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Maternal and neonatal outcomes of in-water and out-of-water births in low-obstetric-risk labour: a retrospective observational study at Piacenza hospital.

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Maternal and neonatal outcomes of in-water and out-of-water births in low-obstetric-risk labour: a retrospective observational study at Piacenza hospital.

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ABSTRACT

INTRODUCTION

The utilisation of birth pool immersion during labour and delivery constitutes one of the primary non-pharmacological methods for alleviating pain. Consequently, an increasing number of women are opting to employ aquatic environments as a means of managing the childbirth experience. However, the literature reports conflicting data and poor-quality evidence on maternal and neonatal outcomes. It becomes important to understand whether water birth is safe for both woman and baby. The objective of this research is to evaluate and compare neonatal outcomes, including infections, admission to the neonatal intensive care unit, and Apgar scores at one and five minutes, alongside maternal outcomes such as vagino-perineal lacerations, postpartum haemorrhage, the duration of labour and the expulsive phase, as well as infections, between water birth and non-water birth scenarios.

MATERIALS AND METHODS

A retrospective observational cohort study employing a parallel design was undertaken. A total of 698 women with low-risk obstetric pregnancies were included and stratified into two groups based on the type of delivery. Data analysis was performed using STATA 16.0 software, applying both descriptive and inferential statistical methods to assess the study variables. A logistic model was created for the study population to identify which variables may contribute to an increased likelihood of injury to the perineum.

RESULTS

The research sample comprised 698 deliveries, which were evenly distributed between the two cohorts. The groups exhibited homogeneity concerning maternal age, parity, administration of antibiotic treatment during labour, and positivity rates of vaginal-rectal swabs. A further notable discrepancy ($p < 0.05$) was observed in the volume of postpartum blood loss; however, the difference was minimal in both cohorts. Logistic regression analysis revealed that for each 1 cm increase in infant head circumference, the risk of perineal injury increased by 1.3 times ($OR = 1.27$; $p = 0.002$).

CONCLUSIONS

The study identified no significant differences in maternal and neonatal outcomes between water and non-water births. Consequently, it appears both suitable and prudent to permit women experiencing low-risk obstetric labour the autonomy to decide whether to deliver in a water-based setting or not. However, further studies are needed. Despite the findings presented, it is crucial to emphasise that further investigation and analysis are absolutely necessary.

Keywords: water birth, low obstetric risk, neonatal infections, vagino-perineal lacerations

INTRODUCTION

Birth pool immersion during labour and delivery is among the main non-pharmacological techniques for pain reduction [1]. The use of water during labour seems to be associated with an increased feeling of maternal well-being and a reduction in obstetric interventions, favouring the naturalness of childbirth [2-5]. For these reasons, water birth is requested by an increasing number of women [6].

However, the present literature reports conflicting data on maternal and neonatal outcomes of water use during the expulsive period. A Cochrane Review states that only low to moderate quality evidence is available and that further studies are needed [2].

A retrospective study published in 2019 found that the major complications associated with water birth involved the newborn with near-drownings, rupture of the funiculus and infections [7].

In the same year, two retrospective studies were published in which the authors claimed that water birth did not show an increase in maternal and neonatal adverse events compared to birth outside water [8-9]. This was confirmed by two studies from 2020 [10-11].

The authors of other studies published in 2020 claim that hospital births that occurred in water had a lower risk of admission to the neonatal intensive care unit and required less care as well as fewer maternal lacerations than out-of-water births [12-13].

In 2014, a joint statement by the American Academy of Pediatrics (AAP) and the American College of Obstetricians and Gynecologists (ACOG) was published recommending that water birth should only be performed for research purposes by obtaining full written informed consent [14]. In 2016, the ACOG states that there is insufficient data to draw conclusions about the relative benefits and risks of water immersion during the second stage of labour and childbirth, therefore, until such data are available, they recommend that birth should not take place in water. This view was reconfirmed in 2021 [15].

The authors of a systematic review in 2024 state that in equipped facilities, water birth can be a reasonable choice for mothers and babies [16].

It therefore becomes important to understand whether immersion in water during labour and the expulsive period does not increase the risks of an adverse event compared to labour and delivery out of water.

Considering the importance of the event and the undisputed possibility of the woman to choose the mode of her own delivery, performing an RCT is hardly feasible.

At the Piacenza AUSL, water births have been performed since 2003 and, as emerged from internal audits, encouraging results have been observed over the years in terms of patient satisfaction and no increase in risk, i.e. the possibility of a patient suffering unintentional harm or

discomfort, attributable to health care, causing a prolonged period of hospitalisation, a worsening of health conditions or death [17].

