WATER BIRTH

HEALTH TECHNOLOGY ASSESSMENT SECTION
MEDICAL DEVELOPMENT DIVISION
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DISCLAIMER

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DISCLOSURE

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EXECUTIVE SUMMARY

Introduction

Childbirth, labour, delivery, birth, partus, or parturition is the culmination of a pregnancy period with the expulsion of one or more newborn infants from the woman's uterus. The process of normal childbirth is characterised in three stages of labour: the shortening and dilation of the cervix (1st stage), descent and birth of the infant (2nd stage), and birth of the placenta (3rd stage). The use of water immersion in labour and birth remains a hot topic in perinatal medicine. There are two separate and distinct aspects to the use of water immersion in labour: 1) the use of immersion for women in first stage of labour (without birth into the water), and 2) immersion for women in the second stage of labour with birth into the water (referred as water birth). Hence, water birth refers to childbirth, usually human that occurs in water. Views on water birth are usually polarised. Proponents believe that water birth results in a more relaxed, less painful experience that promotes a midwife-led model of care. Critics argue that the safety of water birth has not been scientifically proven and that a wide range of adverse neonatal outcomes have been documented. In Malaysia, the practice of water birth and the actual number of water birth is unknown. The Federal Territory State Health Department, Kuala Lumpur reported two unsafe deliveries associated with water birth where the deliveries were not attended by trained healthcare providers. Hence, this technology review was requested by the Secretary of the Malaysia Midwife Board.

Objective/aim

The objective of this systematic review was to assess the safety, effectiveness, economic implication, organizational or legal implication of water birth compared with conventional birth for the mother and the baby.

Results and conclusions

A total of 1,201 titles were identified through the Ovid interface and PubMed. Twenty one articles related to water birth is included in this review: one systematic review, one non randomised controlled trial, two cohort, three case control studies, four cross sectional studies, three case series, six case reports and one economic evaluation study. The studies were conducted in Switzerland, Australia, United Kingdom, Italy, New Zealand, Turkey and Japan.

a. Safety of water birth compared with conventional birth:

Maternal

Blood loss during labour

- Fair level of evidence to suggest that there was no significant difference in blood loss for women having water birth compared with conventional birth.

Perineal trauma

- Fair level of evidence to suggest that there was significantly lower episiotomy rate and third to fourth degree perineal lacerations in women having water birth. However, women having water birth were found to

have higher rate of first to second degree lacerations and vaginal or labial tears.

Maternal infection

- Limited fair level of evidence to suggest that there was no significant difference in maternal infection for women having water birth compared with conventional birth. However, there was a case report on postpartum pneumoperitoneum and peritonitis after water birth.

Fetal / neonatal

Apgar score and umbilical cord arterial pH

- Fair level of evidence to suggest that there was no significant difference in Apgar score and umbilical cord arterial pH in neonates.

Admission to neonatal intensive care unit

- Evidence on admission to neonatal intensive care unit is inconclusive. However, among reasons for admission of neonates delivered in water to the neonatal intensive care unit include snapped umbilical cord, fresh water drowning, water aspiration, persistent pulmonary hypertension and hypoxic ischaemic encephalopathy.

Fetal / neonatal infection

- Fair level of evidence to suggest that there was no significant difference in neonatal infection. However, there were case series and case reports which reported the potential risk of *Legionella pneumophila* pneumonia, adenovirus infection and *Pseudomonas aeruginosa* infection in neonates associated with water birth.

Water aspiration

- Low level of evidence to suggest the greater level of respiratory morbidity following water birth.

Perinatal mortality

- Evidence is inconclusive with regards to perinatal mortality as power of available studies is insufficient.

The lack of evidence of significant difference between the two modes of birth should be taken with caution in view of the limitations of the available studies.

b. Effectiveness of water birth compared with conventional birth:
Maternal

Duration of second stage of labour

- Fair level of evidence to suggest that there was no significant difference in duration of second stage of labour for women having water birth compared with conventional birth.

Use of analgesics

- Fair level of evidence to suggest that there was significant reduction in the use of analgesics among women having water birth.

Satisfaction with childbirth experience

- Limited fair level of evidence to suggest that there was higher level of satisfaction with childbirth experience among women having water birth compared with conventional birth.

Pelvic floor function

- Limited fair level of evidence to suggest that there was no significant difference in pelvic floor function after water birth compared with conventional birth.

Fetal / neonatal

There was no retrieval evidence on the effectiveness of water birth compared with conventional delivery for the fetal / neonatal outcomes.

c. Cost-effectiveness

A cost-effectiveness analysis conducted in Italy found the incremental health care cost (ICER) per avoided perineal tear because of water delivery was estimated as € 1,395.7 (95% CI: € 1,049.2 to € 3,608.5). The cost-effectiveness acceptability curve suggests that at a threshold of € 2,000, more than 80% of water delivery would be cost-effective.

d. Organizational

Water birth is being practiced within the hospital or at home for low risk patient. Guidelines were developed to ensure the safety, as far as possible, for women choosing the option of immersion in water for labour and / or birth for themselves and their unborn / newborn babies. The guidelines include criteria for inclusion and exclusion for immersion in water during labour and / or birth as mentioned in para 3.4 in the text, management of different stages of labour, equipment, water temperature, infection control, cleaning of bath / pool, clothing, education, contamination, emergency situation, health and safety, and audit. Water birth should be attended by a registered midwife and / or medical practitioner who is trained and experienced in facilitating water birth. There is a significant gap in the local setting as water births are not part of the local training curricula of the advanced diploma in midwifery, nor in the training of obstetrics and gynaecology specialists.

e. Legal implication

There was no retrievable evidence or record on legal implication related to water birth.

Methods

Electronic databases were searched through the Ovid interface: Ovid MEDLINE® In-process and other Non-indexed citations and Ovid MEDLINE® 1948 to present, EBM Reviews - Cochrane Central Register of Controlled Trials - October 2013, EBM Reviews - Cochrane Database of Systematic Reviews - 2005 to October 2013, EBM Reviews - Health Technology Assessment - 4th Quarter 2013, EBM Reviews - Database of Abstracts of Reviews of Effects - 4th Quarter 2013, EBM Reviews – NHS Economic Evaluation Database 4th Quarter 2013, Embase – 1988 to 2013 week 46. Searches were also run in PubMed. Google was used to search for additional web-based materials and information. No limits were applied. Additional articles were identified from reviewing the references of retrieved articles. Last search was conducted on 25 November 2013.

WATER BIRTH

1. INTRODUCTION

Childbirth, labour, delivery, birth, partus, or parturition is the culmination of a pregnancy period with the expulsion of one or more newborn infants from the woman's uterus. The process of normal childbirth is characterised in three stages of labour: the shortening and dilation of the cervix (1st stage), descent and birth of the infant (2nd stage), and birth of the placenta (3rd stage).[1]

The use of water immersion in labour and birth remains a hot topic in perinatal medicine. There are two separate and distinct aspects to the use of water immersion in labour:1) the use of immersion for women in first stage of labour (without birth into the water), and 2) immersion for women in the second stage of labour with birth into the water (referred as water birth).[2] Hence, water birth refers to childbirth, usually human that occurs in water.[3] Views on water birth are usually polarised. Proponents believe that water birth results in a more relaxed, less painful experience that promotes a midwife-led model of care.[4,5,6] Critics argue that the safety of water birth has not been scientifically proven and that a wide range of adverse neonatal outcomes have been documented.[7,8,9]

The first recorded water birth occurred in France in 1805. In 1992, the British House of Commons Health Committee issued the Report on Maternity Services that recommended, "all hospitals make it their policy to make full provision whenever possible for women to choose which they prefer for labour and birth with the option of a birthing pool where applicable". The popularity of labouring and birthing in water has increased dramatically around the world. Globally, more than 150,000 water births occurred between 1985 and 1999.[4] Water birth practise is widespread in hospitals in the United Kingdom and western Europe – including Switzerland, Italy, Spain, Portugal, Malta, Denmark, Norway, and Finland.[5] However, very few water births take place in France. In Sweden, a pool can be used in the first stage, but water birth is not permitted. In Ireland, the use of pools was forbidden entirely. This is following a widespread publicity on the deaths in Sweden and Ireland of a baby after a water birth.[5]

In Malaysia, the practice of water birth and the actual number of water birth is unknown. The Federal Territory State Health Department, Kuala Lumpur reported two unsafe deliveries associated with water birth where the deliveries were not attended by trained healthcare providers. Hence, this technology review was requested by the Secretary of the Malaysia Midwife Board.

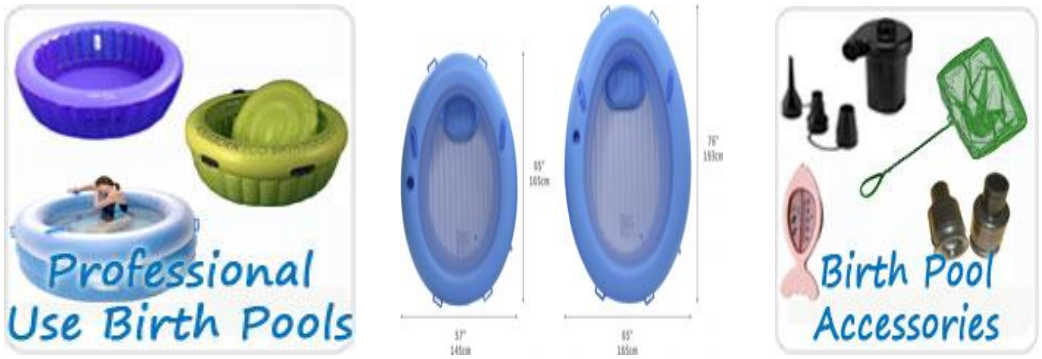
2. OBJECTIVE / AIM

The objective of this systematic review was to assess the safety, effectiveness, economic implication, organizational or legal implication of water birth compared with conventional birth for the mother and the baby.

3. TECHNICAL FEATURES

3.1. Immersion in water during labour and / or birth

Water immersion refers to the immersion in warm water by a pregnant woman during any stage of labour (first stage, second stage, third stage) where the woman's abdomen is completely submerged. This implies the use of a pool, tub or a bath.



Some women choose to labour in the water and get out for delivery. Other women decide to stay in water for the delivery as well (water birth). The claimed theory behind water birth is that since the baby has already been in the amniotic fluid sac for nine months, birthing into similar environment is gentler for the baby and less stressful for the mother. Water birth can take place within a hospital or at home. Water birth should always occur under the supervision of a qualified health care provider.[10]

The depth of the water in the pool, tub or bath should be up to the mothers' breast when she is in a sitting position. This aids buoyancy and promotes movement, which aids the progress of labour and maternal control.[11]

The water temperature should be comfortable for the mother and at a temperature to avoid hyper / hypothermia. In the first stage of labour, the recommended range of temperature is between 34°C to 37°C. In the second stage of labour, the water temperature should be 37°C to 37.5°C.[11]

3.2. Claimed theoretical benefits of labour and birth in water:[4]

i. Acceleration of cervical dilatation
ii. Non pharmacologic pain relief
iii. Decreased use of analgesia and anaesthesia
iv. Less need for labour augmentation
v. Less traumatic birth experience
vi. Fewer operative deliveries
vii. Reduced perineal trauma
viii. Increased maternal satisfaction with the birth experience

Claimed mechanism of action:[4]

Women labouring in water receive both a hydrothermic and hydrokinetic benefit. Woman birthing in water experience a relative weightlessness as the water provides support and creates equal pressure on submerged body surfaces. As the woman relaxes, she experiences less pain, which results in less anxiety and probably reduces adrenalin levels and enhances the endogenous production of oxytocin.

Birthing in water eliminates compression of the inferior vena cava, resulting in increased blood supply to the uterus, which enhances oxygenation of muscle tissues to promote more uterine contractions. The mild vasodilatation that occurs in water decreases the maternal blood pressure and the maternal pulse increase slightly, thus increasing oxygenation to the uterus and foetus.

3.3. Claimed theoretical risks of labour and birth in water:[4]

i. Maternal and neonatal infection
ii. Thermal regulation problem for the foetus
iii. Water aspiration by newborn
iv. Foetal hypoxia
v. Risk of snapped or torn umbilical cord

3.4. Example of inclusion criteria for immersion in water during labour and / or birth:[12]

Antepartum:

i. Healthy women with no medical or obstetric risk factors
ii. Singleton pregnancy
iii. Cephalic presentation
iv. At least 37 completed weeks pregnant
v. Not a carrier of / infected with HIV, Hepatitis B or Hepatitis C virus
vi. Body mass index equal to or less than 35.0 pre-pregnancy or at booking visit

Special circumstances:

i. Positive Group B Streptococcus vaginal swabs during pregnancy are not a primary contraindication for water immersion provided that antibiotics guidelines are adhered to
ii. Women with ruptured membranes for more than 18 to 24 hours may utilise immersion in water during labour and birth provided that the recommended intravenous antibiotics are administered

Intrapartum

In the intrapartum period the following additional criteria must be taken into consideration:

i. There is no contraindication to the use of intermittent auscultation of the foetal heart
ii. All maternal and foetal observations remain within normal range
iii. Clear amniotic fluid in the presence of a reassuring foetal heart rate
iv. Has not received narcotic analgesia within four hours

The woman is required to leave the water if an intrapartum risk factor develops or is detected.

4. METHODS

4.1. Searching

Electronic databases were searched through the Ovid interface: Ovid MEDLINE® In-process and other Non-indexed citations and Ovid MEDLINE® 1948 to present, EBM Reviews - Cochrane Central Register of Controlled Trials - October 2013, EBM Reviews - Cochrane Database of Systematic Reviews - 2005 to October 2013, EBM Reviews - Health Technology Assessment - 4th Quarter 2013, EBM Reviews - Database of Abstracts of Reviews of Effects - 4th Quarter 2013, EBM Reviews – NHS Economic Evaluation Database 4th Quarter 2013, Embase – 1988 to 2013 week 46. Searches were also run in PubMed. Google was used to search for additional web-based materials and information. No limits were

applied. Additional articles were identified from reviewing the references of retrieved articles. Last search was conducted on 25 November 2013.

Appendix 1 showed the detailed search strategies.

4.2. Selection

A reviewer screened the titles and abstracts against the inclusion and exclusion criteria and then evaluated the selected full text articles for final article selection.

The inclusion and exclusion criteria were:

Inclusion criteria

Population	Pregnant women in labour
Interventions	Water birth / water birth delivery / immersion in water birth / delivery under water
Comparators	Conventional delivery / no comparator
Outcomes	i. Perceived benefit of water birth compared with conventional delivery to the mother such as reduction in pain, analgesic use, duration of labour, instrumental delivery ii. Adverse events or complications related to water birth for mother or baby for example mortality, infection, drowning, water aspiration, asphyxiation, water intoxication, cord avulsion/snapped umbilical cord, blood loss, hospitalisation, APSGAR score, umbilical cord pH, perineal trauma iii. Economic implication (cost, cost-effectiveness) iv. Organizational issues: person assisting delivery, place of delivery, type of facilities, monitoring of mother and baby, training, surveillance v. Legal implication
Study design	Health Technology Assessment (HTA), Systematic Review, Randomised Controlled Trial (RCT), Non Randomised Controlled Trial, Cohort studies, Case Control studies, Cross sectional studies, case series, case reports
	English full text articles

Exclusion criteria

Study design	Studies conducted in animals and narrative reviews
	Non English full text articles

Relevant articles were critically appraised using Critical Appraisal Skills Programme (CASP) and graded according to US/Canadian preventive

services task force (Appendix 2). Data were extracted and summarised in evidence table as in Appendix 3.

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5. RESULTS AND DISCUSSION

A total of 1,201 titles were identified through the Ovid interface and PubMed. Twenty one articles related to water birth is included in this review: one systematic review, one non randomised controlled trial, two cohort, three case control studies, four cross sectional studies, three case series, six case reports and one economic evaluation study. The studies were conducted in Switzerland, Australia, United Kingdom, Italy, New Zealand, Turkey and Japan.

5.1. SAFETY

The main outcomes studied were maternal and fetal / neonatal outcomes.

