Woodward 2004	40	47.3 (46.8)	20	58.7 (44.3)		4.51%	-11.4[-35.63,12.83]
Total ***	**987**		**973**			**100%**	**-2.85[-8.85,3.16]**

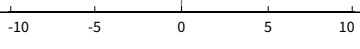
Heterogeneity: Tau^2=55.15; Chi^2=28.2, df=9(P=0); I^2=68.08%

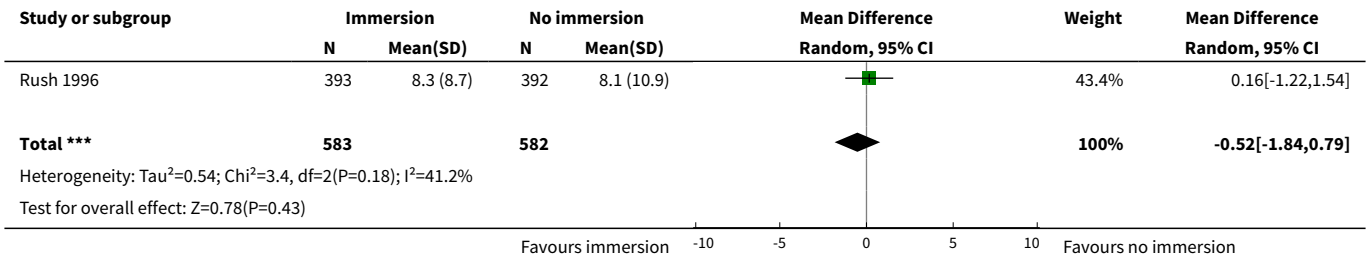
Test for overall effect: Z=0.93(P=0.35)



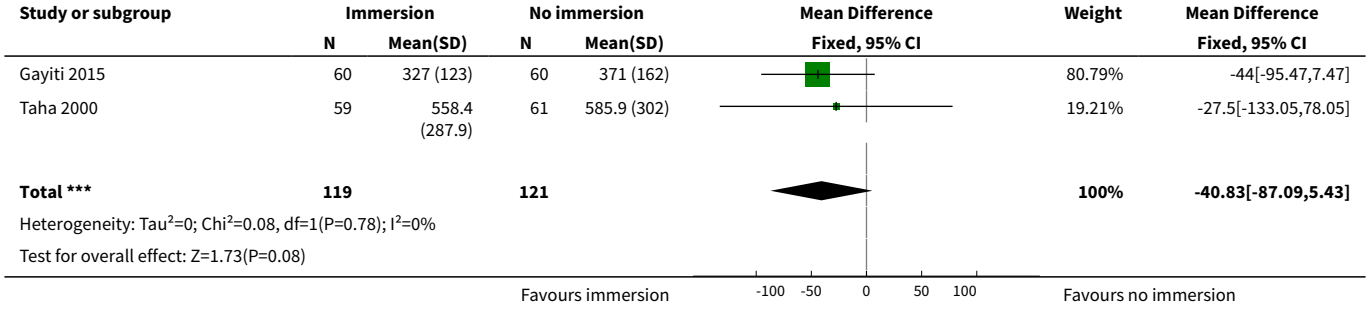
Analysis 3.23. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 23 Duration of third stage (minutes).

Study or subgroup	Immersion N	Immersion Mean(SD)	No immersion N	No immersion Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
Chaichian 2009	53	6 (2.3)	53	7.3 (3.4)		52.49%	-1.3[-2.41,-0.19]
Eckert 2001	137	15.6 (33.4)	137	13.4 (17.7)		4.11%	2.16[-4.17,8.49]

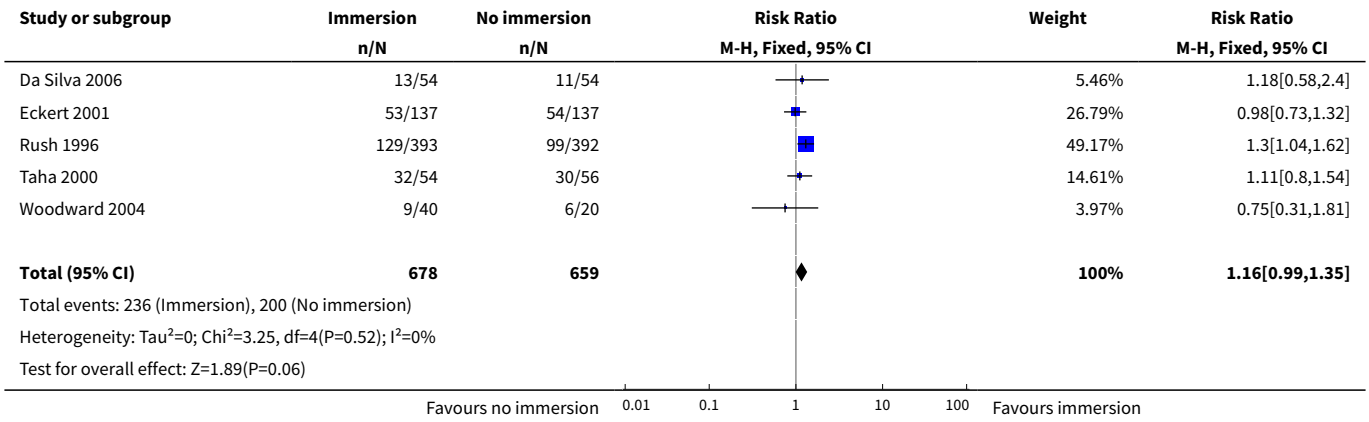




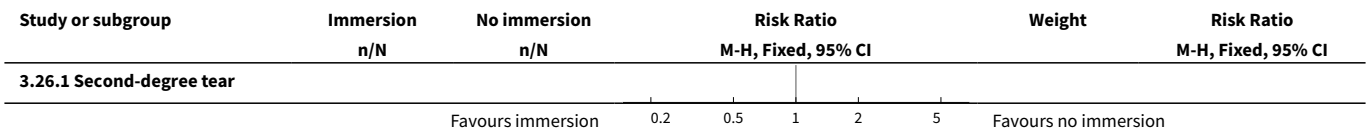
Analysis 3.24. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 24 Duration of total labour (all three stages).

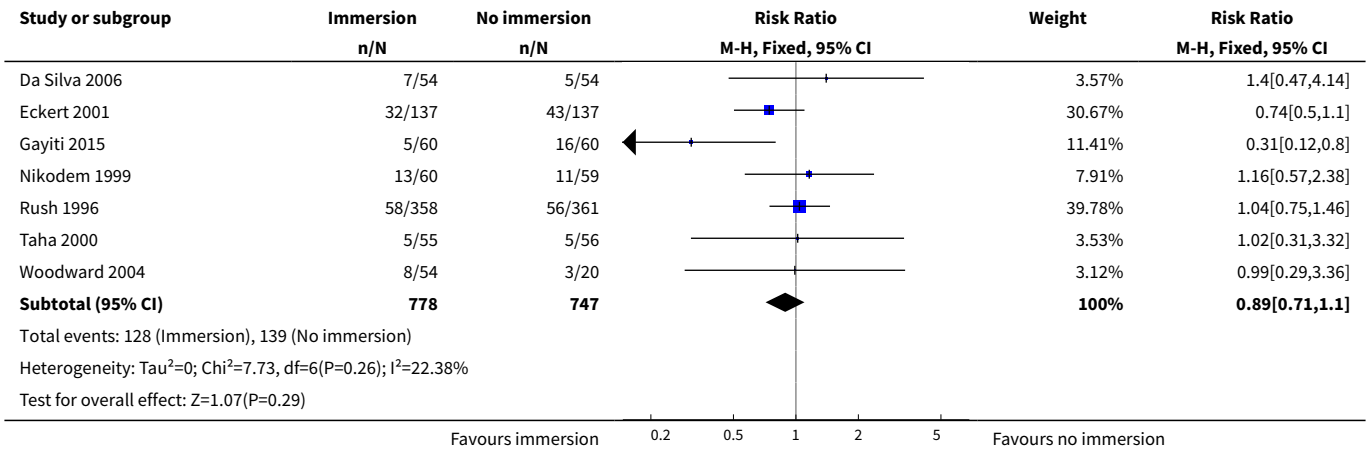


Analysis 3.25. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 25 Perineal trauma (none- intact).



