



# Transcutaneous bilirubinometry is not influenced by term or skin color in neonates



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## ABSTRACT

**Background:** The utility of transcutaneous bilirubin measurements (TcB) in screening for hyperbilirubinemia in preterm infants (<34 weeks) and in non-white infants remains a matter of debate.

**Aim:** To evaluate accuracy of TcB in preterm and term infants of different ethnic backgrounds, using a second generation bilirubinometer.

**Study design:** The Draeger JM-103® device was used to measure TcB. Eighty five measurements of TcB and total serum bilirubin (TSB) were retrospectively compared. Neonates were stratified into groups according to gestational age: <34 weeks (group 1, n = 44) and >34 weeks (group 2, n = 41), and according to ethnic origin: Caucasians (group A, n = 49) and non-Caucasians (group B, n = 36).

Statistical analysis, using Pearson's correlation coefficient (r) and Bland–Altman analysis were performed to evaluate correlation and agreement between TSB and TcB values. Multiple linear regression was used to control for confounders for TSB values.

**Results:** Correlation between TSB and TcB was high. Pearson's correlation coefficients were over 0.9 in all groups (0.910, 0.908, 0.916 and 0.934,  $p < 0.0001$  in groups 1, 2, A, and B respectively). Bland–Altman plots showed acceptable and close limits of agreements (56.8/–57.7, 54.2/–67.2, 57.7/–55.8, and 51.3/–69.9  $\mu\text{mol/L}$  in groups 1, 2, A and B respectively) with a trend for TcB to overestimate TSB in groups 2 and B. Birth term and skin color were not identified as confounding factors for predicting TSB in multiple linear regression.

**Conclusions:** TcB measurements using the Draeger JM-103® device correlate significantly with TSB, regardless of term and skin color. Transcutaneous bilirubinometry seems to be a safe and cost-effective screening method for severe hyperbilirubinemia in newborns of different terms and ethnic origins.

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## 1. Introduction

Neonatal jaundice is a common problem. Although most cases have a benign course, hyperbilirubinemia can be a cause of concern, especially in preterm infants who are at a higher risk for the neurotoxic effects of bilirubin. Regular monitoring of bilirubin levels is therefore necessary to start appropriate treatment as early as possible. Total serum bilirubin (TSB) measurement is the current gold standard for bilirubin determination, but repeated venous or capillary punctures are painful, costly, time consuming and may result in iatrogenic anemia.

Transcutaneous bilirubinometry (TcB) was first developed 30 years ago to facilitate monitoring of neonates with icterus [1]. This non-invasive method was previously limited by the lack of accuracy of older devices but the second generation bilirubinometers, which using

multiwavelength spectral reflectance techniques, have shown to correlate well with TSB dosages in term and near-term newborns [2–7]. In preterm babies at gestational ages < 34 weeks, correlational studies are contradictory [8–10]. Body weight, skin color and gestational age are factors that have been proposed to explain the lack of accuracy for this group [11–13]. However, recent studies have reported high correlation between TcB values obtained with second generation bilirubinometers and TSB measurements [10,11,14–16]. The aim of this retrospective study was to compare TSB measurements with TcB measured using the Draeger JM-103® device in term and preterm neonates, and to study the role of skin color in measurement accuracy.

## 2. Patients and methods

This study was performed in the level III neonatal intensive care unit (NICU) of Bicêtre University hospital, France.

Data for 86 newborns who had paired TcB/TSB determination carried out with a maximal delay of 30 min between both measurements were retrospectively analyzed. For patients with more than one pair of measurements, the earliest values were chosen to best concord

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**Table 1**  
Characteristics of the study groups (IQR: Inter Quartile Range).