5.1.1. Maternal

a. Blood loss during labour

A Cochrane Systematic Review on immersion in water in labour and birth was conducted by Cluett ER, Burns E, in 2009 and was edited and published in Issue 2, 2012. The review included 12 RCTs whereby eight trials were related to first stage of labour, one related to early versus late immersion in the first stage of labour and three trials related to delivery in water (water birth). Of the three trials included for immersion versus no immersion in the second stage of labour, one trial evaluated immersion during second stage of labour (Nikodem 1999) and two trials measured outcomes across the first and second stages (Chaichian 2009; Woodward 2004). The number of participants in the three studies was small. In the study by Nikodem 1999, 60 participants were randomised to the study group and 60 participants were randomised to the control group, while in the study by Chaichian 2009, there were 53 participants in each group. In the study by Woodward 2004, there were 40 participants in the study group and 20 participants in the control group, although it should be noted that only 10 (25%) of the 40 women allocated to birth in water actually did so.[1 level I] The review found no significant differences in the two groups for blood loss during labour, Risk Ratio 0.14; 95% Confidence interval (CI): 0.01 to 2.71.[13 level II-I]

Zanetti –Dallenbach et al. conducted a cohort study in Switzerland to assess the effect of water birth on maternal and fetal outcomes in selected low risk patients in a tertiary obstetrical unit. A total of 513 low risk patients, who requested a water birth were studied during the years 1998 to 2002. Every interested woman was given detailed explanations and information about the inclusion and exclusion criteria and about

guidelines concerning the safety of water birth, either by trained resident, fellow or midwife. According to the course of delivery, four different groups were designated; 89 pregnant women (17.4%) delivered in water [(Study Group (SG)], 133 pregnant women (25.9%) had a normal vaginal delivery after temporary immersion in water [Control Group I (CG I)], 146 pregnant women (28.5%) had a normal vaginal delivery but no temporary immersion in water [Control Group II (CG II) and 145 pregnant women (28.3%) had an operative delivery by caesarean section or assisted vaginal delivery [Control Group III (CG III)]. They found that the haemoglobin and haematocrit values were significantly lower in all control groups except in CG II assessed at two days postpartum, P = 0.005. [14 level II-2]

Another cohort study was conducted by Geissbuhler V, Eberhard J, in an Obstetrics and Gynaecology clinic, Thurgauisches Kantonsspital, Frauenfeld, Switzerland between November 1, 1991 and May 21, 1997. Since November 1, 1991 every birth has been documented with a standardized questionnaire in five parts. The parturient receives the first part of the questionnaire at home six to eight weeks before birth, and brings the completed form with her when she enters the hospital for birth. During labour, after birth and again before the new mother leaves the hospital (usually four to seven days after birth), the attending midwife and doctor record the objective information concerning labour, birth and postpartum phase. A 100-mm-long visual analog scale is then shown with the term ‘wonderful’ to the left and the term ‘dreadful’ to the right. The woman marks a line, more to the left and the or to the right, depending on how she feels about her birth experience. The birth parameters of mother and child in the most often chosen spontaneous birth methods were compared to assess the safety of alternative birth methods in general and of water birth in particular. Two thousand and fourteen of the 5,953 spontaneous births were water births (34%), 1,108 (18%) were Maia-birthing stool births and 2,362 (40%) were bed births. They reported that the mothers’ blood lost was lowest in water births (mean haemoglobin drop before birth and two to four days after birth; - 4.1 g/L in water birth, -9.1 g/L in Maia-birthing stool, and 6.6 g/L in bed birth, P <0.0001).[15 level II-2]

Menakaya et al. conducted a case control study in Australia to describe the maternal and neonatal outcomes associated with water birth among labouring women deemed at low risk for obstetric complications and compare these outcomes against women of similar risk who had a standard land birth. A retrospective audit and comparison of women giving birth in water at Bankstown hospital with a matched cohort who birthed on land at Bankstown hospital over a 10 year period (2000 to 2009) was conducted. In total 438 childbearing women were selected for the study (n = 219 in each arm). Primigravida women represented 42% of the study population. They reported no significant difference in postpartum blood

loss between the two birth groups; 10 (4%) for women in water birth group and 11 (5%) in non-water birth group (standard birth group).[16 level II-2]

Another case control study was conducted by Otigbah et al. in the United Kingdom to document the practice of water births and compare their outcome and safety with normal vaginal deliveries. A retrospective case-control study was conducted over a five year period from 1989 to 1994 at the Maternity Unit, Rochford Hospital, Southend, United Kingdom. Three hundred and one (301) women electing for water births were compared with the same number of age and parity matched low risk women having conventional vaginal deliveries. Length of labour, analgesia requirements, Apgar scores, maternal, fetal and neonatal complications, admission and infections were noted. They reported no statistically significant difference in the postpartum blood loss rate (1.3% for women having water births compared with 2.7% of the controls).[17 level II-2]

Theoni et al. reviewed the first 1600 water births born between March 1997 and December 2004 at the Gynaecology and Obstetrics Unit, Vipiteno / Sterzing, Italy. They also reviewed the number of alternative birthing positions used by primiparae since 1997 and compared the duration of delivery, incidence of perineal trauma, neonatal arterial blood pH, base excess, analgesic requirements, shoulder dystocia, women with previous caesarean section, and postpartum haemoglobin level. They compared 737 primiparae deliveries in water with 407 primiparae deliveries in bed, and 142 primiparae on the delivery stool. Commencing 2001, 250 water samples taken from the pool were analyzed. Two water samples obtained at every water birth. They reported no difference in the postpartum maternal mean haem oglobin levels (10.9 g/dl in water births, 10.1 g/dl in bed births, and 10.23 g/dl in delivery on the delivery stools).[18 level II-3]

b. Perineal trauma

The Cochrane Systematic Review found no significant differences for perineal trauma for immersion in water versus no immersion during second stage of labour: episiotomy rate was 12/100 for immersion versus 10/79 for no immersion, Risk Ratio 0.75; 95% CI: 0.35 to 1.60, second degree tears was 21/100 for immersion versus 14/79 for no immersion, Risk Ratio 1.21; 95% CI: 0.65 to 2.24, third or fourth degree tears, Risk ratio 1.54; 95% CI: 0.07 to 36.11.[13 level II-I] In contrast, Zanetti –Dallenbach et al. reported significantly higher episiotomy rate in all control groups (5.6% in those delivered in water (SG), 48.9% in those who had a normal vaginal delivery after temporary immersion in water (CG I), 37.0% in those who had a normal vaginal delivery but no temporary immersion in water (CG II), and 55.9% in those who had an operative delivery by caesarean section or assisted vaginal delivery (CG III), $P< 0.001$. The first and second degree perineal lacerations were found to be higher in water delivery group (53.9% in SG, 21.8% in CG I, 26.0% in CG II, and 11.7% in

CG III), while third degree perineal lacerations were higher in the control groups (0% in SG, 2.3% in CG I, 0.7% in CG II, and 7.6% in CG III). Vaginal tears and other injuries were found to be higher in the water delivery group (31.5% in SG, 18% in CG I, and 15.8% in CG II).[14 level II-2]

Geissbuhler V, Eberhard J, found that an episiotomy was performed in only 12.8% of births in water, 27.7% of the births on Maia-birthing stool and 25.4% of the bed births, P < 0.001. In spite of the highest episiotomy rates, the bed births also showed the highest third to fourth degree perineal lacerations (2.7% in water births, 2.3% in Maia-birthing stool births and 4.1% in bed births). There was a significant difference between water birth and bed birth P < 0.05. However, first to second degree perineal lacerations, vaginal tears and labial tears were found to be significantly higher in water births compared with bed births (51.25 versus 34.8%; P < 0.001, 19.8% versus 14.6%; P < 0.0001, and 21.4% versus 12.9%; P < 0.001, respectively).[15 level II-2]

Menakaya et al. reported that there were no episiotomies performed in the water birth group which was significantly different to the standard birth group (n = 33, P < 0.001). Forty percent (40%) of women in the water birth group had an intact perineum (n = 88) as opposed to 31% (n = 68) of women in the standard birth group. Although rates of minor degree tears (grades I and II) were comparable between the two groups, 80% of the major degree perineal trauma (grades III and IV) were experienced by those women in the standard birth group (four versus one in the water birth group).[16 level II-2]

Otigbah et al. reported that primigravidae having water births were more likely to have an intact perineum (41% for women having water births compared with 29% of the controls, P < 0.005). However, there was no such difference in the multiparous group. More women having water births sustained tears; 53% for women having water births compared with 39% in the controls P < 0.001, although fewer had episiotomies (5% for women having water births compared with 25% of the controls, P< 0.000).[17 level II-2]
Theoni et al. reported that the episiotomy rate was lower with a water birth than delivery in bed or delivery on the delivery stool (0.68%, 23.3%, and 8.4% respectively, P < 0.01). The rate for perineal tears (grade I, grade II, grade III lacerations) were similar in all three groups.[18 level II-3]

c. Maternal infection

The Cochrane Systematic Review found no significant differences for maternal temperature, mean difference was 0.20; 95% CI: - 0.18 to 0.58.[13 level II-I] Similarly, Zanetti–Dallenbach et al. reported the maternal temperature measured on admission and two days postpartum did not show any differences in groups.[14 level II-2] Otigbah et al. reported one case of maternal pyrexia among the multipara in the water birth group. [17 level II-2]

Brown et al. reported a case of postpartum pneumoperitoneum and peritonitis after water birth in a 28 year old female. The woman presented to the emergency department with a two day history of generalised abdominal pain. She had given birth to her first child three days previously at home. The child had been born by normal vaginal delivery (water birth) complicated by fourth degree tear, which was repaired immediately at another hospital. The patient had been discharged the following day on oral metronidazole and amoxicillin. Presented at emergency department, three days after delivery and represented four days later complaining of persistent abdominal pain, diarrhoea, vomiting and pyrexia. At surgery, a formal abscess wall was encountered within the abdominal cavity and 1,200 ml of clear yellow purulent fluid was found in the peritoneal cavity with soft fibrin plaques between bowel loops. There was no faeculent odour. Careful examination was made of the entire gastrointestinal tract, including under water insufflations of the rectum. No perforation was found. Rectal examination was normal. Speculum examination of the vagina revealed an intact repair. Postoperatively, the patient was treated with metronidazole and co-amoxiclav and made a slow uncomplicated recovery. Cultures taken from the peritoneal fluid grew *Streptococcus Faecalis* and *Candida Albicans* and her antibiotics were changed as guided by sensitivities. They highlighted the possibility of contamination either from the patient's own flora or that of the water. The significance of the fourth degree tear, and her primigravida status is unclear.[19 level III]

5.1.2. Fetal / neonatal

a. Apgar score and umbilical cord arterial pH

The Cochrane Systematic Review reported no significant differences for immersion in water compared with no immersion in water for the second stage of labour in Apgar score less than seven at five minutes (Nikodem 1999), Risk Ratio 4.92; 95% CI: 0.24 to 100.31 and less than eight at five minutes (Woodward 2004): Risk Ratio 1.54; 95% CI: 0.07 to 36.11 and umbilical artery pH less than 7.20, (Risk Ratio 0.89; 95% CI: 0.45 to 1.75).[13 level II-I] Zanetti–Dallenbach et al. reported no differences in fetal outcome parameters including Apgar scores and umbilical artery pH. The mean and standard deviation (SD) for Apgar score were 9.8 (0.5) in SG, 9.8 (0.6) in CG I, 9.8 (0.5) in CG II, and 9.6 (1.0) in CG III. The Umbilical artery pH mean (SD) were 7.26 (0.06) in SG, 7.23 (0.08) in CG I, 7.25 (0.08) in CG II, and 7.22 (0.08) in CG III.[14 level II-2] In contrast, Geissbuhler V, Eberhard J, reported the average arterial blood pH of the umbilical cord as well as the Apgar scoring was significantly higher after water births. Umbilical artery pH mean (SD) were 7.30 (0.77) in water births, 7.29 (0.85) in Maia-birthing stool births and 7.26 (0.78) in bed births. The Apgar score mean (SD) at five minutes and 10 minutes were 9.8 (0.5) and 9.9 (0.3) in water births, 9.8 (0.6) and 9.9 (0.4) in Maia-birthing stool births, and 9.6 (0.7) and 9.9(0.3) in bed births, respectively.[15 level II-2] Mehakaya et

al. reported that there were more babies born with an Apgar score of seven or less at one minute in the water birth group (25 in water birth group versus eight in standard birth group, P< 0.05). However, at five minutes there was no statistically significant difference on Apgar score between the two groups (two in water birth group versus zero in standard birth group, P> 0.05).[16] level II-2 Otigbah et al. reported no significant difference in the mean Apgar score.[17] level II-2 Theoni et al. reported no difference in arterial cord blood pH mean (range): 7.25 (7.04-7.47) in water birth group compared with 7.24 (7.03-7.46) in delivery in air group (bed and stool).[18] level II-3

b. Admission to neonatal intensive care unit

The Cochrane Systematic Review reported no significant differences in admission to neonatal intensive care unit for immersion in water compared with no immersion in water in the second stage of labour, Risk Ratio 0.79; 95% CI: 0.25 to 2.49.[13] level II-I Zanetti–Dallenbach et al. reported no differences in admission rate to neonatal intensive care unit (NICU). The admission to the NICU were comparable in all 4 groups; 0% in SG, 1.5% in CG I, 3.4% in CG II, and 2.1% in CG III.[14] level II-2 Mehakaya et al. reported eight admissions to the special care nursery (SCN) from the water birth group compared with to only one admission in the standard birth group (P = 0.023). Four babies born in water was admitted for observation (two after active resuscitation, one for apnoea event and weight 2,560 gram and one as a result of mild shoulder dystocia), three babies were admitted for feeding difficulties, and a baby was admitted for meconium aspiration syndrome. One baby in the standard birth group was admitted for respiratory distress syndrome.[16] level II-2 Otigbah et al. reported no significant difference in the admissions to the Special Care Baby Unit (SCBU). There were five cases (1.7%) of shoulder dystocia amongst the water births and four (1.3%) in the controls. The admissions to the SCBU were prompted by low Apgar scores. There were two cases in water births and four cases in controls.[17] level II-2

Gilbert RE, Tookey PA, conducted a cross sectional study to compare perinatal morbidity and mortality for babies delivered in water with rates for babies delivered conventionally (not in water). From April 1994 to April 1996, all 1500 consultant paediatricians in British Isles were surveyed each month by British Paediatric surveillance Unit and asked to report whether or not they knew of any births that met the case definition of 'perinatal death or admission for special care within 48 hours of birth following labour of delivery in water'. A postal questionnaire was sent to all NHS maternity units (219) in England and Wales in 1995 and 1996 to determine the total number of deliveries in water during the study period. [20] level II-3

A total of 34 babies out of 4,030 delivered alive in water in England and Wales were admitted for special care, a risk of 8.4 per 1,000 live births (95% CI: 5.8 to 11.8). Fifteen of the survivors had lower respiratory tract problems variously labelled as pneumonia, transient tachypnoea of newborn or “wet lung” (nine babies), suspected aspiration (three babies), meconium aspiration (one baby), water aspiration (one baby) and “freshwater drowning” (one, who had hyponatraemia). Hypoxic ischaemic encephalopathy grade 2 or 3 or perinatal asphyxia was reported in five surviving children including in whom freshwater drowning was diagnosed. Evidence of infection was reported in two babies who survived with pneumonia: in one, group D streptococci were isolated from the maternal high vaginal swab; in the other, group B streptococci were isolated from the baby’s skin swab. Fifteen had other diagnoses or reasons for admission. Five babies had a snapped umbilical cord (of whom one required a transfusion, one developed hypoxic ischaemic encephalopathy grade 2, and one had a chromosomal abnormality). Another baby had a chromosomal abnormality, one developed hypoxic ischaemic encephalopathy grade 3 and had transposition of the great arteries, three had stridor, and one had shoulder dystocia. No clear reason or diagnosis was given for the remaining four babies. United Kingdom reports of special care admission rates for babies of women considered to be at low risk of complications during delivery who delivered conventionally ranged from 9.2 (95% CI: 1.1 to 33) to 64/1000 (95% CI: 58 to 70) live births, respectively.[20 level II-3]

The fetal outcomes of water births in a tertiary maternity hospital in Ankara, Turkey were evaluated by Demirel et al. A retrospective study in infants born by water births from January 2005 to May 2010 was conducted. All delivery and hospitalisation data of newborns were recorded from the patient files retrospectively. The demographic and clinical features of the patients, hospitalisation date, nutritional status, birth complications such as trauma, infection and neonatal intensive care unit (NICU) attendance rate were evaluated. A total of 191 pregnant women who met the inclusion criteria and had complete data were evaluated. Birth trauma was observed in three patients (neonates): one brachial nerve paralysis, one cord rupture and one cephal haematoma. None of these patients needed extended hospitalisation time as the result of these complications (two days, two days, and three days, respectively). Six of the patients (3.1%) were admitted to NICU. Four were hospitalised for respiratory tract problems (three due to transient tachypnoea of newborns and one due to neonatal pneumonia). Except for the patient who received antibiotic therapy because of neonatal pneumonia, infection screening was negative for the other three patients. One patient was admitted for polycythemia, while the other for myelocele.[21 level II-3]

c. Fetal / neonatal infection

The Cochrane Systematic Review reported a study by Nikodem 1999 found no difference in the incidence of raised neonatal temperature at birth greater than 37.5°C (8/55 for immersion in water versus 3/54 for no immersion in water during second stage of labour, Risk Ratio 2.62; 95% CI: 0.73 to 9.35), while Woodward 2004 reported no significant difference in antibiotics given to neonates, Risk Ratio 1.50; 95% CI: 0.17 to 13.52 or in positive neonatal swabs of ear, mouth or umbilicus, Risk Ratio 1.89; 95% CI: 0.90 to 3.96.[13 level II-I] Zanetti–Dallenbach et al. reported no differences in fetal outcome parameters including infection rate. Clinical signs of infections in the neonate were 5.6% in SG (delivered in water), 3.0% in CG I (had a normal vaginal delivery after temporary immersion in water), 1.4% in CG II (had a normal vaginal delivery but no temporary immersion in water), and 3.4% in CG III (had an operative delivery).[14 level II-2] Geissbuhler V, Eberhard J, reported no significant difference in the infections of neonate (0.6% in water births, 1.1% in Maia- birthing stool births and 1.05% in bed births, P > 0.05). The commonest infection of the neonate found during the first week of life is nonspecific conjunctivitis.[15 level II-2] Theoni et al. found that the rate of neonatal infections was not increased in water birth despite the high rates of contamination of the water in the pool after delivery. Overall, 1.22% of neonates (12 in 986) born in water showed signs of infection such as tachypnoea and a suspect colour of the skin compared with 2.63% (17 in 647) in delivery in air (bed and stool groups).[18 level II-3]

