

DOI: <http://dx.doi.org/10.31365/issn.2595-1769.2026.0417>

Comparison between visual assessment of jaundice, transcutaneous bilirubin and total serum bilirubin in healthy term neonates needing phototherapy

Comparação entre avaliação visual de icterícia, bilirrubina transcutânea e bilirrubina sérica total em recém-nascidos a termo saudáveis com necessidade de fototerapia

Comparación entre la evaluación visual de la ictericia, la bilirrubina transcutánea y la bilirrubina sérica total en recién nacidos sanos a término que requieren fototerapia

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ABSTRACT

Introduction: Neonatal jaundice is one of the most common clinical conditions in newborns. **Objective:** To evaluate the correlation between visual assessment of jaundice, transcutaneous bilirubin (TcB) measurement, and total serum bilirubin (TSB) level in newborns requiring phototherapy. **Methods:** This observational, cross-sectional, and prospective study included term newborns from a tertiary hospital who developed jaundice requiring phototherapy. The correlation between visual assessment, TcB, and TSB was analyzed using one-way analysis of variance (ANOVA) followed by Duncan's post-hoc test. The correlation and consistency between TcB and TSB were assessed using Pearson's correlation test and Bland-Altman analysis. A p-value <0.05 was considered statistically significant. **Results:** 187 newborns were included. Visual assessment of jaundice showed a low correlation (22.1%) with TSB levels. The difference between TcB and TSB levels was significantly greater in infants classified as Kramer zones 4 and 5 compared to zones 1-3 (p<0.001). A strong correlation was found between TcB and TSB measurements (r=0.87; p<0.001). TcB values underestimated TSB values by an average of 1.21 mg/dL. **Conclusions:** TcB showed a good correlation with TSB and should be used as a reliable screening method for neonatal jaundice. However, TcB tended to underestimate TSB levels. The visual assessment of jaundice correlated poorly with bilirubin values and should not be used as a standalone method to estimate bilirubin levels in neonates. **Keywords:** Jaundice; Hyperbilirubinemia; Phototherapy; Infant, Newborn.

RESUMO

Introdução: Icterícia neonatal é uma das condições clínicas mais comuns em recém-nascidos. **Objetivo:** Avaliar a correlação entre avaliação visual da icterícia, medida da bilirrubina transcutânea (BTC) e nível de bilirrubina sérica total (BST) em recém-nascidos com necessidade de fototerapia. **Métodos:** Estudo observacional, transversal e prospectivo incluiu recém-nascidos a termo de hospital terciário que desenvolveram icterícia com necessidade de fototerapia. A correlação entre avaliação visual, BTC e BST foi analisada pelo one-way analysis of variance (ANOVA) seguido do teste post-hoc de Duncan. A correlação e consistência entre BTC e BST foram realizadas pelo teste de correlação de Pearson e análise de Bland-Altman. Valor de p<0.05 foi considerado estatisticamente significativo. **Resultados:** Foram incluídos 187 recém-nascidos. A avaliação visual da icterícia demonstrou baixa correlação (22.1%) com os níveis de BST. A diferença entre os níveis de BTC e BST foi significativamente maior nos bebês classificados como zonas de Kramer 4 e 5 comparados as zonas 1-3 (p< 0.001). Foi encontrada uma forte correlação entre as medidas da BTC e TSB (r=0.87; p<0.001). Os valores da BTC subestimaram os valores da BST em média de 1.21 mg/dL. **Conclusões:** A BTC mostrou boa correlação com a BST e deve ser usada como um método de triagem confiável para icterícia neonatal. A BTC tendeu, contudo, a subestimar os níveis de BST. A avaliação visual da icterícia apresentou baixa correlação com os valores de BST e não deveria ser usada como método isolado para estimar os níveis de bilirrubina em recém-nascidos.

Palavras-chave: Icterícia; Hiperbilirrubinemia; Fototerapia; Recém-Nascido.

