Journal of the ASEAN Federation of Endocrine Societies

ORIGINAL ARTICLE

Bridging Gaps in Newborn Screening: A Comparative Study of Point-of-Care Testing Versus Traditional Reference Laboratory Method for Congenital Hypothyroidism

Endah Indriastuti,[1] Rahmah Yasinta Rangkuti,[2] Fatimah Nur Fitriani,[1] Putri Alief Siswanto,[3] Edwin Nugroho Njoto,[1] Muhammad Nazhif Haykal,[1] Fauqa Arinil Aulia[4]

[1]*Department of Medicine, Faculty of Medicine and Health, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*
[2]*Department of Medical Profession, Faculty of Medicine and Health, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*
[3]*Department of Medical Technology, Faculty of Medicine and Health, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*
[4]*Department of Clinical Pathology, Airlangga University/Dr. Soetomo Hospital, Surabaya Indonesia*

Abstract

Objective. This study aimed to compare the reliability, agreement, and practical application (turnaround time) of a point-of-care testing (POCT) device using two different reagents versus the traditional reference laboratory method for thyroid-stimulating hormone (TSH) measurement in newborn congenital hypothyroidism screening.

Methodology. This prospective cross-sectional method-comparison study included 122 term newborns at a mother and child hospital in Surabaya, Indonesia. Heel-prick capillary blood samples were simultaneously analyzed using the Standard F-200 POCT device with two reagents (Group 1: n = 62, Standard™ F TSH-II; Group 2: n = 60, FastClear F TSH-II) and compared to the standard dried blood spot method (GSP® Neonatal hTSH, PerkinElmer) as reference. Analyses included Pearson and Spearman correlations, linear regression, Bland-Altman plots, intraclass correlation coefficient (ICC), Cohen's Kappa, and mean difference tests.

Results. Strong positive correlations were observed in both Group 1 (Pearson's r = 0.87, Spearman's ρ = 0.85; p <0.001) and Group 2 (Pearson's r = 0.88, Spearman's ρ = 0.91; p <0.001). Bland-Altman analysis showed minimal systematic bias with acceptable agreement between the two techniques. The ICC values indicated excellent reliability (Group 1: 0.89; Group 2: 0.91). High categorical agreement was confirmed by Cohen's Kappa values of 0.85 and 0.87 (p <0.001). No significant differences in mean TSH levels were found between the POCT and reference methods. The POCT turnaround time was 30 minutes, significantly shorter than the 15–22 days required for the traditional method.

Conclusion. POCT devices present a promising alternative to traditional reference screening method for congenital hypothyroidism.

Key words: congenital hypothyroidism, newborn, reproducibility of results, preventive medicine, health

INTRODUCTION

The global incidence of congenital hypothyroidism (CH) is estimated to be around 1:1400 to 1:1700 births, which is almost twice as high as the previously cited number of 1:2000 to 1:4000 births.[1,2] In Indonesia, the prevalence of congenital hypothyroidism is estimated to be higher than the global average, with approximately 1 in 2,513 births affected according to screening data from 14 provinces.[3] In Malang, East Java, Indonesia, the ratio was found to be 1:2736 births from 2000 to 2013.[4] These findings highlight the importance of regional and national screening programs for the early identification and therapy of the congenital hypothyroidism, which can prevent irreversible intellectual disability. The global success of newborn screening programs has yet to be fully realized in Indonesia. The coverage rate of CH screening in Indonesia remains notably low, highlighting significant opportunities for improvement and expansion.[5–7] The implementation of newborn screening in Indonesia faces several challenges, including lengthy procedures from sample collection to result release and a shortage of facilities. The disparity in the availability and accessibility of screening facilities has a significant impact on newborn screening coverage, leading to notable differences across provinces. Urban regions like Bali achieved a substantially higher coverage rate (40.54%)

eISSN 2308-118x (Online)
Printed in the Philippines
Copyright © 2026 by Indriastuti et al.
Received: February 5, 2026. Accepted: April 15, 2026.
Published online first: August 25, 2026.
https://doi.org/10.15605/jafes.041.02.6233

Corresponding author: Endah Indriastuti, MD
Lecturer, Clinical Pathology Laboratory, Department of Medicine
Faculty of Medicine and Health, Institut Teknologi Sepuluh Nopember
Sukolilo Campus, Institut Teknologi Sepuluh Nopember, Keputih, Sukolilo,
Surabaya, East Java, Indonesia, 60111
Tel. No.: (+62) 31-5994251, 5947274
E-mail: endah.indriastuti@its.ac.id
ORCiD: https://orcid.org/0009-0006-5663-5162

This work is licensed under a Creative Commons Attribution-NonCommercial 4.0 International License (https://creativecommons.org/licenses/by-nc/4.0/).

compared to remote rural areas such as South Papua, which recorded only 0.02%. Additional obstacles include limited availability of filter paper, insufficient training for healthcare workers, and family rejection due to a lack of understanding about the importance of the examination.[6,8–10]

Congenital hypothyroidism can lead to severe developmental impairment if not promptly treated.[11,12] Early detection and appropriate initial therapy are crucial for the effective management and prevention of complications.[13–15] Most newborn screening programs rely on blood spot thyroid-stimulating hormone (TSH) tests, which are effective but may not detect central congenital hypothyroidism. Some programs use both T4 and TSH measurements, but these methods can be more complex and less cost-effective.[16,17] These advanced methods require specialized expertise and equipment, making it necessary to perform the procedure in a reference laboratory. POCT devices could potentially enhance the CH process by providing rapid and reliable results, enabling early detection and treatment.[18]