There were few case reports and case series of neonatal infections that are thought to be potentially due to water births.[22-26] Nagai et al. reported a case of neonatal sudden death due to *Legionella* Pneumonia associated with water birth in domestic spa in Nagoya, Japan. In June 1999, a 3.5 kilogram baby girl was born after 42 week gestation period in a bathtub that employed the ever-ready system in her home by water birth delivery in the absence of doctors and midwives. The mother had no health problems during pregnancy. The midwife arrived 15 minutes after the girl was born. The baby was normal at the time, but she developed a fever and jaundice on day four. She was admitted to a private obstetrics-gynaecology hospital and received phototherapy. The following day the baby left the hospital because fever had decreased and jaundice had disappeared. On day seven, the baby had recurrent symptoms of fever and vomiting, although she drank milk well that night. At noon on the next day, the baby showed sudden apnoea and was transported to the emergency room with cardiopulmonary arrest. She could not be resuscitated. An autopsy was performed three hours after death. There were numerous yellow nodules, which were less than 5 mm in diameter and which were scattered over the bilateral lung parenchyma. In the pulmonary nodular lesions, the alveoli showed severe infiltrations of neutrophils with prominent karyorrhexis and aggregation of macrophages

with fibrinous exudates. Many gram-negative but Gimenez-positive bright red bacteria were found in the macrophages. As the baby was suspected to have legionellosis, DNA was extracted from the formalin-fixed post-mortem lung tissue homogenate and was tested in a PCR with specific primers for *Legionella* 5S rRNA DNA and the *Legionella pneumophila mip* gene. The lung homogenate was also screened by indirect fluorescent antibody testing with 10 *Legionella* species-specific monovalent antisera. The specimen was positive only with antiserum to *L. pneumophila* serogroup 6. No other abnormal macroscopic or microscopic findings in the autopsy, hence the lung lesions were considered as the main cause of death. During the course of the environmental investigation, numerous living *Legionella* organisms were detected in the water obtained in the same bathtub a week after the baby's death.[22 level III]

Similarly, Franzin et al. reported a case of *Legionella pneumophila* pneumonia in a newborn after water birth in Turin, Italy. In December 1999, an infant was born after a full-term, uneventful pregnancy, following a prolonged vaginal delivery in a hospital birthing pool. No incubator was used, and the infant was discharged four days after birth in good general condition. Three days later, he was readmitted to the same hospital after the appearance of fever and dyspnoea. Respiratory distress increased in the following days, and a chest radiograph revealed diffuse bilateral alveolar-interstitial infiltrates. Ampicillin-sul-bactam (150 mg/kg q.d. i.v) and clarithromycin (8 mg/kg q.d. i.v) were administered for 10 days. Despite progressive clinical improvement, the radiologic picture remained unchanged, and he was transferred to the paediatric department at the age of one month. The results of laboratory tests (serologic, antigen testing, and PCR) were negative for the usual respiratory pathogens, such as *Chlamydia trachomatis*, *Chlamydia pneumoniae*, respiratory syncytial virus, cytomegalovirus, Epstein-Barr virus, Herpes simplex virus type 1, mycobacteria and *Pneumocystis carinii*. Antibody titres against *Legionella pnuemophila* serogroup 1 were positive for samples collected 26 and 33 days after the onset of symptoms (indirect immunofluorescence assay, 1/256; microagglutination, 1/4096). A decrease in antibody titres was observed 51 days after the onset of symptoms. The results of *Legionella* urinary antigen (EIA Biotest) were positive on seven repeated unconcentrated and concentrated urine samples, which were collected from the first to fourth month; they became negative at the next control from the sixth month. Anti-*Legionella* antibodies were negative in the mother, who was always healthy. After a positive diagnosis of *Legionella* infection (at 26 days after the onset of symptoms), clarithromycin (15 mg/kg b.i.d.) was administered to the child for three weeks. The findings of a chest x-ray progressively improved and normalised at three months of age. No clinical symptoms were observed at the latest visit, which was nine months after birth. Environmental investigations were performed on the water supply of the hospital where the child was born. *L. pneumophila*

serogroup 1 was isolated by culture from central hot water tanks and from hot water outlets (tap and shower head of delivery room's pool, and sink tap in the delivery room and the patient's room) at 300 to 2000 cfu/L. *L. pneumophil*a was not isolated from the patient's home.[23 level III]

Soileau et al. reported a case of severe disseminated adenovirus infection in a neonate following water birth delivery in the United States of America. A female infant was born at home by spontaneous vaginal delivery at 40 weeks and four days gestation via a planned water birth. The pregnancy was complicated by a maternal diarrhoeal illness with low grade fevers for about one week prior to delivery with maternal defecation occurring in the water bath during labour. Following delivery, the infant appeared healthy until four days of age when she developed a rectal temperature of 38°C. She was hospitalised and asepsis workout was initiated. A direct viral panel fluorescent antibody (DFA) test obtained via nasopharyngeal swab was positive for Human Adenovirus (HAdV). Supplemental oxygen was added after the patient developed mild respiratory distress (seven days of age). The patient's persistent fevers and increasing oxygen requirement prompted transfer to a tertiary care facility (eight days of age). She was placed on high frequency oscillatory ventilation followed by venoarterial extra-corporeal membrane oxygenation (ECMO) due to worsening chest radiograph, respiratory acidosis, and poor oxygenation. Serum HAdV quantitative PCR (qPCR) performed one day prior to initiation of ECMO detected a high virus load of 1.4 billion genome copies / ml. A tracheal aspirate DFA was also positive for HAdV. Cidofovir was started the next day at 5 mg/kg weekly and after her first dose, serum HAdV qPCR decreased to 55 million copies / ml. The infant developed a coagulopathy and became anuric on ECMO day five (17 days of age) and then developed worsening metabolic acidosis, poor perfusion, grossly bloody stools, and bloody endotracheal tube secretions. Her parents decided to withdraw medical support at this point, and she died shortly after being taken off ECMO (19 days of age). An autopsy findings showed evidence of HAdV pneumonia including diffuse alveolar damage with extensive necrotising bronchiolitis and epithelial cells with intranuclear inclusions, which were positive for HAdV by immunoperoxidase staining as well as bilateral 40 ml pleural effusions.[24 level III]

Rawal J, Shah A, Mehtar S, reported on a newborn baby who developed pseudomonas sepsis after water birth. A full term baby boy, weighing 3,600 grams, was born in the birthing tub of the labour ward in North Middlesex Hospital, London. His mother had no fever before the birth, and the membranes were ruptured for less than 12 hours. His condition at birth was good and Apgar scores were normal. At 11 hours of age he had two episodes of cyanosis. He was feeding poorly. On examination he was hypotonic and his peripheries were poorly perfuse, with mottling of the skin. Probable septicaemia was diagnosed. Swabs from the ear and

umbilicus and samples of urine, blood, and cerebrospinal fluid were taken for culture. He was given intravenous penicillin and gentamicin. Within 48 hours the swabs had grown *Pseudomonas aeruginosa* (*P aeruginosa*) and gentamicin had been changed to ceftazidine. Within a further two days he had recovered and discharged after treated with antibiotics for seven days. The cultures of urine, blood, and cerebrospinal fluid were sterile. The samples taken from the baby incubator yielded no growth, but specimens taken from the birthing tub, filling hose, taps, exit hose, and disposable lining of the tub all grew *P aeruginosa*. The *P aeruginosa* that was isolated from the birthing tub system and from the umbilical swab was serotype 2. Contamination of the birthing tub system had occurred despite meticulous washing with hot water and detergent and drying of the system after each birth.[25 level III]

Coombs R, Spiby H, Stewart P, reviewed infection in babies born to mothers who had used birthing pool in labour in Northern General Hospital NHS trust, Sheffield. From December 1991, 122 mothers used the pool in labour, of these 41 delivered in the pool. The hospital policy was to swab the ears of all infants whose mothers have used the pool and record their respiratory rate for three hours after delivery. Three of the 122 babies had positive ear swabs. Two of them were well with their mothers in the postnatal wards. The swabs grew *B Streptococci* and *Staphylococcus aureus* and both babies were treated with antibiotics until further cultures were negative. The last baby presented at 10 days with greenish discharge from his ear. Initial swabs had grown *Pseudomonas aeruginosa* and *Escherichia coli*. He was treated with parenteral antibiotics for 48 hours followed by topical antibiotic ear drops. His recovery was unremarkable. Five of the 122 infants were admitted to the special care baby unit with a raised respiratory rate or grunting. Four of the five had been delivered under water. All were treated with antibiotics though in all swabs and blood cultures were negative. There was one neonatal death from unexplained birth asphyxia but no clinical evidence of hyperthermia. [26 level II-3]

d. Water aspiration

Few articles reported on cases of near drowning and water aspiration syndrome following water births.[27-30] Nguyen S, Kuschel C, Teele R, reported four neonates who had aspiration of water and subsequent respiratory oedema. Four neonatal patients were transferred to neonatal unit at National Women's Hospital, Auckland, New Zealand in the last 18 months after delivery under water at other hospitals. The first case involved a male born at term weighing 4,155 grams. Delivery occurred accidentally in a water bath that was being used during labour for maternal analgesia. Apgar scores were recorded as 9 and 10 at one and five minutes, respectively. At five hours of age, the neonate was recognised to be in respiratory distress with oxygen saturation of 60% requiring 100%

oxygen via headbox. He was transferred to the neonatal unit and intubated and ventilated on arrival. No risk factors for sepsis were identified. Radiographs of the chest at nine hours of age demonstrated bilateral interstitial and alveolar oedema and bilateral pleural effusions. Irritability and hypertonicity were diagnosed as mild hypoxic ischaemic encephalopathy. Echocardiography demonstrated no abnormal cardiac abnormality. The neonate remained ventilated for three days. The patient was stable in air by the third day of life. The infant was readmitted on the ninth day of life with seizures. Investigations were normal. No additional seizures occurred, and the child's development over the first year of life has been appropriate for age.[27 level II-3]

The second case was a baby boy born by planned water birth at term. Apgar scores were 7 and 10 at one and five minutes, respectively. At six hours of age, the neonate was recognised as tachypnoeic by the mother and required oxygen. The infant was transferred to the neonatal unit and commenced on continuous positive airway pressure (CPAP) and antibiotics. No risk factors for sepsis were indentified. Radiographs of the chest demonstrated marked alveolar and interstitial oedema and pleural effusions. The infant's clinical status improved dramatically. He was in air, breathing spontaneously with no respiratory support by 24 hours of age. The infant completed five days of treatment with antibiotics. All blood cultures were negative.[27 level II-3]

The third case was a male born at term after planned water birth to provide analgesia for a mother who had spinal fusion. The infant was vigorous at birth with a good heart rate; however, he collapsed at five minutes of age with marked respiratory distress. Apgar scores were recorded as 7 and 2 at one and five minutes of age, respectively. A provisional diagnosis of water aspiration was made. The neonate was transferred to the neonatal unit and commenced on nasal CPAP. Radiograph of the chest revealed pulmonary oedema, with alveolar component more obvious in the right lung. Intraveonus antibiotics were commenced. The clinical course was that of rapid improvement over 24 hours. The infant weaned to air and respiratory support was discontinued. The infant completed five days of treatment with antibiotics. All blood cultures were negative. The fourth case involved a female born at term weighing 3,860 grams. At the request of the mother, labour and delivery occurred in a water bath. Apgar cores were 8 and 8 at one and five minutes, respectively. The infant developed respiratory distress at 10 minutes of age and required 60% oxygen via headbox. She was transferred to neonatal unit and commenced on nasal CPAP and antibiotics. Radiographs of the chest showed gross bilateral interstitial and alveolar oedema. The oxygen requirement increased shortly after arrival to 100%. Dramatic clinical improvement over the subsequent 24 hours enabled her to be weaned to air and all respiratory support was

discontinued. All blood cultures were negative and infant was discharged on the third day of life. One of the four neonates demonstrated hyponatraemia, consistent with water intoxication.[27 level II-3]

Mamas IN, Thiagarajan P, reported two neonates who were transferred to neonatal unit, Nobles Hospital, Douglas and Royal Liverpool Children's Hospital, Liverpool, United Kingdom during the last 12 month period with water aspiration after uneventful under water birth. The first case involved a male infant who was born by planned under water birth at term after an uneventful pregnancy. There were no antenatal concerns and his antenatal ultrasound scans were normal. There was no meconium staining of liquour, no prolonged rupture of membranes and no other risk factors for infection. The neonate was born in good condition in the pool and he cried immediately after he was brought to the surface. Apgar scores were 8 and 9 at one and five minutes, respectively. The infant was reviewed at two hours of his life because of grunting and respiratory distress noticed by the midwife. On examination he was still tachypnoeic with a respiratory rate 100 per minutes and had intercostals and subcostal recessions and nasal flaring. He was transferred to the neonatal unit, where investigations were performed. His chest radiograph demonstrated bilateral widespread changes consistent with water aspiration. He was commenced on intravenous cefotaxime at a dose of 50 mg/kg 12 hourly for five days. All blood cultures were negative. He was discharged eight days after his birth. [28 level II-3]

Similarly the second case involved a male infant who was born at term by planned under water birth in the birthing pool. The neonate was born in good condition under water and his Apgar scores were 9 at one minute and 9 at five minutes of his life. At 12 hour of his life, the Paediatric Senior House Officer was asked by the midwife to review the infant as the infant was not breast feeding well. On examination he was tachypnoeic with a respiratory rate of 70 per minutes. However, there were no grunting, no intercostal and subcostal recessions and no nasal flaring. He was transferred to the neonatal unit where investigations were performed. On his chest radiograph the right horizontal fissure was prominent and there were bilateral streaky shadows consistent with water aspiration. There was no confluent pulmonary consolidation. He was started on intravenous cefotaxime at a dose of 50 mg/kg 12 hourly. Blood cultures were negative. He was discharged six days after his birth.[28 level II-3]

Sotiridou E, Mukhopadhyay S, Clarke P, also reported a newborn baby who unexpectedly developed acute respiratory distress from aspiration during a water birth. The baby was born by vaginal delivery in hospital via a planned water birth. The baby appeared in good condition at birth. Apgar scores were 8 at 1 minute and 9 at 5 minutes. At 2.5 hours of age, the neonate was noted to be tachypnoeic, grunting and hypothermic. He was admitted to the neonatal intensive care unit and put on nasal continuous

positive airway pressure ventilation. Within an hour, his oxygen requirements had increased significantly and he required intubation and ventilation due to worsening respiratory acidosis. At intubation, fresh blood was noted in the airways and there were recurrent blood-stained endotracheal and nasogastric aspirates over the next 24 hours. He initially required high ventilator pressures, but his respiratory status improved within 24 hours and all respiratory support was discontinued at 48 hour of age. A chest x-radiograph done soon after admission demonstrated bilateral interstitial and alveolar oedema consistent with aspiration. Based on the history, signs and symptoms, occurrence of haemorrhagic pulmonary oedema, CXR appearances, and rapid clinical improvement with ventilator support, a diagnosis of water aspiration syndrome was made.[29] level III

Carpenter L, Weston P, conducted a case control study to measure the clinical and radiological findings from water birth babies and air birth babies presenting with respiratory distress at term and to determine if there are any specific features that were associated with the medium of delivery. Review of case records and x-rays over a seven year period (2000-20006) for all babies admitted to the NICU with respiratory distress after water birth and a similar group of babies with respiratory distress after air birth was performed. There were 14 water birth babies and 24 air birth babies in the study. They found that there were no differences in birth weight, gestational age, and Apgar scores between the groups. The water birth babies showed greater acidosis, greater requirement for ventilation (four in water birth compared with none in air birth, P = 0.006), and greater requirement for nitric oxide treatment (four in water birth compared with none in air birth, P = 0.006). The water birth group took longer to establish full feeds; age at full feeds (median, range): water birth [60 (19 - 411) hours] compared with [43 (12-130) hours] among air birth, P = 0.038. The X-rays could not be reliably allocated to the correct group, but the water birth X-rays were judged to have more severe changes than the air birth.[30] level II-3

e. Perinatal mortality

The Cochrane Systematic Review reported no significant differences in perinatal deaths, Risk Ratio 3.00; 95% CI: 0.12 to 72.20. Authors of the Cochrane Systematic Review concluded evidence suggest that water immersion during the first stage of labour reduces the use of epidural / spinal analgesia and duration of the first stage of labour. There is limited information for other outcomes related to water use during the first and second stages of labour due to intervention and outcome variability. There is no evidence of increased adverse effects to the fetus / neonate or woman from labouring in water or water birth. However, the studies are very variable and considerable heterogeneity was detected for some outcomes. Further research is needed.[13] level II-I

Gilbert RE, Tookey PA, reported five perinatal deaths among 4,030 live births in water in England and Wales, perinatal mortality 1.2 per 1,000 live births (95% CI: 0.4 to 2.9). Two babies were stillborn, and all three postpartum deaths were associated with abnormal pathological findings (one neonatal herpes infection, intracranial haemorrhage after precipitate delivery and hypoplastic lungs). United Kingdom reports of mortality rates for babies of women considered to be at low risk of complications during delivery who delivered conventionally ranged from 0.8/1000 (95% CI: 0.2 to 4.2) to 4.6/1000 (95% CI: 0.1 to 25) live births. Compared with regional data for low risk, spontaneous, normal vaginal deliveries at term, the relative risk for perinatal mortality associated with delivery in water was 0.9 (99% CI: 0.2 to 3.6). The authors concluded perinatal mortality was not substantially higher among babies delivered in water than among those born to low risk women who delivered conventionally. The data were compatible with a small increase or decrease in perinatal mortality for babies delivered in water.[20 level II-3]

5.2. EFFECTIVENESS

The main outcomes studied were maternal outcomes. None of the studies reported on fetal / neonatal outcomes.