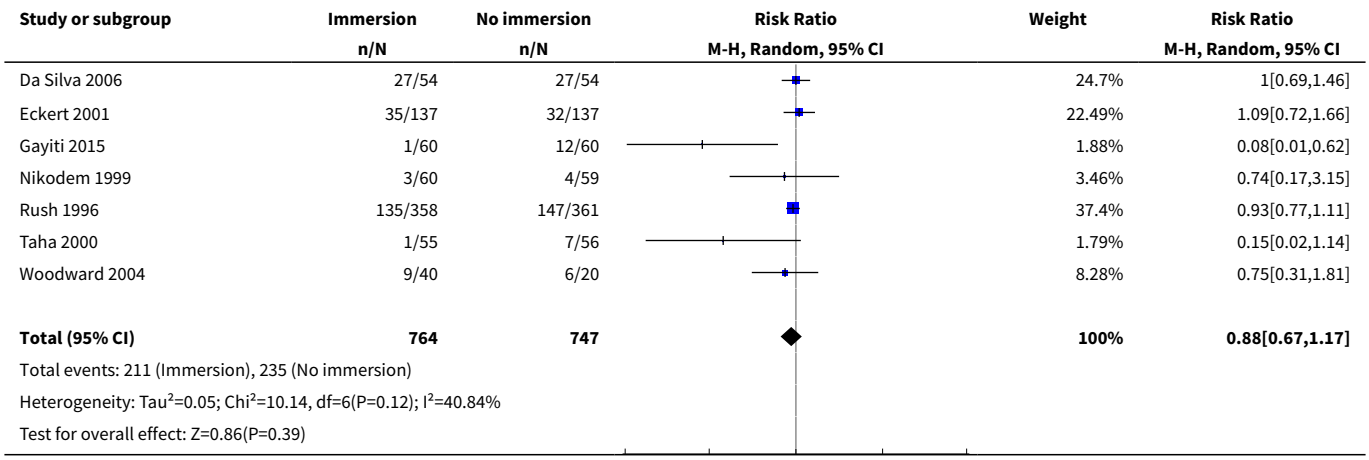
Analysis 3.26. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 26 Perineal trauma (first- and second-degree tears).





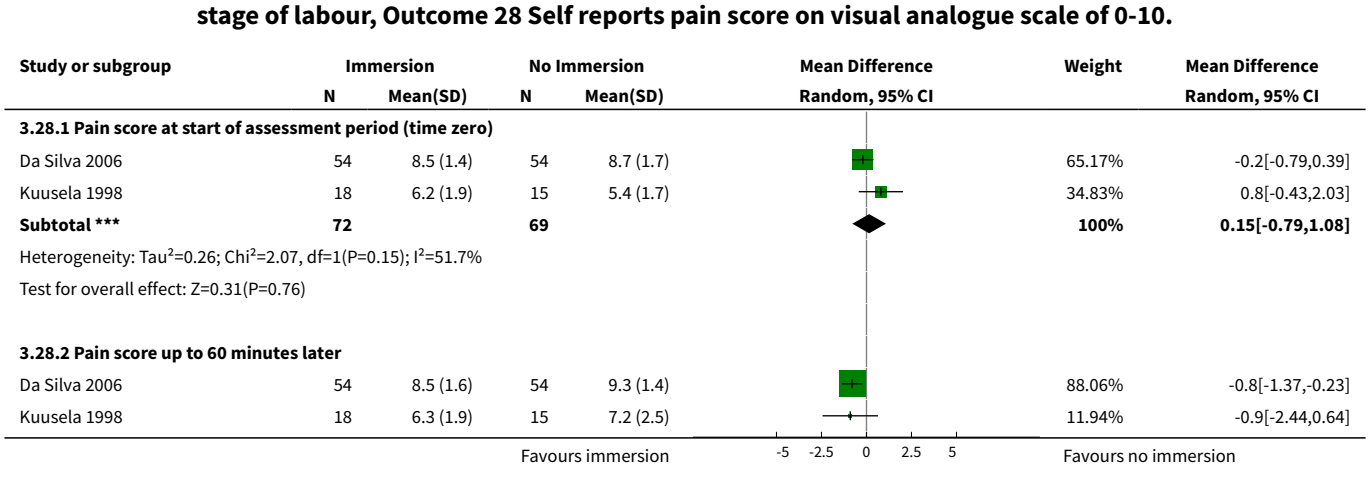
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Da Silva 2006	7/54	5/54		3.57%	1.4[0.47,4.14]
Eckert 2001	32/137	43/137		30.67%	0.74[0.5,1.1]
Gayiti 2015	5/60	16/60		11.41%	0.31[0.12,0.8]
Nikodem 1999	13/60	11/59		7.91%	1.16[0.57,2.38]
Rush 1996	58/358	56/361		39.78%	1.04[0.75,1.46]
Taha 2000	5/55	5/56		3.53%	1.02[0.31,3.32]
Woodward 2004	8/54	3/20		3.12%	0.99[0.29,3.36]
Subtotal (95% CI)	**778**	**747**		**100%**	**0.89[0.71,1.1]**
Total events: 128 (Immersion), 139 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=7.73, df=6(P=0.26); I^2=22.38%					
Test for overall effect: Z=1.07(P=0.29)					

Analysis 3.27. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 27 Perineal trauma (episiotomy).

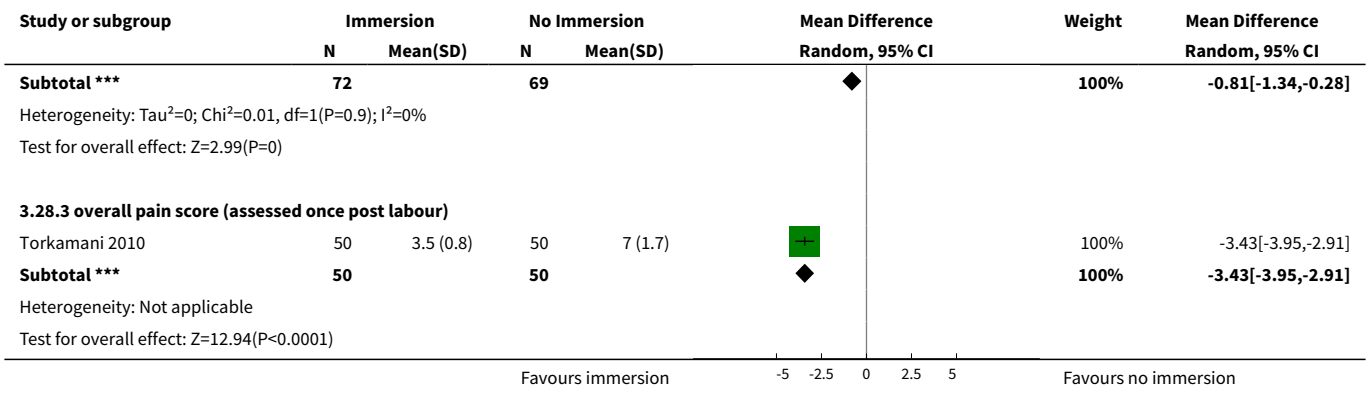


Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Da Silva 2006	27/54	27/54		24.7%	1[0.69,1.46]
Eckert 2001	35/137	32/137		22.49%	1.09[0.72,1.66]
Gayiti 2015	1/60	12/60		1.88%	0.08[0.01,0.62]
Nikodem 1999	3/60	4/59		3.46%	0.74[0.17,3.15]
Rush 1996	135/358	147/361		37.4%	0.93[0.77,1.11]
Taha 2000	1/55	7/56		1.79%	0.15[0.02,1.14]
Woodward 2004	9/40	6/20		8.28%	0.75[0.31,1.81]
Total (95% CI)	**764**	**747**		**100%**	**0.88[0.67,1.17]**
Total events: 211 (Immersion), 235 (No immersion)					
Heterogeneity: Tau^2=0.05; Chi^2=10.14, df=6(P=0.12); I^2=40.84%					
Test for overall effect: Z=0.86(P=0.39)					