POCT devices for thyroid function tests, including TSH and T4 measurements, are technically feasible.[18] Although POCT has been widely developed and applied in various clinical settings, its potential role in newborn screening for CH is currently being explored. A recent study has demonstrated a strong correlation between TSH POCT devices and conventional immunoassay analyzer as the reference method across multiple sample types, including serum, whole blood and finger-prick blood, with satisfactory agreement (Cohen's kappa = 0.7-0.9) and a very strong correlation (r = 0.90-0.93).[19]

Although POCT devices hold promise for the early detection of CH, their implementation requires careful consideration of reliability, technical feasibility, and integration with existing healthcare systems. The reliability of these tests must be comparable to laboratory-based tests to ensure effective screening. Early detection of CH using POCT is expected to significantly enhance outcomes and prevent long-term developmental impairment by providing an early detection and timely treatment. Moreover, this approach is anticipated to achieve broader screening coverage, particularly in rural and remote areas where current coverage rates remain very low. Therefore, the primary objective of this research was to evaluate the analytical agreement, reliability, and practical efficiency (turnaround time) of a POCT device, utilizing two distinct reagents by comparing it against the conventional reference laboratory technique for neonatal TSH screening.

METHODOLOGY

Study population

The present study was conducted at a mother and child hospital in Surabaya, Indonesia involving 122 newborns who underwent TSH testing as part of a congenital hypothyroidism screening program. We included newborns whose parents provided informed consent, those born at term (gestational age ≥37 weeks), and those in stable condition at the time of sampling. We excluded premature infants (gestational age <37 weeks), infants in critical condition at the time of sampling, and newborns whose mothers had known thyroid disease. This approach ensured that our study population was representative of healthy, term newborns without potential confounding factors related to maternal thyroid conditions.

Participants were recruited using consecutive sampling. All eligible term newborns whose parents provided informed consent during the study period were included sequentially until the target sample size was reached. This sampling technique was considered appropriate for this method-comparison study aimed at evaluating agreement between two laboratory techniques.

Study design

This was a prospective, cross-sectional, single-center method-comparison study conducted from May to August 2024. The study aimed to compare TSH measurements obtained using a POCT device against the traditional reference laboratory method for newborn congenital hypothyroidism screening. Each participant underwent simultaneous TSH testing with both the POCT device (Standard F-200) and the standard dried blood spot reference method (GSP® Neonatal hTSH, PerkinElmer). This design allowed direct comparison of the two methods on the same blood samples collected at the same time point, enabling evaluation of agreement, reliability, and practical application (turnaround time) without requiring long-term follow-up.

Sample collection

Capillary blood samples were obtained by heel prick using a sterile lancet. For the POCT device, approximately 35 μL of capillary blood was collected directly into a 0.5 mL EDTA tube. For the traditional reference method, additional capillary blood was spotted onto filter paper cards to create dried blood spots (DBS). The dried blood spot samples were then sent to the referral laboratory for analysis using the standard national protocol for congenital hypothyroidism screening in Indonesia.

In Indonesia, the traditional newborn screening method for congenital hypothyroidism involves initial screening with thyroid-stimulating hormone (TSH) from dried blood spots, followed by confirmatory testing with venous blood sampling if the screening result is abnormal. However, in this study, only the screening phase was compared.

TSH measurement

TSH levels were measured using two devices:

1. Reference laboratory device: The reference laboratory utilized the GSP® Neonatal hTSH (PerkinElmer,

Wallac Oy, Finland) which is the standard for congenital hypothyroidism screening in Indonesia to measure the TSH level of the newborn screening sample. All samples were processed according to the manufacturer's recommendations.

2. POCT device: This study utilized the Standard F-200 (SD Biosensor, South Korea) to measure the TSH level in the newborn screening sample. The TSH measurements using two different reagents, i.e. Standard™ F TSH-II (SD Biosensor, Inc, South Korea) and FastClear F TSH-II (Standard Biosensor Healthcare, Indonesia). EDTA samples were processed according to the manufacturer's recommendations.

We utilized the GSP® Neonatal hTSH PerkinElmer device as the reference which is the national standardized device for congenital hypothyroid screening in Indonesia. This choice ensured a consistent and standardized reference for method comparison. Dried blood spot samples were analyzed according to the manufacturer's protocol at the referral laboratory. The Standard F-200, which was the evaluated POCT device, represents the only available POCT device for TSH levels with lower limit of detection and readily accessible reagents in Indonesia, further facilitating its potential use in clinical settings. These decisions were exclusively driven by the accessibility and practicality of these devices within the local healthcare setting. There are no conflicts of interest regarding the point-of-care devices examined or the gold standard employed in this study.

Two different POCT reagents (Standard™ F TSH-II for Group 1 and FastClear F TSH-II for Group 2) were used to evaluate the performance and consistency of the Standard F-200 POCT platform with its commercially available reagent options in the Indonesian setting. This approach was chosen to assess whether the POCT device maintains reliable results across different reagent formulations, rather than to perform a direct head-to-head comparison between the two reagents.

Blood samples in the form of dried blood spots were analyzed using the reference device, while 35μL of samples in EDTA tubes were measured with the POCT device. TSH level measurements using the reference device were conducted over more than one week depending on the work schedule in the referral laboratory, while POCT was performed within 30 minutes post-collection at the laboratory of the hospital sampling site.