5.2.1. Maternal

a. Duration of second stage of labour

In the Cochrane Systematic Review, three trials reported on the duration of the second stage of labour (Chaichian 2009; Nikodem 1999; Woodward 2004) and there was no statistical significant difference between groups: Mean difference (MD) was 1.24 minutes; 95% CI: - 8.05 minutes to 5.56 minutes.[13 level II-I] Similarly, the cohort study by Zanetti-Dallenbach et al. reported no significant difference in the duration of second stage of labour in the CG II (normal vaginal delivery but no temporary immersion in water) compared with SG (delivered in water); mean (SD) was 49.1 (54.4.3) minutes in CG II compared with 35.3 (36.4) minutes in SG, P = 0.542. However, the duration of labour was found to be significantly longer in CG I (normal vaginal delivery after temporary immersion in water) and CG III (instrumental delivery) compared with SG; 69.7 (64.1) minutes in CG I and 159.7 (105.7) minutes in CG III.[14 level II-2] Menakaya et al. in their case control study comparing water birth with standard birth (spontaneous vaginal birth not in water) found no statistically significant difference in the mean duration of second stage of labour between the two groups. For primigravida the mean duration of labour was 50.45 in water birth compared with 52.21 in standard birth, P = 0.9, while for the multigravida the mean duration of labour was 20.41 in water birth compared with 20.16 in standard birth, P = 0.9.[16 level II-2] Similarly, Theoni et al. also reported no difference in the duration of second stage of labour, 34 minutes in water

birth versus 37 minutes in bed birth.[18 level II-3] In another case control study, Otigbah et al. found primigravidae having water births had shorter second stage of labour compared with controls but not for the multiparae. Length of second stage of labour for primigravidae was 32.7 minutes in water birth compared with 42.6 minutes in control, P < 0.005, while for multiparae was 15.3 minutes in water birth compared with 14.9 minutes in control, P = not significant.[17 level II-2]

b. Pain intensity

In the Cochrane Systematic Review, one trial reported on the proportion of women experiencing moderate to severe pain (Nikodem 1999), and found no difference between groups, Risk Ratio 1.06; 95% CI: 0.73 to 1.53.[13 level II-I]

c. Use of analgesics

Zanetti-Dallenbach et al. reported no significant differences in additional use of analgesia and additional use homeopathy between CG II (normal vaginal delivery but no temporary immersion in water) compared with SG (delivered in water):48% compared with 40.4% and 38% compared with 44.9%, respectively. However, the need for analgesics and homeopathy was significantly higher in the other two control groups CG I (normal vaginal delivery after temporary immersion in water) and CG III (instrumental delivery) compared with SG.[14 level II-2] In another cohort study, Geissbuhler V, Eberhard J, reported fewer painkillers being used for water births. No painkillers at all were needed by 70.6% of women who gave birth in water, 66.1% of women who gave birth on the Maia-birthing stool and 54.1% of women who gave birth on a bed, P < 0.05 for water birth versus Maia-birthing stool, and P < 0.0001 for water birth versus bed birth. The women who gave birth in water used fewer suppositories, injections and epidural analgesia but higher homeopathic remedies. Suppositories were used by 11.8% of women who gave birth in water, 15.9% of women who gave birth on the Maia-birthing stool and 20.9% of women who gave birth on a bed, P < 0.001 for water birth versus Maia-birthing stool, and P < 0.0001 for water birth versus bed birth. Injections were used by 10.2% of women who gave birth in water, 14.6% of women who gave birth on the Maia-birthing stool and 22.6% of women who gave birth on a bed, P < 0.001 for water birth versus Maia-birthing stool, and P < 0.0001 for water birth versus bed birth. In contrast, homeopathic remedies were used by 21.9% of women who gave birth in water, 15.4% of women who gave birth on the Maia-birthing stool and 18.5% of women who gave birth on a bed, P < 0.0001 for water birth versus Maia-birthing stool, and P < 0.01 for water birth versus bed birth.[15 level II-2]

Similarly, a case control study by Otigbah et al. found significant reduction in analgesia requirements in women having water birth, with 38% of women having no analgesia compared with 8% in control or entonox only

58% compared with 32% in control, P< 0.0001. Only 1.0% of the women in the water birth group requested for entonox and pethidine compared with 38% in control, P < 0.0001.[17 level II-2] Theoni et al. in a cross sectional study reported no woman using the water birth method required analgesics.[18 level II-3]

d. Satisfaction with childbirth experience

In the Cochrane Systematic Review, two trials reported on satisfaction with childbirth experience. Nikodem 1999 demonstrated a significantly higher level of satisfaction with birth experience, Risk Ratio 0.24; 95% CI: 0.07 to 0.80, with fewer women in the immersion group feeling that they did not cope satisfactorily with their pushing efforts (3/60 for immersion in water versus 12/57 for no immersion in water during second stage of labour). However, another trial (Woodward 2004) which measured satisfaction with labour and birth on a scale of zero to six where zero is not at all satisfied, found that both groups were reasonably satisfied. Immersion, mean (SD) = 4.32 (1.2) versus no immersion, mean (SD) = 4.29 (1.26), but there were no significant differences between groups, mean difference = 0.03; 95% CI: - 0.64 to 0.70.[13 level II-I]

In the cohort study by Geissbuhler V, Eberhard J, 1,587 women after water births, 770 women after Maia-birthing stool births and 1,315 women after bed births returned the questionnaire with the analog scale on their birth experience (100-mm visual analog scale with the term 'wonderful' to the left and the term 'dreadful' to the right). The experience of birth after a water birth was closer to 'wonderful' than the Maia-birthing stool birth. A bed birth was being the furthest away from 'wonderful' birth experiences. The mean (SD) was 31.3 mm (20.5 mm) after water birth, 34.6 mm (21.6 mm) after Maia-birthing stool birth, and 42.2 mm (23.4 mm) after bed birth. [15 level II-2]

Cortes E, Basra R, Kelleher CJ, conducted a postal survey on patient satisfaction and reasons to choose a water birth. They reported that when women who had a water birth were asked about overall satisfaction with water birth experience and likelihood of having a second water bath, 84% replied "very likely', 5% replied "likely", 8% "undecided", one replied 'unlikely" and one said "very unlikely" (total of 77 women). Among reasons why women would choose a birthing pool delivery, pain relief was the main factor reported (84%), followed by natural approach (80%), prevention of tears (35%), prevention of incontinence (10%), midwife advice (35%), doctor advice (5%), better for the baby (67%) and shorter labour (29%).[31 level II-3]

e. Pelvic floor function

Cortes E, Basra R, Kelleher CJ, conducted a cross sectional study to assess the incidence of perineal trauma and pelvic floor function following water birth (WB) compared to land birth (LB) at St Thomas' Hospital

where the use of water birth was introduced in the Home from home (HfH) birth unit at the end of 2001.Retrospective analysis on the incidence of the perineal trauma following a spontaneous WB or LB were collected using the hospital's healthcare database, which codes information on pregnancy outcomes and related variables. For second part of the study, a postal survey was conducted among women who had no pelvic floor problems prior to pregnancy, completed the second stage of labour in water for WB group, were at least one year postpartum, were not breastfeeding, and had not had further pregnancies. All participants received two validated questionnaires on pelvic floor performance; the international Consultation on Incontinence Questionnaire (ICIQ)-VS for vaginal symptoms, and the ICIQ KH (kin's Health) QoL (KHQ), which includes domains urinary incontinence, sexual matters and quality of life (QoL). Two standard questionnaires, on patient satisfaction and reasons to choose a water birth, were also included. They reported significantly shorter second stage of labour among study groups in the postal questionnaire study. A number of women reported mild vaginal and urinary symptoms. Scores were worst in WB group although this was not statistically significant. Mean score value for vaginal symptoms questionnaire (ICIQ-VS) was 2.6 in WB compared with 2.3 in LB, P > 0.29; 95% CI: -0.4 to 1.3, while the mean score value for (ICIQ-KHQ urinary incontinence) was 5.8 in WB compared with 4.9 in LB, P = 0.20; 95% CI: -0.4 to 1.9. The authors concluded that water birth resulted in a shorter second stage of labour but this did not translate into better pelvic floor function after delivery.[31 level II-3]

Mistrangelo et al. conducted a non-randomised controlled study in midwife led birth centre (MLBC) in Italy to analyse urethral mobility and excursion of the pubo-rectal angle using perineal ultrasound, after normal vaginal delivery and water delivery. A total of 52 primiparous women were enrolled: 25 who had delivery in water (W Group), 27 who had delivery without immersion during labour (NW Group). Every woman underwent perineal test (PT) and perineal ultrasound examination six months after delivery. The parameters assessed were urethral mobility during Valsalva's manoeuvre and movement of the pubo-rectal sling angle during contraction of the levator ani muscle. They found that the duration of second stage of labour was similar in the two groups. No woman in the study reported stress urinary incontinence, urge incontinence or faecal incontinence six months after delivery. The mean urethral mobility during Valsalva's manoeuvre was higher in the W Group, 34.9°(range, 2° to 87°: SD 6.4 °) in comparison to the NW Group, 29.5° (range, 1° to 90°: SD 7.9 °), P = 0.098. The excursion of the pubo-rectal angle was lower in the W Group, 8.7° (range, 4° to 27°: SD 3.5 °) than in the NW Group, 11.0° (range, 3° to 39°: SD 4.3°), P = 0.120. They concluded the present study found no statistically differences in the pelvic floor using perineal ultrasound, between water and "non-water" delivery.[32 level II-2]

5.2.2. Fetal / neonatal

There was no retrieval evidence on the effectiveness of water birth compared with conventional delivery for the fetal / neonatal outcomes.

5.3. COST / COST-EFFECTIVENESS

Pagano et al. conducted an economic evaluation to assess the cost-effectiveness of water compared with normal land delivery. A retrospective controlled study was conducted over a two-year period (January 2002 to December 2004) at the Monfalcone San Polo Hopital, Gorizia, Italy. The cohort included all 110 women who completed a water birth and 110 women who had a land birth during the same period. The two groups were compared with respect to labour duration, perineal tear and newborn's health status. The economic evaluation adopted a cost-effectiveness approach in relation to presence or absence of perineal tears. The two study groups were comparable with respect to maternal age, duration of gestation and newborn's sex, weight and head circumference. The mean duration of labour was similar in the two groups, 4.99 hours in the land delivery group and 4.82 hours in the water delivery. In the water delivery group, 58 women (52.7%) experienced at least one perineal tear versus 80 women (72.7%) in the land delivery group, difference 20% (95% CI: 19% to 21%).Neonatal well-being, expressed as Apgar score, did not differ significantly among the two groups at the first minute (9.48 versus 9.28) and was slightly higher at five minutes in the water delivery group (9.95 versus 9.84; P = 0.0269).Water delivery was found to be both more costly (mean delivery costs was € 967 in the water group and € 688 in the land delivery group, difference was € 279; 95% CI: 262 to 296) and more effective in terms of avoided perineal tears. The incremental health care cost (ICER) per avoided perineal tear because of water delivery was estimated as € 1,395.7 (95% CI: € 1,049.2 to € 3,608.5). The cost-effectiveness acceptability curve suggests that at a threshold of € 2,000, more than 80% of water delivery would be cost-effective.[33]

5.4. ORGANIZATIONAL

To achieve the best practice with water birth it is necessary for organizations to provide systems and structures to support the service. This means developing a service that is committed to responsive practices and ensuring that women are involved in planning their own care with information, advice and support from professionals.[34]

Place for water birth

Water birth is being practice within the hospital or at home for low risk patient.[11,35] According to Bridgewater Community Healthcare Guideline for the Management of Water Birth in the Community, midwives will arrange a home visit at 36 weeks gestation to complete a comprehensive home

birth / pool birth environmental risk assessment prior to the agreement of the home water birth.[35]

Guidelines

In response to increasing consumer demand for the option to use immersion in water for labour and / or birth, guidelines were developed to ensure the safety, as far as possible, for women choosing the option of immersion in water for labour and / or birth for themselves and their unborn / newborn babies.[11,12,35] The aim of the guidelines is to enable midwives and medical practitioners to provide care that is as safe as possible for healthy pregnant women who choose to use immersion in water as pain management strategy during labour and / or birth.[12] The guidelines include criteria for inclusion and exclusion for immersion in water during labour and / or birth, management of different stages of labour, equipment, water temperature, infection control, cleaning of bath / pool, clothing, education, contamination, emergency situation, health and safety, and audit.[11,12,35]

Training[12]

According to Department of Health, Western Australia, Clinical Guidelines for women requesting immersion in water for pain management during labour and / or birth, women using immersion in water for labour and / or birth should be attended by a registered midwife and / or medical practitioner who is experienced in facilitating this care. There should be two health professionals (midwives / medical practitioners) present at birth. Appropriate experience with water birth should include:

- Attendance at an education session/ and / or completion of an e-learning or self-directed learning package on the use of water immersion during labour and water birth as directed / arranged by the maternity facility
- Observation and facilitation under supervision of the care of a woman who has used water immersion during their labour and / or birth (either as a student or after qualification)
- Trained and practiced in emergency evacuation procedure
- Confirmation of recent neonatal resuscitation competency update

There is a significant gap in the local setting as water births are not part of the local training curricula of the advanced diploma in midwifery, nor in the training of obstetrics and gynaecology specialists.

Recommendations from Professional Organizations

In the United States, the American Academy of Paediatrics (AAP) and the American College of Obstetricians and Gynaecologists (ACOG) are not supportive of underwater birth outside the context of a RCT. In the United Kingdom, the Royal College of Obstetricians and Gynaecologists (RCOG) and the Royal College of Midwives (RCM), advocate for full disclosure to

the mother of potential neonatal risks, while still supporting her abilities to choose an underwater birth.[36]

5.5. LEGAL IMPLICATION

There was no retrievable evidence on legal implication related to water birth.

5.6. LIMITATIONS

This technology review has several limitations. The selection of studies was done by one reviewer. Although there was no restriction in language during the search but only English full text articles were included in this report. Most of the studies retrieved were observational studies, case series and case reports. These studies are considered to have high risk of bias. There were only three RCTs on water birth which were included in the Cochrane Systematic Review. However, the three studies had small sample size and in one of the study only 10 (25%) of the 40 women allocated to birth in water actually did so.

6. CONCLUSION

6.1. Safety of water birth compared with conventional birth:

6.1.1. Maternal

Blood loss during labour

- Fair level of evidence to suggest that there was no significant difference in blood loss for women having water birth compared with conventional birth.

Perineal trauma

- Fair level of evidence to suggest that there was significantly lower episiotomy rate and third to fourth degree perineal lacerations in women having water birth. However, women having water birth were found to have higher rate of first to second degree lacerations and vaginal or labial tears.

Maternal infection

- Limited fair level of evidence to suggest that there was no significant difference in maternal infection for women having water birth compared with conventional birth. However, there was a case report on postpartum pneumoperitoneum and peritonitis after water birth.

6.1.2. Fetal / neonatal

Apgar score and umbilical cord arterial pH

- Fair level of evidence to suggest that there was no significant difference in Apgar score and umbilical cord arterial pH in neonates.

Admission to neonatal intensive care unit

- Evidence on admission to neonatal intensive care unit is inconclusive. However, among reasons for admission of neonates delivered in water to the neonatal intensive care unit include snapped umbilical cord, fresh water drowning, water aspiration, persistent pulmonary hypertension and hypoxic ischaemic encephalopathy.

Fetal / neonatal infection

- Fair level of evidence to suggest that there was no significant difference in neonatal infection. However, there were case series and case reports which reported the potential risk of *Legionella pneumophila* pneumonia, adenovirus infection and *Pseudomonas aeruginosa* infection in neonates associated with water birth.

Water aspiration

- Low level of evidence to suggest greater level of respiratory morbidity following water birth.

Perinatal mortality

- Evidence is inconclusive with regards to perinatal mortality as power of available studies is insufficient.

The lack of evidence of significant difference between the two modes of birth should be taken with caution in view of the limitations of the available studies.

6.2. Effectiveness of water birth compared with conventional birth:

6.2.1. Maternal

Duration of second stage of labour

- Fair level of evidence to suggest that there was no significant difference in duration of second stage of labour for women having water birth compared with conventional birth.

Use of analgesics

- Fair level of evidence to suggest that there was significant reduction in the use of analgesics among women having water birth.

Satisfaction with childbirth experience

- Limited fair level of evidence to suggest that there was higher level of satisfaction with childbirth experience among women having water birth compared with conventional birth.

Pelvic floor function

- Limited fair level of evidence to suggest that there was no significant difference in pelvic floor function after water birth compared with conventional birth.

