www.jpnim.com Open Access eISSN: 2281-0692
Journal of Pediatric and Neonatal Individualized Medicine 2024;13(1):e130109
doi: 10.7363/130109
Received: 2022 Nov 11; revised: 2023 Apr 07; accepted: 2023 Apr 21; published online: 2024 Feb 15

Original article

Value of maternal tactile method in detecting fever among under five years children during the COVID-19 era

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Abstract

Objectives: The ability of mothers to accurately predict the presence of fever in their children using the tactile method is still controversial. This study evaluated the accuracy of Iraqi mothers' tactile fever detection in children under 5 during COVID-19 pandemic.

Materials and methods: Interviews were conducted with 200 mothers whose children were under the age of 5 years and who assumed they had fever. Each mother was then asked to touch her child's body for fever evaluation, while an investigator observed them, recorded their responses, and documented the places of palpation. Thereafter, the investigator determined the child's temperature using a non-contact temple thermometer (NCTT). Statistical analysis was conducted to compare the maternal tactile approach to NCTT and single site to multiple site palpation in terms of sensitivity, specificity, and predictive values.

Results: The prevalence of fever in the study sample was 72%, as 144 of the 200 children involved were confirmed to have fever by NCTT. The sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of the maternal tactile method were 96.5%, 62.5%, 86.9%, and 87.5%, respectively. Multiple child body sites were palpated by 42.5% of mothers, whereas 57.5% palpated a single site, with the forehead being the most common palpated site (31%). Multiple site palpation had a significantly lower incorrect temperature assessment rate than single site palpation (3.5%

vs. 27%, p = 0.00001). Additionally, the accuracy increased significantly when the mother palpated multiple sites (96.5% vs. 73%).

Conclusion: The findings of this study suggest that mothers' use of tactile assessment is an effective screening tool when assessing their children's fever; however, mothers' fears can reduce the accuracy of this method, whereas instructing the mother to palpate multiple body parts can increase its reliability.

Keywords

Fever, children, perception, COVID-19, non-contact thermometer, tactile method.

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How to cite

Adel Shareef A, Hachim Alasaf N, Younis Abdullah Al-Fathy M. Value of maternal tactile method in detecting fever among under five years children during the COVID-19 era. J Pediatr Neonat Individual Med. 2024;13(1):e130109. doi: 10.7363/130109.

Introduction

Fever is one of the most common reasons for seeking medical attention in children under the age of 5 years [1, 2]. Approximately 20% of Pediatric Emergency Department visits are attributed to fever [3].

To determine core body temperature, various methods have been invented, such as pulmonary artery, bladder, and lower esophageal catheters. However, these methods are regarded as invasive [4, 5]. Therefore, many authorities consider rectal thermometry to be the gold standard method for determining the core body temperature [6].

More convenient thermometers like electronic, infrared, temporal artery, and tympanic thermometry are now widely available to use at home [7, 8]. However, even in developed countries, mothers prefer to check for fever in their children using the tactile method, despite the availability of various types of thermometers [7, 9, 10]. In one study, 57% of participants, and 48% of those who own thermometer at home, still rely on palpation to determine presence of fever in their children [11].

Many mothers have experienced phobia as a result of their child's fever for a variety of reasons, including seizure, coma, brain damage and death [12-14]. Additionally, the outbreak of SARS-CoV-2 infection in the last 2 years exacerbated this fear, as fever is considered a major symptom of COVID-19 [15-17], especially after the emergence of the Delta variant of SARS-CoV-2, which is more transmissible than previous strains, and led to an increase in the rate of infection among the pediatric population [18-22].