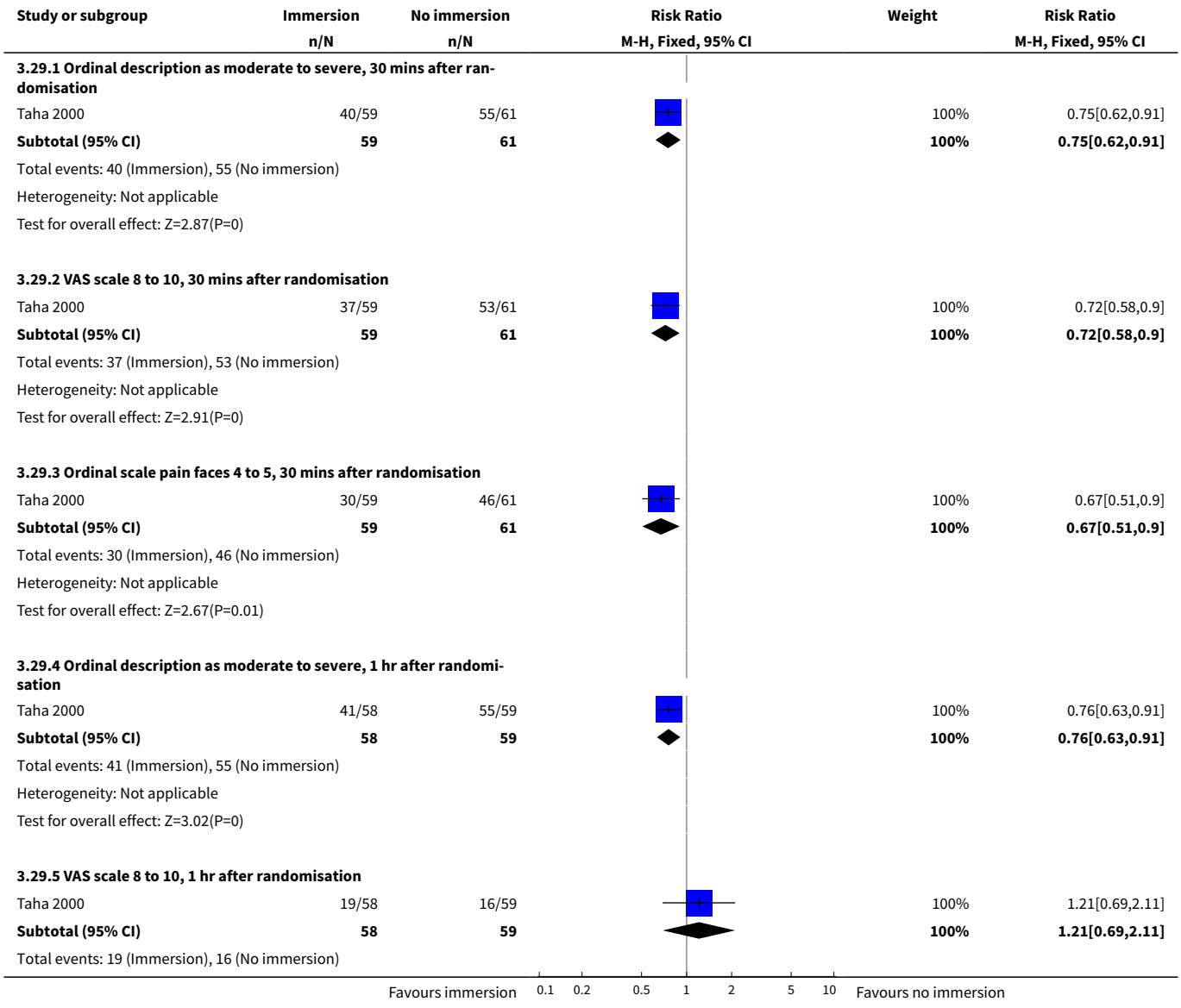
Analysis 3.28. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 28 Self reports pain score on visual analogue scale of 0-10.



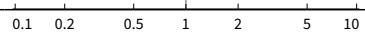
Study or subgroup	Immersion N	Immersion Mean(SD)	No Immersion N	No Immersion Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
3.28.1 Pain score at start of assessment period (time zero)							
Da Silva 2006	54	8.5 (1.4)	54	8.7 (1.7)		65.17%	-0.2[-0.79,0.39]
Kuusela 1998	18	6.2 (1.9)	15	5.4 (1.7)		34.83%	0.8[-0.43,2.03]
Subtotal ***	**72**		**69**			**100%**	**0.15[-0.79,1.08]**
Heterogeneity: Tau^2=0.26; Chi^2=2.07, df=1(P=0.15); I^2=51.7%							
Test for overall effect: Z=0.31(P=0.76)							
3.28.2 Pain score up to 60 minutes later							
Da Silva 2006	54	8.5 (1.6)	54	9.3 (1.4)		88.06%	-0.8[-1.37,-0.23]
Kuusela 1998	18	6.3 (1.9)	15	7.2 (2.5)		11.94%	-0.9[-2.44,0.64]