RESUMEN

Introducción: La ictericia neonatal es una de las afecciones clínicas más comunes en los recién nacidos. **Objetivo:** Evaluar la correlación entre la evaluación visual de la ictericia, la medición de la bilirrubina transcutánea (BTC) y el nivel de bilirrubina sérica total (BST) en recién nacidos que requieren fototerapia. **Métodos:** Este estudio observacional, transversal y prospectivo incluyó a recién nacidos a término de un hospital terciario que desarrollaron ictericia que requirió fototerapia. La correlación entre la evaluación visual, BTC y BST se analizó mediante análisis de varianza unidireccional (ANOVA) seguido de la prueba post-hoc de Duncan. La correlación y consistencia entre BTC y BST se evaluaron mediante la prueba de correlación de Pearson y el análisis de Bland-Altman. Un valor de p <0,05 se consideró estadísticamente significativo. **Resultados:** Se incluyeron 187 recién nacidos. La evaluación visual de la ictericia mostró baja correlación (22,1%) con los niveles de BST. La diferencia entre los niveles de BTC y BST fue significativamente mayor en los lactantes clasificados como zonas 4 y 5 de Kramer en comparación con las zonas 1-3 (p<0,001). Se encontró una fuerte correlación entre las mediciones de BTC y BST (r=0,87; p<0,001). Los valores de BTC subestimaron los valores de BST en un promedio de 1,21 mg/dL. **Conclusiones:** BTC mostró una buena correlación con BST y debería utilizarse como un método de cribado fiable para la ictericia neonatal. Sin embargo, BTC tendió a subestimar los niveles de BST. La evaluación visual de la ictericia mostró una baja correlación con los valores de BST y no debería utilizarse como método aislado para estimar los niveles de bilirrubina en recién nacidos. **Palabras Clave:** Ictericia; Hiperbilirrubinemia; Fototerapia; Recién nacido.

INTRODUCTION

Neonatal jaundice is a common condition affecting 60% of full-term and 80% of preterm infants; it is associated with elevated levels of unconjugated bilirubin in circulation, condition known as indirect hyperbilirubinemia.¹⁻⁵ Most cases of neonatal jaundice are mild and resolve spontaneously. In some instances, however, the newborn may require treatment, such as phototherapy or exchange transfusion.^{5,6} In cases of severe, untreated jaundice, infants can develop significant hyperbilirubinemia, which may lead to bilirubin encephalopathy, permanent brain damage, and even death.⁶⁻¹⁴

Neonatal jaundice results from the accumulation of the yellow-orange pigment bilirubin in the sclera, skin, and other tissues, and follows a cephalocaudal progression.^{2,3,8,15-17} For jaundice to be visually detectable, the total serum bilirubin (TSB) concentration must exceed 5-6 mg/dL. However, even experienced neonatologists underestimate bilirubin concentrations in these newborns.^{2,4,15,18,19}

The American Academy of Pediatrics (AAP) recommends that bilirubin measurement be performed on all newborns of 35 weeks' gestation or older prior to hospital discharge to determine the risk of developing significant hyperbilirubinemia.^{2,3,5,6,8,11,13,20-22}

Measurement of total serum bilirubin remains the gold standard for assessing jaundice.^{1,3,8,13,14,17,20,21,23} However, obtaining a blood sample to measure TSB is an invasive, painful, and time-consuming procedure; it can cause infection in the infant and also generates stress for the parents.^{1-4,6,11,13,14,23} Transcutaneous bilirubin (TcB) measurement was introduced by Yamanouchi and colleagues in 1980.^{6,7,22} Today, TcB is widely accepted as a non-invasive, portable, cost-effective, and easy-to-use alternative for assessing bilirubin, providing an instant result that correlates well with TSB levels.^{1,5,6,9,10,14,21-23}

The device that measures TcB emits

light onto the skin (typically the sternum or forehead) and analyzes the intensity of the reflected light at specific wavelengths.^{1-3,5,7,10,14,15} Various consensus statements and studies recommend TcB measurement as a screening tool to detect clinically significant jaundice and, consequently, reduce the need for frequent blood sampling in newborns of more than 35 weeks' gestation.^{1,5,10,20,21,22,24-26} In general, a safety margin of 3 mg/dL is used when TcB is measured.^{1,21} However, TcB measurements may overestimate or underestimate bilirubin values when compared to TSB.^{1,7,10} The reliability of TcB measurements decreases significantly when bilirubin concentration exceeds 12-15 mg/dL.^{2,15,21,24,26}

Neonatal jaundice is a common issue among newborns; approximately one in ten infants develops clinically significant jaundice requiring monitoring or treatment.² Thus, this study aimed to analyze the correlation between visual assessment of jaundice, TcB and TSB levels in healthy term newborns admitted to rooming-in care who required phototherapy. Furthermore, the accuracy of clinical assessment among healthcare professionals with varying levels of experience – including pediatric residents, pediatricians, and neonatologists – was investigated.

METHOD

Study design and population

This prospective, observational, cross-sectional study was conducted in the rooming-in care of a tertiary maternity hospital in Southern Brazil. The research was approved by the Human Research Ethics Committee of the Hospital de Clínicas Complex at the Federal University of Paraná (CAAE 71306723.8.0000.0096/2023, on August 3, 2023).