Since fever differs from other symptoms that can be evaluated visually, the mother's history regarding fever pattern, duration, onset, and response to antipyretics will be based solely on the mother's ability to correctly perceive temperature with her hand [23]. However, maternal tactile assessment of temperature may result in underestimation or overestimation of a child's temperature [24]. Underestimation may cause a delay in seeking medical attention and, hence, in the early detection of serious bacterial infections, particularly in infants younger than 3 months [25]. In addition, maternal underestimation of fever can result in a delay in initiating preventive measures, such as not sending a child to school, when COVID-19 symptoms are suspected [26, 27]. On the other hand, overestimating the presence of fever can increase maternal worries, leading to overuse of antipyretic and inappropriate antibiotic use [28-30]; additionally, it can overwhelm health care facilities with unnecessary consultations [31]. To our knowledge, few studies on maternal fever perception in Iraq have been published, and none from Nineveh province [32, 33].

The purpose of this study was to assess the accuracy of tactile method for fever detection by Iraqi mothers in children under the age of 5 during the era of COVID-19 by comparing it with the reading of non-contact infrared thermometer. The findings of the study could be used to support public health education efforts intended to teach mothers how to properly assess their child's temperature at home.

Materials and methods

Study design and setting

This prospective case series study was conducted over a 5 months period, from 1 August to 31 December 2021, at Al-Khansaa Hospital, a large maternity and pediatric facility in Mosul, northern Iraq.

Participants' inclusion and exclusion

The study included 200 mothers who brought their children under the age of 5 years to the Pediatric Emergency Room or Outpatient Clinic with a fever as one of their presenting complaints, and whose fever was evaluated using the mothers' tactile technique. The following were excluded: mothers who declined to be interviewed; mothers whose children are critically ill; very anxious mothers; infants in the vicinity of a warming device; to eliminate the possibility of expectation bias, mothers who measured their child's temperature by thermometer at home and those who used antipyretics 8 hours prior to the presentation were also excluded.

Data collection

Semi-structured interviews with the mothers were conducted using a structured questionnaire by one of the investigators (A.A.Sh.), a qualified pediatrician at the same hospital. The first section of the questionnaire gathered demographic information about the child, such as age, gender, and location of residence. In the mother's section, questions were asked about her age, employment, and educational attainment. Furthermore, mothers were inquired about using a thermometer at home before coming to the hospital and if they had given their child any antipyretic in the previous 8 hours. After that, the mother of each eligible child was asked to perform a tactile assessment of fever to determine whether the child was feverish at the time of the assessment. Mothers were instructed to palpate their children's bodies using the dorsum of their hands. The investigator observed and documented the child's body site touched by the mother, and their answers about whether or not her child had fever were recorded.

Non-contact thermometer measurement

Immediately after maternal palpation, the investigator used a thermometer to determine the child's temperature. The authors acknowledge that rectal thermometry more precisely reflects the body's core temperature. However, we were obligated not to utilize rectal thermometry in this study due to the infection prevention and control action plans the hospital adopted during the COVID-19 pandemic to limit patient contact and minimize the possibility of viral transmission. Furthermore, rectal thermometry in children is regarded as culturally and socially unacceptable in our community. It can also be invasive and uncomfortable for children, which may make mothers reluctant to participate in the study.

Therefore, a non-contact temple thermometer (NCTT) (Rossmax HA500, Brugg, Switzerland) was adopted to measure children's temperature. This thermometer can convert infrared radiation emitted by human faces into temperature measurements and display its oral equivalent. Hence, a displayed reading of ≥ 37.5°C is regarded as fever, as a child with a temperature of ≥ 37.5°C (oral) or ≥ 38°C (rectal) is considered feverish by definition [23, 34]. Throughout the study, a single brand-new thermometer was used, maintained and calibrated according to the operating instructions manual. The NCTT has the advantages of being easy to use and disinfect, measuring and displaying a temperature reading quickly, and minimal risk of spreading infections [8]. However, there were a few environmental issues that needed to be addressed to ensure the NCTT's precision. All measures were obtained indoors in a controlled environment, with the ambient temperature in the examination room kept at around 25°C, and the children's foreheads were kept clean and dry. In addition, the participants were acclimated to the room temperature for at least 15 minutes before taking the measurement. Furthermore, obtaining multiple measurements for each child assisted in enhancing the thermometer's reliability.