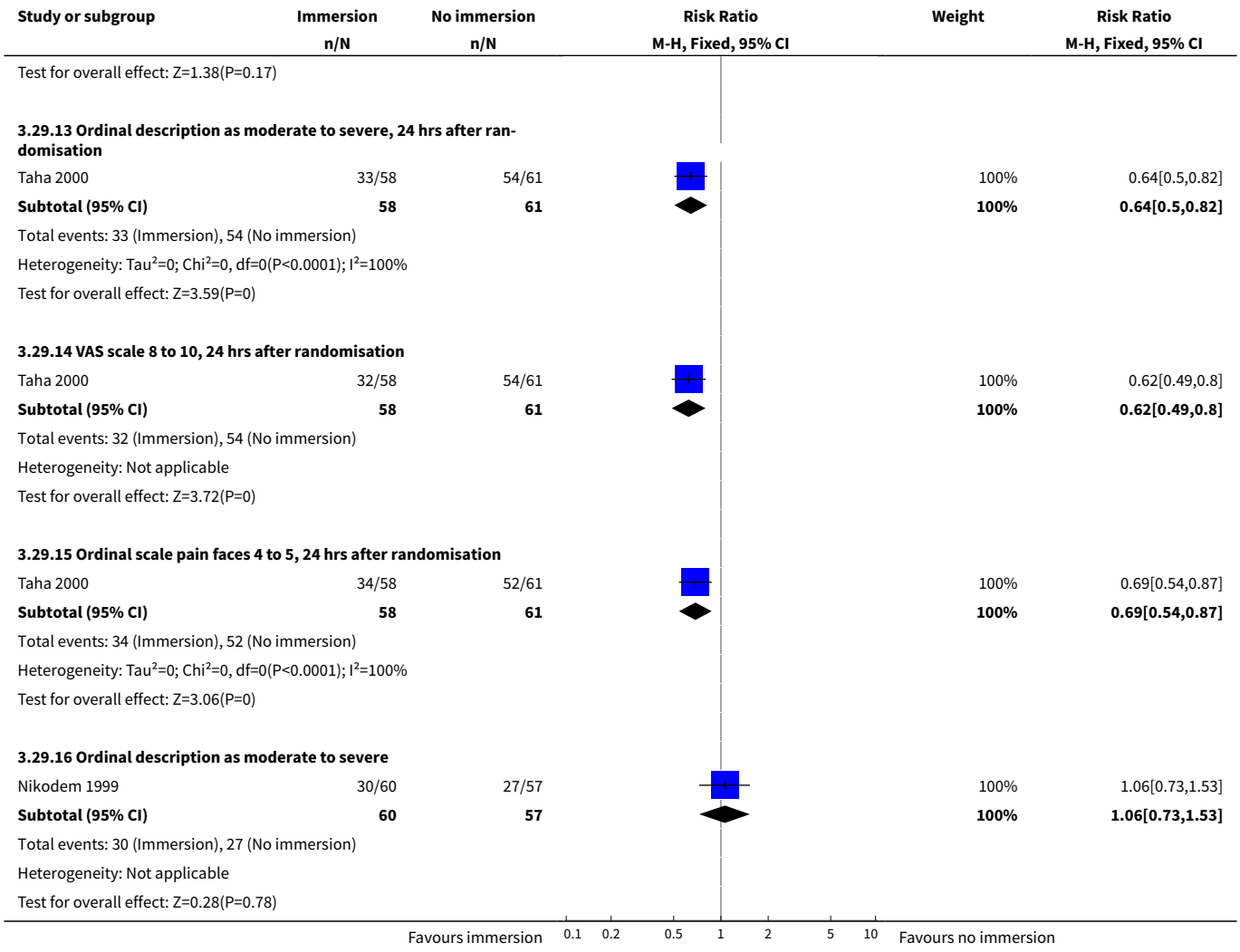


Analysis 3.29. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 29 Pain intensity (experience of moderate to severe pain).

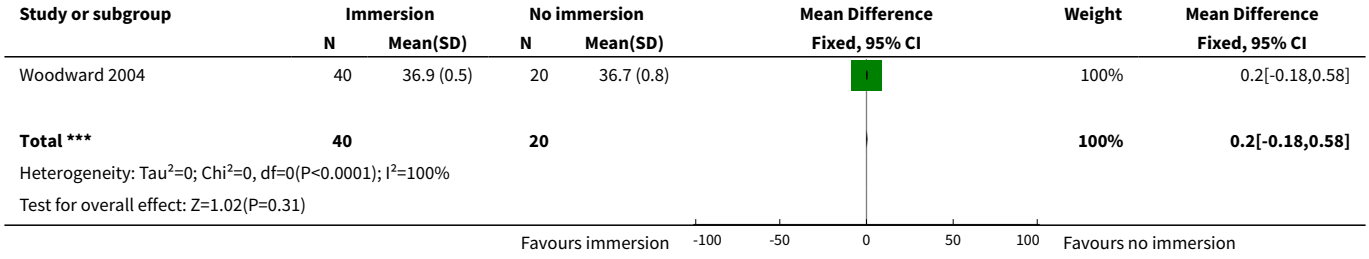


Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Heterogeneity: Not applicable					
Test for overall effect: Z=0.66(P=0.51)					
3.29.6 Ordinal scale pain faces 4 to 5, 1 hr after randomisation					
Taha 2000	34/58	51/59		100%	0.68[0.53,0.86]
Subtotal (95% CI)	**58**	**59**		**100%**	**0.68[0.53,0.86]**
Total events: 34 (Immersion), 51 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%					
Test for overall effect: Z=3.19(P=0)					
3.29.7 Ordinal description as moderate to severe, 2 hrs after randomisation					
Taha 2000	17/23	33/34		100%	0.76[0.59,0.98]
Subtotal (95% CI)	**23**	**34**		**100%**	**0.76[0.59,0.98]**
Total events: 17 (Immersion), 33 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=0, df=0(P<0.0001); I^2=100%					
Test for overall effect: Z=2.14(P=0.03)					
3.29.8 VAS scale 8 to 10, 2 hrs after randomisation					
Taha 2000	18/23	32/34		100%	0.83[0.66,1.05]
Subtotal (95% CI)	**23**	**34**		**100%**	**0.83[0.66,1.05]**
Total events: 18 (Immersion), 32 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.56(P=0.12)					
3.29.9 Ordinal scale pain faces 4 to 5, 2 hrs after randomisation					
Taha 2000	15/23	31/34		100%	0.72[0.52,0.98]
Subtotal (95% CI)	**23**	**34**		**100%**	**0.72[0.52,0.98]**
Total events: 15 (Immersion), 31 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=2.08(P=0.04)					
3.29.10 Ordinal description as moderate to severe, 3 hrs after randomisation					
Taha 2000	3/6	25/26		100%	0.52[0.23,1.16]
Subtotal (95% CI)	**6**	**26**		**100%**	**0.52[0.23,1.16]**
Total events: 3 (Immersion), 25 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.59(P=0.11)					
3.29.11 VAS scale 8 to 10, 3 hrs after randomisation					
Taha 2000	4/6	25/26		100%	0.69[0.39,1.23]
Subtotal (95% CI)	**6**	**26**		**100%**	**0.69[0.39,1.23]**
Total events: 4 (Immersion), 25 (No immersion)					
Heterogeneity: Not applicable					
Test for overall effect: Z=1.26(P=0.21)					
3.29.12 Ordinal scale pain faces 4 to 5, 3 hrs after randomisation					
Taha 2000	3/6	23/26		100%	0.57[0.25,1.27]
Subtotal (95% CI)	**6**	**26**		**100%**	**0.57[0.25,1.27]**
Total events: 3 (Immersion), 23 (No immersion)					
Heterogeneity: Not applicable					

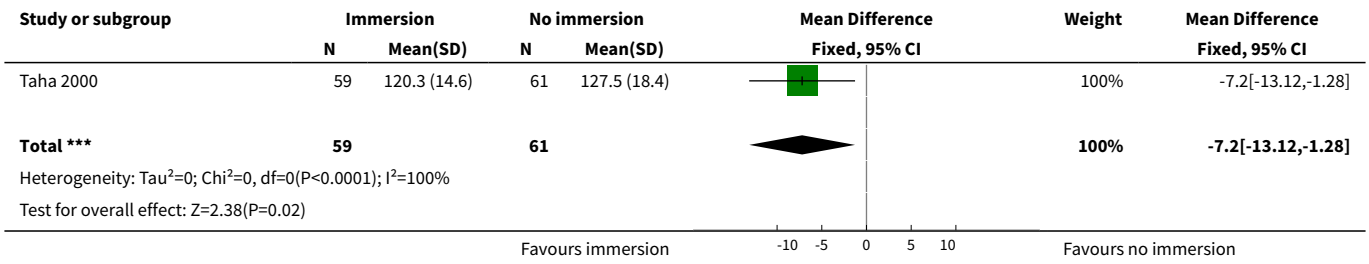




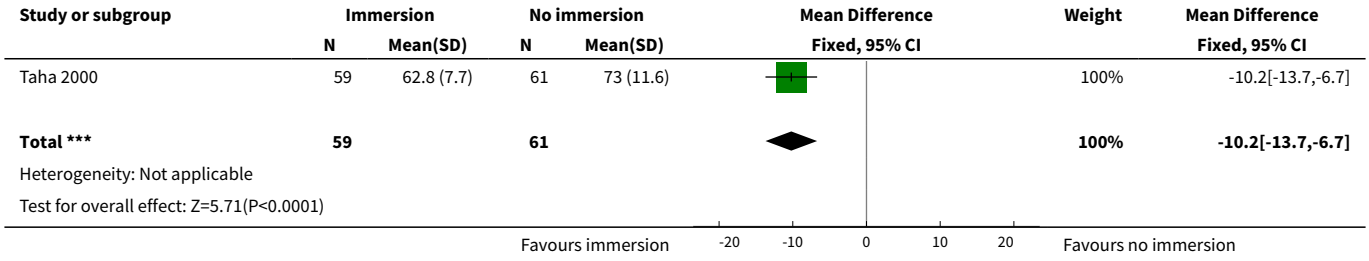
Analysis 3.30. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 30 Maternal temperature.



