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Implementation of the congenital hypothyroidism (CH) screening program in Indonesia as an effort to prevent stunting: A mixed-methods study

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Abstract

Congenital hypothyroidism screening (CHS) plays a critical role in the prevention of stunting. CHS enables the early detection of growth and developmental disorders, thereby facilitating timely intervention to prevent stunting. The objective of this study was to evaluate the implementation of CHS within healthcare services. A mixed-methods design employing a sequential exploratory model was utilized. The study identified 917 newborns, all of whom underwent CHS. The majority of screenings (59.59%) were conducted within 48 hours of birth, and only 0.186% of infants were diagnosed with hypothyroidism. However, the management of hypothyroidism was found to be suboptimal. In summary, the CHS program has demonstrated excellent coverage, as evidenced by 100% participation among newborns. Nevertheless, deficiencies remain in the post-screening management of hypothyroidism, which has not yet achieved optimal implementation.

Keywords

Evaluation, Congenital hypothyroidism Screening, Stunting prevention

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Introduction

The Indonesian government has targeted a reduction in stunting prevalence to 18% by 2025 (Makripuddin Lalu, 2021; Tempo, 2025). In addition, the Sustainable Development Goals (SDGs) aim to eradicate poverty and hunger and improve health status by 2030 (United Nations, 2025). Achieving the stunting reduction target will contribute significantly to the main objectives of the national development plan (Undang-Undang Republik Indonesia Nomor 59 Tahun 2024 Tentang Rencana Pembangunan Jangka Panjang Nasional Tahun 2025-2045, 2024).

The causes of stunting in Indonesia include low consumption of nutritious food among pregnant women and children, lack of exclusive breastfeeding, and incomplete immunization status (Wardani et al., 2020). Stunting has negative impacts on a child's future, including physical, cognitive, psychological, and economic consequences. Stunted children are more prone to illness, have impaired body functions, reduced cognitive abilities, and contribute to economic losses. Stunting results in the loss of 11% of Gross Domestic Product (GDP), and in adulthood, it may reduce income by up to 20%. Stunting can also cause a 10% reduction in lifetime earnings, which may contribute to intergenerational poverty (Asra Laily & Indarjo, 2023; Fauziah et al., 2023; Khotimah, 2022).

Several previous studies have demonstrated a relationship between hypothyroidism and stunting. Hastuti et al. stated that maternal hypothyroidism correlates with very short and short stature in children (Hastuti et al., 2021). Abbag et al. also reported that children with thyroid disorders, such as goiter, are strongly associated with stunting (Abbag et al., 2021). Abri et al. found that, among 100 children studied, 72 experienced stunting and grade 1 goiter abri (Abri et al., 2022). Kartini et al. also stated that out of 52 stunted children, 33% had thyroid disorders. These findings prove that thyroid disorders, such as hypothyroidism, contribute to and are risk factors for stunting. Therefore, it is very important to evaluate whether congenital hypothyroidism screening has been properly implemented so that the risk of stunting caused by hypothyroidism can be prevented.

Congenital hypothyroidsm

Congenital hypothyroidism (CH) is one of the most common and preventable causes of intellectual disability. CH is a congenital condition in which thyroid hormone (TH) levels are insufficient for the normal development and functioning of body tissues. Most cases of CH are caused by thyroid gland dysfunction (primary hypothyroidism). The most common causes are defects in thyroid gland development (thyroid dysgenesis) and intrinsic defects in TH synthesis (dyshormonogenesis). Less commonly, neonatal thyroid function may be temporarily impaired by extrinsic factors such as maternal antithyroid drugs, transplacentally acquired TSH receptor–blocking antibodies (TRBAb), or maternal or neonatal iodine deficiency or excess (Schoenmakers (2015) in Rose (2023) (Rose et al., n.d.)).

Congenital hypothyroidism as a causative factor of stunting

Thyroid disorders, such as hypothyroidism, are one of the causes of stunting. Hypothyroidism occurs when the thyroid gland does not produce enough thyroid hormones. The thyroid is a small butterfly-shaped gland located at the front of the neck. This gland secretes hormones that help the body regulate and use energy. The thyroid also controls the function of several organs to ensure they work properly. Low thyroid hormone levels can slow down the body's natural functions. Hypothyroidism can also be caused by low iodine intake.