Classification of respondents

TSH examination results were divided into two groups:

Group 1: Comparing TSH results from 62 infant samples using POCT Standard™ F TSH-II (pTSH1) and the reference device (rTSH1)

Group 2: Comparing TSH results from 60 infant samples using POCT FastClear F TSH-II (pTSH2) and the reference device (rTSH2)

The division of subjects into two groups was based on the use of two different POCT reagents. This approach allowed the evaluation of the performance and reliability of each reagent separately, ensuring a comprehensive assessment of the POCT devices.

The sample size of this method-comparison study was planned according to recommendations for agreement studies involving correlation, ICC, and Bland-Altman analysis, which generally suggest a minimum of 100 subjects. We enrolled 122 term newborns (Group 1: n = 62; Group 2: n = 60) through consecutive sampling. This sample size exceeds the recommended minimum and provides >90% power to detect a correlation coefficient of r ≥0.80 at $\alpha = 0.05$. A conservative paired t-test calculation indicated a minimum of 34 samples; however, the larger sample was chosen to ensure more stable and reliable estimates of agreement.

Ethical clearance

Ethical approval was obtained from the Faculty of Nursing, Universitas Airlangga (No. 3087-KEPK).

Statistical analysis

The statistical analysis was performed using SPSS version 27. Numerical data were reported as means and standard deviations or medians with ranges. Categorical data were expressed as percentages. Normality test was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. The TSH examination results were not normally distributed, thus the data were log-transformed to achieve normality.

Pearson's correlation coefficient and Spearman's rank correlation were used to evaluate the strength of the relationship between POCT and reference TSH measurements. Linear regression analysis was performed to assess the predictive relationship between the two methods. Agreement and bias between the methods were further examined using Bland-Altman analysis. Reliability was assessed using the Intraclass Correlation Coefficient (ICC) with a two-way mixed-effects model. Agreement in categorical classification was evaluated using Cohen's Kappa statistic. Mean differences between POCT and reference TSH levels were tested using the paired t-test for normally distributed data or the Wilcoxon rank-sum test for non-normally distributed data. A two-sided p-value <0.05 was considered statistically significant. No adjustment for multiple testing was applied, as all analyses were pre-specified and complementary to the study objectives of evaluating reliability, agreement, and practical application between the two methods.

No adjustment for confounding variables was performed. This was a method-comparison study in which each participant served as their own control, with POCT and reference TSH measurements obtained from the same blood sample collected at the same time point. Thus, confounding was inherently minimized by the paired study design.

Data processing

There were no missing data in this study. All 122 participants had complete TSH results from both POCT and reference methods. Data were checked for completeness and implausible values prior to analysis. No implausible values were detected, and all data were retained for statistical analysis.

Analysis process

The analysis process includes these following steps.

1. Correlation Analysis: The correlation between TSH measurements obtained using POCT and reference methods was assessed first, revealing a strong correlation.
2. Regression Analysis: Following the correlation analysis, a regression analysis was conducted to establish the relationship between TSH measurements obtained using the two methods. (Supplementary File)

pTSH1 = 0.05+0.29*TSH result POCT Standard™ F TSH-II

pTSH2 = 0.266+0.27*TSH result POCT FastClear TSH-II

3. Assessment of Agreement and Reliability: Bland-Altman analysis was used to evaluate systematic bias and limits of agreement. ICC and Cohen's Kappa were calculated to assess agreement and reliability of POCT device compared to reference method.
4. Mean Difference Check: The mean difference between the TSH levels obtained from the reference method and those predicted by the regression model using the POCT results was evaluated using paired t-tests or Wilcoxon ranked-sum test, depending on the data normality, with a significance level set at p <0.05.

RESULTS

Characteristics of the study subjects

This study included 122 participants evenly distributed into two groups (Table 1). Group 1 comprised 62 participants with a male predominance (54.8%), while Group 2 included 60 participants (51.7% male). None of the participants were twins, and the majority were delivered via sectio caesarea in both groups. The median age at sampling for both groups was 48 hours. TSH levels showed a median of 1.53 mIU/L for pTSH1 and 1.40 mIU/L for rTSH1, whereas Group 2 exhibited medians of 1.64 mIU/L for pTSH2 and 1.65 mIU/L for rTSH2.

Table 1. Characteristics of the study participants according to group

Characteristics	Group 1 (n = 62)	Group 2 (n = 60)
Gender		
Male	34 (54.8%)	31 (51.7%)
Female	28 (45.2%)	29 (48.3%)
Mode of birth		
Spontaneous labor	13 (21%)	13 (21.7%)
Sectio caesarea	49 (79%)	47 (78.3%)
Age at sampling (hours)	45.6 ± 6.2	45.8 ± 6.1
TSH levels		
pTSH (mIU/L)	1.53 (0.29-4.70)	1.64 (0.54-6.15)
rTSH (mIU/L)	1.40 (0.66-6.20)	1.65 (0.66-5.30)
Turnaround time		
pTSH (min)	30 min	30 min
rTSH (days)	22 days	15 days

pTSH = POCT TSH level (Group 1: Standard™ F TSH-II reagent; Group 2: FastClear F TSH-II reagent)
rTSH = Reference method TSH level

Correlation between TSH measurements obtained using POCT and the reference device

The data presented in Figure 1 depicts the relationship between the levels of pTSH1 and rTSH1 results, as analyzed using linear regression. The Pearson correlation coefficient of 0.87 (p <0.001) indicates a strong, statistically significant positive linear association between the two variables. This suggests that as pTSH1 levels increase, the corresponding rTSH1 results tend to increase in a predictable manner. The Spearman correlation coefficient of 0.85 (p <0.001) further corroborates the strong monotonic relationship between the two variables, irrespective of the specific functional form of the association. This nonparametric analysis complements the linear regression findings, providing additional confidence in the robust relationship between TSH results of the POCT TSH II and the corresponding filter paper.