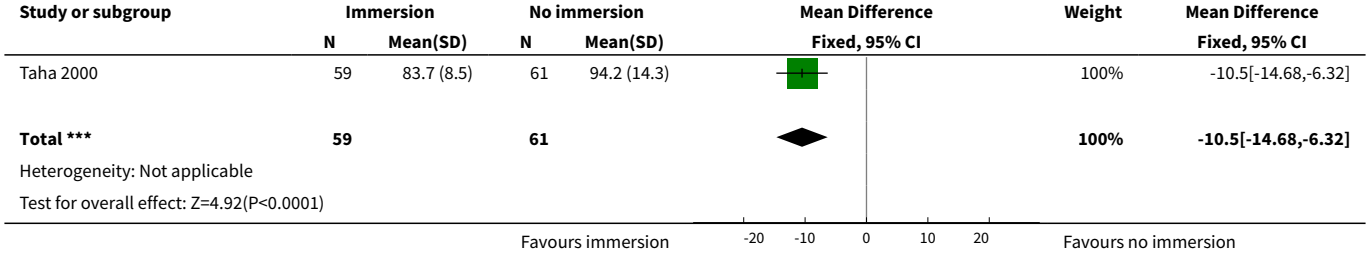
Analysis 3.31. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 31 Systolic blood pressure.



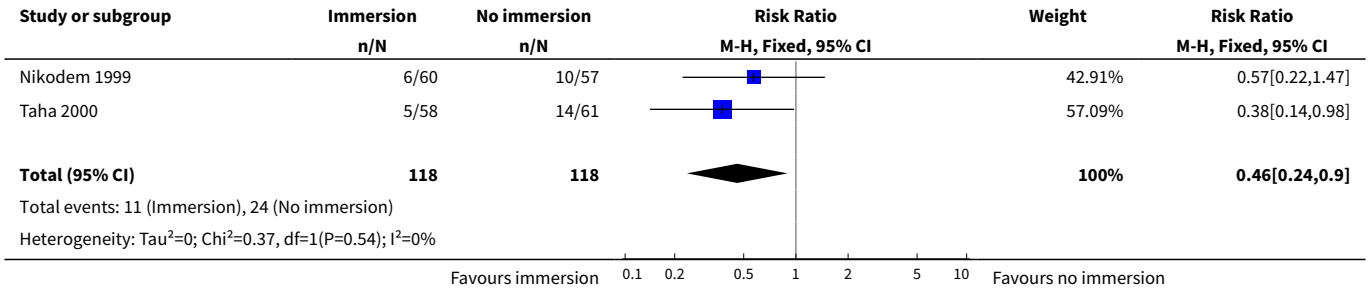
Analysis 3.32. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 32 Diastolic blood pressure.

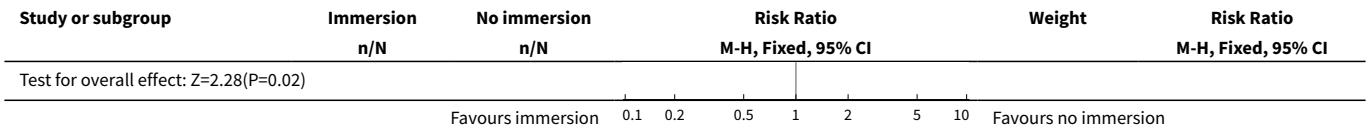


Analysis 3.33. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 33 Mean arterial blood pressure.

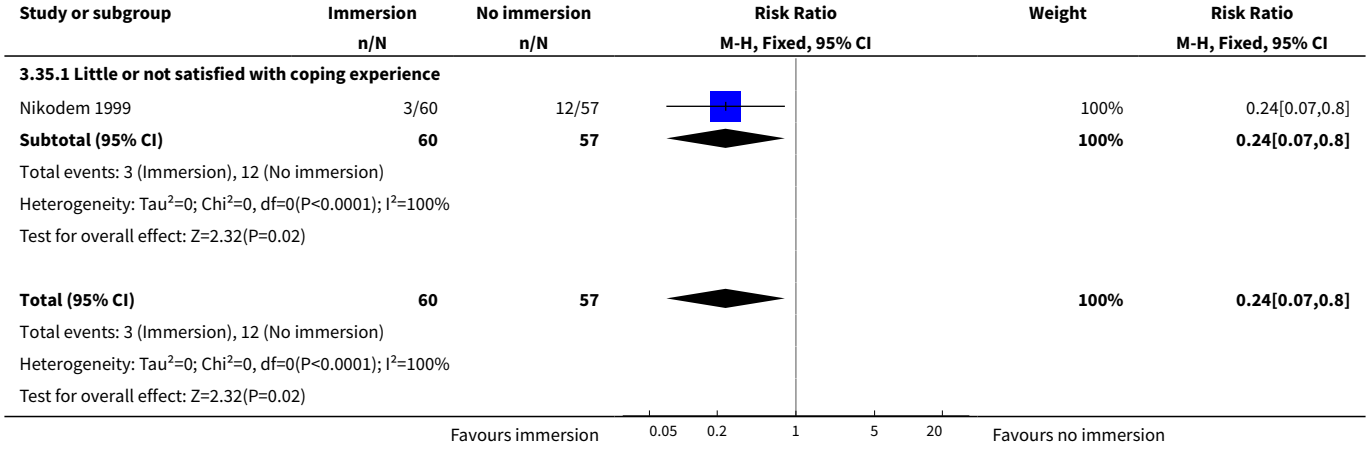


Analysis 3.34. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 34 Preference for care in subsequent labour (Does not wish to use bath with next labour/birth).