6.2.2. Fetal / neonatal

There was no retrieval evidence on the effectiveness of water birth compared with conventional delivery for the fetal / neonatal outcomes.

6.3. Cost-effectiveness

A cost-effectiveness analysis conducted in Italy found the incremental health care cost (ICER) per avoided perineal tear because of water delivery was estimated as € 1,395.7 (95% CI: € 1,049.2 to € 3,608.5). The cost-effectiveness acceptability curve suggests that at a threshold of € 2,000, more than 80% of water delivery would be cost-effective.

6.4. Organizational

Water birth is being practiced within the hospital or at home for low risk patient. Guidelines were developed to ensure the safety, as far as possible, for women choosing the option of immersion in water for labour and / or birth for themselves and their unborn / newborn babies. The guidelines include criteria for inclusion and exclusion for immersion in water during labour and / or birth as mentioned in para 3.4 in the text, management of different stages of labour, equipment, water temperature, infection control, cleaning of bath / pool, clothing, education, contamination, emergency situation, health and safety, and audit. Water birth should be attended by a registered midwife and / or medical practitioner who is trained and experienced in facilitating water birth. There is a significant gap in the local setting as water births are not part of the local training curricula of the advanced diploma in midwifery, nor in the training of obstetrics and gynaecology specialists

6.5. Legal implication

There was no retrievable evidence or record on legal implication related to water birth.

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8. APPENDIX

8.1. Appendix 1: LITERATURE SEARCH STRATEGY

Ovid MEDLINE® In-process & other Non-Indexed citations and OvidMEDLINE® 1948 to present

1. Pregnant Women/
2. (pregnant adj1 wom#n).tw.
3. Labor, Obstetric/
4. (obstetric adj1 labor).tw.
5. pregnant wom#n in labo?r.tw.
6. 1 or 2
7. 3 or 4
8. 6 and 7
9. 5 or 8
10. Delivery, Obstetric/
11. (obstetric adj1 deliver$).tw.
12. Water/
13. Water.tw.
14. Immersion/
15. water birth.tw.
16. Water birth delivery.tw.
17. (natural adj1 childbirth).tw.
18. immersion under water birth.tw.
19. delivery under water.tw.
20. immersion in water.tw.
21. 10 or 11
22. 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20
23. 21 and 22
24. conventional delivery.tw.
25. delivery in air.tw.
26. land birth.tw.
27. conventional vaginal birth.tw.
28. 24 or 25 or 26 or 27
29. 23 or 28

OTHER DATABASES	
EBM Reviews - Cochrane Central Register of Controlled Trials	Same MeSH, keywords, limits used as per MEDLINE search
EBM Reviews - Cochrane database of systematic reviews	
EBM Reviews - Health Technology Assessment	
EMBASE	

PubMeD

((water birth[Title/Abstract] OR water birth delivery[Title/Abstract]) OR (under[All Fields] AND ("water"[MeSH Terms] OR "water"[All Fields] OR "drinking water"[MeSH Terms] OR ("drinking"[All Fields] AND "water"[All Fields]) OR "drinking water"[All Fields]) AND ("parturition"[MeSH Terms] OR "parturition"[All Fields] OR "birth"[All Fields]))) OR (conventional delivery [Title/Abstract] OR land delivery [Title/Abstract])

8.2. Appendix 2

DESIGNATION OF LEVELS OF EVIDENCE

I Evidence obtained from at least one properly designed randomized controlled trial.

II-I Evidence obtained from well-designed controlled trials without randomization.

II-2 Evidence obtained from well-designed cohort or case-control analytic studies, preferably from more than one centre or research group.

II-3 Evidence obtained from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.

III Opinions or respected authorities, based on clinical experience; descriptive studies and case reports; or reports of expert committees.

SOURCE: US/CANADIAN PREVENTIVE SERVICES TASK FORCE (Harris S2001)

Appendix 3

Evidence Table: Safety
Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
1. Cluett ER, Burns E. Immersion in water in labour and birth. Cochrane Database of Systematic Reviews 2009, Issue 2. Edited, published in Issue 2, 2012.	Systematic review Objective was to assess the evidence from randomised controlled trials about immersion in water during labour and water birth on maternal, fetal, neonatal and caregiver outcomes. Search methods The Cochrane Pregnancy and Childbirth Group's Trials Register (30 June 2011) and reference lists of retrieved studies were searched. Selection criteria Randomised controlled trials comparing immersion in any bath tub/pool with no immersion, or other non-pharmacological forms of pain management during labour and / or birth, in women during labour who were considered to be low	I	Included 12 trials: - 8 related to 1st stage of labour - 1 related to early versus late immersion in the 1st stage of labour - 2 to the 1st and 2nd stages and 1 to the 2nd stage only (water birth) **Water birth** - 3 trials - 1 trial evaluated immersion during 2nd stage of labour (Nikodem 1999) and 2 trials measured	Immersion in 2nd stage of labour	No immersion in 2nd stage of labour	-	**Maternal outcomes:** a. Blood loss (postpartum haemorrhage more than 500 ml) - Nikodem 1999 (no sig. difference): (Risk Ratio 0.14; 95% CI: 0.01 to 2.71) b. Perineal trauma (Nikodem 1999; Woodward 2004): - Episiotomy- (12/100 versus 10/79, Risk Ratio 0.75; 95% CI: 0.35 to 1.60) - Second degree tears- (21/100 versus 14/79, Risk Ratio 1.21; 95% CI: 0.65 to 2.24) - Third or fourth degree tears (Woodward 2004)- Risk ratio 1.54; 95% CI: 0.07 to 36.11 c. Maternal temperature (Woodward 2004) – no difference between groups Mean difference 0.20; 95% CI: -0.18 to 0.58)	

Evidence Table: Safety
Question: how safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
	risk of complications, as defined by the researchers. Data collection and analysis Trial eligibility and quality and data extraction were conducted independently. One review author entered data and the other checked for accuracy.		outcomes across the 1st and 2nd stages (Chaichian 2009; Woodward 2004). Nikodem 1999: - Study group: 60 - Control group: 60 Chaichian 2009: - Study group: 53 - Control group: 53 Woodward 2004: - Study group: 40 - Control group: 20 (Only 10 (25%) of the women allocated to birth in water actually did so)				**Fetal / neonatal outcomes** a. Perinatal deaths - Nikodem 1999 (no difference between groups): (Risk Ratio 3.00; 95% CI: 0.12 to 72.20) b. Apgar score - [less than seven at 5 minutes (Nikodem 1999)] Risk Ratio 4.92; 95% CI: 0.24 to 100.31) - [(less than eight at 5 minutes (Woodward 2004): Risk Ratio 1.54; 95% CI: 0.07 to 36.11) c. Umbilical artery pH less than 7.20 (Nikodem 1999; Woodward 2004): - (Risk Ratio 0.89; 95% CI: 0.45 to 1.75) d. Admission to neonatal intensive care unit (Nikodem 1999): - Risk Ratio 0.79; 95% CI: 0.25 to 2.49) e. Infection, including markers of infection such as pyrexia and raised white cell count:	

Evidence Table : Safety
Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
							- Nikodem 1999 [(no difference between in the incidence of raised neonatal temperature at birth greater than 37.5°C : (8/55 versus 3/54: Risk Ratio 2.62; 95% CI: 0.73 to 9.35) - Woodward 2004 [no significant difference in antibiotics given to neonates (Risk Ratio 1.50; 95% CI: 0.17 to 13.52) or in positive neonatal swabs of ear, mouth or umbilicus (Risk Ratio 1.89; 95% CI: 0.90 to 3.96) Authors conclusion Evidence suggest that water immersion during the first stage of labour reduces the use of epidural/spinal analgesia and duration of the first stage of labour. There is limited information for other outcomes related to water use during the first and second stages of labour due to intervention and outcome variability. There is no evidence of increased adverse effects to the fetus /neonate or woman from labouring in water or water birth. However, the studies are very variable and considerable heterogeneity was detected for some outcomes. Further research is needed.	

Evidence Table: Safety
Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
2. Zanetti-Dallenbach R, Lapaire O, Maertens A et al. Water birth, more than a trendy alternative: a prospective, observational study. Arch Gynecol Obstet..2006; 274:355-265	Prospective observational study (Cohort study) in Switzerland Objective was to assess the effect of water birth on maternal and fetal outcomes in a selected low- risk collective of a tertiary obstetrical unit. 513 patients of low risk collective, who requested a water birth, were studied during the years 1998-2002. Every interested women was given detailed explanations and information about the inclusion and exclusion criteria and about guidelines concerning the safety of water birth, either by trained resident, fellow or midwife. According to the course of delivery, 4 different groups were designated;	II-2	513 pregnant women: - 89 pregnant women (17.4%) delivered in water – (SG) - 133 pregnant women (25.9%) had a normal vaginal delivery after temporary immersion in water (CG I) - 146 pregnant women (28.5%) had a normal vaginal delivery but no temporary immersion in water (CG II) - 145 pregnant women (28.3%) had an operative delivery by caesarean section or assisted vaginal delivery (CG III)	Delivered in water (SG)	Normal vaginal delivery after temporary immersion (CG I) Normal vaginal delivery but no temporary immersion (CG II) Operative delivery (CG III)	From admission for delivery until discharge	**Maternal outcomes:** a. Haemoglobin or haematocrit: - No significant differences among groups in the haemoglobin or haematocrit values assessed in the third trimester and in first stage of labour. - Haemoglobin and haematocrit values were significantly lower in all control groups (except in CG II) assessed at 2 days postpartum (P , 0.005) b. Perineal trauma: - Episiotomy- significantly more episiotomies in all control groups (5.6% in SG, 48.9% in CG I, 37.0% in CG II, 55.9% in CG III, P< 0.001) - First and second degree perineal lacerations – more in water delivery group (53.9% in SG, 21.8% in CG I, 26.0% in CG II, 11.7% in CG III) - Third degree perineal lacerations- (0% in SG, 2.3% in CG I, 0.7% in CG II, 7.6% in CG III) - Vaginal tears and other injuries (31.5% in SG, 18% in CG I, 15.*% in CG II) c. Maternal temperature: - Maternal temperature measured on admission and 2 days postpartum did not show any differences in groups	

Evidence Table: Safety
Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
	Study group (SG), Control group I (CGI), Control group II (CGII), Control Group III (CGIII). Primary outcome measurements included the maternal and fetal parameters. .						**Fetal / neonatal outcomes** a. Apgar scores (mean, SD at 5 minutes) - no significant difference - [9.8(0.5) in SG, 9.8 (0.6) in CG I, 9.8 (0.5) in CG II, 9.6 (1.0) in CG III)] b. Umbilical artery pH (mean, SD): - [7.26(0.06) in SG, 7.23 (0.08) in CG I, 7.25 (0.08) in CG II, 7.22 (0.08) in CG III)] c. Admission to neonatal intensive care unit (NICU):- comparable in all 4 groups - (0% in SG, 1.5% in CG I, 3.4% in CG II, 2.1% in CG III) d. Clinical signs of infections in the neonate: - no significant difference - (5.6% in SG, 3.0% in CG I, 1.4% in CG II, 3.4% in CG III) e. Fever (> 38° C) of fetus (mean, SD) - 1(1.10%) in SG, 2(1.50%) in CG I, 0(0%) in CG II, 2(1.40%) in CG III)	

Evidence Table: Safety
Question: How safe is water birth compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
3. Geissbuhler V, Eberhard J. Waterbirths: A comparative study. Fetal Diag Ther. 2000;15:291-300	Prospective observational study (Cohort study) in Switzerland Objective was to compare the quality of alternative birth methods, especially that of water births (when the quality of the monitoring and the birth management is unchanged), with traditional 'bedbirth'. All parturients of the region give birth in clinic for Obstetrics and Gynaecology, Thurgauisches Kantonsspital, Frauenfeld Switzerland. A prospective observational study was started on November 1, 1991 and since then have documented every birth with a standardized questionnaire in five parts. The parturient receives the first part of the questionnaire at home 6 to 8 weeks before birth, and brings the completed form with	II-2	5,953 spontaneous single births with cephalic presentation: - 2,014 (34%) births in water - 1,108 (18%) births on the Maia-birthing stool - 2,362 (40%) births on a wide bed in a half-sitting position (vacuum extractions are not included) - 469 (8%) other methods such as 'Roma' wheel, the birthing bag, 'on all fours', or standing with or without the assistance of the rope of the wall bars.	Births in water.	Births on the Maia-birthing stool. Births on a wide bed in a half-sitting position (vacuum extractions are not included. Other methods such as 'Roma' wheel, the birthing bag, 'on all fours', or standing with or without the assistance of the rope of the wall bars.	From admission for delivery until discharge	**Maternal outcomes:** a. Blood loss in different births methods: comparison of haemoglobin drop before birth and 2 to 4 days after birth: - (Mean, g/l; - 4.1 in water birth, - 9.1 in Maia-birthing stool, - 6.6 in bed birth). - Significant difference between water birth with bed birth, and between water birth with Maia-birthing stool, P<0.0001. b. Perineal trauma: - Episiotomy- significantly more episiotomies in Maia-birthing stool and bed births (12.8% in water, 27.7% in Maia-birthing stool, 25.4% in bed, P< 0.001) - First to second degree perineal lacerations – more in water birth (51.2% in water, 46.7% in Maia-birthing stool, 34.8% in bed). Significant difference between water and bed birth, P<0.001. - Third to fourth degree perineal lacerations – more in bed birth (2.7% in water, 2.3% in Maia-birthing stool, 4.1% in bed). Significant difference between water and bed birth, P<0.05. - No tear at all – higher in water birth (27.6% in water, 22.2% in Maia-birthing stool, 24.9% in bed). Significant difference between water and bed birth, P<0.05.	

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	her when she enters the hospital for birth. During labour, after birth and again before the new mother leaves the hospital (usually 4 to 7 days after birth) the attending midwife and doctor record the objective information concerning labour, birth and postpartum phase. A 100-mm-long visual analog scale is then shown with the term 'wonderful' to the left and the term 'dreadful' to the right. The woman marks a line, more to the left and the or to the right, depending on how she feels about her birth experience. Objective data concerning all births between November 1, 1991 and May 21, 1997, a total of 7,508 births were included.	II-2	Average age of the mother-to-be was 29 in the different groups				- Vaginal tears –higher in water birth (19.8% in water, 14.4% in Maia-birthing stool, 14.6% in bed). Significant difference between water and bed birth, P<0.0001. - Labial tears –higher in water birth (21.4% in water, 13.7% in Maia-birthing stool, 12.9% in bed). Significant difference between water and bed birth, P<0.0001. **Neonatal outcomes** a. Apgar score (mean, SD at 5 minutes and 10 minutes) - significant difference between water and bed birth - [9.8(0.5) and 9.9(0.3) in water, 9.8 (0.6) and 9.9(0.4) in Maia-birthing stool, 9.6 (0.7) and 9.9(0.3) in bed)] b. Umbilical artery pH (mean, SD) - significant difference between water and bed birth: - [7.30(0.77) in water, 7.29 (0.85) in Maia-birthing stool, 7.26 (0.78) and in bed)] c. Infection in the neonate: - no significant difference: - (0.6% in water, 1.1% in Maia-birthing stool, 1.05% in bed, P > 0.05) - The commonest infection of the neonate found during the first week of life is nonspecific conjunctivitis.	

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4. Menakaya U, Albayati S, Vella E et al. A retrospective comparison of water birth and conventional vaginal birth among women deemed to be low risk in a secondary level hospital in Australia. Women and Birth 2013;26:114-118	Case control study in Australia Objective was to describe the maternal and neonatal outcomes associated with water birth among labouring women deemed at low risk for obstetric complications and compare these outcomes against women of similar risk who had a standard land birth. A retrospective audit and comparison of women giving birth in water with a matched cohort who birthed on land at Bankstown hospital over a 10 year period (2000 to 20009).	II-2	438 women: - 219 birth spontaneously in water - 219 matched cohort of similar women who had a spontaneous vaginal birth not in water (standard birth group) identified within 24 hour of each one woman giving birth in water - 184 (42%) (primigravida) - 254 (48%) (multigravida) Primigravida: Age (mean years) - Water birth = 25.02 - Non-water = 25.73	Water birth	Spontaneous vaginal birth not in water (standard birth)	-	**Maternal outcomes:** a. Postpartum haemorrhage (Blood loss > 500 ml): - [10 (4%) in water birth, 11(5%) in non-water birth, P=0.49 for primigravida, P=0.38 for multigravida] . b. Perineal trauma: - Episiotomy- significantly more episiotomies in standard birth group (0 in water birth versus 33 in non-water, P< 0.001) - Intact perineum- higher in water birth (88 in water birth versus 68 in non-water, P=0.122) - First and second degree perineal lacerations – comparable between the two groups but slightly higher in water birth. - Third to fourth degree perineal lacerations – higher in non-water (1 in water versus 4 in non-water) **Neonatal outcomes** a. Apgar scores ≤ 7 at 1 minute and 5 minutes: [At 1 minute (25 in water birth versus 8 in non-water birth, P< 0.05)] - [At 5 minutes (2 in water birth versus 0 in non-water birth, P> 0.05)]	

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			Multigravida: Age (mean years) - Water birth = 28.03 - Non-water = 28.98				b. Admission to special care nursery: - 8 admissions from water birth versus 1 admission in the standard birth group (P=0.023) - [In the water birth group: 4 babies born in water was admitted for observation (2 after active resuscitation, one for apnoea event and weight 2,560 gram and one as a result of mild shoulder dystocia), 3 babies were admitted for feeding difficulties, 1 baby was admitted for meconium aspiration syndrome] - 1 baby in the standard group was admitted for respiratory distress syndrome.	

