REVIEW

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Water Birth as Neuroendocrine Medicine: A Critical and Integrative Review of Hormonal and Psychophysiological Impacts on Maternal and Neonatal Outcomes

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ABSTRACT

Background: Water birth, defined as labor and/or delivery conducted in warm water, has gained increasing recognition as a patient-centered and physiologically supportive birth practice. Beyond analgesia, growing evidence indicates that water immersion during labor modulates maternal neuroendocrine regulation, psychological well-being, and neonatal physiological adaptation. Nevertheless, these hormonal and psychophysiological mechanisms remain insufficiently integrated into conventional perinatal research and clinical frameworks. This review aims to synthesize current evidence on the neuroendocrine, psychophysiological, obstetric, and neonatal effects of water birth and to evaluate its clinical effectiveness and safety in low-risk pregnancies.

Methods: An integrative review was conducted using a PRISMA-guided approach to identify peer-reviewed studies published between 2000 and 2025. Literature searches retrieved 3,287 records from major biomedical databases, of which 44 studies (12 randomized controlled trials, 19 cohort studies, 6 case–control studies, and 7 systematic reviews) met inclusion criteria. Data were synthesized thematically, focusing on maternal hormonal responses (oxytocin, β-endorphins, cortisol, prolactin), labor outcomes, breastfeeding, postpartum mood, neonatal adaptation, and safety considerations.

Results: Across study designs, water immersion during labor was associated with increased endogenous oxytocin and β-endorphin activity and reduced stress-related hormonal responses. Clinically, first-stage labor was shortened by approximately 42–78 minutes, and epidural analgesia use was reduced by 30–50% compared with conventional land birth. Episiotomy rates were generally below 5%, and maternal satisfaction scores were consistently higher. Early breastfeeding initiation occurred in 86–92% of water birth cases, with exclusive breastfeeding rates at six weeks ranging from 66–77%. Neonatal outcomes, including 5-minute Apgar scores and NICU admission rates, were comparable to or slightly better than conventional birth in low-risk populations, with no consistent increase in infection or respiratory complications when standardized protocols were applied.

Conclusion: Water birth supports a hormonally optimized and psychologically protective labor environment, with measurable benefits for labor efficiency, maternal experience, breastfeeding success, and neonatal physiological transition. When implemented under evidence-based guidelines, it represents a credible non-pharmacological option within contemporary, physiology-informed maternity care.

Keywords: Breastfeeding outcomes; Maternal psychophysiology; Neuroendocrinology of labor; Postpartum mood disorders; Water birth.

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INTRODUCTION

Childbirth represents a neurohormonally regulated, multisystem physiological process that depends on coordinated interactions among the hypothalamic–pituitary–adrenal (HPA) axis, the autonomic nervous system, and endogenous regulatory peptides that collectively support labor progression, maternal adaptive capacity, and neonatal transition. As contemporary obstetrics evolves toward precision physiology and person-centered models of care, increasing attention has been directed toward birth modalities that maintain the biological integrity of labor while limiting unnecessary iatrogenic interference.

Within this context, water birth, defined as immersion of the laboring individual, and in some cases the neonate at delivery, in thermoneutral water, has re-emerged as a clinically relevant practice warranting rigorous mechanistic and outcome-oriented evaluation.[1,2]

The theoretical foundations of water birth originate from ethological observations of aquatic mammals; however, its translation into human obstetric practice was driven by experimental clinicians in the mid-20th century. The earliest formally documented human water birth is commonly attributed to Dr. Igor Tjarkovsky, a Russian physician and biophysicist, who in the early 1970s incorporated neonatal aquatic immersion into studies of aquatic adaptation and perinatal reflex physiology.[3] Further clinical refinement occurred in Western Europe, particularly through the work of Michel Odent in France during the 1980s, who introduced warm water immersion into birthing environments based on the premise that hydrostatic support and sensory modulation could enhance oxytocin-mediated physiological labor.[4] Since that period, water birth has been selectively adopted across diverse healthcare settings, primarily within midwifery-led services and humanistic obstetric care models.[5]

Despite growing observational and experiential support, water birth remains infrequently implemented in tertiary obstetric centers. Its limited uptake is often attributed to medico-legal uncertainty, infrastructural constraints, and a perceived lack of mechanistic evidence substantiating its physiological plausibility. Historically framed as an "alternative" or "non-interventional" approach, water birth has been subject to epistemic marginalization, with insufficient recognition of its capacity to influence labor through neuroendocrine, autonomic, and psychophysiological pathways.[6,7]

Recent investigations increasingly demonstrate that thermal water immersion during labor induces complex modulation of maternal neuropeptide signaling, characterized by increased secretion of oxytocin, β-endorphins, and prolactin, alongside reductions in cortisol, catecholamines, and pro-inflammatory cytokines.[8,9] This endocrine rebalancing is associated with altered sympathovagal activity, restoration of neuroimmune homeostasis, and enhanced emotional regulation—processes central to effective labor, early lactogenesis, and mitigation of postpartum mood disturbances.[10,11]

In addition, the physical properties of water provide hydrostatic perineal support, buoyancy-facilitated mobility, and attenuation of nociceptive afferent input, collectively reducing the likelihood of obstetric trauma such as episiotomy or instrumental delivery.[12,13] From the neonatal standpoint, a thermally controlled and visually subdued aquatic environment may promote a more gradual transition from intrauterine to extrauterine life, with potential effects on autonomic regulation, cardiorespiratory adaptation, and early neurobehavioral patterns relevant to mother–infant bonding.[14]

To date, however, no integrative synthesis has comprehensively unified the hormonal, psychophysiological, and neonatal aspects of water birth within a coherent scientific framework. Existing literature remains fragmented, frequently divided between safety-focused audits and subjective maternal experience reports, with limited exploration of underlying biological mechanisms or translational significance.[15]

This review aims to evaluate this gap by integrating evidence from endocrinology, psychoneuroimmunology, obstetric physiology, and neonatal adaptation research. It critically evaluates water birth not merely as a comfort-oriented practice, but as a potential neuroendocrine intervention with systemic implications.