The study included term infants admitted to the rooming-in care who developed neonatal jaundice and required phototherapy between August 3, 2023, and August 2, 2024. Exclusion criteria were newborns with infections or genetic

syndromes, those readmitted for phototherapy without having undergone phototherapy during a previous hospital stay, and infants requiring transfer to the Neonatal Intensive Care Unit.

The estimated sample size was based on an expected prevalence of phototherapy needed among term infants of approximately 6%, with a 95% confidence interval and a 3% margin of error, resulting in a minimum sample of 184 patients.

Study variables

Maternal information – including age during pregnancy, race, and mode of delivery – was obtained from all participants. Neonatal data included sex, gestational age, birth weight, cause of jaundice, visual assessment of jaundice, age in hours at the onset of jaundice and at the start of phototherapy, as well as TcB and TSB measurements. Data such as the duration of phototherapy and length of hospital stay were also collected.

Laboratory assessments included blood typing and Rhesus (Rh) factor for both mother and infant, direct Coombs test, hematocrit, reticulocyte count, and levels of TSB and indirect bilirubin.

Definitions

Visual assessment of jaundice was performed by pediatric residents, pediatricians, or neonatologists using Kramer zones during the newborn's daily physical examination in the rooming-in care and prior to hospital discharge.¹⁹ The Kramer score estimates jaundice intensity based on the progression of yellow skin discoloration from the head toward the hands and feet. In zone 1, jaundice is confined to the face and neck (TSB 4-8 mg/dL, mean 6 mg/dL); in zone 2, jaundice progresses to the trunk down to the umbilical region (TSB 5-12 mg/dL, mean 9 mg/dL); in zone 3, jaundice extends to the groin and upper thighs (TSB 8-16 mg/dL, mean 12 mg/dL); in zone 4, it involves the knees and elbows down to the ankles and wrists (TSB 11-18 mg/dL, mean 15 mg/dL); and in zone 5, it reaches the feet and hands, including the

palms and soles (TSB ≥ 15 mg/dL, mean 18 mg/dL).¹⁹ Clinical assessment of jaundice and TcB measurement were performed within a 30-minute interval. Correct classification of Kramer zones was established retrospectively based on TSB values, comparing the measured TSB against the estimated values for each level corresponding to the Kramer zones.

The transcutaneous bilirubinometer used was the Dräger JM-105®. Three measurements were taken on each newborn's sternum; the device then calculated a mean value and displayed it to the examiner. TcB assessment was performed during routine jaundice screening or, at the very least, prior to hospital discharge.¹⁹ Laboratory tests were ordered when the newborn's TcB level was 2-3 mg/dL below the threshold for initiating phototherapy.²¹ Venous or arterial blood samples for TSB assessment were collected within 30-60 minutes of the TcB measurement. TSB levels were determined using a spectrophotometric method with an automated biochemical analyzer (Alinity i, Abbott). In a few instances, blood samples were not collected during the night to avoid delaying the initiation of phototherapy.

The indication for phototherapy was based on the nomogram proposed by the AAP in 2004 for newborns with a gestational age of 35 weeks or more, and in most cases, it was guided by TSB levels.²⁰ The 2004 consensus guidelines were used because they remained the standard reference for attending physicians regarding jaundice assessment and phototherapy indications.

Statistical analysis

Statistical analyses were performed using Python software (version 3.11) with the SciPy, Statsmodels, Seaborn, Matplotlib, and Pandas packages. Continuous variables were presented as means with standard deviation or medians with interquartile range (IQR), depending on the data distribution. Categorical variables were expressed as absolute and relative frequencies. Categorical variables were compared using Pearson's chi-square test. To compare TcB and TSB with

Kramer zones, a one-way analysis of variance (ANOVA) was used, followed by Duncan's post-hoc test to assess differences between groups.

The correlation between TcB and TSB levels was assessed using Pearson's correlation coefficient (r), and the linear relationship between the variables was expressed via a simple linear regression equation, including the calculation of the coefficient of determination (R^2). Agreement between the two methods was examined using Bland-Altman analysis, estimating mean bias and limits of agreement (± 1.96 standard deviations). Scatter plots with an identity line were constructed to compare the distribution of measurements. To investigate the reproducibility and consistency of clinical thresholds, the Intraclass Correlation Coefficient (ICC) was calculated, and scatter plots were generated to visualize the line of association between TcB and TSB.

A p -value < 0.05 was considered statistically significant, and a significance level of 5% was adopted for all tests.