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5. Otigbah CM, Dhanjal MK, Harmsworth G et al. A retrospective comparison of water births and conventional vaginal deliveries. European Journal of Obstetrics & Gynecology and Reproductive Biology.2000; 91:15-20	Case-control study in United Kingdom. Objective was to document the practice of water births and compare their outcome and safety with normal vaginal deliveries. A retrospective case-control study was conducted over a five year period from 1989 to 1994 at the Maternity Unit, Rochford Hospital, Southend, United Kingdom. Three hundred and one women electing for water births were compared with the same number of age and parity matched low risk women having conventional vaginal deliveries. Length of labour, analgesia requirements, apgar scores, maternal and fetal and neonatal complications, admission and infections were noted.	II-2	Total 602 women: 301 women had water birth: - 133 primigravidae and 168 multiparae - Mean age 26.9 years for primigravidaea and 29.4 years for multiparae 301 women in control group(normal vaginal delivery) - 133 primigravidae and 168 multiparae - Mean age 25.7 years for primigravidaea and 28.4 years for multiparae	Water birth	Normal vaginal delivery not requiring syntocinon augmentation	-	**Maternal outcomes:** a. Postpartum haemorrhage: - 1.3% for women having water births (mean blood loss 925 ml) compared to 2.7% of control (mean blood loss 841 ml). Not statistically significant. b. Perineal trauma: - Episiotomy- significantly higher in control group(5% in water birth versus 25% in control, P< 0.0001) - Intact perineum- siginificantly higher in water birth in primigravidae (41% in water birth compared to 29% in control, P<0.005) - Tears (vaginal tear, first, second and third degree perineal lacerations) – significantly higher in water birth (53% in water birth compared to 39% in control, P< 0.001). c. One case of maternal pyrexia was a multipara in the water birth group. **Neonatal outcomes** a. Mean Apgar scores 1 minute and 5 minutes after delivery-no significant difference. Primigravidae: - [At 1 minute (8.37 in water birth compared to 8.47 in control) - [At 5 minutes (9.54 in water birth compared to 9.56 in control)	

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							Multiparae: - [At 1 minute (8.43 in water birth compared to 8.55 in control) - [At 5 minutes (9.59 in water birth compared to 9.60 in control) a. Shoulder dystocia: - There were five cases (1.7%) of shoulder dystocia amongst water births and four (1.3%) in the controls. b. Admission to Special Care Baby Unit (SCBU): - Two cases in water births and four cases in controls c. Infection: - No infection recorded d. Knot in the cord: - 3 cases in water births and none in control	

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6. Theoni A, Zech N, Moroder L et al. Review of 1600 water births. Does water birth increase the risk of neonatal infection? Journal of Maternal-fetal and Neonatal Medicine. 2005;17(5): 357-361	Cross sectional study in Italy Objective was to review the first 1600 water births at the Gynaecology and Obstetrics Unit, Vipiteno/Sterzing, Italy. Between March 1997 and December 2004, 1600 babies were born in the water bath. Also reviewed the number of alternative birthing positions used by primiparae since 1997 and compared duration of delivery, incidence of perineal trauma, neonatal arterial blood pH, base excess, analgesic requirements, shoulder dystocia, women with previous caesarean section, and postpartum haemoglobin level. Commencing 2001, 250 water samples taken from the pool were analyzed. Two water samples obtained at every water birth.	II-3	1600 women in water births Primiparae: - 737 (water) - 407 (Bed) - 142 (Stool)	Water birth	Bed birth Stool birth	-	**Maternal outcomes:** Primiparae: a. Postpartum maternal haemoglobin levels (g/dl. First postpartum day): - no significant difference [10.9 g/dl (6.5 -14.6) in water birth, 10.1 g/dl (7.6-13) in bed birth, 10.23 g/dl in stool birth]. b. Perineal trauma: - Episiotomy rate- significantly lower in water birth (0.68% in water birth, 23.3% in bed birth, 8.4% in stool birth, P< 0.01) - Grade I, Grade II, Grade III perineal lacerations – similar **Neonatal outcomes** e. Arterial cord blood pH (mean, range): No significant difference between groups [7.25 (7.04-7.47) in water birth group, 7.24 (7.03-7.46) in delivery in air group (bed and stool)]. b. Clinical signs of infection (suspect colour of the skin, tachypnoea): - [(1.22% in water birth group compared with 2.63% in delivery in air (bed and stool)]	

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							Microbiological contamination of water (sample A - after filling the water pool): - 12% contained *Legionella pneumophila,* 11% *Pseudomonas aeruginosa,* 19% *Enterococcus species*, 21% coliforms and 10% *Escherichia coli* **Microbiological contamination of water (sample B - after birth):** - 8% contained *Staphylococcus aureus,* 12% *Pseudomonas aeruginosa,* 82% coliforms, 11% yeast and 64% *Escherichia coli.*	

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7. Brown V, Dua S, Athow A et al. Postpartum pnuemo-peritoneum and peritonitis after water birth. J Radiol Case Rep.2009;4(4): 1-4	Case report, department of general surgery, north Middlesex University Hospital Trust, London, UK. A 28-year-old woman presented to the emergency department with a two day history of generalised abdominal pain. She had given birth to her first child three days previously at home. The child had been born by normal vaginal delivery (water birth) complicated by 4th degree tear, which was repaired immediately at another hospital. The patient had been discharged the following day on oral metronidazole and amoxicillin. Presented at emergency department, three days after delivery and represented four days later complaining of persistent abdominal pain, diarrhoea, vomiting and pyrexia.	III	A 28-year old woman	Water birth (parturition in a birthing pool).	-	-	**Maternal outcomes:** - At surgery, a formal abscess wall was encountered within the abdominal cavity and 1,200 ml of clear yellow purulent fluid was found in the peritoneal cavity with soft fibrin plaques between bowel loops. There was no faeculent odour. - Careful examination was made of the entire gastrointestinal tract, including under water insufflations of the rectum. No perforation was found. Rectal examination was normal. Speculum examination of the vagina revealed an intact repair. - Postoperatively, the patient was treated with metronidazole and co-amoxiclav and made a slow uncomplicated recovery. Cultures taken from the peritoneal fluid grew Streptococcus Faecalis and Candida Albicans and her antibiotics were changed as guided by sensitivities. The possibility of contamination either from the patient's own flora or that of the water, must be considered. The significance of the fourth degree tear, and her primigravida status is unclear.	

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8. Gilbert RE, Tookey PA. Perinatal mortality and morbidity among babies delivered in water: surveillance study and postal survey. BMJ.1999;319:483-487	Cross sectional study in British Isles, England and Wales Objective was to compare perinatal morbidity and mortality for babies delivered in water with rates for babies delivered conventionally (not in water). From April 1994 to April 1996, all 1500 consultant paediatricians in British Isles were surveyed each month by British Paediatric surveillance Unit and asked to report whether or not they knew of nay births that met the case definition of 'perinatal death or admission for special care within 48 hours of birth following labour of delivery in water'. A postal questionnaire was sent to all NHS maternity units (219) in England and Wales in 1995 and 1996 to determine the total number of deliveries in water during the study period.	II-3	Deliveries in water in England and Wales reported for calendar years 1994 (n=1881), 1995 (n=2093), and January to March 1996 (n=528) Total: n=4,032	Water birth	Conventional birth (not in water)		**a. Perinatal mortality in babies delivered in water:** - 5 perinatal deaths among 4,030 live births in water in England and Wales (perinatal mortality 1.2 per 1000 live births (95% CI: 0.4 to 2.9) • 2 babies were stillborn • 3 postpartum deaths were associated with abnormal pathological findings (one neonatal herpes infection, intracranial haemorrhage after precipitate delivery, hypoplastic lungs) **b. Risk of admission for special care in babies delivered in water:** - 34 babies out of 4,030 delivered alive in water in England and Wales admitted for special care, a risk of 8.4 per 1000 live births (95% CI: 5.8 to 11.8) **Clinical diagnosis or reason for admission to special care in babies delivered in water:** - 15 had lower respiratory tract problems [pneumonia, transient tachypnoea or wet lung[9]; suspected aspiration[3], meconium aspiration[1], water aspiration[1], and "freshwater drowning" (1, who had hyponatraemia)] - 2 had infection - 3 had Hypoxic ischaemic encephalopathy (grade 2 or 3)]	

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							- 15 had other diagnoses or reasons for admission. Five babies had a snapped umbilical cord (of whom 1 required a transfusion, 1 developed hypoxic ischaemic encephalopathy grade 2, and 1 had a chromosomal abnormality). One baby had a chromosomal abnormality, one developed hypoxic ischaemic encephalopathy grade 3 and had transposition of the great arteries, three had stridor, and 1 had shoulder dystocia. No clear reason or diagnosis was given for the remaining 4 babies. (Note* = 4 babies that required respiratory support were counted twice, and one baby where respiratory support not required was counted twice). c. UK reports of mortality and special care admission rates for babies of women considered to be at low risk of complications during delivery who delivered conventionally ranged from 0.8/1000 (95% CI: 0.2 to 4.2) to 4.6/1000 (95% CI: 0.1 to 25) live births and from 9.2 (95% CI: 1.1 to 33) to 64/1000 (95% CI: 58 to 70) live births respectively. Compared with regional data for low risk, spontaneous, normal vaginal deliveries at term, the relative risk for perinatal mortality associated with delivery in water was 0.9 (99% CI: 0.2 to 3.6)	

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9. Demirel G, Moraloglu O, Celik IH et al. The effects of water birth on neonatal outcomes; a five-year result of a referral tertiary centre. European Review for Medical and Pharmacological Sciences. 2013;17; 1395-1398	Cross sectional study in Ankara, Turkey. Objective was to evaluate the fetal outcomes of water birth retrospectively in a tertiary maternity hospital in Turkey. A retrospective study in infants born with water birth from January 2005 to May 2010 in tertiary centre in Ankara Turkey. All delivery and hospitalisation data of newborns were recorded from the patient files retrospectively. The demographic and clinical features of the patients, hospitalisation date, nutritional status, birth complications such as trauma, infection and neonatal intensive care unit (NICU) attendance rate were evaluated.	II-3	191 pregnant women who met the inclusion criteria and had complete data were evaluated: - 26% primiparous - 74% multiparous Maternal age (mean, SD, range): 26.3±5.2 917-44) years Gestational week (mean, SD, range):39.2±1.3 (37-41.2) weeks Birth weight (mean, SD, range):3326±409 (2530-4510) grams	Water birth	-		**Neonatal outcomes:** **a. Birth trauma** - Observed in three patients; one brachial nerve paralysis, one cord rupture and one cephal haematoma. None of these patients needed extended hospitalisation time as the result of these complications (2 days, 2 days, and 3 days, respectively). **b. Admissions to NICU:** - Six patients (3.1%) were admitted to NICU. **Reasons for admission to NICU:** - Four were hospitalised for respiratory tract problems (three due to transient tachypnoea of newborns and one due to neonatal pneumonia). Except for the patient who received antibiotic therapy because of neonatal pneumonia, infection screening was negative for the other three patients. - One for polycythemia - One for myelocele	

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10. Nagai T, Sobajima H, Iwasa M et al. Neonatal sudden death due to *Legionella* Pneumonia associated with water birth in a domestic spa bath. J. Clin. Microbiol. 2003;41(5): 2227-2229	Case report, Nagoya, Japan. In June 1999, a 3.5 kilogram baby girl was born after 42 week gestation period in a bathtub that employed the ever-ready system in her home by water birth delivery in the absence of doctors and midwives. The mother had no health problems during pregnancy. The midwife arrived 15 minutes after the girl was born.	III	A 3.5 kilogram baby girl	Water birth (at home)	-	-	**Neonatal outcomes:** - The baby was normal at the time, but she developed a fever and jaundice on day four. She was admitted to a private obstetrics-gynaecology hospital and received phototherapy. The following day the baby left the hospital because fever had decreased and jaundice had disappeared. - On day seven, the baby had recurrent symptoms of fever and vomiting, although she drank milk well that night. At noon on the next day, the baby showed sudden apnoea and was transported to the emergency room with cardiopulmonary arrest. She could not be resuscitated. - An autopsy was performed three hours after death. There were numerous yellow nodules, which were less than 5 mm in diameter and which were scattered over the bilateral lung parenchyma. In the pulmonary nodular lesions, the alveoli showed severe infiltrations of neutrophils with prominent karyorrhexis and aggregation	

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							of macrophages with fibrinous exudates. Many gram-negative but Gimenez-positive bright red bacteria were found in the macrophages. As the baby was suspected to have legionellosis, DNA was extracted from the formalin-fixed post-mortem lung tissue homogenate and was tested in a PCR with specific primers for *Legionella* 5S rRNA DNA and the *Legionella pneumophila mip* gene. The lung homogenate was also screened by indirect fluorescent antibody testing with 10 *Legionella* species-specific monovalent antisera. The specimen was positive only with antiserum to *L. pneumophila* serogroup 6. No other abnormal macroscopic or microscopic findings in the autopsy, hence the lung lesions were considered as the main cause of death. - During the course of the environmental investigation, numerous living *Legionella* organisms were detected in the water obtained in the same bathtub a week after the baby's death.	

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11. Franzin L, Scolfaro C, Valera M et al. *Legionella pneumophila* pneumonia in a newborn after water birth: A new mode of transmission. Clinical Infectious Diseases (CID):.2001;33;e103-e104	Case report, University of Turin, Turin, Italy. In December 1999, an infant was born after a full-term, uneventful pregnancy, following a prolonged vaginal delivery in a hospital birthing pool. No incubator was used, and the infant was discharged four days after birth in good general condition.	III	7 day old male neonate	Water birth (hospital)	-	9 months	**Neonatal outcomes:** - Three days later, he was readmitted to the same hospital after the appearance of fever and dyspnoea. Respiratory distress increased in the following days, and a chest radiograph revealed diffuse bilateral alveolar-interstitial infiltrates. Ampicillin-sul-bactam (150 mg/kg q.d. i.v) and clarithromycin (8 mg/kg q.d. i.v) were administered for 10 days. Despite progressive clinical improvement, the radiologic picture remained unchanged, and he was transferred to the paediatric department at the age of 1 month. The results of laboratory tests (serologic, antigen testing, and PCR) were negative for the usual respiratory pathogens, such as *Chlamydia trachomatis*, *Chlamydia pneumoniae*, respiratory syncytial virus, cytomegalovirus, Epstein-Barr virus, Herpes simplex virus type 1, mycobacteria and *Pneumocystis carinii*. - Antibody titres against *Legionella pnuemophila* serogroup 1 were positive for samples collected 26 and 33 days after the onset of symptoms (indirect immunofluorescence assay, 1/256; microagglutination, 1/4096).	

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							- A decrease in antibody titres was observed 51 days after the onset of symptoms. The results of *Legionella* urinary antigen (EIA Biotest) were positive on seven repeated unconcentrated and concentrated urine samples, which were collected from the first to fourth month; they became negative at the next control from the sixth month. Anti-*Legionella* antibodies were negative in the mother, who was always healthy. - After a positive diagnosis of *Legionella* infection (at 26 days after the onset of symptoms), clarithromycin (15 mg/kg b.i.d.) was administered to the child for three weeks. The findings of a chest x-ray progressively improved and normalised at three months of age. No clinical symptoms were observed at the latest visit, which was nine months after birth. - Environmental investigations were performed on the water supply of the hospital where the child was born. *L. pneumophila* serogroup 1 was isolated by culture from central hot water tanks and from hot water outlets (tap and shower head of delivery room's pool, and sink tap in the delivery room and the patient's room) at 300 to 2000 cfu/L. *L. pneumophil*a was not isolated from the patient's home.	

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12. Soileau SL, Schneider E, Erdman DD et al. Case report: severe disseminated adenovirus infection in a neonate following water birth delivery. J. Med. Virol.2013;85: 667-669	Case report, University of Washington, Seattle, Washington, United States of America. A female infant was born at home by spontaneous vaginal delivery at 40 weeks and four days gestation via a planned water birth. The pregnancy was complicated by a maternal diarrhoeal illness with low grade fevers for about one week prior to delivery with maternal defecation occurring in the water bath during labour.	III	A female infant	Water birth (at home)	-	-	**Neonatal outcomes:** - Following delivery, the infant appeared healthy until four days of age when she developed a rectal temperature of 38°C. She was hospitalised and asepsis workout was initiated. - A direct viral panel fluorescent antibody (DFA) test obtained via nasopharyngeal swab was positive for Human Adenovirus (HAdV). Supplemental oxygen was added after the patient developed mild respiratory distress (7 days of age). - The patient's persistent fevers and increasing oxygen requirement prompted transfer to a tertiary care facility (8 days of age). She was placed on high frequency oscillatory ventilation followed by venoarterial extra-corporeal membrane oxygenation (ECMO) due to worsening chest radiograph, respiratory acidosis, and poor oxygenation. Serum HAdV quantitative PCR (qPCR) performed one day prior to initiation of ECMO detected a high virus load of 1.4 billion genome copies/ ml.	