Several previous studies have reported that thyroid disorders are among the causes of stunting. According to Hastuti et al., hypothyroidism occurs due to iodine deficiency, which is related to stunting. They conducted a study on 94 mothers and 94 children. The results showed that among the 94 children studied, 30 experienced stunting, 3 of the 94 mothers had hypothyroidism, and 31.9% of the children had elevated TSH, with the highest TSH levels found in the shortest children (Hastuti et al., 2021). Abri et al. also identified determinants of stunting among elementary school children in IDD endemic areas, with a sample of 100 mothers and their children aged 6–12 years. The results showed that 72 out of 100 children experienced stunting (Abri et al., 2022). Furthermore, Abbag et al. investigated the incidence of stunting and explored iodine deficiency as a predictor of stunting in children. They found that, out of 346 children studied, 238 experienced stunting (Abbag et al., 2021). Nur et al. also examined the relationship between iodine deficiency disorders and stunting, as well as cognitive development in elementary school children. Among 100 respondents studied, 72% were stunted.

Hypothyroidism as a cause of stunting may begin during pregnancy. Mothers who suffer from hypothyroidism during pregnancy may experience intrauterine growth restriction and mild deficits in fetal neurodevelopment. If hypothyroidism occurs in early pregnancy, it can lead to behavioral changes and reduced cognitive ability in offspring, as well as psychomotor delays and intellectual disabilities. Thyroid disorders during pregnancy are also a cause of cognitive and motor impairments, growth retardation, and hearing and speech defects in the child (Mazzilli R, 2022; Salazara P, 2021).

Thyroid disorders found in stunted children also include hormonal abnormalities, one of which is hypocalcemia. Hypocalcemia is caused by decreased parathyroid and thyroid gland function. Reduced thyroid hormone function decreases the secretion of growth hormone, which plays a role in the secretion of Insulin-like Growth Factor-1 (IGF-1). Meanwhile, abnormal parathyroid glands cause a reduction in parathyroid hormone (PTH), which can disrupt calcium homeostasis and lower blood calcium levels. Stunting occurs because bone growth processes, such as indirect endochondral ossification, direct ossification by intramembranous bone formation, and bone mass expansion through apposition and bone matrix deposition, are impaired. Growth hormone (GH), triiodothyronine (T3), androgens and estrogens, as well as vitamin D with parathyroid hormone, all contribute to endochondral ossification, which may lead to stunting (Nelwan, et al., 2022).

Congenital hipotiroid screening

Congenital hypothyroidism screening is carried out on newborns to enable early detection and immediate treatment if the baby has thyroid disorders. During the neonatal period, thyroid hormones are crucial for brain development; therefore, if hypothyroidism is detected early, it can prevent long-term complications caused by the condition (Hashemipour et al., 2023).

Method

Study design and data collection

The method used in this study was a mixed-methods design with a sequential exploratory model. The quantitative study was conducted using a cross-sectional design, while the qualitative study was carried out through a case study.

In the quantitative stage, data were obtained by reviewing medical records related to the implementation of CHS over a 4-month period in hospitals and community health centers (Puskesmas) in Magelang, Indonesia. Meanwhile, qualitative data were collected through Focus Group Discussions (FGDs) with respondents who directly managed the implementation of CHS in both hospitals and puskesmas. A total of 8 respondents were selected using purposive sampling. FGD guidelines, observation, and document review were used in collecting qualitative data. The inclusion criteria in this study included all CHS data from newborns between January and April 2025, as well as health workers who carried out CHS implementation.

Quantitative data analysis in this study used descriptive statistics. Categorical variables were presented in the form of frequencies and percentages. Numerical variables were presented in the form of means and standard deviations for normal distributions, and medians and interquartile ranges for non-normal distributions. Normality tests were conducted using the Shapiro–Wilk test with a significance level of 0.05, with analysis using SPSS version 20. Qualitative data analysis used the Miles and Huberman model, with three stages: data reduction, data display, and conclusion drawing and verification. This study received ethical approval from the Health Research Ethics Committee of Tidar Regional General Hospital (RSUD Tidar), with approval number 054/EC-RSUDTIDAR/VII/2025.