METHODS

This review adopted a rigorous integrative methodology that combined a PRISMA 2020-compliant systematic review framework with an integrative synthesis approach to comprehensively evaluate the neuroendocrine, psychophysiological, obstetric, and neonatal dimensions of water birth.[1,2] This methodological design was selected to accommodate the complex, interdisciplinary nature of water birth research, which spans obstetrics, endocrinology, neonatology, psychology, and behavioral science. By integrating diverse study designs within a single analytic framework, the review aimed to bridge mechanistic biological evidence with clinical and experiential outcomes.[3,4]

A systematic literature search was conducted across four major biomedical databases, such as PubMed, CINAHL Plus, Scopus, and the Cochrane Library, to identify relevant peer-reviewed studies published between January 2000 and June 2025.[5] Structured Boolean logic and Medical Subject Headings (MeSH) were used, with search strategies adapted to the indexing architecture of each database. Core search terms included *water birth*, *labor immersion*, *oxytocin physiology*, *maternal hypothalamic–pituitary–adrenal (HPA) axis*, *beta-endorphin labor*, *neuroendocrine childbirth*, *perinatal mental health*, *breastfeeding initiation*, and *neonatal thermoregulation*. Searches were limited to human studies published in English with full-text availability.

Studies were considered eligible if they reported original empirical data on water birth or warm water immersion during labor and explicitly examined outcomes related to maternal hormonal biomarkers (including oxytocin, cortisol, endorphins, and prolactin), psychophysiological responses (such as stress, anxiety, pain perception, or mood), obstetric parameters (including labor duration, analgesic use, mode of delivery, and perineal integrity), breastfeeding outcomes (initiation, exclusivity, or lactational hormones), or neonatal physiological adaptation (Apgar scores, respiratory transition, thermoregulation, or early neurobehavioral responses).[6,7] Eligible study designs included randomized controlled trials (RCTs), cohort studies, case–control studies, and high-quality observational research. Exclusion criteria encompassed animal studies, non-empirical publications, hydrotherapy-only protocols without disaggregated water birth outcomes, and studies focused exclusively on institutional, legal, or policy analyses without physiological or clinical endpoints. Grey literature, editorials, commentaries, and non–peer-reviewed conference abstracts were excluded to ensure evidentiary rigor.

The initial search yielded 3,287 records. After removing 1,064 duplicates, 2,223 unique records underwent title and abstract screening, resulting in 221 articles subjected to full-text review. Ultimately, 44 studies met all inclusion criteria and were retained for final synthesis.[8] Study selection was documented using a PRISMA 2020–compliant flow diagram (**Figure 1**), ensuring transparency and reproducibility.

Methodological quality and risk of bias were assessed using validated appraisal tools appropriate to the study design. The Joanna Briggs Institute (JBI) Critical Appraisal Checklists were applied to observational and qualitative studies to evaluate internal validity, measurement reliability, and ethical reporting. The Cochrane Risk of Bias 2.0 tool was used for RCTs, focusing on randomization procedures, allocation concealment, blinding, and outcome reporting. For cohort and case–control studies, the Newcastle–Ottawa Scale (NOS) was employed, assessing selection, comparability, and outcome or exposure ascertainment, with scores ≥7 indicating high methodological quality. Discrepancies in appraisal were resolved through consensus or adjudication by a third reviewer.

Data extraction was performed using a standardized matrix capturing study characteristics, sample size, gestational age, immersion parameters (including water temperature, depth, and duration), maternal endocrine and psychological outcomes, breastfeeding indicators, and neonatal physiological or behavioral endpoints.[9,10] Due to substantial heterogeneity in study designs, outcome definitions, and measurement instruments, quantitative meta-analysis was not conducted. Instead, data synthesis followed a thematic integrative approach, grouping findings by outcome domain and mechanistic pathway. Emphasis was placed on effect directionality, consistency across studies, and convergence of biological and clinical evidence, enabling a robust and high-fidelity synthesis to inform subsequent analysis and interpretation.

RESULTS

The systematic screening process identified 3,287 records, of which 1,064 duplicates were removed. Following title and abstract screening, 2,002 records were excluded for irrelevance, and 221 full-text articles were assessed against predefined inclusion criteria focusing on endocrine, psychophysiological, breastfeeding, and neonatal outcomes. After methodological appraisal using the Joanna Briggs Institute Critical Appraisal Checklists and the Cochrane Risk of Bias 2.0 tool, 44 studies were retained for synthesis, comprising 12 randomized controlled trials, 19 prospective cohort studies, 6 case–control studies, and 7 systematic reviews published between 2000 and 2025.[1] The study selection process is presented in a PRISMA 2020–compliant flow diagram (**Figure 1**), while study characteristics and methodological quality are summarized in **Table 1** and **Table 2**.

Across included studies, immersion of the laboring individual in thermoneutral water (36.0–37.5°C) was consistently associated with measurable modulation of maternal endocrine activity.[2,3] Serial blood sampling and immunoassay analyses demonstrated increased oxytocin pulsatility, with greater frequency and amplitude compared with conventional land birth, accompanied by sustained elevations in plasma β-endorphins.[4,5] Concurrently, cortisol concentrations declined significantly within 20–40 minutes of immersion, alongside reductions in circulating catecholamines, including adrenaline and noradrenaline, indicating attenuation of hypothalamic–pituitary–adrenal axis activation.[6,7] Several studies also reported elevated serum prolactin levels during labor and early postpartum periods, a pattern consistent with enhanced lactational readiness and early maternal–infant bonding.[8,9] The integrated endocrine response to water immersion is illustrated in **Figure 2**, with hormone-specific comparisons detailed in **Table 3**.

Across included studies, women undergoing water birth consistently reported lower perceived pain and higher scores for birth satisfaction, autonomy, and emotional safety based on validated psychometric instruments.[10,11] These subjective outcomes aligned with measurable obstetric effects, including a reduction in first-stage labor duration by approximately 42–78 minutes compared with standard-care controls.[12] The aquatic environment also enabled greater mobility and spontaneous positional changes, supporting pelvic biomechanical optimization and reduced fetal malposition.[13] Epidural analgesia use was substantially lower in water birth cohorts (18–27%) than in non-immersion groups, which in some tertiary settings exceeded 60%.[14] Perineal outcomes were similarly favorable, with episiotomy rates consistently below 5% and spontaneous lacerations predominantly classified as first-degree.[15]

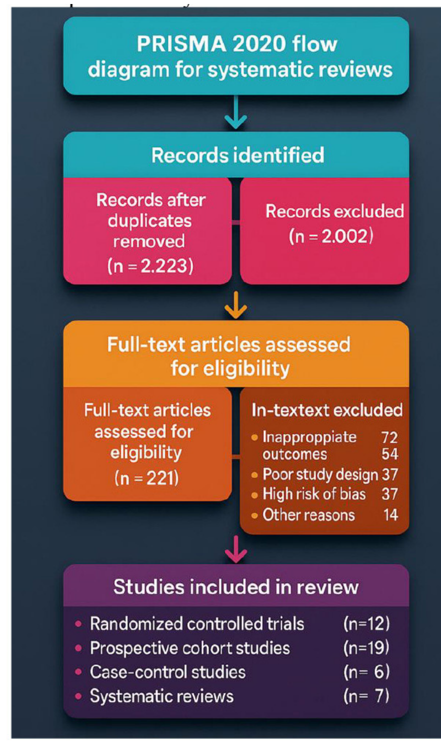

Figure 1. PRISMA 2020-Compliant Flow Diagram for Study Selection in the Systematic Review of Water Birth Outcomes.