RESULTS

During the study period, 3,570 babies were born at our institution. Of these, 3,117 were term newborns, and 2,951 were assigned to rooming-in care with their mothers. Among the babies assigned to rooming-in, 201 (6.8%) developed indirect hyperbilirubinemia requiring phototherapy. Fourteen patients were excluded from the study due to parental refusal ($n=9$), congenital infections ($n=3$), sepsis ($n=1$), and the need for transfer to the Neonatal Unit ($n=1$). The final sample consisted of 187 newborns.

The mean maternal age was 27.7 ± 6.7 years, and 110 (58.8%) mothers were white. Most babies were born via vaginal delivery

(77.0%), and 92 (49.2%) were male. The mean gestational age was 38.6 ± 1.3 weeks, and the mean birth weight was $3,134.4 \pm 447.9$ g. The most common causes of jaundice were ABO incompatibility (40.1%) and breastfeeding jaundice (31.6%).

Jaundice was initially detected at a median age of 25 hours (IQR = 18-36); most cases were classified as Kramer Zone 2 (47.1%), with a mean TcB level of 8.9 ± 2.4 mg/dL and a mean TSB level of 10.6 ± 2.8 mg/dL. Phototherapy was initiated at a median age of 44 hours (IQR = 28-54). At the same time, visual assessment classified most cases as Kramer Zones 2 and 3 (71.1%); however, based on TSB levels, the correct Kramer Zone classification fell between 3 and 5 in 81.3% of cases. Mean TcB at the start of phototherapy was 11.0 ± 2.6 mg/dL, and mean TSB was 12.4 ± 3.2 mg/dL. Overall, TcB values were lower than the corresponding TSB values. The median duration of phototherapy was 30 hours (IQR = 24-50), and the mean length of hospital stay was 119.7 ± 35.9 hours.

Visual assessment of jaundice at the start of phototherapy showed poor agreement with Kramer Zone classification based on TSB levels, with only 22.1% of cases correctly classified. Accuracy analysis regarding visual jaundice assessment versus TSB levels among evaluators showed rates of 21.7% for pediatric residents, 21.2% for pediatricians, and 44.4% for neonatologists (Pearson's chi-square test). Correct Kramer Zone classification was determined retrospectively based on TSB values and adjusted using Duncan's post-hoc test. The difference between TcB and TSB values was significantly greater in infants classified as Kramer Zones 4 and 5 compared to those classified as Zones 1, 2, and 3 ($p < 0.001$) (Table 1).

Table 1. Correlation between Kramer zone, TcB, and TSB

TcB/TSB	Kramer zone at the onset of jaundice						p
	1 (n = 50)	2 (n = 85)	3 (n = 31)	4 (n = 5)	5 (n = 0)		
TcB	6. 8±1.4	9. 0±1.7	11 .2±2.3	13. 1±2.3	--		< 0.001
TSB	7. 8±1.6	10 .5±2.3	12 .5±2.0	15. 4±2.3	--		< 0.001
Difference between TSB and TcB	- 0.6	- 1.1	- 1.1	-2.3 --			< 0.001
TcB/TSB	Kramer zone at the start of phototherapy						p
	1 (n = 23)	2 (n = 62)	3 (n = 60)	4 (n = 19)	5 (n = 0)		
TcB	7. 4±1.5	10 .3±1.8	12 .2±2.1	13. 4±1.8	--		< 0.001
TSB	8. 0±1.6	11 .5±2.3	13 .5±2.2	16. 4±2.2	--		< 0.001
Difference between TSB e BTC	- 0.5	- 1.2	- 1.4	-2.6 --			< 0.001
TcB/TSBS	Correct Kramer zone at the start of phototherapy						p
	1 (n = 3)	2 (n = 19)	3 (n = 54)	4 (n = 54)	5 (n = 33)		
TcB	5, 3±1,0	7, 1±1,0	9, 9±1,3	12, 2±1,6	13 ,5±1,7		< 0,001
TSB	5, 5±0,4	7, 4±0,8	10 ,6±0,8	13, 5±0,9	16 ,7±1,6		< 0,001
Difference between TSB and TcB	- 0,2	- 0,3	- 0,8	-1,3 3,0	-		< 0,001

TcB: Transcutaneous bilirubin. TSB: Total serum bilirubin. One-way ANOVA, Duncan's post-hoc test.

