

Original Article

Effectiveness of flipchart-based education on pregnant women's readiness for newborn congenital hypothyroidism screening

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Abstract:

Congenital hypothyroidism (CH) is a preventable cause of permanent neurodevelopmental impairment when newborn screening and early treatment are delayed. Maternal understanding during antenatal care is crucial because mothers often determine whether newborns undergo CH screening. This study examined the effectiveness of flipchart-based education in improving term pregnant women's knowledge, attitudes, and readiness for newborn CH screening at Momalia Community Health Center, South Bolaang Mongondow. A pre-experimental one-group pre-test/post-test study was conducted from September to October 2024. Twenty-eight term pregnant women meeting the inclusion criteria were recruited using total sampling. The intervention consisted of a structured 20-minute education session using standardized flipcharts covering the definition, consequences, timing, procedure, and benefits of CH screening. Knowledge was measured using 15 Guttman-scale items and attitude using 10 Likert-scale items. Instrument validity and reliability were established before data collection. Pre- and post-intervention scores were analyzed using the Wilcoxon signed-rank test with a 95% confidence level. The mean knowledge score increased from 45.32 ± 4.87 to 84.07 ± 6.14 , while the mean attitude score increased from 28.21 ± 7.36 to 81.07 ± 5.50 . Wilcoxon analysis showed significant improvements in both knowledge and attitude ($p < 0.001$), with large effect sizes ($r = 0.62$ and $r = 0.61$, respectively). Flipchart-based antenatal education substantially improved maternal readiness for CH screening. Integrating simple visual education into routine antenatal services may strengthen newborn screening acceptance in primary care settings.

Keywords:

antenatal education, compliance, congenital hypothyroidism, flipchart, newborn screening

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INTRODUCTION

Congenital hypothyroidism (CH) is a neonatal endocrine disorder characterized by insufficient thyroid hormone production or action from birth. The thyroid hormone is essential for brain maturation, skeletal growth, metabolism, and neuromotor development during early life. Because many affected newborns appear clinically normal in the first days after birth, screening is the only

reliable strategy for timely detection in routine care. International guidelines emphasize that CH screening, confirmatory diagnosis, and immediate levothyroxine therapy can prevent irreversible intellectual disability and optimize neurodevelopmental outcomes when treatment begins within the first two weeks of life (Bowden & Goldis, 2023; Léger et al., 2014; Rastogi & LaFranchi, 2010; van Trotsenburg et al., 2021). Conversely, late diagnosis and delayed treatment have been associated with lower intelligence scores and poorer quality of life among children with CH in Indonesia (Pulungan et al., 2019).

The burden of CH is clinically important because it is a high-impact condition with an effective, low-cost intervention pathway. The global incidence is commonly reported at approximately 1 in 2,000 to 4,000 live births, although incidence varies across screening programs due to iodine status, population characteristics, screening cutoffs, and laboratory strategies (Cherella & Wassner, 2017; Ford & LaFranchi, 2014; van Trotsenburg et al., 2021). In Indonesia, CH screening has been incorporated into national maternal and child health priorities, but program implementation remains uneven across regions. Limited screening coverage may result from gaps in information, service readiness, parental consent, logistical constraints, and incomplete integration of screening education into antenatal care. These barriers are critical because mothers and families usually make decisions about newborn procedures immediately after delivery, when anxiety, fatigue, and limited time can hinder informed decision-making.

Health education during pregnancy is therefore a strategic point of intervention. Antenatal care provides repeated opportunities for midwives and primary care providers to explain the benefits, safety, timing, and procedure of newborn screening. Maternal knowledge is a predisposing factor for health behavior, while attitudes reflect the perceived value, confidence, and readiness to act on that knowledge. The Theory of Planned Behavior and the behavior change wheel both suggest that health action is shaped by capability, opportunity, motivation, perceived control, and supportive environments (Ajzen, 1991; Michie et al., 2011). Within the context of CH screening, knowledge about preventable intellectual disability, the heel-prick procedure, and the need for early treatment may strengthen maternal motivation to approve screening for the newborn.

