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REVIEW ARTICLE

Digital Health Literacy Among Mothers and Its Impact on Neonatal Outcomes: An Integrative Review

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ABSTRACT

Introduction: This review aimed to synthesise evidence on the role of maternal digital health literacy (DHL) in shaping neonatal outcomes, identify barriers and facilitators influencing DHL, and evaluate the effectiveness of interventions designed to improve maternal engagement with digital health platforms.

Methods: An integrative review was conducted following Whittemore and Knafl's framework. A systematic search was performed in PubMed, CINAHL, Scopus, Web of Science, and Google Scholar for studies published between 2010 and 2025. Eligible studies included quantitative, qualitative, and mixed-methods research exploring DHL among mothers during pregnancy, postpartum, or the neonatal period, with reported neonatal outcomes. Data were extracted on study design, participants, interventions, and findings, and were synthesised thematically.

Results: Twenty studies met the inclusion criteria. Evidence consistently demonstrated that higher maternal DHL was associated with improved neonatal outcomes, including increased adherence to immunisation, timely recognition of neonatal danger signs, improved breastfeeding practices, and reduced preventable morbidity. Interventions such as mobile health applications, SMS reminders, teleconsultations, and AI-driven counselling improved maternal engagement and neonatal care practices. Barriers included limited internet access, socioeconomic disparities, digital misinformation, and lack of culturally adapted tools. Sociodemographic factors such as maternal education and urban residence strongly influenced DHL.

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Conclusions: Maternal digital health literacy is a critical determinant of neonatal health. Interventions that enhance DHL can contribute to achieving Sustainable Development Goal 3.2 by reducing preventable neonatal deaths. Policymakers and healthcare providers should prioritise culturally tailored, accessible, and evidence-based digital health strategies within maternal and child health programmes. Future research should focus on developing standardised DHL measurement tools and evaluating long-term impacts of digital interventions on neonatal survival.

KEYWORDS:

• Digital Health Literacy • Maternal Health • Neonatal Outcomes • mHealth • Telemedicine

INTRODUCTION

Background on Digital Transformation in Healthcare

The digitalisation of healthcare has accelerated globally, transforming how health information is created, delivered, and consumed. With the rise of mobile health (mHealth) apps, teleconsultations, online communities, and artificial intelligence (AI)-enabled platforms, health services are increasingly accessible beyond hospital walls.[7] This digital shift has particular relevance for maternal and neonatal health, where timely access to information and services can be lifesaving.[8] Over the past decade, digital health innovations have moved from being supplementary tools to becoming essential components of modern healthcare systems. Mobile phones are now widely used for appointment reminders, medication adherence alerts, and delivery of health education materials, even in resource-limited settings.[6] Telemedicine platforms allow women in rural and underserved areas to consult with specialists without traveling long distances, reducing delays in diagnosis and treatment.

Importance of Maternal Health Literacy in Neonatal Outcomes

Maternal health literacy is a well-established determinant of neonatal outcomes, serving as a foundation for informed decision-making during pregnancy, childbirth, and the postpartum period. It encompasses not only the ability to read and understand health information but also the skills to interpret, evaluate, and apply this knowledge in real-life situations. A mother with adequate health literacy is better equipped to navigate healthcare systems, follow medical advice, and adopt practices that promote neonatal survival and well-being.

Evidence from multiple studies highlights that low maternal health literacy is associated with poor adherence to immunisation schedules, delayed recognition of neonatal danger signs such as fever, respiratory distress, and jaundice, and increased risk of adverse perinatal outcomes including preterm complications and preventable infections.[14] Mothers with inadequate health literacy may also struggle to comprehend instructions on infant feeding, hygiene, and growth monitoring, which can further compromise neonatal health.

Conversely, higher maternal literacy levels are strongly correlated with improved breastfeeding initiation and continuation, adherence to exclusive breastfeeding for six months, timely immunisation, and effective use of growth monitoring charts. Educated mothers are more likely to recognise early warning signs, seek medical help promptly, and utilise available healthcare services, which collectively contribute to reduced neonatal morbidity and mortality.[3]

Emergence of Digital Health Literacy (DHL)

Building upon the broader concept of health literacy, Digital Health Literacy (DHL) refers to the set of competencies required to search, evaluate, and effectively apply health information obtained from digital platforms.[10] In today's interconnected world, mothers are increasingly relying on mobile applications, social media groups, telehealth consultations, and online health forums to access knowledge about pregnancy, childbirth, and neonatal care. DHL, therefore, goes beyond basic literacy skills, encompassing digital navigation, critical appraisal of online information, and the ability to discern credible sources from misinformation.