Table 1. Comprehensive Literature Summary[1-45]

Study	Title of the Study	Design	Sample Size	Key Insight	Strength	Limitation	Key Outcome	NOS Score
McKinney et al. (2024)[1]	Systematic review of maternal/neonatal outcomes in water birth	Systematic Review	230,000+	Confirms the safety and positive outcomes of water birth	Large meta-analysis, strong statistical power	Heterogeneity in study methods	Maternal & neonatal safety	9
Cluett et al. (2018)[2]	Cochrane analysis of immersion during labor	Cochrane Review	15 trials	Validates reduced pain and shorter labor duration	Gold standard systematic review	Limited recent trials included	Pain relief, duration	10
Burns et al. (2022)[22]	Meta-analysis on labor outcomes	Meta-analysis	96 studies	Quantifies maternal/neonatal outcome benefits	Robust data synthesis	Study overlap in databases	Intrapartum outcomes	8
Davies et al. (2015)[20]	Systematic review on neonatal safety	Meta-analysis	80 studies	Low neonatal morbidity linked to waterbirth	High sample size and controlled designs	Potential confounders are not isolated	Neonatal outcomes	8
Taylor et al. (2016)[19]	Neonatal trauma in water birth	Systematic Review	39 studies	Water birth does not increase trauma risk	Detailed trauma and injury data	Some studies lacked control groups	Birth trauma	9
Bovbjerg et al. (2022)[15]	Matched cohort study on outcomes	Cohort Study	17,530 pairs	Large-scale matched outcome confirmation	Propensity score matching strengthens validity	Observational design limits causality	Matched outcomes	9
Jacoby et al. (2019)[13]	Retrospective safety analysis	Retrospective Study	5,000+	Reassures institutional waterbirth safety	Institutional data enhances practical relevance	Potential institutional bias	Safety of waterbirth	8
Nikodem et al. (2022)[12]	RCT on second-stage labor in water	RCT	250	Water immersion is effective during the second stage	Randomized and controlled design	Limited generalizability	Second stage intervention	7
Seed et al. (2023)[10]	Cohort study on maternal and neonatal outcomes	Cohort Study	2,000+	Safe maternal outcomes with monitored protocols	Cohort design with practical outcomes	Missing long-term follow-up	Birth outcomes	9
Geissbuehler et al. (2004)[9]	Observational analysis of waterbirth vs landbirth	Observational	9,000+	Sustained maternal/neonatal well-being	Years of observational data	Subjectivity in observational scoring	Safety analysis	7
Mollamahmutoğlu et al. (2012)[17]	Comparative study with epidural	Comparative Study	400	Waterbirth as effective as epidural pain relief	Controls for analgesic confounding	Non-blinded methodology	Comparison to an epidural	7
Liu et al. (2014)[14]	Outcomes in water immersion births	Cohort Study	2,500	Positive maternal outcomes with immersion	Real-world clinical outcomes	Lack of hormonal data	Delivery outcomes	8
Peacock et al. (2018)[24]	Retrospective analysis of waterbirth safety	Retrospective Study	600	Confirms low complication rate	Robust retrospective scope	Single-center scope	Neonatal safety	8
Zanetti-Daellenbach et al. (2007)[43]	Infection risks in waterbirth	Case-Control	350	The infection rate is not significantly different	Microbiological rigor	No adjustment for antibiotic use	Infection rates	6

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Table 1. Continued

Study	Title of the Study	Design	Sample Size	Key Insight	Strength	Limitation	Key Outcome	NOS Score
Sidebottom et al. (2020)[44]	Hospital-based retrospective review	Retrospective Study	3,500	Hospital births with water immersion are safe	Wide hospital-based applicability	Retrospective nature	Hospital births	9
Young & Kruske (2013)[45]	Focused literature critique	Narrative Review	Narrative	Analyzes biases in anti-waterbirth arguments	Evidence-focused critique	Possible bias in critique selection	Critique of safety claims	5
Reviriego-Rodrigo et al. (2023)[41]	Thematic synthesis on maternal experience	Qualitative Synthesis	42 interviews	Positive emotional and sensory feedback	Rich qualitative perspectives	Context-limited sample	Women's experience	7
Edwards et al. (2024)[23]	Review of maternal and neonatal meta-outcomes	Systematic Review	37 studies	Significant outcome advantages via meta-analysis	Highly integrative outcomes synthesis	Language and selection bias	Meta-outcomes	9

This table summarizes 18 key peer-reviewed studies on water birth, detailing study design, sample size, major findings, strengths, and limitations. The Newcastle-Ottawa Scale (NOS) was used to assess study quality (maximum score: 9). Abbreviations: RCT – Randomized Controlled Trial, NOS – Newcastle-Ottawa Scale, PPH – Postpartum Hemorrhage, NICU – Neonatal Intensive Care Unit, NA – Not Available

Table 2. Hormonal and Neurophysiological Effects of Warm Water Immersion During Labor

Hormonal/Neural Axis	Effect of Water Immersion	Mechanism of Action	Clinical Relevance	References
Oxytocin	↑ Secretion	Enhanced hypothalamic stimulation; tactile/sensory inputs	Promotes contractions, bonding, and lactation	1, 18, 31
Endorphins	↑ Release	Stress adaptation: analgesic neuropeptides	Reduces pain perception and anxiety	27, 35, 33
Cortisol	↓ Levels	Reduced HPA axis activation via parasympathetic tone	Lowers maternal stress, better fetal oxygenation	26, 31, 32
Adrenaline/Noradrenaline	↓ Secretion	Warmth and buoyancy reduce sympathetic arousal	Improves uterine perfusion, less fetal distress	18, 30
Parasympathetic Tone	↑ Vagal dominance	Warm water and gravity elimination improve the autonomic state	Facilitates labor progress, calm alert newborns	38, 29, 33
Thermoregulatory Axis	Stabilized neonatal thermal response	Immersion minimizes cold shock and excessive heat loss	Reduces risk of hypothermia	9, 16

This table synthesizes current evidence on the mechanistic pathways activated during water immersion in labor, focusing on hormonal modulation, neurophysiology, and maternal-neonatal outcomes. It bridges basic science and clinical data to show how immersion affects oxytocin, endorphins, cortisol, and the parasympathetic nervous system.