The high coefficients of determination, with an R-squared value of 0.748, signify that approximately 75% of the variation in rTSH1 results can be explained by the linear model, with changes in pTSH1 group levels. This suggests that the TSH result from the POCT i.e., pTSH1 group result is a strong predictor of the filter paper rTSH1 outcome, warranting further investigation into the underlying mechanisms and potential applications of this relationship.

The other presented scatterplot and associated correlation analyses depict a strong, statistically significant relationship between POCT pTSH2 level and filter paper rTSH2 results (Figure 1). The Pearson correlation coefficient of 0.88 (p <0.001) indicates a robust positive linear association between the two variables, suggesting that as pTSH2 level increases, the corresponding filter paper rTSH2 result tends to rise in a predictable manner.

Furthermore, the Spearman correlation coefficient of 0.91 (p <0.001) confirms a strong monotonic relationship between the variables, regardless of the specific functional form of the association. This nonparametric analysis complements the linear regression findings, providing additional confidence in the reliable relationship between POCT pTSH2 levels and reference device rTSH2 results.

The high coefficient of determination, with an R-squared value of 0.776, indicates that approximately 78% of the variation in rTSH2 reference device results can be explained

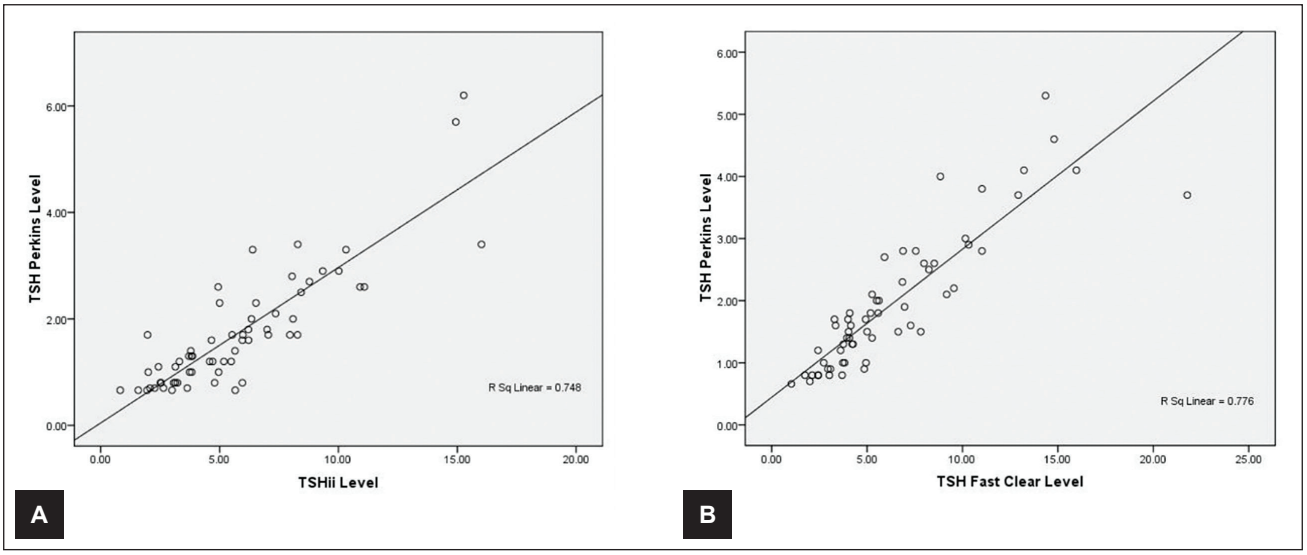

Figure 1. Linear regression analysis of TSH measurements between the POCT device and the traditional reference method. **(A)** Group 1 (using Standard™ F TSH-II reagent) demonstrated a strong positive correlation (Pearson's r = 0.87, *p* <0.001; Spearman's ρ = 0.85, *p* <0.001; R^2 = 0.748). **(B)** Group 2 (using FastClear F TSH-II reagent) showed a similarly robust correlation (Pearson's r = 0.88, *p* <0.001; Spearman's ρ = 0.91, *p* <0.001; R^2 = 0.776). Both panels indicate that POCT TSH levels are strong predictors of the reference laboratory outcomes across different reagent formulations.

