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Health Education Approach In Congenital Hypothyroidism Screening: Sytematic Review

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ABSTRACT

Background: Congenital hypothyroidism (CH) is a preventable cause of intellectual disability in newborns if detected early through neonatal screening. Maternal knowledge and health promotion interventions are critical to ensure timely screening and treatment. This study systematically reviews evidence on maternal education, knowledge, attitude, and promotional strategies for CH screening.
Subjects and Method: This study uses a systematic review conducted by searching for articles from several databases, namely ScienceDirect, MDPI, PubMed, Springer Nature Link, and Taylor & Francis Group and Google Scholar with a search range from 2019-2025. The keywords used to search for articles were "Education" OR "promotion" AND "congenital hypothyroidism" OR "neonatal hypothyroidism" OR "Congenital Thyroid disorder" OR "Primary congenital hypothyroidism" OR "Neonatal Thyroid" AND "newborn screening" OR "early screening"". The articles included in this study are full-text research articles focusing on education about congenital hypothyroidism screening, utilizing quantitative methods. Articles were collected using the PRISMA flow chart.
Results: There are 9 articles included in this review. Educational interventions and community service programs, significantly improved maternal knowledge and attitude toward CH screening. Higher maternal education was associated with better neonatal thyroid outcomes, including lower TSH levels and reduced incidence of screen-positive CH. Key barriers identified include limited maternal awareness, parental refusal, early postnatal discharge, and insufficient formal training for healthcare providers. Effective promotion strategies involved integrating CH education into ante-natal care, leveraging social media, providing continuous training for health cadres, and conducting community-based awareness programs.
Conclusion: Maternal education and structured promotion significantly enhance awareness and uptake of CH screening. However, challenges in healthcare infrastructure, parental compliance, and professional training persist.

Keywords: Congenital hypothyroidism, maternal education, neonatal screening, health promotion

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BACKGROUND

Congenital hypothyroidism (CH) is a medical condition caused by a deficiency of thyroid hormone from birth. If not diagnosed and treated early, congenital hypothyroidism can result in impaired physical and intellectual development in children. Therefore, newborn screening for congenital hypothyroidism is a crucial step in preventing harmful long-term impacts (Kibici et al., 2021). The importance of this screening depends not only on the medical procedure itself but also on parental understanding and awareness of its benefits. A health education approach is a crucial factor that can influence parental participation in this screening program. Parental knowledge about the impact of congenital hypothyroidism on child development, and the importance of screening for early detection, can increase their awareness and motivation to participate in available screening programs (Smith et al., 2020).

Based on this, effective health education for parents must be carried out comprehensively, whether through direct communication with medical personnel, social media, or other easily accessible educational materials. The use of appropriate educational approaches is expected to reduce the gap in public understanding about the importance of congenital hypothyroidism screening and improve adherence to screening programs (Anderson & Reed, 2022). Effective health education for parents plays a crucial role in increasing understanding of the urgency of screening immediately after birth (Hastings et al., 2017). This screening is part of national programs in various countries, including Indonesia, with the goal of detecting the condition as early as possible so that therapeutic interventions can be initiated promptly, thus preventing long-term consequences such as developmental delays and intellectual disabilities (Tsybko et al., 2020).

Previous studies have shown that parental education about children's medical conditions, including congenital hypothyroidism, plays a significant role in the success of screening programs. Research in Pakistan demonstrated that a health education intervention for pregnant women increased knowledge about congenital hypothyroidism from 20% to 98%, while also increasing consent for neonatal screening from 57.7% to 78.9% (Baqai et al., 2019). A similar finding was found in Turkey, where group education provided by health workers significantly increased family participation in neonatal screening (Gündüz et al., 2022).