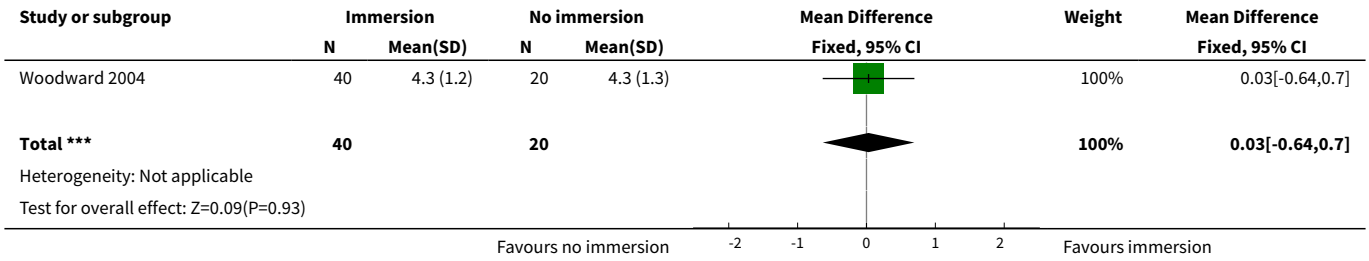




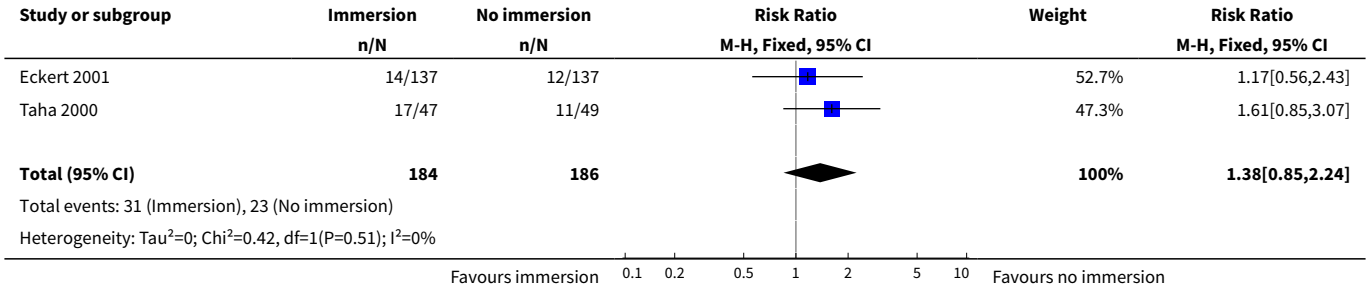
Analysis 3.35. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 35 Satisfied with labour.



Analysis 3.36. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 36 Satisfied with labour on scale.



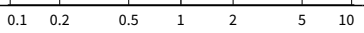
Analysis 3.37. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 37 Postpartum depression (EPDS more than 11).



Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Test for overall effect: Z=1.29(P=0.2)					

Analysis 3.38. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 38 Abnormal fetal heart rate patterns.

Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Random, 95% CI	Weight	Risk Ratio M-H, Random, 95% CI
Eckert 2001	58/137	59/137		69.21%	0.98[0.75,1.29]
Schorn 1993	0/45	0/48			Not estimable
Taha 2000	4/59	10/61		30.79%	0.41[0.14,1.25]
Total (95% CI)	**241**	**246**		**100%**	**0.75[0.34,1.67]**
Total events: 62 (Immersion), 69 (No immersion)					
Heterogeneity: Tau^2=0.22; Chi^2=2.3, df=1(P=0.13); I^2=56.51%					
Test for overall effect: Z=0.7(P=0.48)					

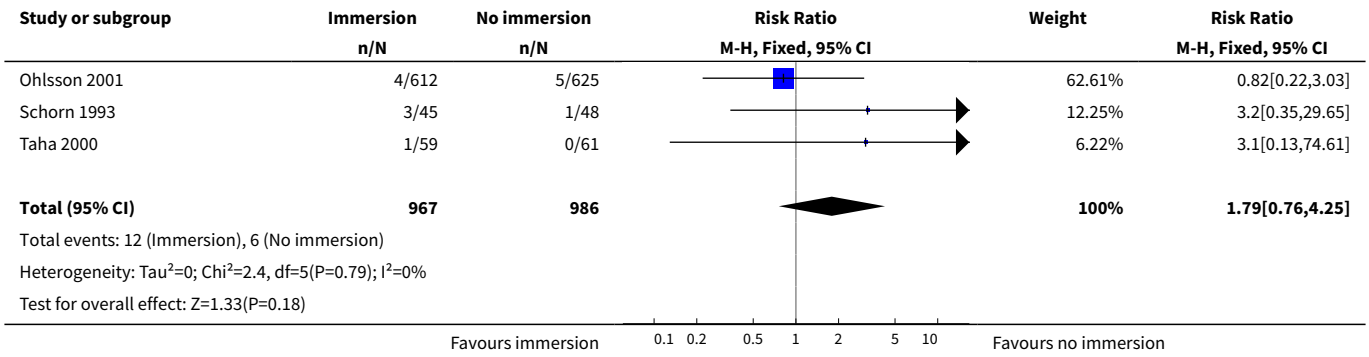


Analysis 3.39. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 39 Presence of meconium-stained liquor.

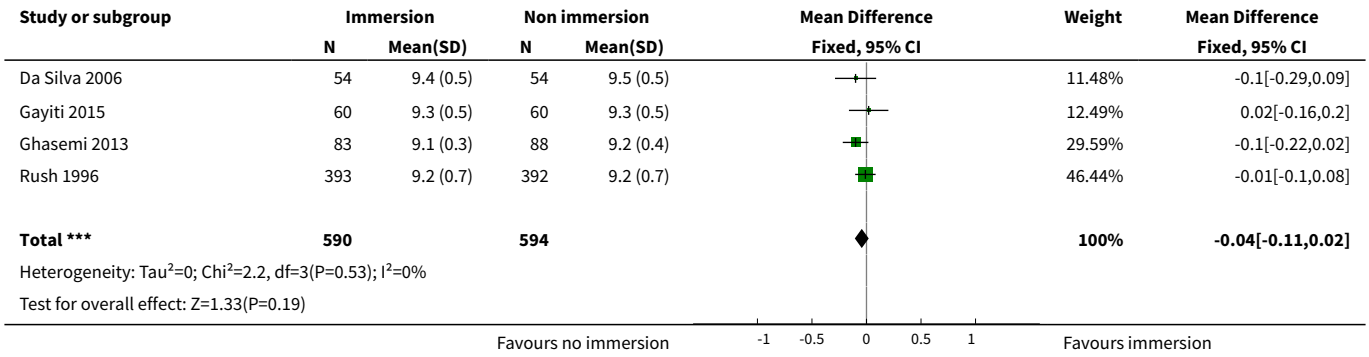
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Da Silva 2006	1/54	6/54		4.58%	0.17[0.02,1.34]
Eckert 2001	33/137	28/137		21.38%	1.18[0.76,1.84]
Kuusela 1998	4/18	6/15		5%	0.56[0.19,1.61]
Nikodem 1999	7/60	5/60		3.82%	1.4[0.47,4.17]
Rush 1996	76/393	80/392		61.16%	0.95[0.72,1.26]
Woodward 2004	10/40	4/20		4.07%	1.25[0.45,3.49]
Total (95% CI)	**702**	**678**		**100%**	**0.97[0.78,1.21]**
Total events: 131 (Immersion), 129 (No immersion)					
Heterogeneity: Tau^2=0; Chi^2=5.23, df=5(P=0.39); I^2=4.42%					
Test for overall effect: Z=0.26(P=0.79)					

Analysis 3.40. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 40 Apgar score less than seven at five minutes.