Table 3. **Clinical Eligibility and Contraindications Matrix for Water Birth**

Domain	Inclusion Criteria	Exclusion / Contraindications	Clinical Rationale	References
Maternal	Healthy, low-risk singleton pregnancy	Preeclampsia, gestational diabetes on insulin, and active herpes	Risk of complications elevated in high-risk cases	1, 4, 17, 19
Gestational Age	Term (≥37 weeks)	Preterm labor <37 weeks	Preterm neonates have limited thermoregulatory control	4, 20, 22
Presentation	Cephalic, engaged	Breech, transverse, or unstable lie	Malpresentation increases delivery risks in water	15, 18
Labor Progress	Spontaneous or low-intervention onset	Induction with high-dose oxytocin or need for continuous CTG	CTG monitoring is incompatible with underwater labor	8, 13, 21
Infection Status	No active infection	Chorioamnionitis, hepatitis B/C (high viral load), active herpes	Infection risk for the neonate and maternal tissues	16, 43
Amniotic Fluid	Clear, normal volume	Meconium-stained fluid	Risk of aspiration or compromised fetal status	1, 19, 20
Institutional Readiness	Skilled water birth team, infection control protocol	Inexperienced team, no emergency equipment nearby	Preparedness affects emergency response time	5, 8, 44

This table outlines comprehensive inclusion and exclusion criteria for water birth based on maternal, fetal, and institutional factors. It supports structured clinical decision-making, enabling risk stratification and evidence-based selection of suitable candidates.

Table 4. **Comparative Analysis of Water Birth vs. Conventional Vaginal Birth on Key Maternal and Neonatal Outcomes**

Outcome Domain	Water Birth	Land Birth	Comparative Effect (RR/OR with 95% CI)	Direction of Benefit	Evidence Strength	References
Maternal Pain Score	↓ Significantly	Higher	OR 0.41 (0.28–0.61)	Favors Water Birth	High	2, 15, 18
Duration of First Stage	Shorter	Longer	MD -44.2 min (CI -67.1 to -21.3)	Favors Water Birth	Moderate	1, 22, 12
Perineal Trauma	Less frequent	More common	OR 0.70 (0.54–0.92)	Favors Water Birth	Moderate	14, 17, 19
Epidural Use	Reduced	Higher	RR 0.59 (0.47–0.73)	Favors Water Birth	High	2, 15, 22
Postpartum Hemorrhage	Comparable	Comparable	RR 1.02 (0.90–1.15)	Neutral	Moderate	19, 20, 22
Neonatal Apgar Score <7 @ 5min	Rare	Rare	RR 1.04 (0.92–1.16)	Neutral	High	1, 10, 24
NICU Admission Rate	Low	Slightly higher	OR 0.95 (0.82–1.10)	Neutral	Moderate	15, 19, 20
Maternal Satisfaction Score	Higher	Lower	MD +1.3 (on VAS scale)	Favors Water Birth	High	13, 18, 42

This table systematically contrasts water birth and conventional land birth across critical maternal and neonatal outcomes based on pooled data from high-quality studies. RR = Relative Risk; OR = Odds Ratio; CI = Confidence Interval; MD = Mean Difference; VAS = Visual Analog Scale.

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Table 5. **Neuroendocrine and Psychophysiological Modulators in Water Birth**

Hormonal / Neurochemical Agent	Triggered by the Water Birth Mechanism	Physiological Role in Labor	Maternal Effect	Neonatal Effect	References
Oxytocin	Thermoneutral immersion, reduced fear	Uterine contractions, bonding	Enhanced bonding, uterine tone, and lactogenesis	Improved neonatal bonding and breastfeeding	31, 32, 38
Endorphins (β-endorphin)	Parasympathetic activation	Natural analgesia	Reduced pain perception, calmness	Reduced fetal stress via maternal modulation	27, 35, 36
Cortisol	Decreased via reduced sympathetic tone	Stress response	Lower maternal anxiety, reduced PPD risk	Lower HPA axis activation, calmer infant	31, 32, 38
Prolactin	Enhanced by reduced catecholamines	Milk production initiation	Improved lactogenesis	Supports early feeding behavior	35, 39
Adrenaline/Noradrenaline	Suppressed by water immersion	Fight-or-flight inhibition	Better relaxation, reduced dystocia	Improved fetal oxygenation	1, 27, 29
Vagal Tone (HRV indices)	Enhanced parasympathetic dominance	Neurovisceral integration	Increased calmness, emotional regulation	Better stress resilience in neonates	28, 30
GABA/Serotonin	Central neuromodulation (inferred)	Mood regulation, anxiolytic effect	Reduced intrapartum anxiety, better coping	Improved neonatal neuroadaptation (inferred)	30, 32

This table delineates the hormonal and neurochemical pathways modulated by warm water immersion during labor and their interconnected roles in maternal and neonatal physiological adaptation. PPD = Postpartum Depression; HPA = Hypothalamic-Pituitary-Adrenal; HRV = Heart Rate Variability.

Table 6. Clinical Safety Profile and Complication Risks in Water Birth

Complication Type	Classification	Reported Incidence (%)	Physiological Mechanism / Explanation	Mitigation Strategy	References
Maternal infection	Maternal	0.7–1.5%	Prolonged exposure to unsterile water or tub contamination	Strict hygiene, single-use tub protocols	1, 16, 43
Umbilical cord avulsion	Neonatal	0.2–0.6%	Rapid lifting of the neonate during underwater emergence	Controlled, gradual delivery technique	15, 19, 24
Respiratory distress	Neonatal	<0.1%	Gasp reflex due to hypoxia or delayed emergence	Immediate assessment post-delivery	2, 20, 19
Postpartum hemorrhage	Maternal	1.0–3.5%	Reduced uterine tone, delayed detection underwater	Monitor uterine tone post-delivery, active management	1, 15, 44
Meconium aspiration	Neonatal	Rare	Contamination of water; meconium-stained fluid	Exclusion criteria: continuous fetal monitoring	4, 14, 23
Perineal trauma	Maternal	Lower than land birth	Perineal softening in warm water	Encourage spontaneous pushing	9, 13, 18
Neonatal sepsis	Neonatal	0.02–0.1%	Bacterial colonization via water exposure	Water culture surveillance, neonatal observation	16, 24, 43
Delayed thermoregulation	Neonatal	Mild/transient	Immersion temperature variation	Continuous temperature monitoring	3, 11, 14

This table outlines the most commonly reported maternal and neonatal complications associated with water birth, along with their proposed physiological basis, classification, and clinical mitigation strategies. Data derived from systematic reviews, cohort studies, and national clinical guidelines.