Various forms of education have been developed, ranging from face-to-face counseling, print media, and the use of digital platforms. A study in Pakistan reported that health education for pregnant women increased knowledge about neonatal health from 20% to 98%, and increased consent to screening from 57.7% to 78.9% (Baqai et al., 2019). Similar results were also reported in Turkey, where group-based education facilitated by health workers was more effective in increasing family participation than individual education (Gündüz et al., 2022). With technological advancements, digital-based interventions such as health apps have also been shown to improve maternal understanding and expand the reach of education (Li et al., 2021).

Furthermore, maternal education also influences screening success. A study in China showed that mothers with low levels of education were at greater risk of refusing or not understanding the benefits of screening, resulting in lower participation (Li et al., 2021). This underscores the importance of educational interventions tailored to the social and cultural context and parents' health literacy levels. In Indonesia, although

a congenital hypothyroidism screening program has been running since the 2000s and has been re-invigorated as a national program, screening coverage remains limited. Barriers include low public awareness, limited healthcare personnel, and logistical challenges in the regions (Savitri et al., 2021).

Several studies also highlight the potential of innovative educational media to improve parental understanding. Digital education based on health apps has been shown to increase parental awareness about neonatal screening more widely and quickly than conventional methods (Li et al., 2021). Thus, technology-based educational interventions can be a promising alternative in the current digital era, especially in areas with limited health educators.

Considering these findings, it is clear that the success of congenital hypothyroidism screening relies not only on the health care system but also on the active involvement of parents through effective education. Therefore, this article aims to conduct a systematic literature review on health promotion educational approaches for parents to increase awareness.

SUBJECTS AND METHOD

1. Study Design

This study used a Systematic Literature Review approach guided by the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses). The review process consisted of five main stages: (1) formulating the research question, (2) identifying relevant studies through a systematic database search, (3) selecting studies based on predetermined inclusion and exclusion criteria, (4) extracting and analyzing relevant data, and (5) synthesizing the findings and drawing conclusions. Each step was conducted according to a predetermined protocol to ensure methodological consistency and reproducibility.

2. Population and Sample

A literature search was conducted using four major academic databases: ScienceDirect, MDPI, PubMed, Springer Nature Link, and Taylor & Francis Group and Google Scholar. The search strategy was developed by combining relevant keywords using Boolean operators (AND, OR) and adapted to the indexing and structure of each database. Keywords included terms such as "Education" OR "promotion" AND "congenital hypothyroidism" OR "neonatal hypothyroidism" OR "Congenital Thyroid disorder" OR "Primary congenital hypothyroidism" OR "Neonatal Thyroid" AND "newborn screening" OR "early screening"

3. Study Instruments

The research question was developed using the PICO (Population, Intervention, Comparison, Outcome, Study Design) framework. The study population was mothers or parents who received a health education intervention related to SHK. The comparison involved a group without exposure to specific risk factors.

4. Data Analysis

Data analysis and synthesis were performed using a narrative thematic approach, aimed at identifying emerging patterns and themes across the included studies. Findings were organized and synthesized according to the type of determinant—individual, household, or community. In addition, a research gap analysis was conducted to highlight areas requiring further investigation.

RESULTS

1. Prisma Flow Diagram

From the initial search, a total of 656 articles were identified across several databases, including Google Scholar (348), MDPI (105), PubMed (28), Science Direct (21), and Taylor & Francis (154). Prior to the

screening process, 239 records were removed, consisting of duplicate records (n= 86), non-eligible articles such as non-English or non-research types (n= 78), unreadable or limited access full-texts (n= 84), and other reasons (n= 111). After removal, 417 articles were retained for screening.

During the first stage of screening, 259 articles were excluded for reasons of irrelevance, such as not addressing congenital hypothyroidism, not focusing on promotion or education, or not related to newborn screening. Consequently, 158 articles were selected for abstract-based review.

In the second stage, 124 articles were excluded because they did not specifically discuss congenital hypothyroidism education, employed inappropriate study designs, or focused only on clinical treatment without involving maternal education or promotion interventions. This left 34 full-text articles to be assessed for eligibility. At the final eligibility assessment, 24 articles were excluded due to not being PICO-compliant or not specifically addressing congenital hypothyroidism screening education. Ultimately, 10 studies met the eligibility criteria and were included in the review.