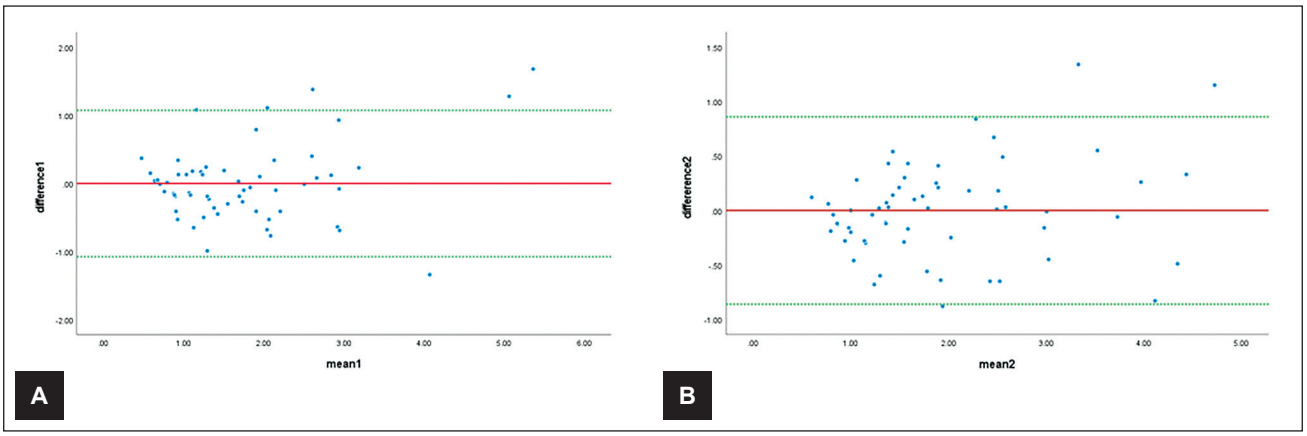

Figure 2. Bland-Altman plots assessing the agreement between the POCT device and the reference method for TSH measurements. **(A)** Group 1 (Standard™ F TSH-II reagent) demonstrates minimal systematic bias with a mean difference of −0.0013 mIU/L. **(B)** Group 2 (FastClear F TSH-II reagent) shows comparable agreement with a mean difference of −0.0003 mIU/L. In both plots, the solid red line represents the mean difference (bias), and the green lines indicate the 95% limits of agreement. Most data points are randomly scattered around the mean difference line within the limits of agreement, indicating good overall agreement, although a slight increase in variability is observed at higher TSH concentrations (>4.0 mIU/L).

by the linear model, with changes in POCT pTSH2 level as the primary predictor. This suggests that the pTSH2 level is a strong and reliable indicator of the rTSH2 reference device level, warranting further investigation into the potential clinical applications and implications of this relationship.

Agreement and reliability statistics

The agreement between the POCT and reference method was evaluated using Bland-Altman analysis, intraclass correlation coefficient (ICC), and Cohen's kappa, stratified by group. Bland-Altman analysis in Figure 2 revealed negligible systematic bias in both groups, with a mean difference of −0.0013 in Group 1 and −0.0003 in Group 2. The 95% limits of agreement were −1.077 to 1.074 for Group 1 and −0.861 to 0.861 for Group 2. Although a mild increase in variability was observed at higher mean values, the majority of data points were randomly distributed around the mean difference line, indicating good overall agreement between the POCT device and the reference method.

As summarized in Table 2, the intraclass correlation coefficient also demonstrated excellent reliability in both groups (Group 1: 0.89 [95% CI: 0.84–0.93]; Group 2: 0.91 [95% CI: 0.86–0.94]). These ICC values indicate excellent reliability and consistency between the POCT devices and the reference method. Cohen's kappa further confirmed strong agreement (Group 1: 0.85, *p* <0.001; Group 2: 0.87, *p* <0.001).

Table 2. Reliability and agreement statistics between POCT and reference method

Group	ICC (95% CI)	Cohen's Kappa (*p*-value)	Mean difference	Lower limit of agreement	Upper limit of agreement
Group 1	0.89 (0.84-0.93)	0.85 (p <0.001)	-0.0013	-1.077	1.074
Group 2	0.91 (0.86-0.94)	0.87 (p <0.001)	-0.0003	-0.861	0.861

Group 2 consistently showed slightly better agreement and reliability compared with Group 1 across all statistical parameters. These Kappa values indicate strong agreement between the POCT devices and the reference method in classifying TSH levels.

Mean difference between TSH measurements from the POCTs and reference method

The analysis of mean difference of pTSH1 and rTSH1 in Group 1 was conducted using the Wilcoxon rank-sum test, chosen for its suitability in handling non-normal distributions, even after logarithmic transformation. The results revealed that the median of pTSH1 level was 1.53, while the median for the rTSH1 assay was 1.40. Importantly, the Wilcoxon rank-sum test showed no statistically significant difference between the TSH levels obtained from the two assays, with a p-value of 0.530. These findings suggest that the POCT assay provides results that are comparable to those of the reference TSH assay in Group 1 results. The use of the Wilcoxon rank-sum test, a robust non-parametric approach, was appropriate given the non-normal distribution of the TSH Group 1 data, thereby enhancing the validity and reliability of the statistical conclusions drawn from this analysis.

Meanwhile, the mean difference of pTSH2 and rTSH2 in Group 2 was conducted using the paired t-test because it was distributed normally after logarithmic transformation. The results revealed that the median of pTSH2 level for the new pTSH2 (ln-pTSH2) was 0.49, while the median for the established rTSH2 assay (ln-rTSH2) was 0.50. The paired t-test showed no statistically significant difference between the TSH levels obtained from the two assays (p = 0.41). These findings suggest that the TSH examination of the POCT assay results is comparable to the result of the reference device in Group 2.

DISCUSSION

In Indonesia, the CH screening program has been in place for over a decade, but the number of infants undergoing congenital hypothyroid screening remains low, and the results are still not timely. One of the challenges noted is the absence of effective delivery systems, which results in delays in shipment and CH screening test results. In Indonesia, the government has established 11 referral laboratories for congenital hypothyroid testing.[5] However, this number is still considered insufficient. For example, the current referral laboratory for CH screening examination in East Java is only available at the Dr. Soetomo Hospital. This situation puts a great burden on this referral laboratory considering that the birth rate in East Java in 2020 was approximately 500,000 births per year.[20]

The infant birth rate in Indonesia is approximately 4.5 million births per year.[21] The Ministry of Health targets about 463,000 samples or equivalent to 10% of newborns for congenital hypothyroid screening. At the beginning of 2015, the number of sample screening achievements was less than 2%. However, this number is currently better, where, in 2023, the number of achievements is 368,552 newborns, or about 8.26% of births.[2] Looking at the number of births, this achievement is still very far when compared to other Southeast Asian countries such as Malaysia, which has reached 95%, Singapore >99%, Thailand 94.1% and the Philippines 65%.[22] This situation provides a basis for trying to find alternatives to the number of achievements given the importance of newborn screening to obtain a golden generation.