The growing relevance of DHL is evident in maternal health services worldwide. For instance, smartphone applications provide week-by-week pregnancy guidance, while teleconsultations ensure remote access to obstetricians and pediatricians, particularly during emergencies or in rural settings where healthcare infrastructure is limited. In addition, many government and non-governmental initiatives are leveraging SMS reminders for immunisation schedules, mobile-based nutritional counselling, and AI-driven decision support tools to enhance maternal engagement.

DHL is increasingly recognised as a core skill in modern maternal healthcare because it directly impacts health-seeking behaviour, adherence to recommended practices, and timely recognition of danger signs in both mothers and neonates.[9] However, disparities exist, as women with limited education, poor internet access, or low socioeconomic status may struggle to fully benefit from digital health innovations. Addressing these inequalities requires culturally sensitive interventions that strengthen mothers' digital capabilities while ensuring equitable access to reliable digital health tools.

Rationale for an Integrative Review

Despite the growing body of literature on digital health interventions, evidence on the specific role of DHL in shaping neonatal outcomes remains scattered across diverse study designs, including quantitative surveys, qualitative interviews, mixed-methods research, and program evaluations. Traditional systematic reviews often limit inclusion to specific designs, which may restrict the depth of understanding in emerging fields like DHL. An integrative review, by contrast, allows the synthesis of findings from heterogeneous methodologies, providing a more comprehensive and nuanced picture of the phenomenon.[21]

In the context of maternal and neonatal health, an integrative review is particularly valuable because DHL is influenced by a complex interplay of social, cultural, technological, and health system factors. For example, while quantitative studies may demonstrate statistical associations between DHL and neonatal morbidity, qualitative research often reveals underlying perceptions, barriers, and behavioural determinants that numbers alone cannot capture. By combining such evidence, an integrative review can bridge knowledge gaps and offer practical insights.

Moreover, synthesising diverse evidence ensures that policymakers and practitioners can make well-informed decisions when designing interventions or policies to improve DHL among mothers. It highlights not only what works, but also under what circumstances and for whom digital health strategies are effective. This approach also identifies gaps in existing knowledge, such as the need for standardised measurement tools for DHL, long-term follow-up studies, and evaluation of culturally tailored digital interventions in low-resource settings.

Thus, the integrative review methodology is justified as the most appropriate framework for examining DHL and its impact on neonatal outcomes. It consolidates fragmented evidence into a coherent narrative that can inform clinical practice, guide future research, and support policy-level initiatives aimed at reducing neonatal morbidity and mortality.

Objectives

1. Examine the association between maternal DHL and neonatal health outcomes.
2. Identify barriers and facilitators influencing maternal DHL.
3. Evaluate interventions and programs that enhance DHL among mothers.
4. Highlight gaps in current evidence and propose implications for practice and policy.

METHODS

This integrative review was conducted following the methodological framework proposed by Whittemore and Knafl (2005), which is widely recognised for synthesising evidence from diverse research designs including experimental, non-experimental, and theoretical literature. This framework comprises five stages: (1) problem identification, (2) literature search, (3) data evaluation, (4) data analysis, and (5) presentation of findings. Adopting this approach enabled a comprehensive understanding of digital health literacy (DHL) and its influence on neonatal outcomes, overcoming the limitations of reviews restricted to a single study design.

Eligibility Criteria (PICOS)

- To ensure transparency and consistency, the review followed the Population, Intervention/Exposure, Comparison, Outcomes, and Study type (PICOS) model.
- Population: Mothers during pregnancy, postpartum, or neonatal periods.
- Exposure: Digital health literacy, including ability to access, evaluate, and use digital platforms for health purposes.
- Comparison: Not limited to a specific comparator; studies with or without control groups were included.
- Outcomes: Neonatal health outcomes such as morbidity, mortality, breastfeeding and feeding practices, immunisation coverage, NICU admission, and growth monitoring.
- Study Types: Quantitative (cross-sectional, cohort, RCTs), qualitative, mixed-methods, and program evaluation studies were eligible.

Search Strategy

A systematic search was performed across five electronic databases: PubMed, CINAHL, Scopus, Web of Science, and Google Scholar. The time frame was restricted to studies published between January 2020 and March 2025, reflecting the rapid growth of digital health technologies in recent years. Search terms were developed using MeSH and free-text keywords, including:

- ("digital health literacy" OR "eHealth literacy" OR "mHealth" OR "telehealth").
- AND ("maternal" OR "mother" OR "pregnant women").
- AND ("neonatal outcomes" OR "newborn health" OR "infant survival" OR "perinatal outcomes").

Boolean operators, truncations, and filters were applied to optimise sensitivity and specificity. Reference lists of relevant articles were hand-searched to identify additional studies. Grey literature, such as WHO policy briefs and UNICEF reports, was also considered to minimise publication bias.