This stepwise and rigorous screening ensured that only the most relevant and methodologically sound studies were synthesized. The included studies provided valuable evidence on maternal education, promotion interventions, and strategies to strengthen newborn screening for congenital hypothyroidism.

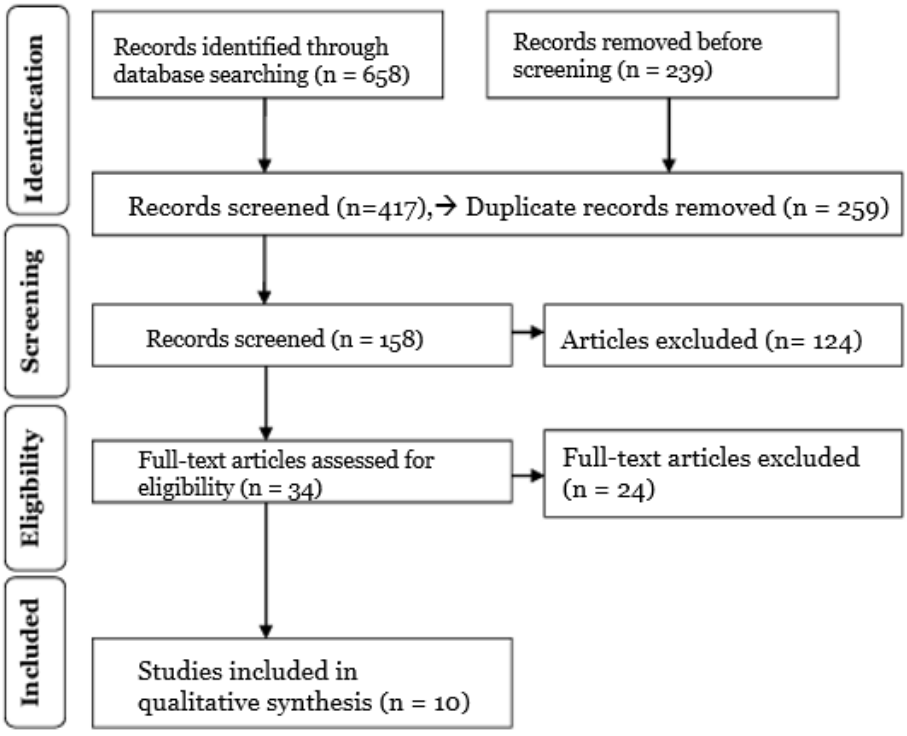

Figure 1. Prisma Flow Diagram

2. Maps of Study included

The illustrations show the distribution of the seven peer-reviewed and grey literature studies included in the analysis of maternal education and promotion efforts regarding congenital hypothyroidism (CH) screening.

Indonesia emerges as the most represented country, accounting for seven of the nine studies, reflecting the growing attention to maternal knowledge and community-based interventions in improving CH screening uptake. Notable study sites highlighting the focus on both urban and semi-urban healthcare settings. China contributed two population-based observational studies, emphasizing the role of maternal education in predicting neonatal thyroid function and screening outcomes. Mongolia contributed one study, highlighting the challenges of nationwide newborn screening implementation in resource-limited contexts.

The findings demonstrate a consistent pattern: maternal education, awareness, and targeted promotion interventions—such as video-based counseling, community service programs, and healthcare worker training—significantly improve knowledge and attitudes toward CH screening. However, the studies also reveal systemic challenges, including limited healthcare professional training, parental refusal, and logistical constraints, which can hinder the effectiveness of CH promotion programs. Overall, the distribution of studies underscores the need for targeted, evidence-based education and promotion strategies to increase maternal awareness, improve screening coverage, and ultimately reduce the risk of congenital hypothyroidism-related complications in neonates.