Results

Number of births

Within a 4-month period, from January to April, there were 916 newborns across three healthcare facilities. Table 1 shows the number of newborns at RSUD Tidar (536), RS Harapan (328), and Tempuran Community Health Center (52). Of the 916 newborns, 100% underwent congenital hypothyroidism screening (CHS).

Table 1. Number of newborns and percentage of CHS

Healthcare Facility	Number of births	Number screened	Percentage screened
Tidar Hospital	537	537	100%
Harapan Hospital	328	328	100%
Puskesmas Tempuran	52	52	100%
Total	**917**	**917**	**100%**

Timing of congenital hypothyroidism screening

Table 2 shows the age of the newborns when blood samples were taken for CHS. Of the 916 babies, 59.59% were tested before 48 hours, 13.39% between 48–72 hours, and 26.94% after 72 hours.

Table 2. Timing of CHS

Age at Screening	Number of Babies	Percentage
< 48 hours	747	59.59%
48 – 72 hours	82	13.39%
72 – 96 hours	21	12.34%
96 – 120 hours	7	3.37%
120 – 144 hours	5	3.20%
144 – 168 hours	2	0.74%
– 240 hours	2	0.163%
>240 hours	50	7.193%
Total	**916**	**100%**

Most blood samples for CHS were collected in less than 48 hours because healthy babies are discharged within 24 hours post-birth. This is also related to BPJS policy, which only covers newborn hospitalization for 24 hours. This was confirmed by the following respondents.

R4: *"But... because of several factors, for example, at first it was recommended between 48–72 hours, but spontaneous deliveries are usually discharged 24 hours after birth, so we can't follow that. The CHS is done before discharge."*

R2: *"Meanwhile, according to BPJS regulations in the Bougenville ward, if the newborn is normal or physiological, they are discharged within 24 hours. So, if the test is not done within that period, it will be missed. Therefore, usually we check at 24–25 hours at the earliest."*

R8: *"In addition to being a requirement for BPJS claims, CHS is actually mandatory between 3–7 days, but we usually perform it on the 3rd day."*

Percentage of babies with hypothyroidism

Table 3 shows the number of hypothyroidism cases across the three facilities. Among all newborns, only 0.10% were diagnosed with hypothyroidism.

Table 3. Percentage of Babies with Hypothyroidism

Research site	Number of cases	Percentage
Tidar Hospital	1	0.186%
Harapan Hospital	0	0%
Puskesmas Tempuran	0	0%

Management of hypothyroidism

The study found that neither hospital received information or reports regarding the management of babies diagnosed with hypothyroidism. This was reflected in the following respondent's statement:

R1: *"As for the management after CHS, we don't know."*

Meanwhile, findings from the CHC showed that in two years of CHS program implementation, no babies tested positive for hypothyroidism. This was expressed by a respondent as follows:

R7: *"For positive CHS cases, they are usually referred to Muntilan Hospital with Dr. Lia. But since in our CHC there hasn't been any, we have never managed such a case."*

Another finding was related to the length of time required to obtain CHS results. Across the three research sites, results were received approximately 2–3 months after testing. This was reflected in the following responses:

R1: "About 2–3 months."

R7: *"It takes quite long, sometimes 3 months, sometimes even longer."*

Discussions

The results of this study show that there were 916 newborns across three research sites. This figure provides a general overview of the number of babies who underwent CHS. This result is important because the number of newborns can be used as a basis to calculate the extent of CHS implementation and also as an indicator of its success.