Ethical considerations

The research protocol was accepted by the Ethics Committee of the College of Medicine at Ninevah University on March 13, 2022, with approval number 107. Each child's mother provided written informed consent prior to their participation in the study, and all methods complied with the 2008 revisions to the Helsinki Declaration.

Statistical analysis

Frequencies and percentages, median and interquartile range (IQR), and mean and standard deviation (SD) were used to statistically describe the data. Accuracy measures (sensitivity, specificity, negative predictive value [NPV], positive predictive value [PPV], and total accuracy) were used to express and compare the reliability of the tactile approach. Fisher exact test was used to compare categorical variables, and p-value < 0.05

was used to indicate statistical significance. Version 22 of IBM® SPSS® Statistics was used to conduct statistical analysis (SPSS Inc., Chicago, IL, USA).

Results

Of those children whose mothers consented to the study, 109 were excluded, as 38 had had their temperature verified by thermometry at home, and 71 had received antipyretics within the preceding 8 hours. Thus, a total of 200 mother-child dyads were recruited for the study. The 200 children had a median age of 12 months (IQR 7-18.25 months), 105 (52.5%) were females and 95 (47.5%) were males. The mean (SD) age of the interviewed mothers was 28.7 ± 6 years; the majority of mothers, 74 (37%), had only completed primary school, while 56 (28%) had completed university (**Tab. 1**).

When temperatures were assessed using a thermometer, 144 out of the 200 children evaluated had a fever, implying a prevalence of fever of 72% in this population of screened children. The maternal tactile method correctly detected fever in 139 of the 144 children whose fever was confirmed by thermometer, and identified 35 children as nonfebrile of the 56 children whose thermometer readings were less than 37.5°C, yielding a sensitivity of 96.5% and specificity of 62.5% for tactile fever detection.

Among the 160 children who categorized as febrile by mothers using the tactile method, 139 were actually feverish, while only 35 of the 40 children labeled as nonfebrile by mothers were indeed afebrile by thermometer assessment, resulting in a PPV of 86.9% and NPV of 87.5% (**Tab. 2**).

In terms of the child's body sites palpated by the mothers to assess for fever, multiple sites were palpated by 85 (42.5%) mothers, while a single site was palpated by 115 (57.5%) mothers. Among the mothers who palpated a single site, the forehead was the most frequently palpated site (31%), followed by the abdomen (14%), while the least palpated sites were the extremities (2.5%) and the groin (1%) (**Tab. 3**).

When the findings of maternal tactile temperature assessment using single and multiple sites were compared, it was shown that multiple sites palpation had a significantly higher rate of correct assessment (96.5%; 82/85) as compared with single site palpation (73%; 84/115) (p = 0.00001) (**Tab. 4**).

Furthermore, analysis of the accuracy measures revealed that multiple sites palpation had higher sensitivity, specificity, PPV, NPV, and accuracy when compared to single site palpation (**Tab. 5**).

Table 1. Demographic profile of the patients (n = 200).

Characteristic		Frequency	Percentage
Child's age	≤ 12 months	109	54.5%
	13-36 months	66	33%
	37-59 months	25	12.5%
Gender	Male	95	47.5%
	Female	105	52.5%
Residence	Urban	122	61%
	Rural	78	39%
Mother's age	< 20 years	9	4.5%
	20-24 years	48	24%
	25-29 years	55	27.5%
	30-34 years	47	23.5%
	35-39 years	28	14%
	≥ 40 years	13	6.5%
Maternal level of education	Illiterate	16	8%
	Read & write	15	7.5%
	Primary	74	37%
	Secondary	39	19.5%
	University	56	28%

Table 2. Comparison of the tactile assessment of fever by mothers with the non-contact temple thermometer (NCTT).

