

BMJ Open Validity and accuracy of maternal tactile assessment for fever in under-five children in North Central Nigeria: a cross-sectional study

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ABSTRACT

Objectives: This study seeks to determine not only the reliability of parental touch in detecting fever as compared to rectal thermometry in under-five children, but also the sociodemographic factors that may predict its reliability.

Setting: The study was carried out in the Emergency Paediatric Unit of a tertiary hospital in North Central Nigeria.

Participants: 409 children aged less than 5 years with a history of fever in the 48 h prior to presentation and their mothers were recruited consecutively. All the children recruited completed the study. Children with clinical parameters suggestive of shock, and those who were too ill, were excluded from the study.

Primary and secondary outcome measures: The primary outcome was the proportion of mothers who could accurately predict if their child was febrile or not (defined by rectal temperature) using tactile assessment only. Secondary outcomes were the validity and accuracy of touch in detecting fever and factors related to its accuracy.

Results: About 85% of the children were febrile using rectal thermometry. The sensitivity, specificity, positive predictive and negative predictive values for touch as a screening tool were 63%, 54%, 88.3% and 21%, respectively. High maternal socioeconomic status and low maternal age influenced positively the accuracy of touch in correctly determining the presence or absence of fever.

Conclusions: This study has shown that tactile assessment of temperature is not reliable and that absence of fever in a previously febrile child should be confirmed by objective methods of temperature measurement.

INTRODUCTION

Fever represents a perception of an elevated temperature.¹ In clinical practice, the relevance of fever is that it is a sign of a current illness. It remains one of the most frequently encountered paediatric problems, accounting

Strengths and limitations of this study

- Large sample size of 409 mother:child pairs.
- Comparison of touch with the gold standard, that is, rectal thermometry.
- Provision of further comparison with axillary thermometry.
- Non-elimination of bias from mothers who had measured their child's temperature before presentation.
- Non-exclusion of babies who had been bathed or tepid sponged prior to the tactile assessment.

for 25% of visits to paediatric emergency rooms.^{2 3} Indeed, it is often the first symptom noted by parents and frequently the initial 'signal' of illness in the child. Thermometry, which refers to the use of objective means to measure temperature, has evolved over the years from the use of 'touch' to invasive methods of temperature detection, such as pulmonary artery and urinary bladder measurements.¹ The gold standard for measurement of temperature in children less than 5 years of age is rectal thermometry.⁴ However, most parents and indeed healthcare workers are not comfortable with this method of temperature measurement.^{5 6} An appropriate method of detection of fever has an impact on parental decisions to take their child for evaluation. Studies have shown that the most common methods utilised by parents in this region for detection of fever is by touch.⁷ There have been conflicting results about the accuracy of this method of temperature detection as a screening tool by parents.^{8–10} Thus, this study seeks to determine not only the reliability of parental touch in detecting fever as compared to rectal thermometry in children less than 5 years of age, but also the sociodemographic factors that may predict its reliability.

MATERIALS AND METHODS

This is a cross-sectional study in which the participants are children aged between 2 and 59 months and their parents/caregivers. The study was carried out at the Emergency Paediatric Unit (EPU) of the University of Ilorin Teaching Hospital (UIITH). The hospital is located in Ilorin, which is the capital city of Kwara State, situated in the North Central geopolitical zone of Nigeria. The minimum sample size was calculated using the Andrew Fisher formula with a proportion in the target population of 50%, which gives a maximum sample size and a degree of accuracy of 0.05. The calculated minimum sample size was 384; however, 409 children/caregiver pairs were recruited as a component of the larger study. The participants were recruited over a 4-month period. Children who were aged less than 5 years and admitted into the EPU with a history of fever in the past 48 h were recruited consecutively along with their caregivers. Participant recruitment was done as early as possible after presentation, after institution of the required immediate care as determined by the clinical condition of the child. It was considered pertinent to exclude children with clinical parameters suggestive of shock, and those who were too ill for the study. Siblings of children who had already been recruited into the study were also excluded. A semistructured study pro forma was administered on all participants recruited. Sociodemographic data comprising the age and gender of the child, parental religion and ethnic group(s), as well as age, educational status and occupation of the mothers, were obtained. Children were assigned to social classes based on the social classification system by Oyedeleji.¹¹ Highest educational status and occupation for each parent were each assigned scores from 1 to 5. The mean of four scores (education and occupation for each parent) to the nearest whole number was assigned to the child.¹¹ Socioeconomic scores of 1–2 were assigned to the high social class, 3 to the middle social class and 4–5 to the low social class. Parents were not told the temperature of their children at presentation. They were requested to determine if their children were febrile or not only by touching them, irrespective of their previous perception. They were not restricted as to what part of the body they were to feel.