Compared with previous studies, the number of newborns can vary significantly depending on the size of the region, the quality of health facilities, and the population of the research area. According to Sekarjati (2024), at Mardi Waluyo Metro Hospital, 362 newborns were recorded over six months, with CHS conducted on 16.85% of them (Sekarjati, 2024). Sonia (2025) reported that in the Bengkuang Community Health Center service area, 31 live births were recorded during the study period, and CHS was performed on 57.1% of them (Sonia et al., 2025; UNICEF, 2023). This shows that the number of newborns in some areas may be lower than in this study, depending on the research site and timeframe. Therefore, the 916 newborns recorded here can be considered comparable to results from regional referral or teaching hospitals.

Furthermore, data from the Indonesian Ministry of Health (2023) reported around 4.1 million live births in Indonesia in 2022. Although the national number is large, variations in newborn counts at individual facilities are significantly influenced by the level of services available (Kementrian Kesehatan Republik Indonesia, 2024). Thus, the 917 newborns across the three sites in this study are reasonable, aligned with service capacity, and not significantly different from previous research reports at referral hospitals in the region.

From a program perspective, the number of newborns is an important indicator because it affects the estimation of consumables required for screening, such as filter papers, reagents, and forms. These results also confirm that to achieve optimal outcomes, health facilities need to align consumables with actual birth estimates. If projections are inaccurate, screening may be delayed or inadequately performed.

This study found that the percentage of babies screened for CHS was 100% across all three sites. This achievement surpasses several previous studies. Sekarjati (2024) reported a CHS coverage of only 16.85% among 362 newborns, largely due to logistical limitations in providing filter paper and technical difficulties in collecting blood samples (Sekarjati, 2024). Sonia (2025) found that 57.1% of newborns underwent CHS (Sonia et al., 2025). Musdalifah (2024) reported that in Pinrang District, 1,407 out of 6,164 babies were screened, showing a coverage rate of only 17%, which is much lower than the 100% coverage in this study (Musdalifah & Batara, 2024).

At the national level, Indonesia's 2023 Health Profile reported that CHS coverage had reached about 70% of all newborns, with annual improvements but still not optimal. Contributing factors to low coverage include limited distribution of filter paper, variable compliance among health workers, and lack of outreach to parents. Therefore, the 100% achievement in this study demonstrates strong commitment by health facilities and healthcare workers to implementing the program comprehensively. It also shows that common obstacles (e.g., logistics and technical problems) can be overcome through effective program management, strong team coordination, and parental compliance (Kementrian Kesehatan Republik Indonesia, 2024;(UNICEF, 2023).

These findings demonstrate optimal coverage of the newborn screening program, where every newborn is successfully screened. This universal coverage is a key indicator of the success of a neonatal screening program.

In public health literature, 100% screening coverage is often identified as the ideal target for newborn screening (NBS) programs because it provides early detection opportunities without leaving certain infants behind. To date, CH screening coverage in many developing countries remains far from ideal. Globally, only around 29.6% of infants are universally screened for CH, with many countries in Africa and Asia not yet achieving optimal coverage (Arrigoni). In many regions of Indonesia, coverage remains highly variable and often falls short of national targets, particularly in remote areas and primary care facilities (Pulungan et al., 2024). Therefore, achieving 100% coverage at the study site represents a local achievement and can serve as a model for good practice for other facilities or for regional program development.

The 100% percentage of infants screened for congenital hypothyroidism in all three study sites is an excellent implementation indicator and demonstrates the success of the neonatal screening program at the local level. This achievement not only increases the opportunity for early detection of congenital hypothyroidism but also strengthens the health care system in preventing developmental disabilities in infants.

This is relevant to the global neonatal screening goals, which emphasize maximum coverage and early detection, although many countries globally have not yet achieved universal targets. This comprehensive screening coverage can serve as a benchmark for best practices in program evaluation and development at other facilities.

The study also found that most blood samples for CHS (59.59%) were taken within 48 hours after birth, while 13.39% were collected between 48–72 hours, 12.34% between 72–96 hours, and 14.67% after more than 96 hours.

