

Research Article

Clinical accuracy of Non-contact infrared thermometry in febrile Indian infants

RajeshwarBalaji¹, Srinivasan Thiagarajan¹, Vijaya Chavada², Sriram Pothapregada¹

Author's Affiliation:

1- Department of Paediatric, Indira Gandhi Medical College and Research Institute, Puducherry.

2- Department of Community Medicine, Indira Gandhi Medical College and Research Institute, Puducherry.

Correspondence:

Srinivasan Thiagarajan, Email: drthiagu87@gmail.com Ph : +91 8903055659

Received on: 28-Apr-2019

Accepted for Publication: 02-Mar-2020

ABSTRACT

Background: Conventional forms of temperature measurement like Mercury-in-glass thermometer and digital thermometer are currently being fast replaced by novel modalities like Non-contact thermometers.

Objective: To compare the clinical accuracy of Non-contact infrared thermometer with digital thermometer.

Methods: This analytical cross-sectional study included two hundred and fifty febrile infants (less than 1 year of age) in a tertiary health care facility for a period of two months. Random Sampling technique was used. Axillary temperature was taken after wiping underarm with dry towel and digital thermometer probe tip placed under the arm sequentially so the tip remained in contact with skin and temperature recording was recorded after the beep sound from the digital thermometer. Forehead temperature was taken with infrared thermometer at approximately 0.5-1 cm distance from glabella.

Results: Data was analyzed with SPSS software. Among 250 infants enrolled for the study, 2.4% were under a month old, 97.6% were aged from one month to one year. There is a significant correlation between the measurements by NCIT and Digital thermometers ($P < 0.001$). There is no significant difference ($p = 0.747$, NS) of measurements by NCIT and Digital thermometers. Hence there is an excellent agreement between both methods.

Limitations: Smaller sample size and digital thermometer as gold standard for comparison are considered as limitations of this study.

Conclusion: Non contact infrared thermometer has a very good clinical accuracy, compared to digital thermometer and thus can be used in paediatric population for measurement of body temperature.

Keywords: Temperature measurement in infants; Non -contact infrared thermometry in infants; clinical accuracy of temperature measurement in infants.

INTRODUCTION

Temperature measurement is an important tool not only in arriving at the correct diagnosis but also to start early treatment of a specific condition in febrile infants¹. Accurate temperature measurement is difficult because of their non-cooperative nature which is further made difficult by the time consuming nature of axillary thermometry. Furthermore, frequent disturbance of the infants may lead to hypoxia and deterioration in their clinical condition, hence minimal handling is fundamental. Thus, a novel technique is the need of the hour while being convenient for infants and at the same time, preserving clinical accuracy of measurement². Measurement of temperature in infants can be obtained by rectal, axillary, and tympanic thermometry. The gold standard is the mercury-in-glass thermometer. However, in practice, every available method has several advantages and disadvantages. The forehead is an excellent area to measure temperature as it is supplied by temporal artery, which receives high blood flow from the carotid artery³. Non-contact infrared thermometer (NCIT) could represent a valid alternative, incorporating quick and non-invasive method, not requiring sterilisation because of no body contact. These reasons make it a candidate for screening of febrile infants^{4,5}. However, some authors found discordant results on the performance of NCITs^{3, 6, 7}. Our study was focussed on demonstrating the correlation and agreement of temperature measurement between NCIT with digital thermometer.

METHODOLOGY

This study was an analytical cross-sectional study conducted in the Department of Paediatrics in a tertiary health care facility for a period of two months. Approval from institute research and ethics committee was obtained before commencement of the study. Two hundred and fifty febrile infants (less than 1 year of age) attending Paediatrics OPD were enrolled for the study after obtaining consent from their parents. Sick looking and unstable infants were excluded. EQUINOX EQ-IF-02 was used for non-contact infrared thermometry and Gen-X digital thermometer was used for axillary digital thermometry. Axillary temperature was taken after wiping underarm with dry towel and digital thermometer probe tip placed under the arm sequentially so the tip remained in contact with skin and temperature recording was recorded after the beep sound from the digital thermometer. Forehead temperature was taken with infrared thermometer at approximately 0.5-1 cm distance from glabella [6]. All temperatures were taken by trained nurse and duty doctor. In every infant, all the measurements were recorded within 6 mins. Age and sex of the infant were recorded and entered into a database. Informed consent for the study was obtained from the parent/guardian.