Evidence from antenatal and maternal-child health research supports the role of education in improving knowledge, attitudes, intention, and adherence. Information, education, and communication interventions have improved compliance with pregnancy-related health recommendations, including micronutrient supplementation and other preventive practices (Islami & Maulina, 2026; Lungu et al., 2023; Permatasari et al., 2021). Educational approaches using booklets, audiovisual media, pregnancy classes, and participatory methods have also been associated with better maternal knowledge and health-related decision-making (Adisti et al., 2024; Andika et al., 2023; Lestari et al., 2025; Rachmah et al., 2023). In the context of health services, communication quality and client-centered information are important determinants of maternal satisfaction and willingness to engage with recommended care (Dewi et al., 2026).

Flipchart-based education is particularly relevant for primary care settings. Flipcharts combine visual cues, sequential explanations, and direct educator-participant interaction. They are inexpensive, reusable, easy to transport, and suitable for low-resource community health centers. Visual education can simplify unfamiliar biomedical concepts, while face-to-face delivery allows mothers to ask questions and correct misconceptions immediately. A randomized trial by Eluri et al. (2022) demonstrated that flipchart-assisted maternal education improved knowledge and skills in

essential newborn care, supporting the use of simple, structured visual media in perinatal education. Similarly, education using visual and interactive methods has been shown to enhance maternal knowledge and readiness for pregnancy-related care (Adisti et al., 2024; Andika et al., 2023; Lestari et al., 2025).

Preliminary observations at Momalia Community Health Center in South Bolaang Mongondow indicated that pregnant women had received limited counseling on CH screening. Interviews with 10 pregnant women suggested that all had never received specific education regarding the meaning of congenital hypothyroidism, the timing of screening, or the consequences of delayed detection. This situation highlights an implementation gap: screening may be in policy, but maternal readiness to adopt it can remain low when communication is insufficient. Therefore, this study aimed to determine the effectiveness of flipchart-based education in improving knowledge, attitudes, and readiness for newborn CH screening among term-pregnant women at the Momalia Community Health Center.

METHOD

This study used a quantitative pre-experimental design with a one-group pre-test/post-test approach. The design was selected to evaluate changes in knowledge and attitudes before and after a structured educational intervention using flipchart media. The study was conducted at the Obstetrics Clinic of the Momalia Community Health Center in South Bolaang Mongondow from September to October 2024.

The study population comprised pregnant women attending antenatal care at the health center during the study period. Total sampling was used because the number of eligible participants was limited, and all accessible respondents meeting the criteria were invited. The final sample consisted of 28 pregnant women. Inclusion criteria were term pregnancy at 36-40 weeks of gestation, maternal age 20-35 years, possession of a maternal and child health handbook, ability to communicate in Indonesian, and willingness to participate voluntarily. Pregnant women who were uncooperative, unable to complete the questionnaire, or withdrew from the study were excluded.

The intervention consisted of one structured 20-minute education session delivered individually or in small groups by the researcher using standardized flipcharts. The flipchart content covered five essential topics: the definition and causes of CH; the consequences of untreated CH for growth and brain development; the benefits of early newborn screening; the timing and procedure of heel-prick blood sampling; and the role of mothers and families in consenting to screening and follow-up. The educator used the same flipchart sequence and explanation guide for all participants to minimize information variability. Participants were encouraged to ask questions after the explanation.

The instruments included a knowledge questionnaire and an attitude questionnaire. The knowledge questionnaire consisted of 15 dichotomous Guttman-scale items concerning CH, screening benefits, procedure, timing, and follow-up. Correct responses were scored 1, and incorrect responses 0, then transformed into a 0-100 scale. The attitude questionnaire consisted of 10 Likert-scale statements rated from 1 to 5, measuring perceived importance, willingness, confidence, and readiness to support newborn CH screening. The total attitude score was also transformed into a 0-

100 scale. Instrument testing was conducted with 15 term-pregnant women with similar characteristics who were outside the study sample. Validity testing showed acceptable item validity ($r\text{-count} \geq 0.514$), and reliability testing showed acceptable internal consistency (Cronbach's alpha > 0.60).

Operationally, compliance in this study was defined as readiness to comply with newborn CH screening, as reflected in improved knowledge and attitudes following the educational intervention. This interpretation was necessary because the study measured the antenatal stage before newborn screening could be directly verified after delivery. The outcome variables were the knowledge and attitude scores. Sociodemographic characteristics included age, educational level, and gravida status.