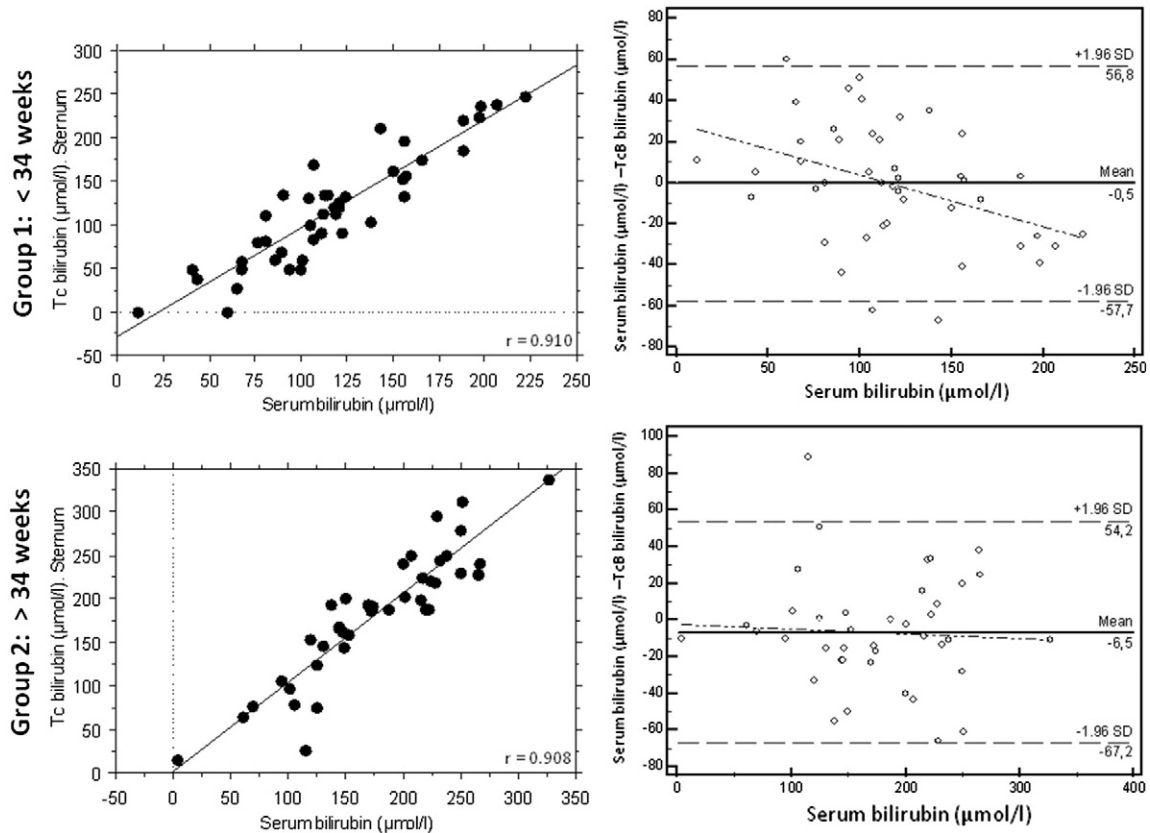
	Group 1 (n = 44) <34 weeks	Group 2 (n = 41) >34 weeks	Group A (n = 49) Caucasians	Group B (n = 36) Non-Caucasians
Sex ratio (M/F)	18/26	23/18	28/21	13/23
Preterm/term	44/0	0/41	24/25	20/16
Caucasian/non-Caucasian	20/24	18/23	49/0	0/36
Birth weight median/IQR (g)	1335/535	3030/1087.5	1660/1020	1760/2010
Gestational age median/IQR (weeks)	30/2	38/4.2	34/5	31.5/8

**Table 2**  
Comparison between TSB and TcB measurements (TSB: total serum bilirubin. TcB: Transcutaneous bilirubin. SD: standard deviation).

	n	Mean TSB $\pm$ SD	Mean TcB $\pm$ SD	p-Value	TSB–TcB $\pm$ SD	Pearson r coefficient	p-Value
Group 1 (<34 weeks)	44	117.6 $\pm$ 46.9	118.0 $\pm$ 64.5	0.9182	–0.5 $\pm$ 29.2	0.910	<0.0001
Group 2 (>34 weeks)	41	176.1 $\pm$ 65.5	182.6 $\pm$ 74.0	0.1842	–6.5 $\pm$ 31.0	0.908	<0.0001
Group A (Caucasians)	49	143.2 $\pm$ 61.5	142.2 $\pm$ 71.4	0.8275	1.0 $\pm$ 28.9	0.916	<0.0001
Group B (Non-Caucasians)	36	149.4 $\pm$ 66.9	158.7 $\pm$ 82.2	0.0795	–9.3 $\pm$ 30.9	0.934	<0.0001
Total population	85	145.8 $\pm$ 63.5	149.2 $\pm$ 76.0	0.3015	–3.4 $\pm$ 30.0	0.923	<0.0001

with gestational age at birth. Exclusion criteria were phototherapy within the 12 h preceding measurements, hemolytic disease, cholestasis, severe perinatal asphyxia and anomalies of skin perfusion, such as edema or compromised hemodynamic parameters. Patients were divided into four groups according to gestational age (group 1: <34 weeks GA and group 2: >34 weeks GA), and skin color (group A: Caucasian and group B: non-Caucasian).

For TSB measurements, venous samples (21/85) were analyzed in the hospital biochemistry laboratory (colorimetric method by diazotation, Roche® kit) and capillary samples (64/85) were analyzed using the NICU blood gas machine (spectrophotometric method). Correlation between the two methods of TSB determination is regularly controlled by the hospital's laboratory technicians. TcB was measured by the Draeger JM-103® transcutaneous bilirubinometer. This second



**Fig. 1.** Comparison between TSB and transcutaneous (Tc) bilirubin measurements in groups 1 (<34 weeks) and 2 (>34 weeks). Left column: linear regression and Pearson r coefficient. Right column: Bland Altman plots [17] showing agreement between TSB and Tc bilirubin.

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