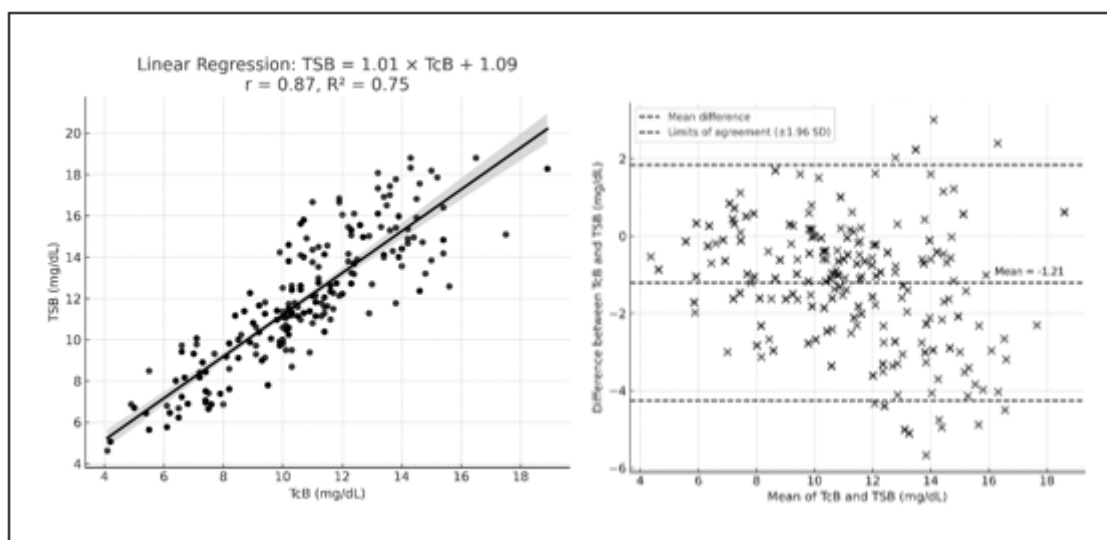
Both the Pearson correlation coefficient and linear regression analysis revealed strong correlation between TcB and TSB levels ($r = 0.87$, $p < 0.001$; $R^2 = 0.75$). In the Bland-Altman analysis, TcB values were, on average, 1.21 mg/dL lower than TSB values, with limits of agreement ranging from -4.26 to +1.84 mg/dL (Figure 1).

The mean differences between TcB and TSB, stratified by TSB levels, were as follows: for TSB ≤ 12 mg/dL, -0.67 mg/dL (95% CI: -2.80 to 1.45 mg/dL); for TSB > 12 mg/dL, -

1.91 mg/dL (95% CI: -5.41 to 1.24 mg/dL); for TSB > 13 mg/dL, -2.28 mg/dL (95% CI: -5.80 to 1.24 mg/dL); and for TSB > 15 mg/dL, -2.97 mg/dL (95% CI: -6.22 to 0.29 mg/dL) (Figure 2).