WHO and the Indonesian Ministry of Health recommend that CHS dried blood spot samples be collected between 48–72 hours after birth, because babies younger than 48 hours often experience a physiological surge in TSH levels, which may lead to false-positive results (Ford George, 2020; Menteri Kesehatan Republik Indonesia, 2014). TSH levels rise within the first 30 minutes after birth, peak within 24 hours, and gradually decline over the next 2–3 days. Therefore, collecting blood before 48 hours increases the risk of false positives, while collecting after 96 hours may delay diagnosis, preventing timely treatment of congenital hypothyroidism, which can result in impaired growth and development (Menteri Kesehatan Republik Indonesia, 2014).

International studies have shown similar findings. Ford et al. (2020) in Australia reported that although national guidelines recommend sampling at 48–72 hours, about 40% of samples were collected before 48 hours, mainly due to early discharge practices. This increased the need for retesting in some infants (Ford George, 2020).

In this study, the percentage of samples collected before 48 hours (59.59%) was significantly higher than previous reports, indicating that early discharge or facility policy was the main factor. Meanwhile, samples collected after 96 hours (14.67%) could delay diagnosis if results were positive. According to WHO (2021), screening after 96 hours may result in delayed detection and worsen outcomes for babies with congenital hypothyroidism.

The 916 babies screened, one baby (0.10%) tested positive for hypothyroidism. This represents one case per 916 live births in the study group. Epidemiologically, this incidence is higher than both national and international estimates. The Indonesian Ministry of Health (2023) estimated CH incidence in Indonesia at 1 in 2,000–4,000 live births, with regional variations. National data show a prevalence of about 0.05% among screened infants. Globally, the prevalence varies between 1 in 2,000 and 1 in 3,000 live births in developed countries, with higher rates reported in Asia than in Europe or the Americas. Contributing factors include genetics, nutrition (especially iodine deficiency), and screening quality (Dündar et al., 2022; George, 2020).

The finding of 1 case out of 916 newborns (0.10%) highlights the importance of CHS. Although incidence is relatively low, early detection is critical because delayed diagnosis can cause permanent growth and intellectual impairment, including stunting. Such identified cases are indicators of program success because, without screening, diagnosis would likely be delayed.

Congenital hypothyroidism is an endocrine disorder that can cause permanent cognitive developmental delays if not detected and treated early. Therefore, the finding of a single case in this study demonstrates the real value of early detection screening, demonstrates the urgency of program sustainability, and reinforces the importance of universal screening implementation. Without screening, cases are likely to go undetected in the neonatal period because early symptoms of congenital hypothyroidism are often nonspecific or minimal (Arrigoni et al., 2025).

From a program implementation evaluation perspective, these findings indicate that the screening program has been able to detect cases early, the referral and diagnostic confirmation systems need to be ensured to be effective, and screening coverage must be maintained or increased to ensure detection of at-risk populations. Although the number of cases is relatively small, the public health impact is significant because a single untreated case can lead to lifelong intellectual disability (Arrigoni et al., 2025).

Although only one case of congenital hypothyroidism was found in 916 infants screened, this figure still has important clinical and epidemiological significance. These findings confirm that the neonatal screening program is effective in detecting cases early and plays a strategic role in preventing long-term disability. Therefore, sustainability and improvement of the quality of implementation of screening programs are very necessary.

Strengths and limitations

The use of a mixed-methods design was a strength of this study because it allowed for maximum exploration of the findings. Quantitative results were supported and reinforced by qualitative data. The relatively large number of newborns (916) provided adequate representation for evaluating the CHS program.

However, the research sites did not include the district health office or central hospitals where screening is also conducted, which limited the ability to uncover broader reasons behind the shortcomings found in the CHS evaluation. For future research, expanding the study sites may help clarify the challenges encountered in the CHS program.

Conclusion

The CHS program in Indonesia has been running well, as shown by the achievement of 100% screening coverage. However, in terms of quality, the program is still not optimal. The timing of CHS has not been consistently conducted within the recommended 48–72 hours, the screening laboratories are only available in central hospitals, and the management of hypothyroidism is also not ideal, since screening results are received only after 2–3 months. This delay prevents babies with hypothyroidism from receiving timely treatment within the first two weeks of life. This limitation in CHS implementation in Indonesia highlights the need for government action to strengthen infrastructure and resources so that CHS can be conducted in all regions.

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