Study Selection and PRISMA Flow

All retrieved citations were imported into a reference manager, and duplicates were removed. Titles and abstracts were independently screened by two reviewers against eligibility criteria. Full texts of potentially relevant studies were then assessed for inclusion. Disagreements were resolved by discussion or by consulting a third reviewer. The study selection process was documented in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines, with a flow diagram illustrating the number of studies identified, screened, excluded, and finally included. A total of **340 records** were initially identified through database searching (PubMed = 120, CINAHL = 80, Scopus = 65, Web of Science = 30, Google Scholar = 45). After removal of **230 duplicates, 110 records** remained for screening. Titles and abstracts were screened for relevance, leading to the exclusion of **50 studies** that did not meet the inclusion criteria (e.g., unrelated population, intervention, or outcomes).

The **full texts of 60 articles** were assessed for eligibility. Of these, **40 articles** were excluded for reasons such as absence of neonatal outcomes (n = 15), non-digital interventions (n = 8), poor methodological quality (n = 10), or language/availability issues (n = 7).

Finally, **20 studies** fulfilled all eligibility criteria and were included in the integrative review. These comprised **quantitative surveys (n = 8), qualitative studies (n = 5), mixed-methods research (n = 3), systematic reviews (n = 2), and program evaluations (n = 2).**

Data Extraction

A standardised data extraction form was used to collect study characteristics, including:

- Author(s) and year of publication
- Country/setting
- Study design and sample characteristics
- Definition and measurement of DHL
- Type of digital health intervention (if applicable)
- Neonatal outcomes assessed
- Key findings and limitations

Extraction was performed by two reviewers independently to minimise bias.

Data Evaluation and Quality Appraisal

The methodological quality of the included studies was assessed using appropriate tools depending on study design. For quantitative

studies, the Joanna Briggs Institute (JBI) critical appraisal checklists were applied; qualitative studies were assessed using the Critical Appraisal Skills Programme (CASP) tool. Mixed-methods studies were evaluated using the Mixed Methods Appraisal Tool (MMAT). The quality ratings informed the interpretation of findings but were not used to exclude studies.

Data Analysis and Synthesis

A thematic synthesis approach was adopted, following the constant comparison method. Findings across studies were coded, grouped into categories, and synthesised into overarching themes representing patterns in the relationship between DHL and neonatal outcomes. Quantitative results were narratively summarised, while qualitative findings provided contextual insights into maternal experiences, barriers, and facilitators. This integrative approach ensured that evidence from diverse sources contributed to a holistic understanding of the phenomenon under study.

RESULTS

1. Characteristics of Included Studies

A total of 20 studies published between 2010 and 2025 were included in this integrative review. The majority originated from high-income countries such as the United States, the United Kingdom, and European nations, reflecting a well-established digital health infrastructure. However, emerging evidence from low-and middle-income countries (LMICs), particularly India, Ghana, and parts of Southeast Asia, highlighted the growing importance of digital interventions in resource-constrained settings.

The included studies represented diverse methodologies: systematic reviews (n = 2), cross-sectional surveys (n = 8), qualitative explorations (n = 5), mixed-methods designs (n = 3), and program evaluations (n = 2). Sample sizes ranged from small qualitative studies with fewer than 30 participants to large-scale surveys with more than 5,000 mothers. Digital health literacy was assessed through validated scales in some studies, while others relied on self-reported technology use and access. Interventions studied included mHealth apps, SMS reminders, teleconsultations, and AI-supported platforms.

2. Themes Emerging from the Literature

(a) Access and Utilisation of Digital Resources

Across settings, mothers reported increasing reliance on mobile applications, online communities, and telemedicine services for neonatal care advice and support.[9] Digital tools were used for monitoring vaccination schedules, obtaining nutritional guidance, and seeking real-time medical consultations. Nevertheless, barriers such as poor internet connectivity, high costs of mobile data, and limited access to smartphones restricted widespread adoption in LMICs.[8]

Rural women were disproportionately affected due to infrastructural gaps, such as unstable electricity supply and limited health facility coverage.[1] Moreover, digital health platforms were often available only in English or urban-centric languages, creating an additional barrier for women with low literacy or from minority groups.

(b) Digital Health Literacy and Health-Seeking Behaviour

Studies consistently demonstrated that higher DHL enhanced mothers' ability to interpret health messages, recognise neonatal danger signs, and make timely health-seeking decisions.[5,14] For instance, mothers with higher DHL were more likely to initiate care for neonatal jaundice or respiratory infections before complications developed. Enhanced DHL also improved adherence to immunisation schedules and follow-up visits.

However, some studies raised concerns about digital misinformation. Mothers exposed to unverified online sources occasionally developed vaccine hesitancy or anxiety about infant feeding practices.[13] This was especially evident among adolescent mothers, who were more prone to peer influence and social media-driven myths.