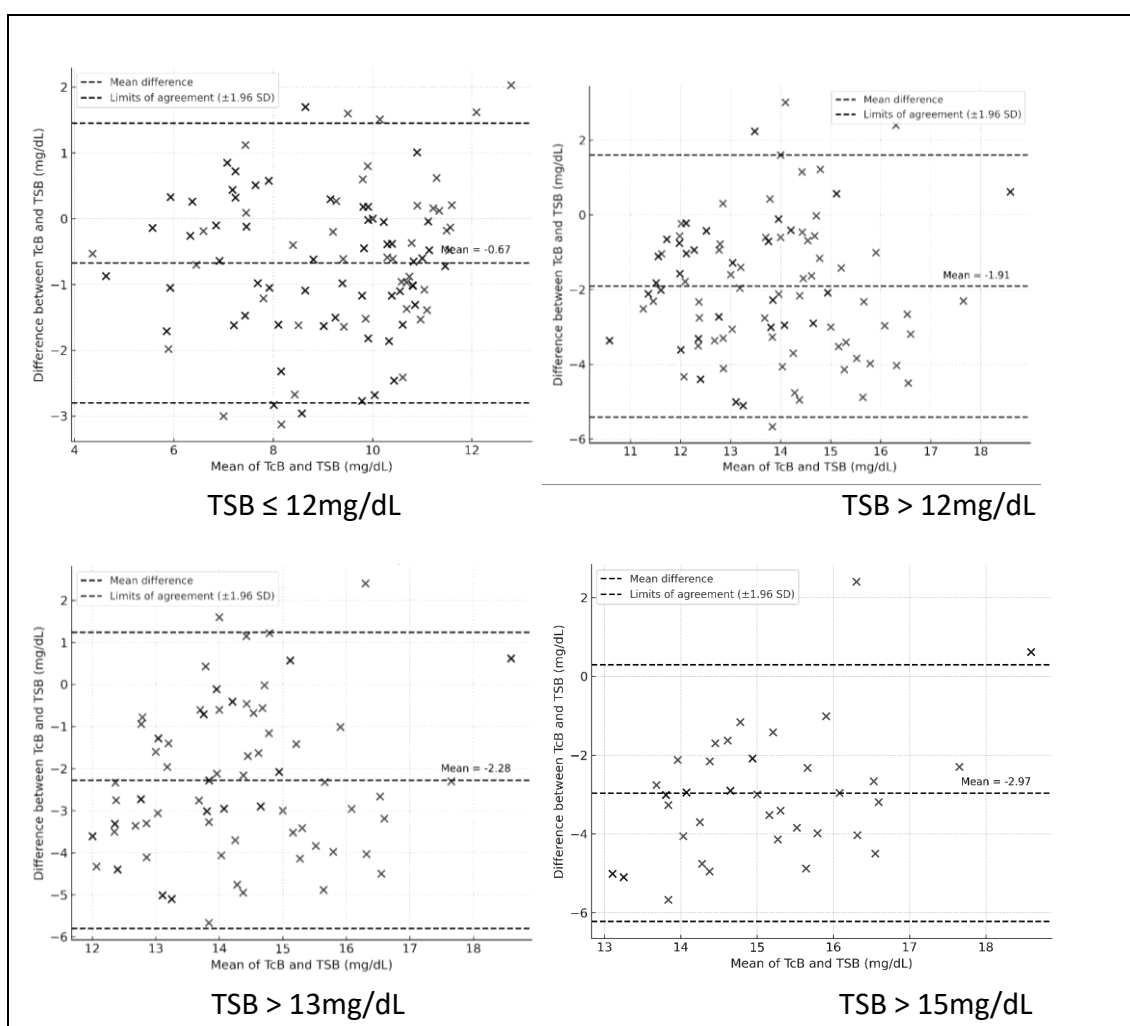
Agreement between TSB and TcB measurements was also evaluated using the Intraclass Correlation Coefficient (ICC). For TSB ≤ 12 mg/dL, ICC = 0.91 (95% CI: 0.87–0.94); for TSB ≤ 13 mg/dL, ICC = 0.90 (95% CI: 0.87–0.93); and for TSB ≤ 15 mg/dL, ICC = 0.88 (95% CI: 0.84–0.91) (Figure 3).

Figure 1. Correlation between TSB and TcB measurements and the mean of the differences in the distribution of TcB and TSB measurements



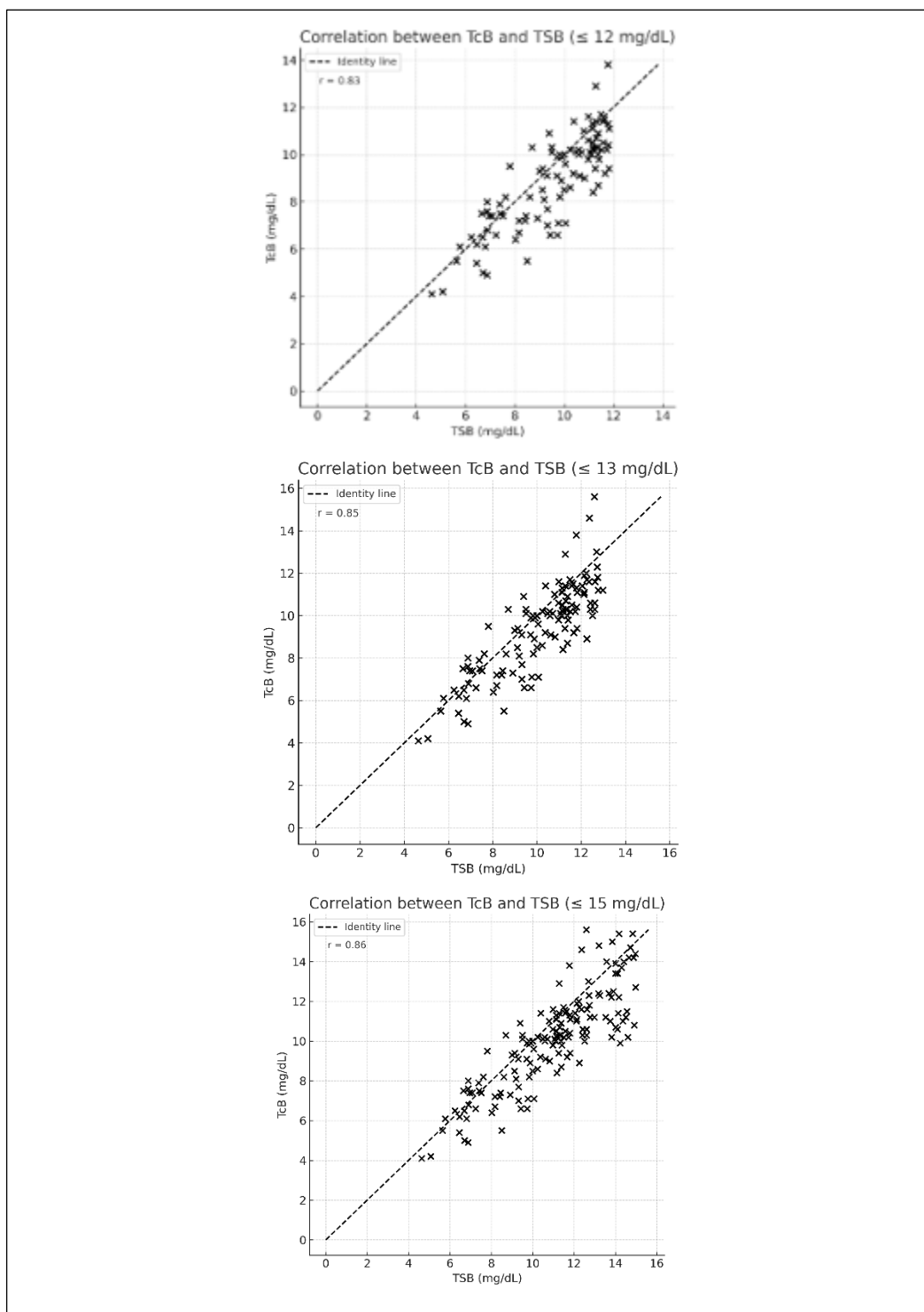
Note: TSB: Total Serum Bilirubin. TcB: Transcutaneous Bilirubin. Pearson correlation coefficient: $r = 0.87$. Bland-Altman analysis (mean -1.21 ± 1.96 , 95% CI: $[-4.26]-[1.84]$).