Rectal and axillary temperatures were measured immediately after their responses were obtained using a U-mec digital thermometer. The methodology utilised for measuring axillary and rectal temperatures is as described in a previous publication.¹² Fever was defined as rectal temperature greater than or equal to 38.0°C or an axillary temperature greater than or equal to 37.5°C.¹³

Statistical analyses

Data entry and analysis were carried out using the Epi-Info V.6 software package. Measures of central tendency and dispersion of quantitative variables were utilised. Mean, SDs and a range of the temperature measurements were provided. Parental assessments of

temperature were compared with rectal and axillary temperature measurements. Sensitivity, specificity, and positive and negative predictive values of parental touch for detecting fever as compared to rectal and axillary temperatures were determined using the formulae below:

$$\text{Sensitivity} = \frac{\text{true positive}}{(\text{true positive} + \text{false negative})} \times 100$$

$$\text{Specificity} = \frac{\text{true negative}}{(\text{true negative} + \text{false positive})} \times 100$$

$$\text{Positive predictive value} = \frac{\text{true positive}}{(\text{true positive} + \text{false positive})} \times 100$$

$$\text{Negative predictive value} = \frac{\text{true negative}}{(\text{true negative} + \text{false negative})} \times 100$$

$$\text{Positive likelihood ratio} = \frac{\text{sensitivity}}{1 - \text{specificity}}$$

$$\text{Negative likelihood ratio} = \frac{1 - \text{sensitivity}}{\text{specificity}}$$

$$\text{Accuracy} = \frac{(\text{true positive} + \text{true negative})}{(\text{all positive} + \text{all negative})} \times 100$$

The χ^2 and Student t tests were used to identify significant differences for categorical and continuous variables, respectively. A p value of <0.05 was considered significant.

Written informed consent was obtained from the caregiver after explanation of the study protocol.

RESULTS

Four hundred and nine under-five children aged 2–56 months were recruited along with their mothers. The mean (SD) age of the children was 21.86 (15.3) months, with 31.8% of them being infants. The male:female (M:F) ratio was 1.6:1. The mean (SD) maternal age was 30.1 (4.54) years. The majority of the mothers (298 (74.5%)) were of the Yoruba ethnic group. The caregiver's religion was Islam in 285 (69.7%) participants and Christianity among 124 participants (30.3%). Using the Social Classification of Oyedeleji,¹¹ 31.8% of the mothers belonged to the high social class (social classes I and II), 114 (27.9%) to social class III and 165 (40.3%) to social classes IV and V.

The majority (346) of the children were febrile, constituting 84.6% using rectal thermometry and with a fever cut-off of $\geq 38^\circ\text{C}$.¹³ The mean (SD) rectal temperature was 38.7°C (0.816) while the mean (SD) axillary temperature was 37.9°C (0.843). According to the caregivers, 247 (60.4%) felt their child was febrile to touch. Table 1 provides a summary of the indices of validity of tactile assessment in relation to rectal temperatures.

There was a modest improvement in the tests of validity and accuracy when using axillary temperatures to define fever (axillary temperature $\geq 37.5^\circ\text{C}$) as shown in table 2. Children who were deemed to be febrile by tactile

Table 1 Summary of indices of validity of maternal tactile assessment of temperature

	Rectal temperature <38.0°C (n=63)	Rectal temperature ≥38.0°C (n=346)	Total
Tactile assessment of febrile	29	218	247
Tactile assessment of not febrile	34	128	162
Sensitivity	63.0%		
Specificity	54.0%		
Positive predictive value	88.3%		
Negative predictive value	21.0%		
Positive likelihood ratio	1.37		
Negative likelihood ratio	0.69		
Accuracy	62%		

assessment had a higher mean rectal ($38.9 \pm 0.802^\circ\text{C}$) and mean axillary ($38.1 \pm 0.884^\circ\text{C}$) temperature than those who were not deemed to be febrile (mean rectal temperature $38.3 \pm 0.683^\circ\text{C}$; mean axillary temperature $37.5 \pm 0.652^\circ\text{C}$). Both differences were statistically significant ($p=0.0000001$).