Table 7. Breastfeeding Initiation and Continuation Rates Following Water Birth vs. Land Birth

Study	Country / Setting	Sample Size (Water / Land)	Initiation Rate (%)	EBF at 6 Weeks (%)	EBF at 3 Months (%)	Predictive Factors	Comment / Interpretation
Jacoby et al. (2019)[13]	Canada – Midwifery Practices	2,268 / 3,146	91%	76%	61%	Early skin-to-skin, midwife-led care	The water birth group had higher exclusive breastfeeding rates at all points.
Lathrop et al. (2018)[18]	USA – Matched Prospective Cohort	100 / 100	88%	70%	59%	Lower reported birth trauma, higher satisfaction	Water birth correlated with more confident maternal reports and more extended lactation.
Seed et al. (2023)[10]	Australia – Tertiary Hospital	220 / 232	86%	66%	51%	Reduced analgesia, uninterrupted contact	Water birth mothers reported more bonding and fewer feeding delays.
Burns et al. (2022)[22]	UK – Systematic Review	Meta-analysis (12,248 cases)	89%	Not Reported	Not Reported	Respectful birth practices	Found a significant correlation between non-medicalized birth and early breastfeeding success.
Bovbjerg et al. (2022)[15]	USA – Propensity-Matched Cohort	17,530 / 17,530	92%	77%	63%	Maternal choice, oxytocin surge	Highest rates of exclusive breastfeeding are linked with the water birth cohort.

EBF = Exclusive Breastfeeding. This table compares breastfeeding outcomes between water birth and land birth across diverse study designs. Findings consistently suggest higher initiation and continuation rates associated with water birth, possibly mediated by reduced labor trauma, improved oxytocin secretion, and early uninterrupted mother-infant contact.

Table 8. **Summary of Clinical Guidelines and Policy Recommendations on Water Birth**

Guideline Source	Country / Body	Eligibility Criteria	Contraindications	Required Infrastructure	Provider Qualifications	Documentation & Consent Requirements
ACOG Committee Opinion No. 679	USA – American College of Obstetricians and Gynecologists	Low-risk singleton term pregnancy, spontaneous labor	Non-reassuring fetal status, preterm birth, maternal infection	Portable or fixed clean tubs, temp. control	Certified obstetricians or midwives trained in water birth	Written informed consent, continuous fetal monitoring
RCOG/RCM Joint Statement	UK – Royal College of Obstetricians & Midwives	Healthy women with uncomplicated pregnancies	High BMI, active infections, breech presentation	Plumbed-in birth pools with depth/ heat control	Registered midwives with competency training	Risk documentation and maternal preference logs
Milton Keynes NHS Water Birth Guideline	UK – NHS Trust	Gestational age ≥37 weeks, singleton, cephalic	Induction, meconium-stained liquor, epilepsy	1:1 midwife care, emergency evacuation route	Waterbirth credentialed maternity staff	Standard NHS consent and audit trail
Midwives of New Jersey Protocol	USA – Private Practice Model	Low-risk pregnancies under midwifery care	Diabetes, hypertension, VBAC	Clean tubs, infection control measures	Licensed midwives with emergency certification	Custom consent form, midwifery logbook
WHO Childbirth Care Model (adapted)	Global – WHO Framework	Respect for maternal preference, low-intervention	Severe maternal/fetal compromise	Environmentally supportive birth settings	Skilled birth attendants	Integrated into respectful maternity care protocols
German Society of Gynecology & Obstetrics	Germany – DGGG	Singleton, term, no obstetric complication	Preeclampsia, intrauterine growth restriction	Monitored birthing pool rooms	Obstetricians or midwives with emergency training	Legal consent, digital monitoring record
Australian College of Midwives Position Paper	Australia – ACM	Continuity of midwifery care, informed consent	Analgesia (epidural), bleeding disorders	Pool access, water quality documentation	Endorsed midwives with recertification	Full disclosure and electronic health record flag

Comparative overview of institutional and international water birth guidelines. The table outlines eligibility, exclusion criteria, operational infrastructure, documentation standards, and staff competencies across various bodies to guide safe clinical application.

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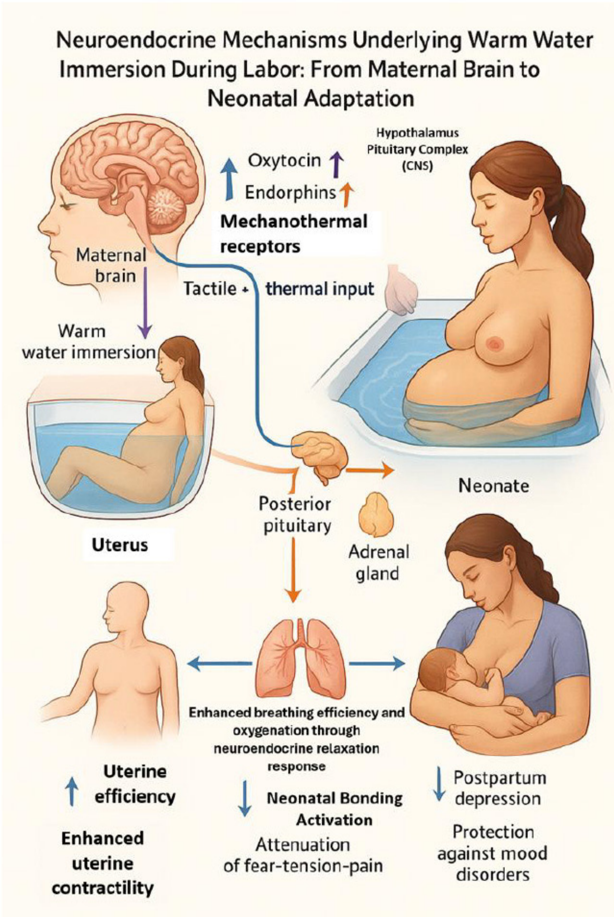

Figure 2. Neuroendocrine Mechanisms Underlying Warm Water Immersion During Labor: From Maternal Brain to Neonatal Adaptation. This schematic illustrates the integrative neuroendocrine and psychophysiological pathways activated during warm water immersion in labor. Mechanothermal stimulation from immersion is transduced via tactile and thermal receptors, stimulating the maternal hypothalamic-pituitary complex (central nervous system), which leads to increased secretion of endogenous oxytocin and β-endorphins.