In this study, out of the 122 patient samples examined, no results exceeded the normal range for congenital hypothyroidism. This outcome is unsurprising given the rare incidence of congenital hypothyroidism in this population.[23,24] Indeed, it is important to emphasize that this study was designed as a method-comparison study aimed at evaluating the analytical performance, reliability, agreement, and practical application (particularly turnaround time) of the POCT device compared with the standard reference laboratory method. Because no newborns with elevated TSH levels were identified in this cohort, this study does not assess diagnostic accuracy parameters such as sensitivity and specificity. The findings should therefore be interpreted within the context of method agreement and reliability rather than clinical diagnostic performance.

The average waiting time for POCT examination was faster than that of the traditional reference method. The average turn-around time for the POCT TSH results was 30 minutes compared to 15-22 days for the traditional referral method. Early detection followed by early appropriate therapy are critical for successful CH management. Delays in results will affect the provision of therapy in patients with congenital hypothyroidism. The therapy of CH is recommended to be started at the time the baby reaches 2 weeks old.[25,26] The utilization of POCT in CH screening can potentially provide faster results. Nevertheless, the confirmatory examination using a vein blood sample is still required after screening, which is the traditional examination pathway. The earlier the screening results are obtained, the earlier therapy could be started.

In this study, there was a strong positive linear relationship between TSH levels measured using the POCT and the reference device. This strong relationship was observed in both groups regardless of the type of cartridge used. Two different POCT reagents were used to examine the robustness and consistency of the same POCT platform (Standard F-200) across its available reagent options in Indonesia. The use of both reagents was not intended as a direct comparison between them, but to evaluate whether the device performs reliably with different reagent batches. A strong linear monotonic relationship was also obtained in the Pearson and Spearman tests, which gave confidence in the strong association between the two results in both groups 1 and 2. The difference test between TSH results using the POCT device and the reference device also did not yield significant results in both groups. This clearly demonstrated that the TSH results generated by the POCT device were comparable to those obtained via the traditional reference method. These results highlight the potential of POCT devices as an alternative to support the expansion of CH screening coverage in Indonesia as well as warranting further investigation into the potential clinical applications and implications of this relationship.

It has to be mentioned that a mild increase in variability was observed at higher mean TSH values. Possible explanations include the high-dose hook effect, in which extremely high analyte concentrations may saturate the antibodies, leading to falsely altered signal intensity.[19] Other contributing factors include differences in sample matrix and variations in antibody affinity between the two methods. These observations highlight the importance of confirmatory testing with the reference laboratory method when POCT results approach or exceed clinical decision limits, particularly in newborn congenital hypothyroidism screening.[27]

Globally, POCT devices have been widely used in terms of screening and diagnosis, for example in early detection of sickle cell disease and neonatal hypoglycemia in infants.[28–31] The utilization of POCT is especially promising in an archipelago area, such as Indonesia, where access to healthcare often involves lengthy and challenging travel across vast oceans and rugged terrains. POCT offers an excellent alternative to enhance CH screening coverage in such geographically dispersed regions and limited resource settings.

The TSH results in the POCT device and the reference device have the same unit value conversion. However, in this study, the results obtained from the POCT device required regression analysis to determine the relationship between the two methods. This can be due to several reasons including the difference in the methods, sensors, and antibodies used in the examination process on both devices.[19] The discrepancies may also be attributed to variations in the light intensity conversion algorithms used by the devices.

We acknowledge several limitations in our study that should be considered when interpreting the results. Firstly, the sample size of newborns, while sufficient for initial comparisons, may not be large enough to capture the full spectrum of congenital hypothyroidism cases, particularly those with abnormal TSH levels. Future studies with larger sample sizes are necessary to validate our findings and improve the generalizability of the results. Secondly, none of the subjects in our study exhibited TSH levels outside the normal range. This study was designed as a method-comparison study to evaluate the analytical performance, reliability, agreement, and practical application of the POCT device compared with the traditional reference laboratory method, rather than to determine its diagnostic accuracy, including sensitivity and specificity. Further research including subjects with confirmed CH is required to address this gap. Thirdly, the study was conducted at a single hospital in Surabaya, Indonesia. This may limit the generalizability of the findings to other regions or healthcare settings. Multi-center studies are recommended to validate the applicability of POCT devices across diverse populations and healthcare environments.

Despite these limitations, our study provides valuable insights into the potential of POCT devices as a feasible and promising alternative to traditional CH screening methods. We recommend further research to address these limitations and to explore the long-term benefits of POCT in newborn screening programs.

CONCLUSION

The current state of CH screening achievements in Indonesia requires prompt attention. POCT devices present a feasible and promising alternative to the traditional reference screening device for congenital hypothyroidism. Further studies need to be conducted to evaluate the sensitivity and specificity of the POCT by involving patients outside the normal range with a larger sample size and a wider population sample.

Statement of Authorship
All authors certified fulfillment of ICMJE authorship criteria.

CRediT Author Statement
EI: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing – original draft preparation, Writing – review and editing, Supervision, Funding acquisition; **RYR:** Conceptualization, Formal analysis, Investigation, Resources, Data curation, Writing – original draft preparation, Writing – review and editing, Project administration; **FNF:** Conceptualization, Investigation, Data curation, Writing – original draft preparation, Writing – review and editing; **PAS:** Writing – review and editing, Visualization, Project administration; **ENN:** Methodology, Formal analysis, Writing – original draft, Visualization; **MNH:** Methodology, Software, Validation, Formal analysis, Data curation, Writing – original draft preparation, Writing – review and editing; **FAA:** Data curation, Writing – review and editing.

