

Evaluation of the use of non-invasive hemoglobin measurement in early childhood

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Background: Iron deficiency anemia in children affects psychomotor development. We compared the accuracy and trend of a non-invasive transcutaneous spectrophotometric estimation of arterial hemoglobin (Hb) concentration (SpHb) by rainbow pulse CO-oximetry technology to the invasive blood Hb concentration measured by an automated clinical analyzer (Hb-Lab).

Methods: We measured the SpHb and Hb-Lab in 109 patients aged 1-5 years. Regression analysis was used to evaluate differences between the two methods. The bias, accuracy, precision, and limits of agreement of SpHb compared with Hb-Lab were calculated using the Bland-Altman method.

Results: Of the 109 enrolled subjects, 102 pairs of the SpHb and Hb-Lab datasets were collected. The average value of measured Hb was 12.9 ± 1.03 (standard deviation [SD]) g/dL for Hb-Lab. A significant correlation was observed between SpHb and Hb-Lab measurements ($\text{SpHb} = 7.002 + 0.4722 \text{ Hb-Lab}$, correlation coefficient $r = 0.548$, 95% confidence interval = 0.329-0.615). Bland-Altman analysis showed good visual agreement, with a mean bias between SpHb and Hb-Lab of 0.188 ± 0.919 g/dL (mean \pm SD).

Conclusions: We concluded that non-invasive Hb measurement is useful for Hb estimation in children and provides new insights as a screening tool for anemia.

Impact: Our results indicated a good correlation between non-invasive transcutaneous spectrophotometric estimation of arterial hemoglobin (Hb) concentration using a finger probe sensor by rainbow pulse CO-oximetry technology and invasive blood Hb concentration. Although previous studies have indicated that in patients with a worse condition, the bias between the two methods was large, this study, which was conducted on children with stable disease, showed a relatively small bias. Further studies using this non-invasive device might help to understand the current status of anemia in Japan and promote iron intake and nutritional management in children.