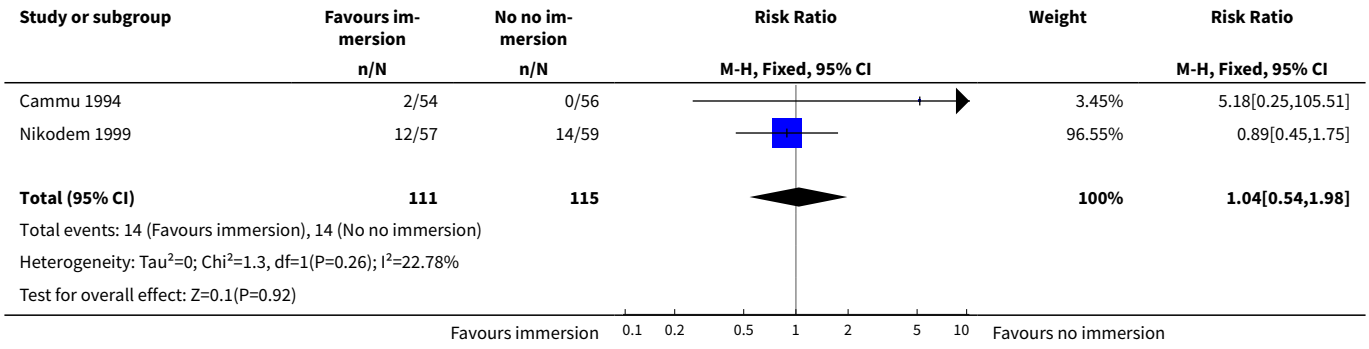
Study or subgroup	Immersion n/N	No immersion n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Cammu 1994	1/54	0/56		6.21%	3.11[0.13,74.7]
Eckert 2001	1/137	0/137		6.33%	3[0.12,73]
Nikodem 1999	2/60	0/59		6.38%	4.92[0.24,100.31]



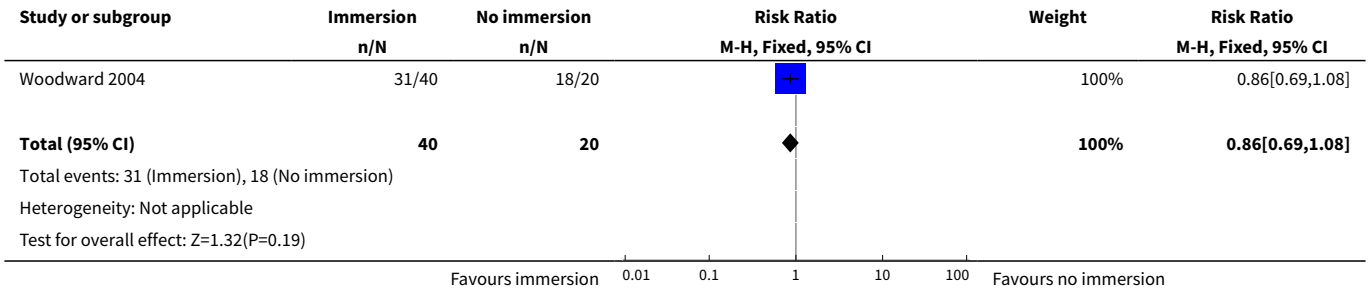
Analysis 3.41. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 41 Apgar score at five minutes.



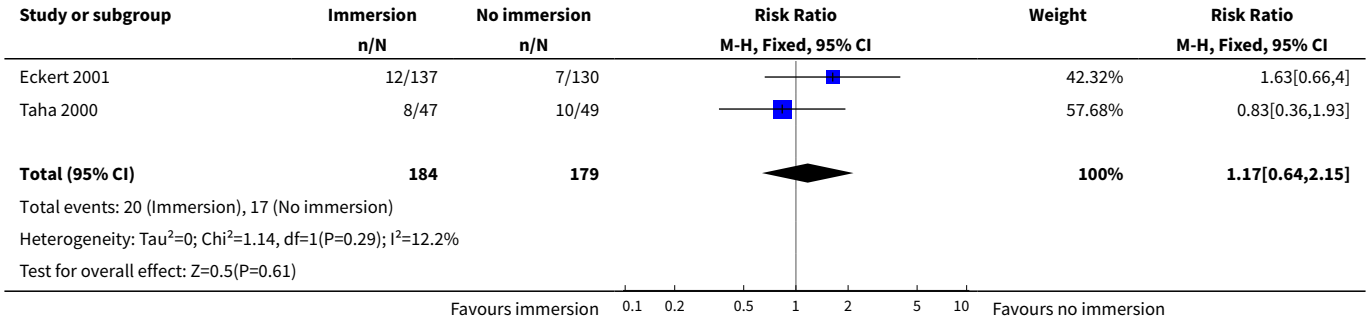
Analysis 3.42. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 42 Umbilical artery pH less than 7.20.



Analysis 3.43. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 43 Breastfeeding.



Analysis 3.44. Comparison 3 Immersion in water versus no immersion during any stage of labour, Outcome 44 Not breastfeeding after six weeks post birth.



Comparison 4. Early versus late immersion in water

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Use of pharmacological analgesia (epidural/spinal analgesia/paracervical block)	1	200	Risk Ratio (M-H, Fixed, 95% CI)	2.21 [1.39, 3.52]
2 Neonatal infection	1	200	Risk Ratio (M-H, Fixed, 95% CI)	3.0 [0.12, 72.77]
3 Use of oxytocin	1	200	Risk Ratio (M-H, Fixed, 95% CI)	1.9 [1.35, 2.68]
4 Abnormal fetal heart rate patterns	1	200	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]
5 Apgar score less than seven at one minute	1	200	Risk Ratio (M-H, Fixed, 95% CI)	0.0 [0.0, 0.0]

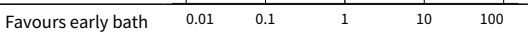
Analysis 4.1. Comparison 4 Early versus late immersion in water, Outcome 1 Use of pharmacological analgesia (epidural/spinal analgesia/paracervical block).

Study or subgroup	Early bath n/N	Late bath n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Eriksson 1997	42/100	19/100		100%	2.21[1.39,3.52]
Total (95% CI)	**100**	**100**		**100%**	**2.21[1.39,3.52]**
Total events: 42 (Early bath), 19 (Late bath)					
Heterogeneity: Not applicable					
Test for overall effect: Z=3.34(P=0)					

Favours early bath — Favours late bath

Analysis 4.2. Comparison 4 Early versus late immersion in water, Outcome 2 Neonatal infection.

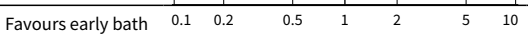
Study or subgroup	Early bath n/N	Late bath n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Eriksson 1997	1/100	0/100		100%	3[0.12,72.77]
Total (95% CI)	**100**	**100**		**100%**	**3[0.12,72.77]**
Total events: 1 (Early bath), 0 (Late bath)					
Heterogeneity: Not applicable					
Test for overall effect: Z=0.68(P=0.5)					



Favours early bath — Favours late bath

Analysis 4.3. Comparison 4 Early versus late immersion in water, Outcome 3 Use of oxytocin.

Study or subgroup	Early bath n/N	Late bath n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Eriksson 1997	57/100	30/100		100%	1.9[1.35,2.68]
Total (95% CI)	**100**	**100**		**100%**	**1.9[1.35,2.68]**
Total events: 57 (Early bath), 30 (Late bath)					
Heterogeneity: Not applicable					
Test for overall effect: Z=3.65(P=0)					



Favours early bath — Favours late bath

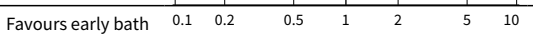
Analysis 4.4. Comparison 4 Early versus late immersion in water, Outcome 4 Abnormal fetal heart rate patterns.

Study or subgroup	Early bath n/N	Late bath n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Eriksson 1997	0/100	0/100			Not estimable
Total (95% CI)	**100**	**100**			**Not estimable**
Total events: 0 (Early bath), 0 (Late bath)					
Heterogeneity: Not applicable					
Test for overall effect: Not applicable					

Favours early bath — Favours late bath

Analysis 4.5. Comparison 4 Early versus late immersion in water, Outcome 5 Apgar score less than seven at one minute.