RESULTS

Data entry was done in MS Excel 2010. SPSS 18.0 software was used to analyse the results. A difference of 0.5°C was considered clinically acceptable [6, 7]. Among the 250 infants enrolled for the study, 2.4% were under a month old, 97.6% were aged from one month to one year (Table 1). The mean temperature recordings of the two devices were 37.62°C (SD 1.02) and 37.61°C (SD 0.95) respectively. The mean difference between two measurements was found to be -0.036 (95% CI: -0.42 to 0.30). There was a significant correlation between the measurements by NCIT and Digital thermometers ($r=0.52$; $P<0.001$). There was significant agreement of measurements ($\kappa=0.452$) by both instruments in measuring the body temperature by NCIT and Digital thermometers. Bland Altman graph was used to depict the results of the study (Figure 1)

Table 1: Descriptive statistics of mean temperature by Age group and type of thermometer (n=250)

Age (d)		Digital	NCIT
<=30 (N=6)	Mean	37.3667	37.4000
	SD	.55377	.51381
31 to 360 (N=244)	Mean	37.6977	37.6915
	SD	1.00261	.94694
Total (N=250)	Mean	37.6216	37.6152
	SD	1.02303	.95942

DISCUSSION

Many studies confirmed the clinical accuracy of Non-contact infrared thermometry⁸⁻¹⁶. Apa H et al study showed a significant positive correlation between axillary and non-contact infrared thermometer with a correlation coefficient of 0.78 and NCIT showed sensitivity of 71.7% and specificity of 95.8%⁸. A 2018 study revealed that forehead is the preferred site for temperature measurement by infrared thermometer and that correlation between NCIT forehead and DAT axilla was $r = 0.32$ (-0.38 to -0.25) which is deemed significant[3], concordant with the results of our study.

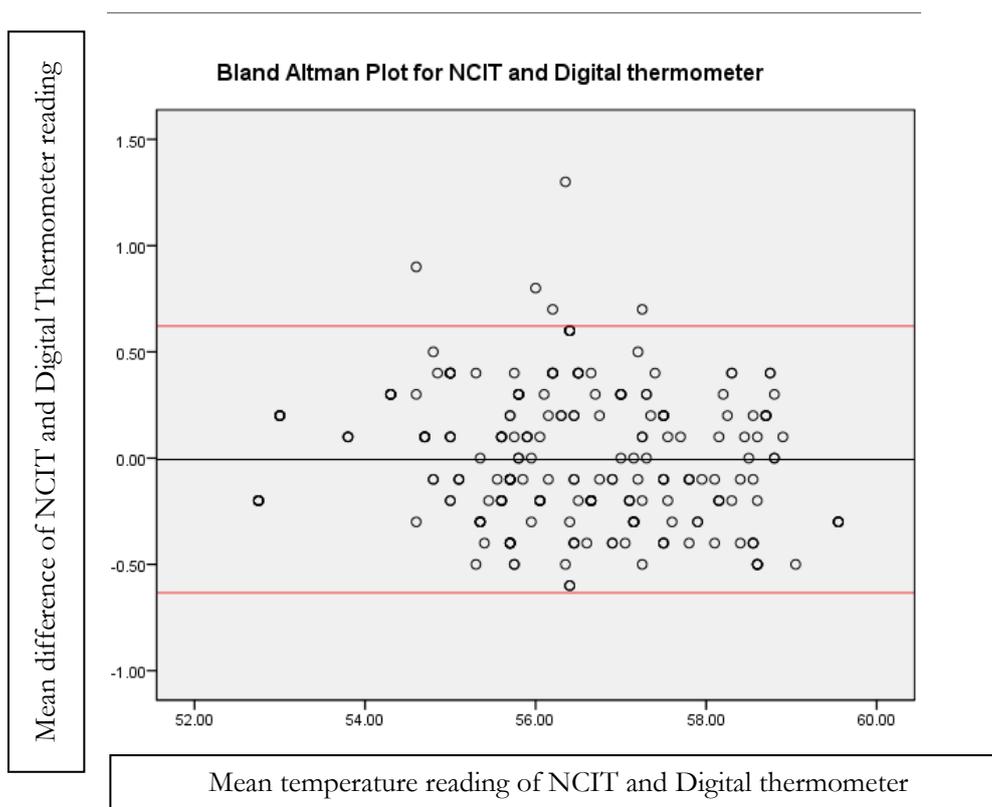
Though many studies have proven the clinical accuracy of NCIT in clinical settings, some conflicting reports also emerged. A study by Franconi et al comparing DAT and NCIT demonstrated higher temperature measurements of axilla compared to forehead with mean difference of 0.41 degree Celsius⁶. Another study showed unsatisfactory correlation between axillary digital thermometer and forehead non-contact thermometer with a mean difference in temperature of -0.5 degree Celsius (95% limits of agreement)⁷. Both these studies

show that there is significant disagreement between the temperature measurements of digital and Non-contact infrared thermometer, which is discordant with the results of this study.