Mothers' assessment	NCTT reading		Total
	≥ 37.5°C	< 37.5°C	
Fever present	139 (69.5%)	21 (10.5%)	160 (80%)
Fever absent	5 (2.5%)	35 (17.5%)	40 (20%)
Total	144 (72%)	56 (28%)	200 (100%)

Data are presented as n (%).
NCTT: non-contact temple thermometer.
Sensitivity = 139/144 * 100 = 96.5%; specificity = 35/56 * 100 = 62.5%; positive predictive value (PPV) = 139/160 * 100 = 86.9%; negative predictive value (NPV) = 35/40 * 100 = 87.5%.

Table 3. Sites of the child's body palpated for temperature assessment.

Site palpated	Frequency	Percentage
Multiple sites	85	42.5%
Single site	115	57.5%
• Forehead	62	31%
• Cheek	6	3%
• Neck	4	2%
• Chest	8	4%
• Abdomen	28	14%
• Extremities	5	2.5%
• Groin	2	1%

Table 4. Comparison of the results of mothers' fever assessment by palpating single versus multiple sites.

	Correct fever assessment	Incorrect fever assessment	Total
Single site	84 (73%)	31 (27%)	115 (100%)
Multiple sites	82 (96.5%)	3 (3.5%)	85 (100%)

Data are presented as n (%).
Fisher exact test p-value = 0.00001.

Table 5. Accuracy measures of maternal perception of fever using single versus multiple sites palpation.

	Single site palpation	Multiple sites palpation
Sensitivity	91.5%	96.7%
Specificity	25%	95.8%
PPV	76%	98.3%
NPV	53.3%	92%
Accuracy	73%	96.5%

PPV: positive predictive value; NPV: negative predictive value.

Discussion

The rectal thermometer is the gold standard for measuring core body temperature; nevertheless, many other more convenient types of thermometers have been invented [6]. Despite this, mothers continue to choose to assess their child's temperature using the traditional tactile approach, which has a tendency to over- or underestimate fever reporting [9].

In this prospective study, we attempted to evaluate mothers' abilities to accurately identify fever in their children using the tactile technique. The results revealed that the maternal tactile approach has high sensitivity (96.5%) in identifying fever, a finding that is comparable to that reported by previous studies by Akinbami et al. (95%) [35], Wammanda et al. (96.3%) [36], Rosenbloom et al. (86.4%) [34], and Edwards et al. (93%) [37], while Abdulkadir et al. [38] and Katz-Sidlow et al. [11] reported significantly lower sensitivity than our study (63% and 67%, respectively). A possible explanation for this difference is the methodological variations, as Abdulkadir et al. and Katz-Sidlow et al. utilized rectal thermometer readings as a reference standard and a threshold of ≥ 38°C for fever definition [11, 38].

The specificity observed in the current study was low (62.5%), which is in line with findings from Abdulkadir et al. (58.9%) [38], and Okposio and Abhulimhen-Iyoha (64.3%) [39], as well as a meta-analysis by Li et al., who reported pooled specificity of (54.6%) [40]. However, this result differs from that reported by Katz-Sidlow et al., who reported higher specificity (84%) [11]. Because fever can be an indication of COVID-19 infection, mothers may have been overly concerned about their children's health, leading to an increase in the frequency of false positive cases and, hence, a decrease in the specificity of our study.

The PPV, which represents the probability of a child who has been labeled as feverish by his mother being actually febrile when measured with a thermometer, was high (86.9%). Comparable PPV to our study was also published by Abdulkadir et al. (88.3%) [38], Wammanda et al. (76%) [36] and Rosenbloom et al. (75.7%) [34]. Significantly lower PPV was reported by Edwards et al. (24%) [37], Odinaka et al. (51.9%) [41] and Katz-Sidlow et al. (33%) [11]. The higher prevalence of fever in our study population (72%) may account for the higher PPV, in contrast to the lower prevalence observed by Edwards et al. (7.5%), Odinaka et al. (45.1%), and Katz-Sidlow et al. (24%) [11, 37, 41].