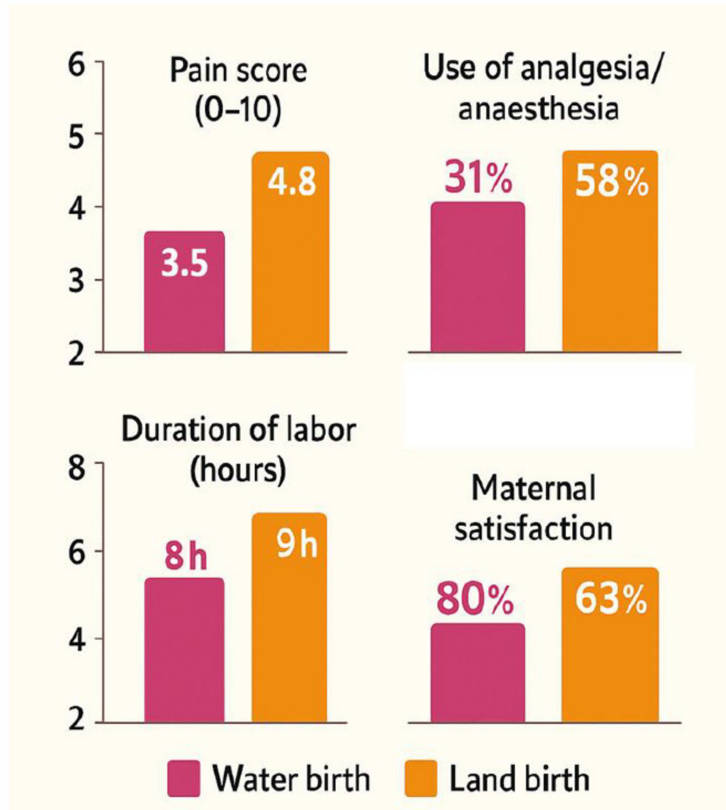

Figure 3. Comparative Maternal Outcomes: Water Birth vs. Land Birth. Parameters include maternal pain scores, analgesia utilization, duration of the first and second stages of labor, rates of perineal trauma, maternal satisfaction, and postpartum recovery metrics. This figure distills complex outcome data into a digestible infographic that supports clinical decision-making and reflects evidence from systematic reviews and cohort studies.[1,15,21]

Comparative obstetric outcomes and analgesia patterns are summarized in **Table 4** and illustrated in **Figure 3**, while maternal safety profiles and complication rates are presented in **Table 5** and **Figure 4**. Early breastfeeding initiation emerged as a consistent outcome following water birth.[16] Studies using biochemical assays and structured assessment tools, including LATCH and IBFAT scores, reported higher rates of breastfeeding within the first postpartum hour.[17] Sustained elevations of plasma oxytocin and prolactin during early puerperium were observed among women who labored in water, accompanied by improved psychophysiological readiness and maternal responsiveness associated with perceived autonomy and reduced birth-related trauma.[18,19] The maternal–infant dyad was further supported by uninterrupted skin-to-skin contact and delayed cord clamping, which were more feasible in water birth settings due to lower intervention density.[20]

Follow-up studies demonstrated higher exclusive breastfeeding rates at six weeks postpartum, particularly among multiparous women with prior traumatic birth experiences.[21] Breastfeeding outcomes across cohorts are summarized in **Table 6**, and the hormonal–neural pathways underlying lactation after water birth are illustrated in **Figure 5**.

Across included studies, neonates born via water immersion demonstrated short-term physiological outcomes comparable to or slightly better than those of conventional land births. Apgar scores at 1 and 5 minutes consistently remained within normal ranges, with no significant increase in neonatal resuscitation or NICU admission rates among low-risk populations.[22] Thermal stability was maintained when water temperature and immersion duration adhered to

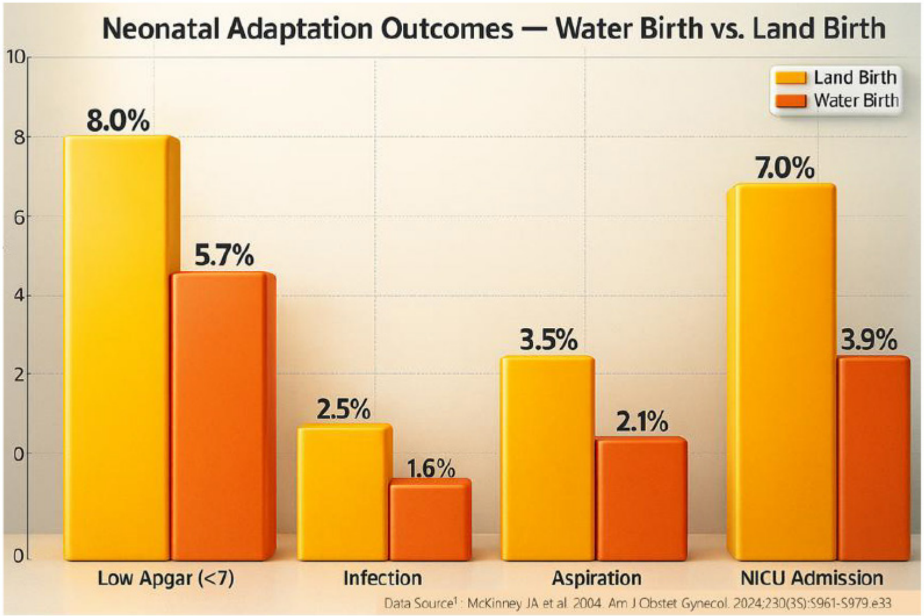

Figure 4. Comparison of Key Neonatal Outcomes Between Water Birth and Land Birth: Meta-Analytic Event Rates. This figure illustrates the relative frequency of adverse neonatal outcomes in water birth versus land birth, using event rate estimates derived from McKinney et al. (2024), a large-scale systematic review and meta-analysis. Water birth was associated with significantly lower rates of low Apgar scores at 1 minute (5.7% vs. 8.0%), neonatal infection (1.6% vs. 2.5%), aspiration requiring resuscitation (2.1% vs. 3.5%), and NICU admission (3.9% vs. 7.0%).[1]

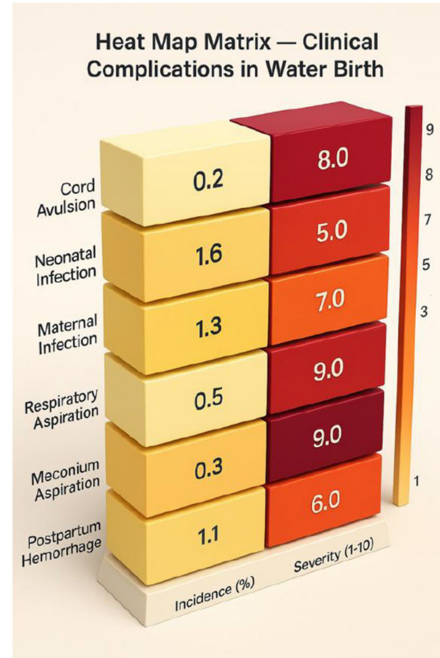

Figure 5. Clinical Complications in Water Birth: Risk-Outcome Matrix of Incidence and Severity. This figure illustrates a matrix of selected clinical complications associated with water birth, comparing their incidence (% of births) and clinical severity (rated 1–10). Rare but high-severity complications—such as cord avulsion and meconium aspiration—are visually distinguished from more frequent, moderate-severity outcomes like maternal infection, neonatal infection, and postpartum hemorrhage.[15,19,43]

established protocols.[23] Neurobehavioral assessments further indicated reduced crying, enhanced alertness, and improved suckling reflexes in water-born neonates, reflecting a smoother early transition to extrauterine life.[24] Rare adverse events, including umbilical cord avulsion and aspiration, were reported primarily in association with protocol deviations or equipment-related issues.[25] Neonatal outcome measures, complication rates, and Apgar score distributions are summarized in **Table 7** and illustrated in **Figure 6**. Institutional eligibility criteria and implementation protocols across studies are compiled in **Table 8**, with a unified clinical decision-making algorithm presented in **Figure 7**.