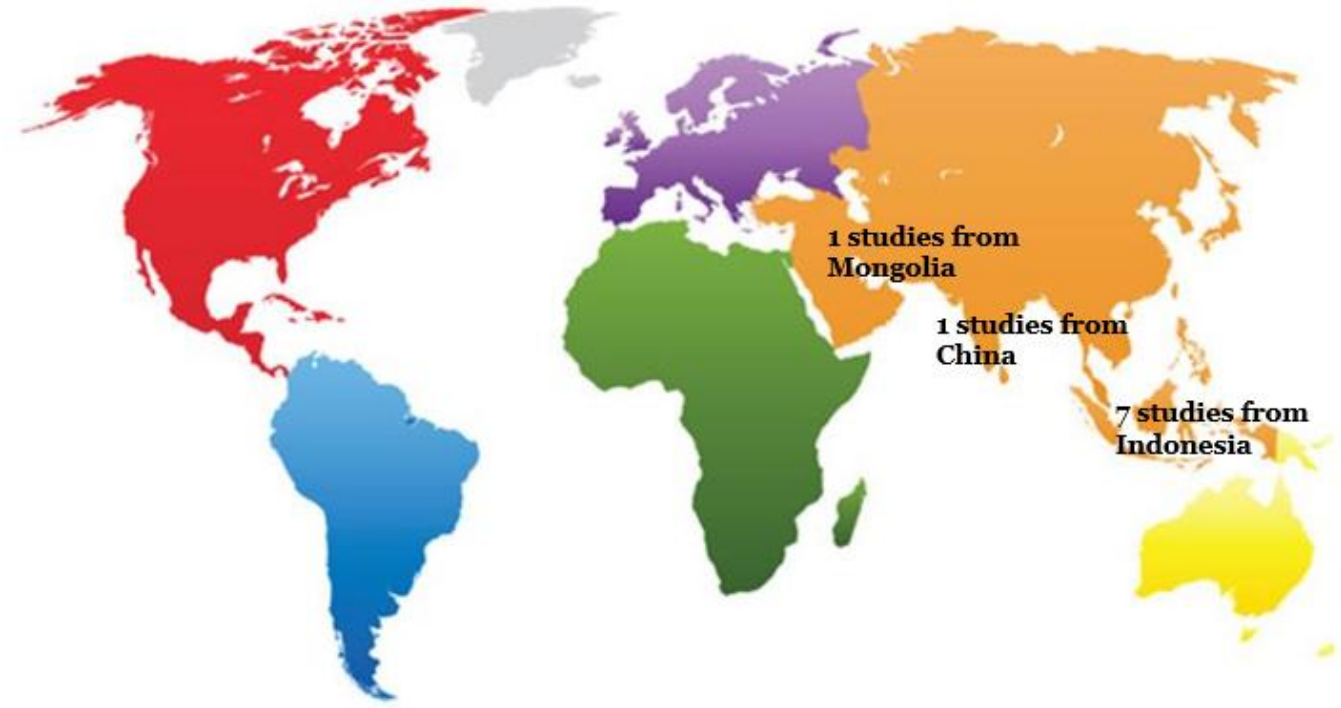

Figure 2. Map of the distribution of articles included

3. Description study

This table presents the Population–Concept–Context (PCC) framework used to describe the characteristics of the articles included in this study. The PCC framework is applied to systematically map the evidence by identifying the study population, the main concepts investigated,

and the context in which the research was conducted. Through this approach, the table provides a clear and structured overview of the selected studies, facilitating the understanding of how each article contributes to the overall analysis of this research.