Data collection was conducted after obtaining informed consent. Participants first completed the pre-test questionnaire to establish baseline knowledge and attitudes. The researcher then delivered flipchart-based education. Immediately after the session, respondents completed the post-test questionnaire. The short interval between education and post-test was intended to assess the immediate educational effect while minimizing contamination from external information sources.

Data were analyzed using descriptive statistics for respondent characteristics and outcome scores. Means, standard deviations, medians, minimums, and maximums were reported for knowledge and attitude scores. Because the study used paired pre-test/post-test data and the sample size was small, the Wilcoxon signed-rank test was used to determine differences between pre-test and post-test scores. Effect size was calculated as $r = Z / \text{square root of } N$, with values around 0.10, 0.30, and 0.50 interpreted as small, medium, and large effects, respectively. Statistical significance was set at $p \leq 0.05$. Ethical principles included voluntary participation, confidentiality, and the right to withdraw at any time.

RESULT

28 term-pregnant women participated in the study and completed both pre-test and post-test assessments.

Table 1. Sociodemographic characteristics of term pregnant women (n = 28)

Characteristics	n	%
Age, mean +/- SD (min-max)	27.04 +/- 3.65 (21-35)	
21-25 years	11	39.3
26-30 years	13	46.4
31-35 years	4	14.3
Education		
Primary (elementary-junior high school)	3	10.7
Secondary (senior high school)	17	60.7
Higher education (university)	8	28.6
Gravida, mean +/- SD (min-max)	2.04 +/- 1.04 (1-4)	
Primigravida	12	42.9
Multigravida	16	57.1

Respondents were aged 21-35 years, with a mean age of 27.04 years (SD = 3.65). Most were aged 26-30 years (46.4%), had secondary education (60.7%), and were multigravida (57.1%).

Table 2. Comparison of pre-test and post-test knowledge and attitude scores

Parameter	Knowledge		Attitude	
	Pre-test	Post-test	Pre-test	Post-test
Mean	45.32	84.07	28.21	81.07
Median	47.00	87.00	27.50	80.00
Standard deviation	4.87	6.14	7.36	5.50
Minimum	40	73	20	75
Maximum	53	93	40	90

The knowledge and attitude scores increased after flipchart-based education. The mean knowledge score increased from 45.32 (SD = 4.87) to 84.07 (SD = 6.14), while the mean attitude score increased from 28.21 (SD = 7.36) to 81.07 (SD = 5.50).

Table 3. Wilcoxon signed-rank test results for knowledge and attitude

Variable	Effect size (r)	Z value	p-value
Knowledge	0.62	-4.655	<0.001
Attitude	0.61	-4.639	<0.001

Wilcoxon signed-rank analysis showed statistically significant improvements in both outcomes. Knowledge improved significantly after the intervention ($Z = -4.655$, $p < 0.001$, $r = 0.62$), and attitude also improved significantly ($Z = -4.639$, $p < 0.001$, $r = 0.61$). Both effect sizes were large, indicating that the intervention produced meaningful changes in maternal readiness for CH screening.

DISCUSSION

This study found that flipchart-based education significantly improved knowledge and attitudes among pregnant women regarding newborn CH screening. The increase in knowledge from a mean score of 45.32 to 84.07 indicates that the educational session substantially improved mothers' understanding of the purpose, timing, procedure, and consequences of CH screening. The increase in attitude scores from 28.21 to 81.07 suggests that education also improved perceived importance, acceptance, and readiness to support newborn screening. The large effect sizes for both knowledge and attitude reinforce that the intervention was not only statistically significant but also practically meaningful.

These findings are consistent with behavioral theory. Knowledge is a predisposing factor that shapes the way individuals interpret health risks and evaluate preventive actions. In CH screening, many mothers may not perceive urgency because newborns with CH frequently appear normal at birth. Flipchart-based education helps translate an invisible risk into understandable information:

untreated CH can impair brain development, but early detection and treatment can prevent serious outcomes. This explanation may strengthen perceived benefits and reduce perceived barriers, two mechanisms often emphasized in health behavior change models (Ajzen, 1991; Michie et al., 2011).