The primary objective of the study is to compare neonatal infections in water and out-of-water births. Secondary objectives are to compare maternal outcomes (vagino-perineal lacerations, postpartum haemorrhage, duration of labour and expulsive period, infections) and neonatal outcomes (Apgar at the first and fifth minute, neonatal intensive care unit admissions) of water birth versus out-of-water birth.

MATERIALS AND METHODS

This is a retrospective observational cohort study with a parallel cohort.

Women with low obstetrical risk labour [18] and eutocic delivery were enrolled, thus meeting the following requirements:

- single foetus in cephalic presentation;
- labour occurred spontaneously from 37+0 weeks of pregnancy;
- absence of pathologies arising in pregnancy or during labour;
- normal fetal heart rate;
- intact amniotic sac or premature rupture of amniochorionic membranes (PROMs) for less than 24 hours and who have received antibiotic therapy in the case of a positive vagino-rectal swab for Beta Haemolytic Streptococcus (GBS) or rupture longer than 18 hours;
- clear amniotic fluid;
- without augmentation with oxytocin;
- non-use of the epidural.

In the first cohort, women who had completed the entire expulsive period in water were included; in the parallel cohort, women who did not use the tub immersion for either labour or delivery were enrolled.

The sample size was calculated on the basis of the incidence of post-partum haemorrhage (PHE) in non-exposed women (16%) and in women exposed to bath immersion (9%) at the Piacenza AUSL, the statistical power was defined as 80% with alpha at 5% and ratio of exposed to non-exposed of 1:1. The sample consisted of 698 women, 349 per group.

The deliveries included in the study were selected starting from the last water birth performed at the time of approval in the Ethics Committee i.e. August 2023 going back in time until the sample was reached i.e. December 2018. The same was done for the women who did not have a bath immersion.

Data were collected from the medical records of the women giving birth.

The water deliveries took place in the two tanks [19] provided at the Piacenza AUSL delivery room adequately sanitised and with temporal microbiological monitoring [20], the water temperature is controlled with an immersible thermometer at 36.5°C [21].

Postpartum haemorrhage was estimated in ml through the use of retrosacral bags placed after expulsion or after exiting the tub, postpartum haemorrhage is considered to be a loss of more than 500ml as indicated in the Guidelines [22].

The length of labour is measured in minutes, commencing from the initiation of the active phase as recorded by the midwife in the medical documentation, up until the onset of the expulsive stage. The expulsive stage is timed in minutes from the commencement of exertions associated with expulsion until parturition occurs.

Perineal lacerations are classified into I, II, III and IV degrees [23].

To determine the presence of a maternal or neonatal infection, the administration of antibiotic therapy in the five days following delivery was assessed.

Data analysis was carried out with STATA 16.0 software.

Quantitative variables were articulated as the mean and standard deviation (SD) when exhibiting a normal distribution, or as the median and interquartile range (IQR) in the absence of normal distribution. Categorical variables were delineated in terms of relative and absolute frequencies.

The distribution of the quantitative variables in the two groups was assessed by t-test or Mann Whitney test, while for the categorical variables, the χ^2 test or Fisher's exact test was performed.

A logistic model was created for the study population to identify which variables may contribute to an increased likelihood of injury to the perineum (parity, duration of labour and expulsive period, infant's head circumference).

Ethical considerations

The study was conducted according to Good Clinical Practice and the principles enshrined in the Declaration of Helsinki [24].

For the conduct of the study, a favourable opinion was obtained from the Area Vasta Emilia Nord Ethics Committee on 18/07/2023 (protocol no. 2023/0075011 of 20/07/2023) and company authorisation on 27/07/2023 (resolution 2023/0000349 of 27/07/2023).

Given that this was a retrospective study, obtaining informed consent from patients was not feasible in all instances due to their unavailability. The data pertaining to these patients were processed in compliance with the stipulations outlined in Article 110 of Legislative Decree 196/2003, as amended.

Data collected for the purposes of the study were used in pseudonymised form.

RESULTS

The sample studied consisted of 698 deliveries, of which 349 were water deliveries, while in 349 cases tub immersion was not used either in labour or during the expulsive period.

The sample was homogeneous for the variables maternal age at delivery, parity, vaginal-rectal swab for detection of Beta Haemolytic Streptococcus and administration of antibiotic therapy during labour (Table 1).