Table 1. Characteristics of Selected Studies

Author (Year)	Country	Study Design	Population (P)	Concept (C)	Context (C)	Key Notes
Dewi & Rahyani (2025)	Indonesia	Pre-experimental (one group pretest-posttest)	Third-trimester pregnant women	Knowledge, Health Education	Antenatal Care in Community Health Care	Video-based counseling significantly improved knowledge (mean increased from 73.72 to 97.51; p<0.001).
Damayanti et al. (2022); Aulya et al. (2020)	Indonesia	Community service intervention	Pregnant women & health cadres	Knowledge, Education	Community & Primary Health Care	Knowledge improved in both cadres and pregnant women after intervention; active participation observed; education increased awareness of CH screening.
Tinendunget et al. (2022)	Indonesia	Quantitative correlational study	Mothers of newborns	Knowledge, Attitude	Health Center	Significant relationship between knowledge and attitude (p=0.002); knowledge influenced by age, education, occupation, and information sources.
Leng et al. (2018)	China	Population-based observational study	Mothers and newborns	Maternal Education, Neonatal Health	National Screening Program	Lower maternal education associated with higher neonatal TSH levels; education is predictor of neonatal thyroid outcomes.
Tsevgee et al. (2021)	Mongolia	Cross-sectional observational study	Newborns	Screening, Epidemiology	Neonatal Screening Program	CH prevalence 1:2091; most newborns asymptomatic; early screening critical for early treatment.
Pulungan et al. (2024)	Indonesia	National cross-sectional survey	Health professionals	Implementation, Barriers	Health System (National)	Major barriers: parental refusal, early discharge, limited resources; low training coverage; knowledge gaps in parents.
Zenni Radhia et al. (2023)	Indonesia	Pre-experimental (one group pre-post)	Pregnant women (trimester III)	Knowledge, Attitude	Health Center	Significant improvement in knowledge and attitudes after education (p <0.001).

Author (Year)	Country	Study Design	Population (P)	Concept (C)	Context (C)	Key Notes
Puspitasari et al. (2019)	Indonesia	Quasi-experimental (control group)	Mothers of infants	Knowledge, Attitude	Posyandu	Education significantly improved knowledge and attitudes compared to control group ($p<0.05$).
Sundari et al. (2025)	Indonesia	Pre-experimental	Pregnant women	Attitude, Education	Midwifery Practice	Attitude scores improved significantly after education ($p=0.001$); demographic factors influenced outcomes.
Putri et al. (2025)	Indonesia	Pre-experimental	Pregnant women (trimester III)	Knowledge	Primary Health Center	Knowledge significantly increased (70.63 → 85.61; $p<0.001$); influenced by age, education, parity.
Purnama & Widyastuti (2025)	Indonesia	Quasi-experimental	Pregnant women	Knowledge	Health Center	Education improved knowledge significantly ($p=0.001$); awareness of screening increased.

Educational interventions consistently demonstrated effectiveness in improving maternal knowledge and attitudes toward congenital hypothyroidism (CH) screening. Dewi and Rahyani (2025) conducted a pre-experimental study in Indonesia using video-based counseling for third-trimester pregnant women. The intervention significantly increased knowledge, with mean pretest and posttest scores of 73.72 and 97.51, respectively ($p=0.000$), showing the potential of video media as an effective educational tool. Similarly, Kr Zenni Radhia et al. (2023) and Jasmin Linadi Yulia Putri et al. (2025) reported significant improvements in both knowledge and attitudes after structured health education sessions, where maternal knowledge shifted from low/ moderate to good categories, supported by statistical significance ($p <0.000$). Sundari et al. (2025) further confirmed that interactive face-to-face counseling combined with leaflets significantly enhanced positive maternal attitudes.

Community-based approaches also yielded positive outcomes. Damayanti and Ekacahyaningtyas (2022), together with Aulya et al. (2020), demonstrated that health cadres and pregnant women in Lalombi Village experienced notable knowledge improvements, with cadres increasing from 20% moderate to 52% good and pregnant women from poor to 70% good. Active engagement in discussions facilitated comprehension of CH screening importance, underscoring the role of capacity building and village-level collaboration. Similarly, Oktavia Puspitasari et al. (2019) found that mothers of infants showed significant gains in knowledge and willingness to participate in early detection after education interventions delivered through Posyandu activities.