CONCLUSION

Moderate agreement and significant correlation of NCIT with Digital thermometry was proven. Thus, Non-contact infrared thermometer has a very good clinical accuracy compared to digital thermometer and thus can be used in paediatric population for measurement of body temperature. Non-contact thermometers offer easier temperature measurements in infants and non-cooperative children and are also safer to use. The results of other studies are controversial and future studies with a larger sample size in Indian infants are needed to prove the accuracy of non-contact thermometer.

Figure 1: Bland Altman Plot for NCIT and Digital Thermometer readings:



REFERENCES

1. Smith J, Alcock G, Usher K. Temperature measurement and thermoregulation in the term and preterm infant: A review of the literature. *Neonatal Netw* 2013; 32(1):16-25.
2. Michael M, L'Heureux N, Auger FA, Germain L. From newborn to adult: phenotypic and functional properties of skin equivalent and human skin as a function of donor age. *J Cell Physiol* 1997;171:178-89.
3. Abraham V, Johnson E, Deep K. Comparison of Non-contact Infrared Temperature with Digital Axillary Temperature. *Journal of Indian Pediatrics*.2018; 55:09-610.
4. Davis.T.NICE Guidelines Feverish illness in children: assessment and initial management in children younger than 5 years. *Arch dis child Educ Pract Ed*.2013;98:232-5.
5. Chiappini E, Venturini E, Principi N et al., Writing Committee of the Italian Pediatric Society Panel for the Management of Fever in Children. Update of the 2009 Italian Pediatric Society Guidelines about management of fever in children. *Clin Ther*2012;34:1648-53.
6. Franconi I, La Cerra C, Marucci AR, Petrucci C, Lancia L.Digital Axillary and Non-Contact Infrared Thermometers for Children. *Clin Nurs Res*. 2018 ;27:180-190.

7. Sethi A, Patel D, Nimbalkar A, Phatak A, Nimbalkar S. Comparison of Forehead Infrared Thermometry with Axillary Digital Thermometry in Neonates. *Indian Pediatr* 2013;50: 1153-1154
8. Apa H, Gozmen S, Keskin-Gozmen S, Aslan F, Bayram N, Devrim I. Clinical accuracy of non-contact infrared thermometer from umbilical region in children: A new side. *Turk J. Pediatr.* 2016;58:180-186
9. Hakan N, Okumus N, Aydin M, Kucukozkan T, Tuygun N, Zenciroglu A. The comparison of temporal temperature measurement by non-contact infrared thermometer with other body temperature measurement methods. *Izmir Dr. Behcet Uz Cocuk Hast.* 2017;7:141-146.
10. Teran C et al., Clinical accuracy of non contact infrared skin thermometer in paediatric principle. *Child Care Health Dev.* 38;471-47.
11. Sollai S, Dani C, Berti E, Fancelli C, Galli L, Martino M, Chiappini E. Performance of a non-contact infrared thermometer in healthy newborns. *BMJ Open* 2016;6;1-5.
12. Uslu S, Ozdemir H, Bulbul A, et al. A comparison of different methods of temperature measurements in sick newborns. *J Trop Pediatr* 2011;57:418–23.
13. Osio CE, Carnelli V. Comparative study of body temperature measured with a non-contact infrared thermometer versus conventional devices. The first Italian study on 90 pediatric patients. *Minerva Pediatr* 2007;59:327–36.
14. Teran CG, Torrez-Llanos J, Teran-Miranda TE, et al. Clinical accuracy of a non-contact infrared skin thermometer in paediatric practice. *Child Care Health Dev* 2012;38:471–6.
15. Duran R, Vatansever U, Acunas B, et al. Comparison of temporal artery, mid-forehead skin and axillary temperature recordings in preterm infants <1500 g of birthweight. *J Paediatr Child Health* 2009;45:444–7.
16. Robertson-Smith J, McCaffrey FT, Sayers R, et al. A comparison of mid-forehead and axillary temperatures in newborn intensive care. *J Perinatol* 2015;35:120–2.