The mothers were from 42 different countries, grouped into four groups: Italy, Europe (excluding Italy), Africa, Asia and America. The type of delivery was statistically significantly associated with nationality ($p < 0.001$), thus showing a prevalence of women of Italian nationality who had a water birth, and with the variables neonatal weight ($p = 0.009$) and head circumference ($p = 0.01$), which were found to be greater in newborns from water birth, but these differences, of 73 g and 3 mm, respectively, were not clinically relevant (Table 1).

	Total sample N = 698	NO water birth N = 349	YES water birth N = 349	p
NATIONALITY				$< 0.001^{\#}$
• Italy	475 (68%)	206 (59%)	269 (77%)	
• Europe (no Italy)	115 (16%)	69 (20%)	46 (13%)	
• Africa	68 (10%)	50 (14%)	18 (5%)	
• Asia and America	39 (6%)	23 (7%)	16 (5%)	
Absolute frequency (percentage frequency) MD = 1				
AGE (mean $\pm$ SD in years)	31.1 $\pm$ 4.9	31.0 $\pm$ 5.0	31.1 $\pm$ 4.8	0.7754 ^{\$}
PREVIOUS VAGINAL DELIVERIES				0.883 ^{\$}
• 0	257 (37%)	129 (37%)	128 (37%)	
• 1	325 (47%)	162 (46%)	163 (47%)	

• 2 • 3 • ≥ 4 Absolute frequency (percentage frequency)	90 (13%) 17 (2%) 9 (1%)	43 (12%) 9 (3%) 6 (2%)	47 (13%) 8 (2%) 3 (1%)	
GBS • Negative • positive Absolute frequency (percentage frequency) MD=7	568 (82%) 123 (18%)	282 (82%) 60 (18%)	286 (82%) 63 (18%)	0.862 [#]
ANTIBIOTIC THERAPY IN LABOUR FOR GBS+ OR PROM>18H • No • Yes Absolute frequency (percentage frequency) MD=1	542 (78%) 155 (22%)	269 (77%) 79 (23%)	273 (78%) 76 (22%)	0.769 [#]
WEIGHT (mean $\pm$ SD in g)	3361 $\pm$ 368	3325 $\pm$ 380	3398 $\pm$ 352	0.009 [§]
CRANIC CIRCUMFERENCE (mean $\pm$ SD in cm) MD=3	34.1 $\pm$ 1.1	34.0 $\pm$ 1.2	34.3 $\pm$ 1.0	0.010 [§]

Table 1: Sample characteristics

MD: missing data; #: test X^2 ; §: t-test; §: Fisher's exact test

Neonatal outcomes

There were no statistically significant differences between infants born in and out of water for the variables Apgar at the fifth minute, administration of antibiotic therapy within five days after birth and admission to the neonatal intensive care unit.

There was a statistically significant difference ($p=0.033$) for the Apgar variable at the first minute: infants born in water scored 10 in a higher percentage than those born out of water

(61% versus 50%), however, no clinically relevant differences were evident as almost all infants had a score of more than 9 at the first minute (Table 2).

	Total sample N = 698	NO water birth N = 349	YES water birth N = 349	p
APGAR 1				0.033 [#]
• ≤7	10 (1%)	6 (2%)	4 (1%)	
• 8	20 (3%)	13 (4%)	7 (2%)	
• 9	279 (40%)	154 (44%)	125 (36%)	
• 10	389 (56%)	176 (50%)	213 (61%)	
APGAR 5				0.152 [#]
• 8 o 9	18 (3%)	12 (3%)	6 (2%)	
• 10	680 (97%)	337 (97%)	343 (98%)	
NEWBORN ANTIBIOTIC				1 ^{\$}
• No	689 (99%)	344 (99%)	345 (99%)	
• Yes	9 (1%)	5 (1%)	4 (1%)	
NICU RECREATION				0.560 [#]
• No	686 (98%)	342 (98%)	344 (99%)	
• Yes	12 (2%)	7 (2%)	5 (1%)	

Table 2: Neonatal outcomes reported as absolute frequency and percentage frequency

[#]: χ^2 test; ^C: Fisher's exact test;

Maternal outcomes

There were no statistically significant differences between the two groups for the variables antibiotic administration in the five days following delivery, duration of labour and expulsive period.

There was a statistically significant association ($p < 0.001$) between the degree of perineal laceration and type of delivery: with water deliveries the percentage of presence of laceration grade 2 or higher was lower than with non-water deliveries (33% versus 47%). In addition, the

median volume of postpartum blood loss is significantly lower in the case of water birth compared with non-water birth ($p < 0.001$), however, the loss is small and not haemorrhagic in both groups (Table 3).