Figure 2. Mean difference in the distribution of TcB and TSB measurements



Note: TSB: Total Serum Bilirubin. TcB: Transcutaneous Bilirubin. Bland-Altman analysis.

Figure 3. Scatter plots of transcutaneous bilirubin levels versus total serum bilirubin



Scatter plots comparing transcutaneous bilirubin (TcB) and total serum bilirubin (TSB) levels in newborns, using three thresholds: ≤ 12 mg/dL, ≤ 13 mg/dL, and ≤ 15 mg/dL. The dashed line represents the line of identity (TcB=TSB). A strong correlation was observed at all thresholds. The Pearson correlation coefficient (r) was high, supporting the strong linear agreement. The intraclass correlation coefficient (ICC2) was: 0.91 (95% CI: 0.87–0.94) for TSB ≤ 12 mg/dL; 0.90 (95% CI: 0.87–0.93) for TSB ≤ 13 mg/dL; and 0.88 (95% CI: 0.84–0.91) for TSB ≤ 15 mg/dL.

DISCUSSION

Neonatal jaundice is one of the most common clinical conditions occurring during the transitional period after birth. Phototherapy is widely used to treat newborns when total serum bilirubin (TSB) reaches high levels, to prevent a serious condition called kernicterus.¹⁻⁹ Therefore, early and accurate diagnosis of neonatal jaundice is essential for appropriate treatment.^{1-4,8,20,21} Various neonatal consensus statements and studies recommend using transcutaneous bilirubin (TcB) measurement as a non-invasive method to identify newborns who will require TSB measurement before starting phototherapy.^{1-3,5,8,21} The AAP endorses the use of TcB as a valid and reliable method, particularly when the TcB value is 3 mg/dL below the phototherapy threshold and when the TcB value is below 15 mg/dL.²¹

In this study, visual assessment of jaundice showed a low correlation with TSB measurement, especially when jaundice was visually classified as Kramer zones 4 and 5. These findings align with the literature, which consistently reports that visual assessment of jaundice alone is not a reliable screening method for identifying significant neonatal hyperbilirubinemia.^{12,15,16,18} At our institution, TcB devices are used routinely, generally following visual assessment of jaundice. Contrary to our findings, Mishra et al. reported that both visual assessment and TcB showed a significant correlation with TSB values.²⁵ In our study, neonatologists were the most accurate assessors of jaundice, likely due to their greater professional experience (median 14 years, IQR 7-20) compared to pediatricians (median 5 years, IQR 2-8) and medical residents. Riskin et al.²⁷ also reported that neonatologists identified significant neonatal hyperbilirubinemia better than experienced nurses. Previous studies suggest that the complete absence of jaundice can also be used to predict with high accuracy that those infants will not develop jaundice.^{18,21}