(c) Neonatal Health Outcomes Associated with Maternal DHL

Evidence strongly linked maternal DHL with improved neonatal health outcomes. Mothers with higher DHL demonstrated greater adherence to exclusive breastfeeding recommendations, timely immunisation, and appropriate growth monitoring.[11] A notable program evaluation from AIIMS Nagpur reported that telemedicine-supported

neonatal care halved mortality rates in remote tribal regions by enabling earlier detection and intervention for sick newborns (TOI, 2025).

Other studies highlighted reductions in preventable neonatal morbidity, such as diarrhoeal disease and respiratory infections, among populations where mothers accessed digital counselling regularly. Improved maternal confidence and knowledge were also associated with enhanced newborn survival in several LMIC-based interventions.

(d) Sociodemographic and Contextual Factors

Maternal education, household income, and urban residence consistently predicted higher levels of DHL.[3] Educated mothers with stable internet access were more confident in using digital tools, while those with limited formal education struggled with navigation and interpretation of digital content.

Cultural perceptions also influenced uptake. In some communities, digital platforms were perceived as impersonal or irrelevant, especially when chatbot-based services lacked a human element.[6] Trust in healthcare providers versus online information varied widely, with some women valuing face-to-face interactions more than digital guidance.

(e) Interventions and Programs

Digital interventions targeting mothers included SMS reminders, mobile applications, online educational platforms, and AI-supported tools.[4] SMS reminders proved highly effective in improving immunisation adherence and follow-up attendance in LMICs. AI-driven applications showed promise in predicting nutritional deficiencies and prompting appropriate supplementation among postpartum women.

In addition, teleconsultations and digital counselling enhanced access to care during the COVID-19 pandemic, when physical visits were limited. Interventions tailored to local languages and cultural contexts reported higher acceptability and engagement compared to generic, globally designed platforms.

DISCUSSION

Interpretation of Findings

This review underscores the transformative role of DHL in maternal and neonatal care. Higher levels of DHL empower mothers to actively participate in health decision-making, resulting in improved preventive practices, early recognition of danger signs, and timely utilisation of health services. By bridging gaps in knowledge and access, DHL supports progress toward Sustainable Development Goal (SDG) 3.2, which targets the reduction of preventable neonatal deaths.

Systematic reviews and program evaluations consistently confirm that digital health interventions contribute to improved perinatal outcomes, including reduced preterm birth rates, better immunisation coverage, and lower neonatal mortality.[11] However, the risk of misinformation and inequities in digital access highlight the need for context-specific and evidence-based strategies.

STRENGTHS AND LIMITATIONS

Strengths:

- Inclusion of diverse study designs (quantitative, qualitative, and program evaluations) allowed a comprehensive understanding.
- Evidence from both high-income countries and LMICs provided global and contextual insights.
- Integration of real-world examples, such as AIIMS Nagpur's Tele-SNCU program, demonstrated practical applicability.

Limitations:

- Limited representation of studies from LMICs, where neonatal mortality remains highest.
- Variability in definitions and tools for measuring DHL, with few standardised instruments.
- Lack of longitudinal studies tracking long-term neonatal outcomes beyond the first six months of life.

Research Gaps

1. Limited longitudinal studies linking maternal DHL to child survival outcomes over several years.
2. Need for culturally adapted and validated DHL assessment tools in LMICs.
3. Scarce evidence on effective strategies to mitigate digital misinformation among mothers.

4. Limited exploration of the role of health workers in enhancing mothers' DHL at the community level.

Policy and Practice Implications

- Integrating DHL into routine care: Antenatal and postnatal education programs should include digital literacy training, ensuring mothers can use mobile health applications and verify online information.
- Capacity building: Training community health workers, nurses, and midwives to guide mothers in digital platform use can bridge gaps in trust and access (WHO, 2020).
- Equity-focused interventions: Development of multilingual, culturally tailored mobile applications and chatbots designed for low-literacy populations is essential.
- Partnerships: Collaboration between governments, NGOs, and technology companies can enhance reach and sustainability of digital health programs.

CONCLUSION

This integrative review demonstrates that maternal digital health literacy is a critical determinant of neonatal outcomes. Mothers with higher DHL are more likely to adopt preventive practices, initiate timely healthcare-seeking behaviour, and improve infant survival through practices such as breastfeeding and immunisation adherence. Evidence from both high-income and low-resource settings confirms that digital interventions, including SMS reminders, teleconsultations, and AI-driven tools, enhance maternal engagement and neonatal health.

To achieve global neonatal health targets, particularly under SDG 3.2, investments must be directed toward equitable, culturally relevant, and evidence-based digital literacy programs. Addressing barriers such as limited internet access, digital misinformation, and socioeconomic disparities is essential to ensure no mother or newborn is left behind in the digital era. Future research should prioritise the development of standardised DHL measurement tools and the evaluation of long-term impacts of digital interventions on neonatal survival and growth.

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