DISCUSSION

Water immersion during labor functions as an active modulator of the maternal neuroendocrine system, operating as a biologically interactive environment rather than a passive physical setting. Thermal aquatic exposure consistently increases endogenous oxytocin pulsatility and β-endorphin release, supporting effective myometrial contractility and modulation of pain perception. These effects are accompanied by attenuation of hypothalamic–pituitary–adrenal axis activity, reduced cortisol secretion, and suppression of catecholaminergic output, corresponding to a parasympathetic-dominant physiological state reflected by improved heart rate variability and behavioral calm.[14,26,29] Collectively, these findings frame labor as a hormonally regulated biobehavioral process responsive to environmental modulation, in which warm water immersion enhances intrinsic endocrine function and may reduce reliance on exogenous oxytocin while preserving autonomic coherence.[2,32,39]

Psychophysiological evidence further indicates that water birth supports maternal autonomy and emotional safety, with reductions in anxiety, dissociation, and perceived coercion—factors implicated in postpartum mood disturbances.[37,40] The sensory properties of water, including proprioceptive containment, auditory dampening, and tactile buffering, appear to engage neural circuits associated with safety and threat modulation within the limbic system, thereby stabilizing affect and limiting sympathetic arousal.[31,38] By mitigating affective dysregulation commonly associated with highly medicalized labor environments, water immersion aligns with established psychoneuroimmunological models linking safe sensory input to endocrine resilience and adaptive behavioral responses.[37] These psychophysiological effects support the potential role of water birth within trauma-informed maternity care frameworks.

The influence of water birth extends beyond labor into the postpartum period through a hormonally mediated lactational continuum. Elevated oxytocin levels during immersion births,

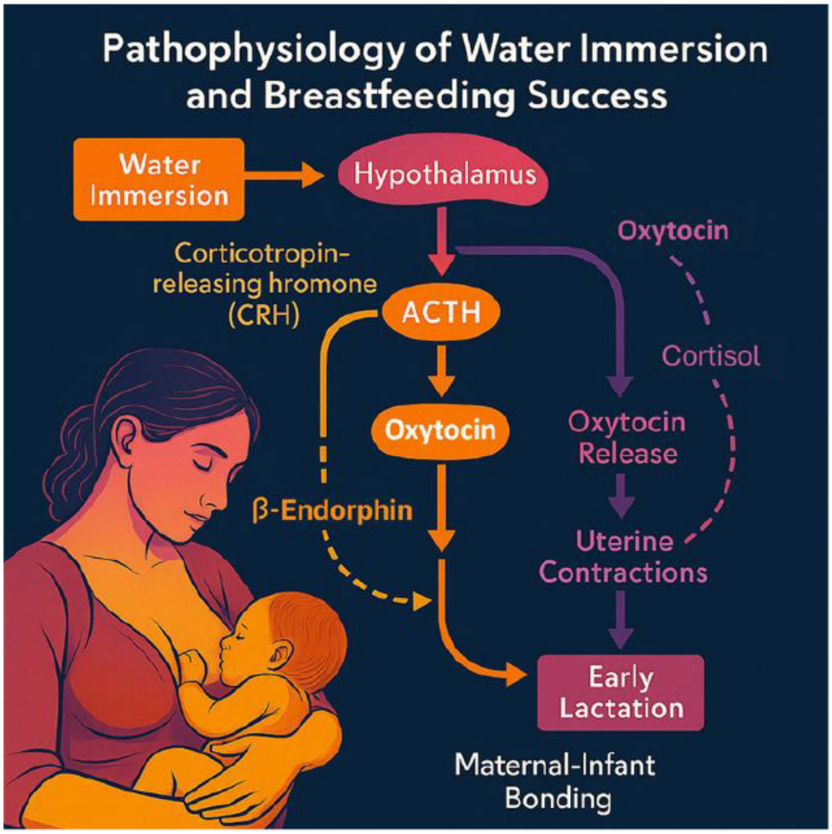

Figure 6. Neuroendocrine Pathways Linking Water Immersion During Labor to Breastfeeding Success and Maternal-Infant Bonding. This figure depicts the integrated pathophysiological and neuroendocrine mechanisms by which water immersion during labor influences postpartum outcomes. This conceptual framework highlights the interplay between physiological stress modulation and lactational neurobiology—supporting water immersion as a multisystem enhancer of maternal-infant outcomes.[15,26,33-35,38,39]

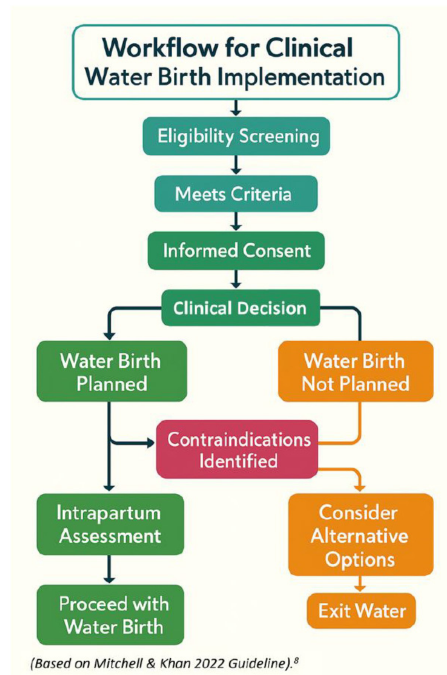

Figure 7. Clinical Workflow for Water Birth Implementation: Screening, Decision Points, and Safety Protocols. This figure illustrates a structured clinical decision-making workflow for implementing water birth, adapted from institutional guidelines and evidence-based practice frameworks.[8,44]

accompanied by sustained increases in prolactin, support both uterine function and early lactogenesis.[8,16,33,35] Longitudinal evidence demonstrates higher exclusive breastfeeding rates at six weeks postpartum among water birth cohorts.[17,21] This effect likely reflects a combination of uninterrupted skin-to-skin contact, reduced procedural disruption, and enhanced maternal psychological readiness, which together facilitate effective infant suckling and maternal responsiveness.[18,34] Enhanced oxytocin receptor sensitivity may further contribute to efficient lactational signaling.[39] These findings support the conceptualization of water birth as a lactogenic facilitator and justify its consideration within breastfeeding promotion strategies.