Data Availability Statement

The data that support the findings of this study can be provided by the corresponding author upon reasonable request.

Author Disclosure

The authors declared no conflict of interest.

Funding Source

This study was supported by the Faculty of Medicine and Health, Institut Teknologi Sepuluh Nopember (Grant number: 1086/PKS/ITS/2024).

References

1. Kaluarachchi DC, Allen DB, Eickhoff JC, Dawe SJ, Baker MW. Increased congenital hypothyroidism detection in preterm infants with serial newborn screening. J Pediatr. 2019;207:220–5. PMID: 30579585 DOI: 10.1016/j.jpeds.2018.11.044
2. Octavius GS, Daleni VA, Sagala YDS. An insight into Indonesia's challenges in implementing newborn screening programs and their future implications. Children (Basel). 2023;10(7):1216. PMID: 37508713 PMCID: PMC10378005 DOI: 10.3390/children10071216
3. Faizi M, Rochmah N, Hisbiyah Y, Perwitasari R, Deakandi W, Titiharja FF. Effectiveness of health education toward healthcare knowledge improvement about congenital hypothyroidism newborn screening. Int J Thyroidol. 2022;15(2):105–9. DOI: 10.11106/ijt.2022.15.2.105
4. Salim IA, Putri R, Rosmalawati TA, Cahyono HA, Muttaqin F. Screening for congenital hypothyroidism in Malang, East Java in 2020. Pediatr Sci J. 2022;2(2):38–43. DOI: 10.51559/pedscij.v2i2.28
5. Octavius GS, Daleni VA, Sagala YDS. An insight into Indonesia's progress for newborn screening program: What is currently going on. Heliyon. 2024;10(13):e33479. PMID: 39035496 PMCID: PMC11259875 DOI: 10.1016/j.heliyon.2024.e33479
6. Anggraini A, Suryawati C, Fatmasari Y. Evaluasi pelaksanaan program skrining hipotiroid kongenital oleh puskesmas karangrejo Kota Metro Lampung. Sari Pediatri. 2019;7(1):2356–3346.
7. Rayhan Yasmin N, Kurniati I, Karima N. Result representation of congenital hypothyroid screening (CHS) based on area topography in Bandar Lampung City in May-October 2019. Rev Prim Care Prac and Educ. 2022;5(2):72–7. DOI: 10.22146/rpcpe.76332
8. Anggraini R, Yudha Patria S, Julia M. Ketepatan Waktu pelayanan skrining hipotiroidism kongenital di Yogyakarta. Sari Pediatri. 2017;18(6):436–42. 10.14238/sp18.6.2017.436-42
9. Setyaningsih W, Wulandari RD. The evaluation of congenital hypothyroidism screening program in Indonesia: A literature review. J Aisyah J Ilmu Kesehat. 2022;7(2). DOI: 10.30604/jika.v7i2.1161
10. Pulungan AB, Puteri HA, Faizi M, Hofman PL, Utari A, Chanoine JP. Experiences and challenges with congenital hypothyroidism newborn screening in Indonesia: A national cross-sectional survey. Int J Neonatal Screen. 2024;10(1):8. PMID: 38390972 PMCID: PMC10885017 DOI: 10.3390/ijns10010008
11. Kopel J. A global perspective on newborn congenital hypothyroidism screening. Prov (Bayl Univ Med Cent). 2020;33(1):137–9. PMID: 32063801 PMCID: PMC6988672 DOI: 10.1080/08998280.2019.1668715
12. Pulungan AB, Oldenkamp ME, van Trotsenburg ASP, Windarti W, Gunardi H. Effect of delayed diagnosis and treatment of congenital hypothyroidism on intelligence and quality of life: An observational study. Med J Indones. 2019;28(4):396–401. DOI: 10.13181/mji.v28i4.3473
13. Esposito A, Vigone MC, Polizzi M, et al. Effect of initial levothyroxine dose on neurodevelopmental and growth outcomes in children with congenital hypothyroidism. Front Endocrinol (Lausanne). 2022;13:923448. PMID: 36133316 PMCID: PMC9484273 DOI: 10.3389/fendo.2022.923448
14. Pelaez JM, Rojas-Ramos JCR, Domingos MT, et al. Cognitive outcome of 458 children over 25 years of neonatal screening for congenital hypothyroidism. J Pediatr (Rio J). 2023;99(5):478–84. PMID: 37088106 PMCID: PMC10492150 DOI: 10.1016/j.jped.2023.03.003
15. Ruth Adisty N, Hidayat B. Gambaran pertumbuhan anak dengan hipotiroid kongenital pasca-terapi levotiroksin di RSUP Dr. Hasan Sadikin pada tahun 2014 sampai dengan 2018. Sari Pediatri. 2020;22(2):98–103. DOI: 10.14238/sp22.2.2020.98-103
16. Boelen A, Zwaveling-Soonawala N, Heijboer AC, van Trotsenburg ASP. Neonatal screening for primary and central congenital hypothyroidism: Is it time to go Dutch? Eur Thyroid J. 2023;12(4):e230041. PMID: 37326450 PMCID: PMC10388664 DOI: 10.1530/ETJ-23-0041
17. Donaldson MDC, Grosse SD. Does early identification of central congenital hypothyroidism result in improved outcomes? J Clin Endocrinol Metab. 2021;106(5):e2373–5. PMID: 33517453 PMCID: PMC8328040 DOI: 10.1210/clinem/dgab059
18. Mashabi Y. Screening T4 and TSH in early detection of congenital hypothyroidism in newborns: What's the dilemma? Jurnal Biomedika dan Kesehatan. 2024;7(1):1–5. DOI: 10.18051/JBiomedKes.2024.v7.1-5
19. Shurbaji S, Al Tamimi F, Al Ghwairi MM, et al. High-sensitive detection and quantitation of thyroid-stimulating hormone (TSH) from capillary/fingerstick and venepuncture whole-blood using fluorescence-based rapid lateral flow immunoassay (LFIA). Heliyon. 2023;9(10):e20589. PMID: 37842620 PMCID: PMC10569953 DOI: 10.1016/j.heliyon.2023.e20589
20. Badan Pusat Statistik Jawa Timur. Accessed December 15, 2024. www.jatim.bps.go.id
21. Therrell BL, Padilla CD, Loeber JG, et al. Current status of newborn screening worldwide: 2015. Semin Perinatol. 2015;39(3):171–87. PMID: 25979780 DOI: 10.1053/j.semperi.2015.03.002
22. Therrell BL, Padilla CD, Borrajo GJC, et al. Current status of newborn bloodspot screening worldwide 2024: A comprehensive review of recent activities (2020–2023). Int J Neonatal Screen. 2024;10(2):38. PMID: 38920845 PMCID: PMC11203842 DOI: 10.3390/ijns10020038
23. Kurniawan LB. Congenital hypothyroidism: Incidence, etiology and laboratory screening. Indonesian J Clin Pathology Med Lab. 2020;26(3):375–80. DOI: 10.24293/ijcpml.v26i3.1527
24. Pulungan AB, Soesanti F, Utari A, et al. Preliminary study of newborn Screening for congenital hypothyroidism and congenital adrenal hyperplasia in Indonesia. eJKI. 2020;8(2).
25. Rose SR, Wassner AJ, Wintergerst KA, et al; Section on Endocrinology Executive Committee; Council on Genetics Executive Committee. Congenital hypothyroidism: Screening and management. Pediatrics. 2023;151(1):e2022060419. PMID: 36827521 DOI: 10.1542/peds.2022-060420
26. Rochmah N, Faizi M, Dewanti C, Suryawan A. Pediatric quality of life in congenital hypothyroidism: An Indonesian study. Int J Thyroidol. 2020;13(2):150–4. DOI: 10.11106/ijt.2020.13.2.150
27. Butler AM, Charoensiriwatana W, Krasao P, et al. Newborn thyroid screening: Influence of pre-analytic variables on dried blood spot thyrotropin measurement. Thyroid. 2017;27(9):1128–34. PMID: 28810813 DOI: 10.1089/thy.2016.0452
28. Adegoke SA, Makalo L, Sallah A, et al. Point-of-care newborn screening for sickle cell disease at selected health facilities in the Gambia. Hemoglobin. 2024;48(3):169–74. PMID: 38980121 DOI: 10.1080/03630269.2024.2369523
29. Nnodu O, Isa H, Nwegbu M, et al. HemoTypeSC, a low-cost point-of-care testing device for sickle cell disease: Promises and challenges. Blood Cells Mol Dis. 2019;78:22–8. PMID: 30773433 PMCID: PMC6692636 DOI: 10.1016/j.bcmd.2019.01.00730.
30. Karbalivand H, Iyare A, Aponte A, Xianhong X, Kim M, Havranek T. Hypoglycemia screening of asymptomatic newborns on the 2nd day of life. J Neonatal Perinatal Med. 2022;15(2):311–6. PMID: 34974442 DOI: 10.3233/NPM-210861
31. Wada A, Takagi Y, Kono M, Morikawa T. Accuracy of a new platelet count system (PLT-F) depends on the staining property of its reagents. PLoS One. 2015;10(10):e0141311. PMID: 26496387 PMCID: PMC4619826 DOI: 10.1371/journal.pone.0141311