Maternal sociodemographic characteristics were found to significantly influence knowledge and attitudes. Tinendunget, Fendrawati, and Fidyawati (2022) revealed that maternal age, education, occupation,

and information sources were significantly associated with knowledge ($p<0.05$). Additionally, knowledge and attitudes were interrelated ($p= 0.002$), indicating the importance of targeted strategies for younger, less-educated, or non-working mothers. Sundari et al. (2025) similarly noted that maternal age, education, occupation, and parity shaped the extent of attitude changes following health education.

Beyond individual and community levels, maternal education emerged as a critical determinant of neonatal thyroid function. Leng et al. (2018), in a large population-based study in China involving more than 60,000 births, found that higher maternal education was inversely associated with neonatal TSH levels, with lower incidence of screen-positive CH cases among mothers with advanced education. This highlights the broader, intergenerational benefits of improving maternal education.

Experiences from Mongolia reinforced the importance of universal newborn screening. Tsevgee et al. (2021) reported a CH prevalence of 1 in 2,091 live births, with most cases asymptomatic at birth and thyroid dysgenesis as the predominant etiology (81.8%). The median initiation time of L-thyroxine treatment was 15 days, emphasizing the necessity of timely detection and intervention to prevent irreversible outcomes.

Despite these advancements, systemic challenges remain. Pulungan et al. (2024) identified barriers in Indonesia, including parental refusal (39.2%), early newborn discharge before 24 hours (38.3%), limited filter paper supply (35.9%), and lack of formal training among healthcare professionals (only 38.5%). Although most respondents reported positive attitudes toward CH screening, parental lack of awareness (96.5%) was a persistent obstacle. These findings underscore the importance of integrating educational programs with logistical and policy support to strengthen CH screening coverage.

Overall, the collective evidence highlights that maternal education, health promotion, community involvement, and systematic newborn screening policies are essential to improve awareness, knowledge, and attitudes toward congenital hypothyroidism screening. Educational interventions—particularly those combining video-based tools, community empowerment, and interactive counseling—alongside improved programmatic support, can significantly enhance early detection and effective management of CH.

DISCUSSION

Maternal Education as a Key Determinant

Maternal education plays a central role in shaping health behaviors and outcomes related to congenital hypothyroidism (CH) screening. Studies in Indonesia and internationally demonstrate that structured health education significantly improves maternal knowledge and attitudes toward CH. For example, Dewi and Rahyani (2025) reported that video-based counselling markedly increased knowledge among third-trimester pregnant women. These findings reinforce the idea that targeted educational interventions can bridge critical knowledge gaps during antenatal care. Similarly, Leng et al. (2018) found that higher maternal education was inversely associated with neonatal TSH levels, highlighting not only behavioral but also biological benefits of maternal awareness. This suggests that education has intergenerational effects, improving both maternal decision-making and neonatal health outcomes.

The theoretical underpinning of these findings aligns with the Health Belief Model

(Rosenstock, 1974), which emphasizes that health behavior is influenced by perceived susceptibility, perceived severity, perceived benefits, and cues to action. In this context, educational interventions act as cues to action, enhancing maternal risk perception about untreated hypothyroidism and reinforcing the benefits of early screening. The model helps explain why mothers who receive structured counselling are more likely to comply with CH screening recommendations.

Community-Based Health Promotion

Beyond individual education, community engagement has proven effective in reinforcing CH awareness. Damayanti and Ekacahyaningtyas (2022) and Aulya et al. (2020) showed that participatory education involving health cadres improved knowledge levels among both cadres and pregnant women. The role of health cadres is particularly critical in rural and low-resource settings, as they act as trusted messengers and role models. Their involvement reflects principles of social learning theory (Glanz et al., 2015), where knowledge and behaviors are reinforced through observation, peer support, and community participation.