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							- A tracheal aspirate DFA was also positive for HAdV. Cidofovir was started the next day at 5 mg/kg weekly and after her first dose, serum HAdV qPCR decreased to 55 million copies / ml. The infant developed a coagulopathy and became anuric on ECMO day 5 (17 days of age) and then developed worsening metabolic acidosis, poor perfusion, grossly bloody stools, and bloody endotracheal tube secretions. Her parents decided to withdraw medical support at this point, and she died shortly after being taken off ECMO (19 days of age). - Autopsy findings showed evidence of HAdV pneumonia including diffuse alveolar damage with extensive necrotising bronchiolitis and epithelial cells with intranuclear inclusions, which were positive for HAdV by immunoperoxidase staining as well as bilateral 40 ml pleural effusions.	

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13. Rawal J, Shah A, Stirk F et al. Water birth and infection in babies. BMJ.1994;309:511	Case report. A full term baby boy, weighing 3600g, was born in the birthing tub of the labour ward in North Middlesex Hospital, London. His mother had no fever before the birth, and the membranes were ruptured for less than 12 hours.	III	Full term baby boy, weighing 3600 grams	Water birth (hospital)	-	-	**Neonatal outcomes:** - His condition at birth was good and Apgar scores were normal. At 11 hours of age he had two episodes of cyanosis. He was feeding poorly. On examination he was hypotonic and his peripheries were poorly perfused, with mottling of the skin. Probable septicaemia was diagnosed. Swabs from the ear and umbilicus and samples of urine, blood, and cerebrospinal fluid were taken for culture. He was given intravenous penicillin and gentamicin. Within 48 hours the swabs had grown *Pseudomonas aeruginosa* (*P aeruginosa*) and gentamicin had been changed to ceftazidine. Within a further two days he had recovered and discharged after treated with antibiotics for seven days. - The cultures of urine, blood, and cerebrospinal fluid were sterile. The samples taken from the baby incubator yielded no growth, but specimens taken from the birthing tub, filling hose, taps, exit hose, and disposable lining of the tub all grew *P aeruginosa*. The *P aeruginosa* that was isolated from the birthing tub system and from the umbilical swab was serotype 2. - Contamination of the birthing tub system had occurred despite meticulous washing with hot water and detergent and drying of the system after each birth.	

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14. Coombs R, Spiby H, Stewart P. Water birth and infection in babies. BMJ.1994;309:1089	Case series, Northern General Hospital NHS trust, Sheffield. From December 1991, 122 mothers used the pool in labour, of whom 41 delivered in the pool. The hospital policy is to swab the ears of all infants whose mothers have used the pool and record their respiratory rate for three hours after delivery. Bacteriological surveillance of the birth pool; – taking sample of water after delivery and sample of water for culture before the woman's immersion.	II-3	122 babies.	Water birth (hospital)	-	-	**Neonatal outcomes:** - Three of the 122 babies had positive ear swabs. Two of them were well with their mothers in the postnatal wards. The swabs grew *B Streptococci* and *Staphylococcus aureus*, and both babies were treated with antibiotics until further cultures were negative. The last baby presented at 10 days with greenish discharge from his ear. Initial swabs had grown *Pseudomonas aeruginosa* and Escherichia coli. He was treated with parenteral antibiotics for 48 hours followed by topical antibiotic ear drops. His recovery was unremarkable. - Five of the 122 infants were admitted to the special care baby unit with a raised respiratory rate or grunting. Four of the five had been delivered under water. All were treated with antibiotics though in all swabs and blood cultures were negative. - There was one neonatal death from unexplained birth asphyxia but no clinical evidence of hyperthermia.	

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15 . Nguyen S, Kuschel C, Teele R. Water birth- a near-drowning experience. Paediatrics. 2002;110:411 -413	Case series, Auckland, New Zealand. Four neonatal patients were transferred to neonatal unit at National Women's Hospital, Auckland, New Zealand in the last 18 months after delivery under water at other hospitals.	II-3	4 neonatal patients. Case 1: A male born at term weighing 4,155 grams. Case2: A male born at term weighing 4,675 grams. Case 3: A male born at term weighing 4,355 grams. Case 4: A female born at term weighing 3,860 grams.	Water birth (hospital)	-	-	**Neonatal outcomes (aspiration of water and subsequent pulmonary oedema):** Case 1: - Delivery occurred accidentally in a water bath that was being used during labour for maternal analgesia. Apgar scores were recorded as 9 and 10 at 1 and 5 minutes, respectively. At five hours of age, the neonate was recognised to be in respiratory distress with oxygen saturation of 60% requiring 100% oxygen via headbox. He was transferred to the neonatal unit and intubated and ventilated on arrival. No risk factors for sepsis were identified. Radiographs of the chest at 9 hours of age demonstrated bilateral interstitial and alveolar oedema and bilateral pleural effusions. Irritability and hypertonicity were diagnosed as mild hypoxic ischaemic encephalopathy. Echocardiography demonstrated no abnormal cardiac abnormality. The neonate remained ventilated for three days. The patient was stable in air by the third day of life. The infant was readmitted on the ninth day of life with seizures. Investigations were normal. No additional seizures occurred, and the child's development over the first year of life has been appropriate for age.	

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							Neonatal outcomes: Case 2: - After an uneventful pregnancy, a baby boy was born by planned water birth at term. Apgar scores were 7 and 10 at 1 and 5 minutes, respectively. At six hours of age, the neonate was recognised as tachypnoeic by the mother and required oxygen. The infant was transferred to the neonatal unit and commenced on continuous positive airway pressure (CPAP) and antibiotics. No risk factors for sepsis were indentified. Radiographs of the chest demonstrated marked alveolar and interstitial oedema and pleural effusions. The infant's clinical status improved dramatically. He was in air, breathing spontaneously with no respiratory support by 24 hours of age. The infant completed five days of treatment with antibiotics. All blood cultures were negative. Case 3: - Water birth had been planned to provide analgesia for a mother who had spinal fusion. The infant was vigorous at birth with a good heart rate; however, he collapsed at 5 minutes of age with marked respiratory distress. Apgar scores were recorded as 7 and 2 at 1 and 5 minutes of age, respectively. A provisional diagnosis of water aspiration was made, the neonate	

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							Neonatal outcomes: Case 3: - was transferred to the neonatal unit, and commenced on nasal CPAP. Radiograph of the chest revealed pulmonary oedema, with alveolar component more obvious in the right lung. Intraveonus antibiotics were commenced. The clinical course was that of rapid improvement over 24 hours. The infant weaned to air and respiratory support was discontinued. The infant completed five days of treatment with antibiotics. All blood cultures were negative. Case 4: - At the request of the mother, labour and delivery occurred in a water bath. Apgar cores were 8 and 8 at 1 and 5 minutes, respectively. The infant developed respiratory distress at 10 minutes of age and required 60% oxygen via headbox. She was transferred to neonatal unit and commenced on nasal CPAP and antibiotics. Radiographs of the chest showed gross bilateral interstitial and alveolar oedema. The oxygen - requirement increased shortly after arrival to 100%. Dramatic clinical improvement over the subsequent 24 hours enabled her to be weaned to air and all respiratory support was discontinued. All blood cultures were negative and infant was discharged on the third day of life.	

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Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
16. Mamas IN, Thiagarajan P. Water aspiration syndrome at birth-report of two cases. Journal of Maternal-Fetal and Neonatal Medicine. 2009;22(4): 365-467	Case series, Liverpool, United Kingdom. Present two cases of neonates, who were transferred to neonatal unit, Nobles Hospital, Douglas and Royal Liverpool Children's Hospital, Liverpool, United Kingdom during the last 12 month period with water aspiration after uneventful under water birth.	II-3	2 neonatal patients. Case 1: A male infant born at term weighing 4.040 kilograms. Case2: A male infant born at term weighing 4.440 kilograms.	Water birth (hospital)	-	-	**Neonatal outcomes (water aspiration):** Case 1: - A male infant was born by planned under water birth at term after an uneventful pregnancy. There was no antenatal concerns and his antenatal ultrasound scans were normal. There was no meconium staining of liquour, no prolonged rupture of membranes and no other risk factors for infection. The neonate was born in good condition in the pool and he cried immediately after he was brought to the surface. Apgar scores were 8 and 9 at 1 and 5 minutes, respectively. The infant was reviewed at hour 2 of his life because of grunting and respiratory distress noticed by the midwife. On examination he was still tachypnoeic with a respiratory rate 100 per minutes and had intercostals and subcostal recessions and nasal flaring. He was transferred to the neonatal unit, where investigations were performed. His chest radiograph demonstrated bilateral widespread changes consistent with water aspiration. He was commenced on intravenous cefotaxime at a dose of 50 mg/kg 12 hourly for 5 days. All blood cultures were negative. Discharged 8 days after his birth.	

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							Neonatal outcomes (water aspiration): Case 2: - A male infant was born at term by planned under water birth in the birthing pool. There was no antenatal concerns; all the scans were normal. There was no meconium staining of liquour, no prolonged rupture of membranes and no other risk factors for infection. The neonate was born in good conditionunder water and his Apgar scores were 9 at 1 minute and 9 at 5 minutes of his life. At 12 hour of his life, the Paediatric senior House Officer was asked by the midwife to review the infant as the infant was not breast feeding well. On examination he was tachypnoeic with a respiratory rate of 70 per minutes. However, there were no grunting, no intercostal and subcostal recessions and no nasal flaring. He was transferred to the neonatal unit, where investigations were performed. On his chest radiograph the right horizontal fissure was prominent and there were bilateral streaky shadows consistent with water aspiration. There was no confluent pulmonary consolidation. He was started on intravenous cefotaxime at a dose of 50 mg/kg 12 hourly. Blood cultures were negative. Discharged 6 days after his birth.	

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Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
17. Sotiridou E, Mukhopadhyay S, Clarke P. Neonatal aspiration syndrome complicating a water birth. J Obstet Gynaecol. 2010; 30(6) :631-633	Case report, Norwich, United Kingdom. Report a newborn baby who unexpectedly developed acute respiratory distress from aspiration during a water birth.	III	A full term male infant weighing 3,700 grams. Mother – 24 year old healthy primigravida who had spontaneous labour at 41 weeks gestation after an uneventful pregnancy.	Water birth (hospital)	-	-	**Neonatal outcomes:** - The baby was born by vaginal delivery in hospital via a planned water birth. The baby appeared in good condition at birth. Apgar scores were 8 at 1 minute and 9 at 5 minutes. At 2.5 hours of age, the neonate was noted to be tachypnoeic, grunting and hypothermic. He was admitted to the neonatal intensive care unit and put on nasal continuous positive airway pressure ventilation. Within an hour, his oxygen requirements had increased significantly and he required intubation and ventilation due to worsening respiratory acidosis. At intubation, fresh blood was noted in the airways and there were recurrent blood-stained endotracheal and nasogastric aspirates over the next 24 hours. He initially required high ventilator pressures, but his respiratory status improved within 24 hours and all respiratory support was discontinued at 48 hour of age. A chest x-radiograph done soon after admission demonstrated bilateral interstitial and alveolar oedema consistent with aspiration. Based on the history, signs and symptoms, occurrence of haemorrhagic pulmonary oedema, CXR appearances, and rapid clinical improvement with ventilator support, a diagnosis of water aspiration syndrome was made.	

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18. Carpenter L, Weston P. Neonatal respiratory consequences from water birth. Journal of Paediatrics and Child Health. 2012;48: 419-423	Case control study, Waikato Hospital, Hamilton, New Zealand. Objective was to measure the clinical and radiological findings from water birth babies and air birth babies presenting with respiratory distress at term and to determine if there are any specific features that were associated with the medium of delivery. Review of case records and x-rays over a 7-year period (2000 - 20006) for all admitted babies to the NICU with respiratory distress after water birth and a similar group of babies with respiratory distress after air birth.	II-2	14 babies in water birth group with respiratory distress requiring support by continuous positive airway pressure (CPAP) or conventional mechanical ventilation. 24 babies in air birth group with respiratory distress requiring respiratory support from CPAP following spontaneous vertex delivery into air.	Water birth by primary care provider [lead maternity carers (LMC)]	Air birth by primary care provider [lead maternity carers (LMC)]	-	**Neonatal outcomes:** **a. Clinical features of the enrolled babies:** - No differences in birth weight, gestational age, and Apgar scores between the groups - The water birth babies were more likely to be ventilated and had a lower pH in the first 12 hour than the air birth group. The water birth group took longer to establish full feeds. • Ventilated; water birth (4), air birth (0), P=0.006 • Nitric oxide; water birth (4), air birth (0), P=0.006 • Age at full feeds (median, range); water birth [60 (19-411) hours], air birth [43 (12-130) hours], P=0.038 **b. X-ray assessment:** - 35 films available; 22 air births and 13 water births - There were 25 voluntary reviewers - There were (35 x 25) 875 films assessments of water versus air birth, of which 371 (42%) were correct - The severity scores of the chest x-ray changes were different; there were 325 film assessments of the water birth babies, and 48% of these were judged as severe changes, compared with only 16% for air birth babies **Conclusion** In low-risk babies with respiratory distress, water birth is associated with a greater level of respiratory morbidity than seen after air birth.	

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Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
1. Cluett ER, Burns E. Immersion in water in labour and birth. Cochrane Database of Systematic Reviews 2009, Issue 2. Edited, published in Issue 2, 2012.	Systematic review Objective was to assess the evidence from randomised controlled trials about immersion in water during labour and water birth on maternal, foetal, neonatal and caregiver outcomes. Search methods The Cochrane Pregnancy and Childbirth Group's Trials Register (30 June 2011) and reference lists of retrieved studies were searched. Selection criteria Randomised controlled trials comparing immersion in any bath tub/pool with no immersion, or other non-pharmacological forms of pain management during labour and / or birth, in women during labour who were considered to be low	I	Included 12 trials: - 8 related to 1st stage of labour - 1 related to early versus late immersion in the 1st satge of labour - 2 to the 1st and 2nd stages and 1 to the 2nd stage only (water birth) **Water birth** - 3 trials - 1 trial evaluated immersion during 2nd stage of labour (Nikodem 1999) and 2 trials measured	Immersion in 2nd stage of labour	No immersion in 2nd stage of labour	-	**Maternal outcomes:** a. Pain intensity (moderate to severe pain) - Nikodem 1999 (no. difference between groups): (Risk Ratio 1.06; 95% CI: 0.73 to 1.53) b. Mode of delivery (Nikodem 1999; Woodward 2004): - Assisted vaginal birth – (Risk Ratio 0.73; 95% CI: 0.21 to 2.54) - Caesarean section rate- (Risk Ratio 0.33; 95% CI: 0.07 to 1.52) c. Duration of labour (Chaichian 2009; Nikodem 1999; Woodward 2004) – no statistical sig. difference between groups (Mean difference -1.24 minutes; 95% CI: - 8.05 minutes to 5.56 minutes) d. Satisfaction with childbirth experience - Nikodem demonstrated a significantly higher level of satisfaction with birth experience (Risk Ratio 0.24; 95% CI: 0.07 to 0.80) with fewer women in the immersion group feeling	

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	risk of complications, as defined by the researchers. Data collection and analysis Trial eligibility and quality and data extraction were conducted independently. One review author entered data and the other checked for accuracy.		outcomes across the 1st and 2nd stages (Chaichian 2009; Woodward 2004). Nikodem 1999: - Study group: 60, - Control group: 60 Chaichian 2009: - Study group: 53 - Control group: 53 Woodward 2004: - Study group: 40 - Control group: 20 (Only 10(40%) of the women allocated to birth in water actually did so)				that they did not cope satisfactorily with their pushing efforts (3/60 versus 12/57). 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, found that both groups are reasonably satisfied. Immersion [Mean (SD) = 4.32 (1.2)] versus no immersion [Mean (SD) = 4.29 (1.26)], but there were no significant differences between groups (Mean Difference 0.03; 95% CI: -0.64 to 0.70).	

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2. Zanetti-Dallenbach R, Lapaire O, Maertens A et al. Water birth, more than a trendy alternative: a prospective, observational study. Arch Gynecol Obstet..2006; 274:355-265	Prospective observational study (Cohort study) in Switzerland Objective was to assess the effect of water birth on maternal and fetal outcomes in a selected low- risk collective of a tertiary obstetrical unit. 513 patients of low risk collective, who requested a water birth, were studied during the years 1998-2002. Every interested women was given detailed explanations and information about the inclusion and exclusion criteria and about guidelines concerning the safety of water birth, either by trained resident, fellow or midwife. According to the course of delivery, 4 different groups were designated;	II-2	513 pregnant women: - 89 pregnant women (17.4%) delivered in water – (SG) - 133 pregnant women (25.9%) had a normal vaginal delivery after temporary immersion in water (CG I) - 146 pregnant women (28.5%) had a normal vaginal delivery but no temporary immersion in water (CG II) - 145 pregnant women (28.3%) had an operative delivery by caesarean section or assisted vaginal delivery (CG III)	Delivered in water (SG)	Normal vaginal delivery after temporary immersion (CG I) Normal vaginal delivery but no temporary immersion (CG II) Operative delivery (CG III)	From admission for delivery until discharge	**Maternal outcomes:** a. Additional use of analgesia: - Significantly higher in CG I and CG III, P < 0.001 (40.4% in SG, 72.9% in CG I, 48% in CG II, 80% in CG III) b. Additional use of homeopathy: - Significantly higher in CG I and CG III (44.9% in SG, 65.4% in CG I, 38% in CG II, 66% in CG III) c. Duration of labour: Duration of 1st stage of labour- - Significantly longer in CG I and CG III, P < 0.001 [(mean, SD); 330.5 (211.6) minutes in SG, 438.7 (188.4) minutes in CG I, 352.8 (189.3) minutes in CG II, 522.5 (250.9) minutes in CG III)] Duration of 2st stage of labour- - Significantly longer in CG I and CG III [(mean, SD); 35.3 (36.4) minutes in SG, 69.7 (64.1) minutes in CG I, 49.1 (54.4.3) minutes in CG II, 159.7 (105.7) minutes in CG III)] Duration of 3rd stage of labour- - In the SG, 57% of patients delivered placenta in the tub - Lasted significantly longer in SG compared to control groups (P< 0.001) [(mean, SD); 14.2 (14.9) minutes in SG, 9.5 (7.1) minutes in CG I, 8.6 (8.3) minutes in CG II, 7.4 (6.3) minutes in CG III)]	

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	Study group (SG), Control group I (CGI), Control group II (CGII), Control Group III (CGIII). Primary outcome measurements included the maternal and fetal parameters. .							