This study demonstrated a strong

correlation between TcB and TSB measurements, a finding also observed by several researchers.^{3,4,6,7,9,11,13,14,22,23} However, Speychal et al. reported poor agreement between the two methods.²⁴

Our results showed that TcB measurements underestimated TSB measurements. This finding aligns with studies by Jones et al.,¹¹ who observed that the JM-105 bilirubinometer underestimated TSB values when used on the sternum of Caucasian neonates, and Ohishi et al.,²⁶ who revealed similar underestimation in healthy Japanese newborns. Conversely, other studies reported that TcB measurements overestimated TSB values.^{4,6,9,13,14,23,24} Overestimation can lead to unnecessary blood sampling and treatment, whereas underestimation can delay necessary intervention and result in potentially serious complications for these newborns.^{9,13}

In this study, the mean difference between TcB and TSB values was -1.21 mg/dL, with limits of agreement ranging from -4.23 to 1.84 mg/dL. Jones et al.¹¹ reported a mean difference of -0.21 mg/dL $\pm$ 1.15 mg/dL, whereas Ying et al.¹³ found a mean difference of 1.17 mg/dL (range: -2.22 to 4.56 mg/dL), and Esteban et al.²³ reported a mean difference of 1.72 $\pm$ 1.48 mg/dL.

Our findings also showed that the higher the TSB values, the lower the accuracy of TcB values. Bland-Altman analysis revealed good overall agreement between TcB and TSB levels; however, as TSB levels increased, the discrepancy between TcB and TSB levels widened. This has also been observed in other studies.^{11,13,23}

In this study, when TSB values exceeded 15 mg/dL, the mean difference between TcB and TSB was -2.97 mg/dL, representing the largest negative bias observed among all analyzed values. The range of limits of agreement was also considerably wider, extending to more than 6 mg/dL below the TSB value. These findings indicate that TcB becomes less reliable at high

bilirubin levels, a conclusion supported by AAP recommendations, which advise obtaining a TSB measurement when TcB values exceed 15 mg/dL.²¹

Although the Dräger JM-105 device requires a high initial investment (costing approximately US\$7,000), its use for TcB screening has been shown to reduce long-term costs by decreasing hospital readmissions and the need for frequent blood draws – benefits that also reduce physician workload and laboratory costs.^{5,11} Furthermore, these cost estimates do not account for non-monetary factors, such as stress experienced by the infant and parents or potential complications associated with blood sampling.¹¹

This study has some limitations. In daily clinical practice, jaundice assessments are performed by physicians with varying levels of training and experience (as this is a teaching hospital with pediatric and neonatology residency programs, and physicians are hired via public civil service exams rather than based on superior knowledge or experience with newborns), which may influence the consistency of visual assessments. Although all transcutaneous bilirubin (TcB) devices are regularly calibrated according to manufacturer recommendations, no inter-device variability testing was performed, and potential discrepancies in device performance cannot be ruled out. Finally, our study included only jaundiced neonates requiring phototherapy, which limits the generalizability of these findings to milder cases of jaundice that did not require treatment. Furthermore, the study was conducted at a single tertiary care hospital, which may reduce its external validity.

However, this research has strengths, such as comparing the three methods used for jaundice assessment within the same group of infants, thereby providing comparative data. It also highlights the importance of healthcare services investing in devices for neonatal jaundice assessment.

CONCLUSION

TcB measurements showed good accuracy compared to TSB levels in healthy term newborns and can be effectively used for neonatal jaundice screening. Although TcB levels tend to underestimate TSB levels, their use offers significant advantages, such as a reduction in invasive procedures, decreased stress for the infant and family, and fewer unnecessary blood draws.

The extent of jaundice based on cephalocaudal progression – clinically assessed using Kramer zones – showed poor correlation with bilirubin levels; therefore, clinicians should not rely on this method to estimate bilirubin concentrations in infants.

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Scientific Editor:

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Publisher:

Sociedade de Pediatria do Rio de Janeiro – SOPERJ

E-mail: secretaria@soperj.org.br

Financial support:

None.

Availability of research data:

The underlying content of the research text is contained in the article.

Conflict of interests:

None.

Authors' contributions:

Marinho DH: statistical analysis, data collection, conceptualization, resource management, project management, investigation, methodology, writing – original draft, writing – review and editing, software, supervision, validation, visualization.

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