Authors are required to accomplish, sign and submit scanned copies of the JAFES Author Form consisting of: (1) Authorship Certification, that authors contributed substantially to the work, that the manuscript has been read and approved by all authors, and that the requirements for authorship have been met by each author; (2) the Author Declaration, that the article represents original material that is not being considered for publication or has not been published or accepted for publication elsewhere, that the article does not infringe or violate any copyrights or intellectual property rights; that no references have been made to predatory/suspected predatory journals; and that use of artificial intelligence (AI) or AI-assisted technologies shall be declared to include the name of the AI tool or service used;(3) the Author Contribution Disclosure, which lists the specific contributions of authors; (4) the Author Publishing Agreement which retains author copyright, grants publishing and distribution rights to JAFES, and allows JAFES to apply and enforce an Attribution-Non-Commercial Creative Commons user license; and (5) the Conversion to Visual Abstracts (*optional for original articles only) to improve dissemination to practitioners and lay readers Authors are also required to accomplish, sign, and submit the signed ICMJE form for Disclosure of Potential Conflicts of Interest. For original articles, authors are required to submit a scanned copy of the Ethics Review Approval of their research as well as registration in trial registries as appropriate. For manuscripts reporting data from studies involving animals, authors are required to submit a scanned copy of the Institutional Animal Care and Use Committee approval. For Case Reports or Series, and Images in Endocrinology, consent forms, are required for the publication of information about patients; otherwise, appropriate ethical clearance has been obtained from the institutional review board. Articles and any other material published in the JAFES represent the work of the author(s) and should not be construed to reflect the opinions of the Editors or the Publisher.