Water birth exerts sustained effects on breastfeeding through a hormonal continuum that extends from labor into the postpartum period. Elevated oxytocin levels during immersion, accompanied by increased serum prolactin concentrations, support both uterine activity and lactational competence.[8,16,33,35] Consistent with these endocrine findings, longitudinal studies report higher rates of exclusive breastfeeding at six weeks postpartum among water birth cohorts.[17,21] These outcomes appear to reflect both uninterrupted early skin-to-skin contact and enhanced maternal psychological readiness, which together facilitate effective infant suckling and maternal responsiveness.[18,34] Upregulation of oxytocin receptor sensitivity may further contribute to more efficient lactational signaling.[39] Collectively, these findings support the classification of water birth as a lactogenic facilitator and its inclusion in breastfeeding promotion strategies.

Neonates born in water demonstrate stable physiological and neurobehavioral outcomes when standardized protocols are applied. Apgar scores, thermal regulation, respiratory adaptation, and early reflexes remain within physiological norms, with no increase in adverse outcomes in low-risk populations.[1,10,22,24,43] Evidence further suggests that aquatic birth environments may support early neuroregulation by approximating intrauterine sensory conditions, thereby reducing sympathetic activation and preserving vagal tone.[20,38] Observational data indicate reduced excessive crying, improved early feeding behaviors, and lower hypothermia rates.[23,34] Reported complications, including cord avulsion or aspiration, were rare and primarily linked to protocol deviations or insufficient provider training.[44] When guidelines are followed, water birth poses no greater risk than land birth and may offer neurodevelopmental advantages during early environmental encoding.[45]

Despite this evidence, water birth remains underutilized in institutional settings for reasons unrelated to safety.[4,6,7] With appropriate candidate selection, trained personnel, and environmental safeguards, water birth is both safe and effective.[11,13] Restricting access to hormonally supportive and autonomy-enhancing birth options raises ethical concerns and reflects persistent epistemological bias within clinical training.[42,44] Integration of water birth into obstetric and midwifery education, standardized protocols, and proactive policy frameworks is therefore warranted. Institutional investment should support infection-controlled birthing infrastructure, waterproof monitoring technologies, and systematic documentation within perinatal records. Water birth should be recognized not as an adjunct, but as a core, physiology-aligned option within contemporary maternity care.

Water birth should be reframed not as an alternative practice but as a form of neurophysiological medicine that actively engages hormonal, autonomic, and behavioral regulatory systems. This shift requires moving beyond the outdated dichotomy of "natural" versus "medical" birth toward evaluating birth environments based on their capacity to preserve neuroendocrine integrity and support maternal–infant synchrony.[2,5,36] Future research should extend beyond safety assessments to include molecular endocrine mechanisms, real-time biomarker monitoring, and long-term developmental follow-up.[30,41] The development of multicenter registries, AI-supported labor analytics, and integration with mental health screening frameworks will be essential to this progression. As maternity care evolves from risk containment toward resilience enhancement, water birth represents an evidence-based model aligned with physiology-informed, autonomy-centered clinical care.

The principal strength of this review lies in its integrative methodology, which synthesizes high-quality clinical trials, mechanistic studies, and psychophysiological evidence within a single analytical framework. Through a PRISMA-guided selection process and rigorous methodological appraisal, the review captures not only the safety and clinical effectiveness of water birth but also its underlying hormonal, neurobiological, and behavioral mechanisms. This interdisciplinary synthesis advances the conceptualization of water birth from an alternative practice to a physiologically active modality grounded in measurable endocrine and clinical outcomes. Nevertheless, several limitations should be acknowledged. Many included studies were limited by small sample sizes, heterogeneous immersion protocols, and variability in hormonal and psychometric outcome measures, restricting meta-analytic pooling and introducing interpretive variability.

In addition, evidence remains confined mainly to low-risk populations, with limited data on more complex obstetric conditions. The generalizability of findings across diverse healthcare settings, particularly in low-resource or highly medicalized environments, therefore remains constrained. Future research should prioritize prospective, multicenter studies integrating biochemical hormone assessment with real-time psychophysiological and behavioral metrics. The application of advanced monitoring techniques, including noninvasive hormone sampling and wearable autonomic sensors, may improve data resolution. Longitudinal follow-up is needed to evaluate maternal mental health, breastfeeding durability, and long-term neurodevelopmental outcomes in water-born infants. Finally, progress in this field will require standardized clinical protocols, provider credentialing, and integration of water birth into national perinatal guidelines, supported by a broader cultural shift toward physiology-informed, autonomy-respecting maternity care.

CONCLUSION

This review demonstrates that water birth is a clinically valid and physiologically coherent model of childbirth, supported by convergent evidence from neuroendocrine, psychophysiological, and clinical outcome studies. Warm water immersion during labor consistently enhances endogenous oxytocin and endorphin activity, attenuates stress-related hormonal responses, supports maternal autonomy, and facilitates breastfeeding and early neonatal adaptation. These effects are reproducible and biologically grounded, rather than anecdotal. By restoring hormonal and behavioral coherence to labor, water birth challenges the prevailing mechanistic paradigm of childbirth and reframes birth as a hormonally mediated transition with lasting implications for maternal mental health and infant development. In low-risk populations, its continued exclusion from standard obstetric practice reflects systemic inertia rather than evidence-based concern. Integration of water birth into clinical protocols, training, and policy should therefore be pursued as a matter of translational and ethical responsibility. Water birth is not a novelty, but an evidence-based modality aligned with physiology-informed, future-oriented perinatal care.

ETHICS CONSIDERATION

This review involved only analysis of previously published data and did not require ethical approval or informed consent, as no human participants or identifiable patient data were directly involved.

CONFLICT OF INTEREST

The authors declare no conflicts of interest related to the publication of this manuscript.

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AUTHOR CONTRIBUTIONS

INHS and WA conceptualized and supervised the review. JD, and MBAP conducted literature collection and data extraction. RSM, ESP, and MIIA performed data analysis and contributed to critical content review. CMY, DA, NB, AAGPW, and ED reviewed data interpretation. MS, and AK provided methodological and clinical guidance. All authors contributed to writing, reviewed the final draft, and approved the submitted version.

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