The logistic regression aimed at identifying the factors that increase the risk of perineal laceration, regardless of the mode of delivery, shows that a 1 cm increase in the infant's head circumference increases the risk of injury by 1.3 times ($OR = 1.27$; $p = 0.002$). The risk of injury is reduced by 70% in the case of a previous vaginal delivery, by 84% if there are 2 previous deliveries and by 88% if there are at least 3 previous deliveries.

	Total sample N = 698	NO water birth N = 349	YES water birth N = 349	p
Degree of perineal laceration • 0 • 1 • ≥ 2 Absolute frequency (percentage frequency)	232 (33%) 188 (27%) 278 (40%)	111 (32%) 75 (21%) 163 (47%)	121 (35%) 113 (32%) 115 (33%)	$< 0.001^{\#}$
MOTHER ANTIBIOTIC • No • Yes Absolute frequency (percentage frequency) MD = 1	651 (93.4%) 46 (6.6%)	319 (91.7%) 29 (8.3%)	332 (95.1%) 17 (4.9%)	0.066 [#]
TRAVEL DURATION (median and IQR in minutes)	188 (123-280)	180 (120-285)	194 (130-272)	0.376 [^]
DURATION PERIOD EXPULSIVE	18 (10-40)	18 (10-36)	19 (10-44)	0.461 [^]

(median and IQR in minutes)				
EPP (median and IQR in ml)	200 (100-300)	250 (200-400)	150 (100-300)	<0.001 [^]

Table 3: Maternal outcomes

MD: missing data; #: test X^2 ; ^: Mann Whitney test

DISCUSSION

The primary objective of this research was to evaluate neonatal infections, operationalized through the administration of antibiotic therapy during the five-day postnatal period. The findings indicated that 1.7% of infants born outside of water settings and 2% of those born within water environments necessitated antibiotic treatment; however, the data analysis revealed no statistically significant differences between the two groups. The low rate of neonatal infections secondary to water birth, in agreement with a systematic review of case reports [25], is probably due to the use of adequate water filters and careful sanitation of the tubs following the guidelines of the procedures [19-20].

The neonatal outcomes in terms of Apgar score at the first and fifth minute are reassuring in both groups [26]. 98.2% of the out-of-water births and 98.8% of the in-water births received an Apgar score greater than or equal to 8 at the first minute, however, a significant difference emerges in that an Apgar score of 9 at the first minute is more common among the out-of-water births compared to a score of 10 among the in-water births, but this is not a clinically relevant difference. All infants received a score greater than or equal to 8 at the fifth minute.

Neonatal intensive care unit admissions were 2% in out-of-water births while we note a lower percentage (1.4%) of admissions of water births, this is however not a statistically significant difference although it is in agreement with a study conducted in 2023 [13].

Maternal infections, i.e. the administration of antibiotic therapy in the five days following delivery, did not show statistically significant differences in the two groups, in contrast to a study from 2022 [27], however, it is shown that among out-of-water deliveries antibiotic therapy was administered in 8.3% of cases and in 4.9% of deliveries in water, this could be clinically relevant.

There are no differences between the duration of the expulsive period, while an average labour duration of 14 minutes longer can be noted in labour that took place in water.

There is greater blood loss in deliveries that occur out of water, without however reaching haemorrhagic characters [28-29]. This could be explained by a delay in the positioning of the retrosacral sac and a difficult estimation of the quality of blood loss in water.

Perineal injuries are superimposable in the two groups. The logistic regression performed on the sample shows that as the infant's head circumference increases by 1 cm, there is an increased risk of laceration.

Limitations of the study

This is a single-centre study that does not evaluate the effects of water immersion in other settings. It was also impossible to compare the fetal pH and maternal and neonatal inflammation indices, more objective data, of the two cohorts as they were not always performed.

Paediatric societies that do not recommend water birth do not place time limits on immersion during labour, which is why the total time of immersion in the tub in addition to the expulsive period was not considered, but this could be a limitation especially for the assessment of maternal outcomes.

CONCLUSIONS

Our study shows that at the Piacenza AUSL birthplace, immersion in the birth pool during labour and the expulsive period does not lead to any worsening or improvement in maternal and neonatal outcomes in deliveries considered at low obstetrical risk.

For this reason, it would seem appropriate and advisable to allow the woman with low obstetrical risk labour the freedom of choice as to whether to give birth in or out of water.

However, further multicentre and prospective studies using objective variables such as indices of inflammation and measurement of cord pH are needed.

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