The magnitude of knowledge improvement in this study is clinically relevant because CH screening is highly time sensitive. Guidelines recommend early newborn screening and prompt treatment for confirmed CH to prevent irreversible neurodevelopmental consequences (Léger et al., 2014; van Trotsenburg et al., 2021). Research in Indonesia has shown that delayed diagnosis and treatment are associated with poorer intelligence and quality-of-life outcomes (Pulungan et al., 2019). Therefore, increasing maternal readiness before delivery may be an important upstream strategy for improving screening uptake and timely follow-up.

The positive change in attitude is equally important. Health education that improves knowledge but fails to influence attitudes may not translate into action. In this study, the attitude score increased by more than 50 points, suggesting that mothers became more receptive to CH screening after receiving structured visual information. This result supports previous evidence that antenatal education, pregnancy classes, and communication-based interventions can improve maternal knowledge, confidence, and adherence to recommended health behaviors (Adisti et al., 2024; Andika et al., 2023; Islami & Maulina, 2026; Lungu et al., 2023). It also aligns with the broader evidence that health education during pregnancy can improve maternal behavior and support better child health outcomes (Permatasari et al., 2021; Prasetyo et al., 2023; Rachmah et al., 2023).

The use of flipcharts likely contributed to the effectiveness of the intervention. Flipcharts provide sequential visual prompts that allow educators to deliver complex information in a simple and consistent manner. In primary care settings, this is useful because health workers must often communicate important information within limited time and resources. The educator can point to images, explain procedures, and invite questions, creating an interactive learning environment. Eluri et al. (2022) similarly demonstrated that flipchart-assisted maternal education improved knowledge and skills in essential newborn care. These findings support the use of low-cost visual media as a practical strategy for health education in community health centers. Because visual media still depends on educator-participant interaction, its effectiveness should also be supported by clear, empathetic, and therapeutic communication, a principle emphasized in Indonesian nursing communication literature (Kurniawan et al., 2024).

The study also has implications for antenatal service organizations. CH screening education should not be delivered only after birth, because mothers may be physically tired and families may be focused on immediate newborn care. Antenatal counseling allows mothers and families to understand the screening procedure earlier and prepare for consent. Integrating CH screening messages into routine antenatal classes, maternal-child health handbooks, and midwife counseling may strengthen the continuum between pregnancy care and newborn preventive services. The inclusion of family members may further improve decision-making, especially in communities where health decisions are shared with husbands or older family members.

Despite the significant findings, several limitations must be considered. First, this study used a one-group pre-test/post-test design without a control group, so causality cannot be inferred as strongly as in randomized controlled studies. Second, compliance was measured as readiness, based on knowledge and attitude, rather than verified newborn-screening behavior after delivery. Third, the post-test was administered immediately after the education session, so the study

measured short-term educational effect rather than long-term retention. Fourth, the sample size was small and drawn from one community health center, limiting generalizability. Future studies should use controlled designs, include larger sample sizes, evaluate actual screening completion rates after birth, and compare flipcharts with audiovisual or digital media.

Nevertheless, the findings provide useful evidence for primary care practice. In settings where newborn CH screening coverage remains low, simple educational tools can help bridge the information gap. Flipcharts are affordable, adaptable, and feasible for midwives to use during antenatal visits. When combined with standardized messages, family involvement, and follow-up reminders, flipchart-based education can support maternal readiness and improve newborn screening implementation.

CONCLUSION

Flipchart-based education significantly improved pregnant women's knowledge and attitudes regarding newborn congenital hypothyroidism screening at Momalia Community Health Center. The intervention produced large effect sizes for both outcomes, indicating meaningful improvement in maternal readiness to support CH screening. These results suggest that simple visual media can be integrated into antenatal counseling to improve acceptance of newborn screening in primary care. Future research should evaluate actual post-delivery screening uptake, long-term knowledge retention, and the comparative effectiveness of different educational media.

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ETHICAL CONSIDERATIONS

This study adhered to ethical principles for human subject's research, including voluntary participation, informed consent, confidentiality, and the right to withdraw. The original manuscript did not provide a specific ethics approval number; therefore, the authors should include the approval number before journal submission, if available.

AI USE DECLARATION

Artificial intelligence tools were used only to assist with language refinement, grammar checking, formatting consistency, and manuscript clarity. The authors remain fully responsible for the study design, data, analysis, interpretation, and final manuscript content.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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