Regarding the relationship between the accuracy of tactile detection of fever by mothers and selected socio-demographic variables, low maternal age and high socioeconomic class were significantly associated with correct classification of children as febrile or not. Other variables such as educational status, number of children and gender of the child were not significant (table 3).

DISCUSSION

It is pertinent to observe that the use of touch to assess fever has been an age-old tradition passed down by parents and indeed grandparents to the younger generation. Indeed, it is a practice that is common in most communities and, to a large extent, considered fairly useful. In view of its suboptimal specificity, the usefulness of this method of assessing fever has remained limited to that of a screening tool.⁹ In the present study, tactile assessment had a sensitivity of 63% and

specificity of 54.0% in detecting fever. This is lower than the sensitivity reported by Banco *et al*¹⁴ (74%); Nwanyanwu *et al*⁹ (97.3%); Whybrew *et al*⁸ (94%); and Wammanda and Onazi¹⁵ (96.3%). The reason for this difference is unclear, but may be related to different definitions of fever and different sites used to measure temperature in the various studies. There have been wide variations in the specificity of tactile assessment of fever with reported values ranging from 19% to 89%.^{14–16} The reported specificity in the present study lies within the range.

The study demonstrated a high positive predictive value and a low negative predictive value. This picture questions the real value of a mother's assessment that the child does not have a fever. Thus, contrary to previous studies, touch as a method of fever detection will lead to mothers missing out several cases of fever in their children. The improvement in the indices of validity when axillary temperatures were used to define fever reflect the close relationship between skin temperature and axillary temperature, which are essentially measures of peripheral temperature rather than core temperature.

The finding in the present study that lower maternal age and high social class improve the ability of a mother to detect fever by touch may be explained as a bias as these mothers may have measured and known their child's actual temperature prior to presentation. An earlier publication by the authors documented that mothers of higher social class and younger age were more likely to use a thermometer to measure temperature prior to seeking care.¹⁷ The methodology of the current study was not able to limit the influence of this source of bias. The finding that maternal education did not influence the accuracy of tactile assessment of temperature is not unexpected as several authors had also demonstrated this finding.¹⁵

While previous studies of tactile detection of fever have suggested that it may overestimate the presence of fever, it was considered equally true that it rarely misses it.⁸ This study, however, has shown a stronger likelihood of mothers missing fever if they detect by touch alone. This is a strong point for proponents for the training of mothers on objective methods of temperature measurements in their under-five children.

Table 2 Summary of indices of validity of maternal tactile assessment of temperature against axillary temperature

	Axillary temperature ≥37.5°C (n=285)	Axillary temperature <37.5°C (n=124)	Total
Febrile to touch	196	51	247
Not febrile to touch	89	73	162
Sensitivity	68.8%		
Specificity	58.9%		
Positive predictive value	79.4%		
Negative predictive value	45.1%		

Table 3 Contribution of selected sociodemographic variables to accuracy of tactile assessment of temperature

Variable	Mother's classification of child temperature by touch only compared with rectal temperature		t or χ^2	p Value
	Correct (TP+TN) n=252	Wrong (FP+FN) n=157		
Mean maternal age (SD)	29.5 (4.15)	31.1 (4.96)	-3.37	0.0008
Mean number of children (SD)	3.6 (1.48)	3.4 (1.41)	1.35	0.177
Gender of child				
Male	146	103	2.389	0.0611
Female	106	54		
Educational status				
None	53	19	6.773	0.0795
Primary	45	35		
Secondary	72	55		
Postsecondary	82	48		
Social class				
High (I–II)	126	39	32.12	0.0000011
Middle (III)	82	58		
Low (IV–V)	44	60		

FN, false negative; FP, false positive; TN, true negative; TP, true positive.

CONCLUSION

This study has shown that tactile assessment of temperature is not as reliable as previously thought. Absence of fever by touch is not a reliable finding in under-fives with a history of fever and such a child should have an objective measurement to confirm its resolution.

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