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3. Geissbuhler V, Eberhard J. Waterbirths: A comparative study. Fetal Diag Ther. 2000;15:291-300	Prospective observational study (Cohort study) in Switzerland Objective was to compare the quality of alternative birth methods, especially that of water births (when the quality of the monitoring and the birth management is unchanged), with traditional 'bedbirth'. All parturients of the region give birth in clinic for Obstetrics and Gynaecology, Thurgauisches Kantonsspital, Frauenfeld Switzerland. A prospective observational study was started on November 1, 1991 and since then have documented every birth with a standardized questionnaire in five parts. The parturient receives the first part of the questionnaire at home 6 to 8 weeks before birth, and brings the completed form with	II-2	5,953 spontaneous single births with cephalic presentation: - 2,014 (34%) births in water - 1,108 (18%) births on the Maia-birthing stool - 2,362 (40%) births on a wide bed in a half-sitting position (vacuum extractions are not included) - 469 (8%) other methods such as 'Roma' wheel, the birthing bag, 'on all fours', or standing with or without the assistance of the rope of the wall bars.	Births in water.	Births on the Maia-birthing stool. Births on a wide bed in a half-sitting position (vacuum extractions are not included. Other methods such as 'Roma' wheel, the birthing bag, 'on all fours', or standing with or without the assistance of the rope of the wall bars.	From admission for delivery until discharge	**Maternal outcomes:** a. Use of analgesics: - No painkillers – more in water birth (70.6% in water, 66.1% in Maia-birthing stool, 54.1% in bed). Significant difference between water and bed birth, P<0.0001. - Suppositories – more in bed birth (11.8% in water birth, 15.9% in Maia-birthing stool, 20.9% in bed). Significant difference between water and bed birth, P<0.0001. - Injections – more in bed birth (10.2% in water birth, 14.6% in Maia-birthing stool, 22.6% in bed). Significant difference between water and bed birth, P<0.0001. - Epidural analgesia – more in bed birth (0.4% in water birth, 2.0% in Maia-birthing stool, 8.1% in bed). Significant difference between water and bed birth, P<0.0001. - Homeopathic remedies – more in water birth (21.9% in water birth, 15.4% in Maia-birthing stool, 18.5% in bed). Significant difference between water and bed birth, P<0.001. b. Birth experience, on 100-mm visual analog scale with the term 'wonderful' to the left and the term 'dreadful' to the right: - [mean, SD; (31.3 (20.5) mm in water birth, 34.6 (21.6) mm in Maia-birthing stool, 42.2 (23.4) mm in bed birth)]	

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	her when she enters the hospital for birth. During labour, after birth and again before the new mother leaves the hospital (usually 4 to 7 days after birth) the attending midwife and doctor record the objective information concerning labour, birth and postpartum phase. A 100-mm-long visual analog scale is then shown with the term 'wonderful' to the left and the term 'dreadful' to the right. The woman marks a line, more to the left and the or to the right, depending on how she feels about her birth experience. Objective data concerning all births between November 1, 1991 and May 21, 1997, a total of 7,508 births were included.	II-2	Average age of the mother-to-be was 29 in the different groups					

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4. Menakaya U, Albayati S, Vella E et al. A retrospective comparison of water birth and conventional vaginal birth among women deemed to be low risk in a secondary level hospital in Australia. Women and Birth 2013;26:114-118	Case control study in Australia Objective was to describe the maternal and neonatal outcomes associated with water birth among labouring women deemed at low risk for obstetric complications and compare these outcomes against women of similar risk who had a standard land birth. A retrospective audit and comparison of women giving birth in water with a matched cohort who birthed on land at Bankstown hospital over a 10 year period (2000 to 20009).	II-2	438 women: - 219 birth spontaneous-ly in water - 219 matched cohort of similar women who had a spontaneous vaginal birth not in water (standard birth group) identified within 24 hour of each one woman giving birth in water - 184 (42%) (primigravida) - 254 (48%) (multigravida) Primigravida: Age (mean years) - Water birth = 25.02 - Non-water = 25.73	Water birth	Spontaneous vaginal birth not in water (standard birth)	-	**Maternal outcomes:** a. Duration of labour: – no statistical sig. difference in mean duration of both first and second stages of labour between the two groups - 1st stage (minutes): Primigravida (349.10 in water birth, 352.20 in non- water, P=0.39) Multigravida (231.39 in water birth, 213.95 in non- water birth, P=0.84) - 2nd stage (minutes): Primigravida (50.45 in water birth, 52.21 in non- water birth, P=0.9) Multigravida (20.41 in water birth, 20.16 in non- water birth, P=0.9) b. Length of stay (mean days)- no significant difference: - Primigravida (2.73 in water birth, 2.66 in non-water birth, P=0.14) - Multigravida (2.22 in water birth, 2.09 in non-water birth, P=0.14)	

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			Multigravida: Age (mean years) - Water birth = 28.03 - Non-water = 28.98					

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5. Otigbah CM, Dhanjal MK, Harmsworth G et al. A retrospective comparison of water births and conventional vaginal deliveries. European Journal of Obstetrics & Gynecology and Reproductive Biology.2000; 91:15-20	Case control study in United Kingdom. Objective was to document the practice of water births and compare their outcome and safety with normal vaginal deliveries. A retrospective case-control study was conducted over a five year period from 1989 to 1994 at the Maternity Unit, Rochford Hospital, Southend, United Kingdom. Three hundred and one women electing for water births were compared with the same number of age and parity matched low risk women having conventional vaginal deliveries. Length of labour, analgesia requirements, apgar scores, maternal and fetal and neonatal complications, admission and infections were noted.	II-2	Total 602 women: 301 women had water birth: - 133 primigravidae and 168 multiparae - Mean age 26.9 years for primigravidaea and 29.4 years for multiparae 301 women in control group(normal vaginal delivery) - 133 primigravidae and 168 multiparae - Mean age 25.7 years for primigravidaea and 28.4 years for multiparae	Water birth	Normal vaginal delivery not requiring syntocinon augmentation	-	**Maternal outcomes:** a. Duration of labour: - Length of 1st and 2nd stages of labour significantly reduced in primigravidae in water birth group but not for the multiparae. - 1st stage (minutes): Primigravidae (300 in water birth, 390 in control, P< 0.05) Multiparae (215 in water birth, 206 in control, P= not significant) - 2nd stage (minutes): Primigravidae (32.7 in water birth, 42.6 in control, P < 0.005) Multiparae (15.3 in water birth, 14.9 in control, P= not significant) b. Analgesia requirements: - Significant reduction in analgesia requirements in women having water births: - No analgesia – (38% in water birth, 8% in control, P <0.0001). - Entonox only – (58% in water birth, 32% in control, P <0.0001). - Pethidine only – (0.3% in water birth, 16% in control, P <0.0001). - Entonox and Pethidine – (1% in water birth, 38% in control, P <0.0001).	

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6. Theoni A, Zech N, Moroder L et al. Review of 1600 water births. Does water birth increase the risk of neonatal infection? Journal of Maternal-fetal and Neonatal Medicine. 2005;17(5): 357-361	Cross sectional study in Italy Objective was to review the first 1600 water births at the Gynaecology and Obstetrics Unit, Vipiteno/Sterzing, Italy. Between March 1997 and December 2004, 1600 babies were born in the water bath. Also reviewed the number of alternative birthing positions used by primiparae since 1997 and compared duration of delivery, incidence of perineal trauma, neonatal arterial blood pH, base excess, analgesic requirements, shoulder dystocia, women with previous caesarean section, and postpartum haemoglobin level. Commencing 2001, 250 water samples taken from the pool were analyzed. Two water samples obtained at every water birth.	II-3	1600 women in water births Primiparae: - 737 (water) - 407 (Bed) - 142 (Stool)	Water birth	Bed birth Stool birth	-	**Maternal outcomes:** Primiparae: **a.** Analgesic requirements: - No woman using the water birth required analgesics. **b.** Duration of labour: - No difference in the duration of second stage (34 minutes in water birth versus 37 minutes in bed birth). - Duration of 1st stage of labour was significantly shorter with water birth than with land delivery (380 minutes versus 468 minutes)	

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Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
7. Cortes E, Basra R, Kelleher CJ. Waterbirth and pelvic floor injury: a retrospective study and postal survey using ICIQ modular long form questionnaires. European Journal of Obstetrics & Gynecology and Reproductive Biology.2011; 155:27-30	Cross sectional study in United Kingdom. Objective was to assess the incidence of perineal trauma and pelvic floor function following water birth (WB) compared to land birth (LB). At St Thomas' Hospital, the use of water birth was introduced in the Home from home (HfH) birth unit at the end of 2001. Conducted a retrospective analysis on the incidence of the perineal trauma following a spontaneous WB or LB. Data were collected using the hospital's healthcare database, which codes information on pregnancy outcomes and related variables. For second part of the study, a postal survey was conducted among women who had no	II-3	Spontaneous WB; n = 160 nulliparous women Land birth (LB); N = 623 nulliparous women	Water birth (WB)	Land birth (LB)	1 year (for postal survey)	**Maternal outcomes:** **a. Labour outcomes at Mid-wife led delivery suite:** - No statistically significant difference in maternal age, maternal body mass index (BMI), birth weight, length of first stage of labour, or the incidence of an intact perineum or first and second degree tears between the WB and LB groups. - WB resulted in shorter second stage of labour compared to LB; 43 minutes in WB compared to 57 minutes in LB, P<0.01. - A greater incidence of third degree tears in WB group; 4/160 (2.5%) versus 8/623 (1.3%) in LB group (P .0.05, RR: 1.9, 95% CI: 0.58 to 6.23) - Overall incidence of perineal trauma following 1st WB versus 1st LB was not statistically significant (P=0.43; RR:1.04, 95% CI: 0.91 to 1.2) **b. Vaginal and urinary symptoms:** - A number of women reported mild vaginal symptoms (ICIQ-VS), Mean score value: (2.6 in WB compared to 2.3 in LB, P >0.29; 95% CI: -0.4 to 1.3) - A number of women reported mild urinary symptoms (ICIQ-KHQ urinary incontinence), Mean score value: (5.8 in WB compared to 4.9 in LB, P =0.20; 95% CI: -0.4 to 1.9)	

Evidence Table: Effectiveness
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	pelvic floor problems prior to pregnancy, completed the second stage of labour in water for WB group, were at least one year postpartum, were not breastfeeding, and had not had further pregnancies. All participants received two validated questionnaires on pelvic floor performance; the international Consultation on Incontinence Questionnaire (ICIQ)-VS for vaginal symptoms, and the ICIQ KH (kin's Health) QoL (KHQ), which includes domains urinary incontinence, sexual matters and quality of life (QoL). Two standard questionnaires, on patient satisfaction and reasons to choose a water birth, were also included.						**c. Water birth experience:** - Overall satisfaction with WB experience and likelihood of having a second water bath; 84% replied "very likely', 5% replied "likely", 8% "undecided", 1 replied 'unlikely" and 1 said "very unlikely" (total 77 women) - Among reasons why women would choose a birthing pool delivery, pain relief was the main factor reported (84%), followed by natural approach (80%), prevention of tears (35%), prevention of incontinence (10%), midwife advice (35%), doctor advice (5%), better for the baby (67%) and shorter labour (29%). **Conclusion** Water birth results in a shorter 2nd stage of labour. This does not lead to less overall perineal trauma or better pelvic floor performance postpartum. Physical limitations in protecting the perineum during the expulsion phase may be associated with an increase in the incidence of 3rd degree tears in the WB population.	

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8. Mistrangelo E, Gaggero CR, Nadalini C et al. Does water delivery affect pelvic floor/ ultrasound evaluation of perineal function. Arch Gynecol Obstet.2007; 276:133-138	Non randomised controlled study in midwife led birth centre (MLBC) in Italy. Objective was to analyse urethral mobility and excursion of the pubo-rectal angle, using perineal ultrasound, after normal vaginal delivery and water delivery. From 1 November 2004 to 31 May 2005, all primiparous women who had second stage and delivery in the water-birthing pool (W Group) and woman every two who had normal vaginal delivery without water immersion during labour (NW Group) were enrolled. All women undergone perineal test (PT) and perineal ultrasound examination 6 months after delivery. The parameters assessed were urethral mobility during Valsalva's manoeuvre and movement of the pubo-rectal sling angle during contraction of the levator ani muscle.	II-2	52 primiparous women: - Water group (W group), n = 25 primiparous women - Non water group (NW group), n = 27 primiparous women	Water birth (W Group)	Non water (NW Group)	6 months	• The two groups had similar characteristics: mean age, body mass index (BMI), birth weight, perineal tears, duration of the first and second stages. • No woman reported stress urinary incontinence, urge incontinence or faecal incontinence 6 months after delivery. **a. Urethral mobility (mean, range, SD):** - Mean urethral mobility during Valsalva's manoeuvre was higher in the W Group 34.9° (range, 2° to 87°:SD 6.4 °) in comparison to the NW Group 29.5° (range, 1° to 90°:SD 7.9 °), P=0.098. **b. Excursion of the pubo-rectal sling angle:** - The excursion of the pubo-rectal angle was lower in the W Group 8.7° (range, 4° to 27°:SD 3.5 °) than in the NW Group 11.0° (range, 3° to 39°:SD 4.3 °), P=0.120. **Authors conclusion:** The present study found no statistically differences in the pelvic floor, using perineal ultrasound between water and "non-water" delivery.	

Evidence Table: Cost-Effectiveness
Question: Is water birth cost-effective compared with conventional delivery?

Bibliographic citation	Study Type / Methodology	LE	Number of patients and patient characteristics	Intervention	Comparison	Length of follow up (if applicable)	Outcome measures/ Effect size	General comments
1. Pagano E, De Rota B, Ferrando A et al. An economic evaluation of water birth: the cost-effectiveness of mother well-being. Journal of Evaluation in Clinical Practice: 2010;16; 916-919	Economic evaluation in Italy. Objective was to assess the cost-effectiveness of water compared with normal land delivery. A retrospective controlled study was conducted over a two-year period (January 2002 to December 2004) at the Monfalcone San Polo Hopital, Gorizia (Italy). The cohort included all the 110 women who completed a water birth identified from the hospital Delivery Registry. For every water birth, the subsequent woman who had a land birth was identified in the Registry and entered in the study if satisfying the criteria that allowed for labouring and delivering in water (n=110). Costs have been estimated by valuing all the supplied activities through local tariffs. Difference among the two groups were analysed in relation to the following outcomes; labour duration, perineal tear and newborn's health status.		- 110 nulliparous women who completed a water birth - 110 women who land birth	Water birth	Normal land delivery	-	• The two study groups were comparable with respect to maternal age, duration of gestation and newborn's sex, weight and head circumference. • The mean duration of labour was similar in the two groups; 4.99 hours in the land delivery group and 4.82 hours in the water delivery. • In the water delivery group, 58 women (52.7%) experienced at least one perineal tear versus 80 women (72.7%) in the land delivery group, difference 20% (95% CI: 19% to 21%). • Neonatal well-being, expressed as Apgar score, did not differ significantly among the two groups at the first minute (9.48 versus 9.28) and was slightly higher at 5 minutes in the water delivery group (9.95 versus 9.84; P=0.0269). • Mean delivery costs were € 967 in the water group and € 688 in the land delivery group, difference was € 279 (95% CI: 262 to 296). • The incremental health care cost (ICER) per avoided perineal tear owing to water delivery was	

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	Perineal tears included first to third degree tears and episiotomy, while simple abrasions not requiring suture were not considered. Nowborn's health status werebased on Apgar score at 1 and 5 minutes after birth. The economic evaluation adopted a cost-effectiveness approach in relation to the presence / absence of perineal tears, the outcome most related to the maternal well-being. An incremental cost-effectiveness ratio (ICER) was calculated and cost-effectiveness acceptability curve, based on bootstrapped simulations (1000 runs) was depicted.		-				• estimated as € 1,395.7 (95% CI: 1,049.2 to 3,608.5). • The cost-effectiveness acceptability curve suggests that at a threshold of €2,000, more than 80% of water delivery would be cost-effective.	