Community-based strategies also leverage social capital, encouraging collective responsibility for neonatal health. By embedding CH education into routine community activities such as *Posyandu* sessions, information can be disseminated consistently and sustainably. This approach ensures that knowledge is not only delivered but also reinforced through repeated interaction and peer influence.

Strategies for Effective Educational Interventions

The success of educational interventions depends not only on content but also on delivery and context. Several strategies can be emphasized:

1. Multimedia education: Video-based counseling, mobile applications, and online learning modules can provide visual and interactive experiences. These tools are especially valuable in populations with varying literacy levels.
2. Health cadres as educators: Local health volunteers are accessible and culturally aligned educators who enhance trust and credibility (WHO, 2020).
3. Integration into antenatal care: Embedding CH education into routine antenatal visits ensures that mothers receive consistent and repeated exposure to key health messages.
4. Tailored messaging: Culturally sensitive content that considers language, beliefs, and social context improves understanding and acceptance.
5. Reinforcement and follow-up: Repeated exposure, reminders, and interactive discussions enhance knowledge retention and compliance with screening (Nutbeam, 2008).
6. Monitoring and evaluation: Continuous assessment of maternal knowledge and screening uptake allows for adaptive modifications in health promotion strategies.

Systemic and Programmatic Challenges

Despite the success of educational approaches, systemic challenges persist. Pulungan et al. (2024) reported that early discharge before 24 hours (38.3%), parental refusal (39.2%), limited filter paper availability (35.9%), and lack of professional training (only 38.5% received formal training) remain key obstacles to CH screening implementation in Indonesia. These findings are consistent with global evidence showing that educational gains alone are insufficient when health system readiness is lacking (McKay et al., 2024).

Moreover, international guidelines emphasize that the effectiveness of CH screening depends on timely and accurate implementation. The European Society for Paediatric Endocrinology (ESPE) consensus recommends that screening be performed between 48–72 hours of life to avoid false negatives and false positives, and that levothyroxine therapy be initiated within the first two weeks for optimal neurodevelopmental outcomes (Léger et al., 2014; Rose et al., 2023). Without addressing systemic barriers, even well-informed mothers may face difficulties accessing timely screening and treatment.

Integration of Education and System Strengthening

The evidence suggests that a multilevel strategy is needed to optimize CH screening outcomes. First, individual education improves maternal knowledge and attitudes, empowering women to demand and utilize screening services. Second, community engagement ensures sustainability and cultural alignment by involving cadres, community leaders, and family networks. Third, system-level strengthening addresses logistical and policy challenges, including supply chain management, standardized timing of screening, professional training, and public awareness campaigns. Integration of these three levels creates a comprehensive approach that not only raises awareness but also ensures that awareness translates into action and effective treatment (Van et al, 2020).

Implications for Policy and Practice

For policymakers and health practitioners, the findings of this review emphasize the need to prioritize maternal education and community involvement within broader neonatal health strategies. Educational interventions should be embedded in antenatal care, supported by trained health cadres, and extended through digital platforms to maximize reach. At the same time, systemic barriers must be addressed through policy initiatives such as ensuring universal screening coverage, strengthening referral systems, and investing in capacity building for healthcare workers. Public health campaigns at the community and national levels are also crucial to reducing parental refusal and increasing acceptance of CH screening.

In conclusion, effective CH screening requires more than maternal awareness; it necessitates the integration of education, community mobilization, and health system support. While educational interventions have demonstrated strong short-term impacts on knowledge and attitudes, their sustainability and translation into improved neonatal outcomes depend on structural and systemic support. By aligning health promotion strategies with community-based approaches and national policy frameworks, countries like Indonesia can move toward achieving universal coverage of CH screening, ensuring early detection and timely treatment, and ultimately preventing the lifelong complications associated with congenital hypothyroidism.

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CONFLICT OF INTEREST

The authors declare that the study was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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