Study or subgroup	Early bath n/N	Late bath n/N	Risk Ratio M-H, Fixed, 95% CI	Weight	Risk Ratio M-H, Fixed, 95% CI
Eriksson 1997	0/100	0/100			Not estimable
Total (95% CI)	**100**	**100**			**Not estimable**
Total events: 0 (Early bath), 0 (Late bath)					
Heterogeneity: Not applicable					
Test for overall effect: Not applicable					



APPENDICES

Appendix 1. Search terms for ClinicalTrials.gov and ICTRP

each line was run separately.

water AND immersion AND labo(u)r

waterbirth

water birth

bath AND labo(u)r

hydrotherapy AND labo(u)r

FEEDBACK

Wein, December 2006

Summary

How can the review authors conclude "Overall, the evidence indicates that immersion in water decreases maternal reported pain levels and the uptake of pharmacological analgesia" when their analysis reports the odds ratio for pharmacological analgesia as 1.08 (95% CI 0.71 to 1.65)?

(Summary of comment from Peter Wein, December 2006)

Reply

In the authors' conclusions section of the previous update of this review (Cluett 2002), the statement "immersion in water decreases maternal reported pain levels" was based on the one trial (Taha 2000) that reported this outcome (OR 0.23, 95% CI 0.08 to 0.63). The limitation of only one study is indicated in the maternal outcome section of the review. The reference to a decrease in maternal 'uptake of pharmacological analgesia' was based on the outcome 'use of epidural/spinal/paracervical block' (OR 0.84, 95% CI 0.71 to 0.99), which included data from four trials, not the outcome 'any pharmacological analgesia' which include data from two trials and is the one cited by Wein above. We accept the wording was ambiguous, and have clarified it in the current update.

Interestingly, in this update data for these outcomes have altered minimally: use of epidural/spinal/paracervical block is now OR 0.82, 95% CI 0.70 to 0.98, with data from six trials; 'any pharmacological analgesia', remains unchanged, as do the data for maternal pain experience.

(Response from Elizabeth Cluett, October 2008)

Contributors

Peter Wein

WHAT'S NEW

Date	Event	Description
11 June 2018	Amended	Percentages in the abstract main results have been corrected as they had been reported the wrong way round i.e. 'no immersion versus immersion' instead of 'immersion versus no immersion'.

HISTORY

Protocol first published: Issue 3, 1996
Review first published: Issue 3, 1997

Date	Event	Description
18 July 2017	New search has been performed	Overall conclusions have not changed.
18 July 2017	New citation required but conclusions have not changed	Search updated, 17 new trial reports identified, plus we re-assessed the trials previously awaiting further classification (Malarewicz 2005; Torkamani 2010). We also reviewed all trials assessed in the previous version of our review to confirm inclusion/exclusion. Data from three new trials have been included (Gayiti 2015; Ghasemi 2013; Torkamani 2010). Other trials identified in the search were excluded (Cai 2005; Irion 2011; Henrique 2015; Lee 2013, Kashanian 2013; Khadijeh 2015; Malarewicz 2005; Zou 2008), and one has been added to ongoing study section as to date no outcome data have been available (Dabiri 2016). Text of review updated in all sections, incorporating latest evidence from trials and GRADE analysis, as well as wider literature. Overall, conclusions not changed.
14 December 2011	Amended	Corrected error in Abstract and in Analysis 1.17.
30 June 2011	New search has been performed	Papers from June 2011 search reviewed and data incorporated as appropriate. 1 new study included (Chaichian 2009) and 2 added to Characteristics of studies awaiting classification pending more information from the authors. Risk of bias tables generated. Text updated, although no change in overall conclusions.
5 January 2009	New citation required but conclusions have not changed	Change in authorship.
20 November 2008	Feedback has been incorporated	Response from authors to feedback from Wein incorporated.
20 November 2008	New search has been performed	Search updated. New trials identified, appraised and data are included. Title changed to reflect focus on water immersion in labour and birth, so pregnancy removed from title, and outcomes updated accordingly. Background information updated.

Date	Event	Description
		Results and discussion sections updated but no change to overall conclusions.
29 October 2008	Amended	Converted to new review format.
25 April 2004	New search has been performed	Search updated. Five new trials are included (Eckert 2001; Eriksson 1997; Nikodem 1999; Ohlsson 2001; Taha 2000).
25 April 2004	New citation required and conclusions have changed	The inclusion of the new trials has resulted in a change in the implications for practice, which now indicates that immersion in water during the first stage of labour reduces reported maternal pain and the use of analgesia. The outcome measures have been modified to ensure clarity. Neonatal outcomes have been added to reflect current methods of wellbeing assessment. Change in authorship for this update.

CONTRIBUTIONS OF AUTHORS

Two review authors (E Cluett (EC) and E Burns (EB)) read all newly identified reports and reviewed previous papers, and reached consensus about inclusion and exclusion for each study. Using an agreed form, we separately extracted data from each included study, then met to compare these and agree about data to be analysed. We jointly considered the analysis and wrote the review. EC entered the data onto Review Manager and EB evaluated them for accuracy. EC is the contact author. Anna Cuthbert (AC) prepared the 'Summary of findings' tables and addressed peer review and editorial feedback.

DECLARATIONS OF INTEREST

Elizabeth R Cluett: The first review author (E Cluett) is chief investigator of two trials related to the subject of this review (Cluett 2001; Cluett 2004); these trials were reviewed by E Burns and previous author Cheryl Nikodem. We excluded both trials.

Ethel Burns: none known.

Anna Cuthbert: I am a research associate working in the editorial base of Cochrane Pregnancy and Childbirth and am employed by the University of Liverpool. Cochrane Pregnancy and Childbirth receives infrastructure funding from the NIHR, UK.

SOURCES OF SUPPORT

Internal sources

- OCHRAD Oxford Brookes University, UK.
- Faculty of Health Sciences, UK.

  University Of Southampton

External sources

- National Institute for Health Research, UK.

  The 2009 update was supported by the UK NIHR Programme of centrally-managed pregnancy and childbirth systematic reviews of priority to the NHS and users of the NHS: 10/4001/02

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Methods updated to current PCG standard text. 'Summary of findings' tables have been incorporated in this update (2017).

We added the comparison "immersion in water versus no immersion during any stage of labour" as four of the trials included immersion in first and second stage and we felt this overall comparison was useful.

There have been a few changes to outcomes in this update, as outlined below.

- The primary outcomes have been reduced in this update from 24 to six, so that many of the previous primary outcomes are now listed as secondary outcomes.
- We have defined 'perineal trauma' as two distinct outcomes - 'perineal trauma - third- and fourth-degree tears' has been added to our primary outcomes. 'Intact perineum, first- and second-degree tears and episiotomy' are now reported separately as secondary outcomes.
- We have changed use of 'pharmacological analgesia (including regional and general anaesthesia) during any stage of labour' to 'use of analgesia (regional)' and listed this as a primary outcome on its own; 'use of analgesia (general analgesia or pharmacological analgesia)' is now a secondary outcome.
- Blood loss during labour (first, second, third stage, and immediate postnatal period) has now changed to 'estimated blood loss' (secondary outcome) and 'postpartum haemorrhage (> 500 mL)'.
- We removed the outcomes birthweight and gestational age as these are unlikely to be substantially affected by care in labour and we were unable to analyse these data baseline characteristics of the individual women.

In 2017, we added in an additional search of ClinicalTrials.gov and the WHO International Clinical Trials Registry Platform (ICTRP).

INDEX TERMS

Medical Subject Headings (MeSH)

*Immersion; *Labor Stage, First; *Labor Stage, Second; *Water; Analgesia, Obstetrical [statistics & numerical data]; Infant, Newborn, Diseases [epidemiology]; Infections [epidemiology]; Intensive Care Units, Neonatal [statistics & numerical data]; Natural Childbirth; Perineum [injuries]; Randomized Controlled Trials as Topic

MeSH check words

Female; Humans; Infant, Newborn; Pregnancy