In the present study, the NPV was also high (87.5%), representing the probability that a child identified as afebrile by his mother is actually afebrile when measured with the thermometer. Similarly, Katz-Sidlow et al. and Okposio and Abhulimhen-Iyoha reported high NPV (95% and 86.3%, respectively) [11, 39], while Abdulkadir et al. observed significantly lower NPV (21%). This rather contradictory finding may due to the high prevalence of fever reported by Abdulkadir et al. (84.6%) [38].

More than half of the mothers in the current study used a single child's body part to palpate for fever, a result which is consistent with that obtained by Okposio and Abhulimhen-Iyoha [39], who also reported that 59.6% of the mothers used a single site. The forehead was the most common site palpated by the mothers who palpated a single body part, a result that is similarly observed by Jalil et al. (35.2%) [24], Koech et al. (86.4%) [42], and Rosenbloom et al. (64.7%) [34]. In contrast, Asekun-Olarinmoye et al. observed that the neck is the most frequently palpated site (43.7%) [23]. The older children (1 month-12 years) in Asekun-Olarinmoye et al.'s study may account for this difference, as the shorter necks of the younger children in our study make them less accessible to palpation by the mothers.

In our study, the maternal ability to correctly assess presence of fever in their children was higher in that group of mothers who utilized multiple child's body site palpation (96.5%) than mothers who palpated single child's body site (73%). In the

same vein, all measures of accuracy (sensitivity, specificity, PPV, NPV, and accuracy) were higher in mothers who palpated multiple sites on their child's body compared to those who palpated a single site. Similarly, Singhi and Sood also reported higher sensitivity (100%) and specificity (92.2%) when mothers palpated multiple sites [43]. Odinaka et al. also reported an increase in sensitivity from 76.2% to 86.7% and an increase in NPV from 66.7% to 76.5% when mothers palpated more than one child's body site [41]. However, Okposio and Abhulimhen-Iyoha found no significant improvement in the accuracy measures when mothers used multiple sites for palpation [39]. This discrepancy may be explained by the fact that the prevalence of fever in their study was 34.5%, which is significantly lower than the prevalence found in our study, which was 72%.

Our study has a few limitations that must be considered. First, the single-center nature of this study may limit the generalizability of our findings. However, being a referral hospital for the entire province may offset this limitation. Second, the NCTT was used as the reference standard for temperature measurement in our study to reduce patient contact; however, this thermometer may not accurately reflect the patient's true core body temperature, which is best measured using the traditional rectal thermometer [44-46]. A further limitation is that observational studies are susceptible to bias as a result of the Hawthorne effect. This term describes how some people modify their behavior when they become aware that they are being observed [47, 48].

The strengths of our study include the precise inclusion and exclusion criteria that helped to eliminate selection bias. Second, one investigator recruited all the mothers for the study and used a single thermometer to assess the children's temperatures. This eliminated the inter-observer and inter-instrument variations. Third, the fact that the study's lead researcher was a board-certified pediatrician practicing at the same hospital where the research was being conducted reassured the mothers and encouraged them to participate in the study.

Conclusion

In light of the findings of this study, the high sensitivity of maternal tactile fever assessment implies that this technique could be used as a screening method for fever when thermometers are not available, as mothers will rarely miss fever when it is present in their children.

Mothers' concerns about COVID-19, on the other hand, resulted in a rise in the rate of false positive cases because they overestimated the presence of fever, resulting in low specificity.

The palpation of multiple areas of the child's body can result in a significant enhancement in the mother's ability to correctly estimate the child's temperature and, consequently, an improvement in the accuracy of the tactile technique.

Acknowledgements

The Authors are appreciative to the mothers who participated in this study as well as the nurses and support staff at Al-Khansaa Hospital for their assistance with patient recruitment.

Declaration of interest

The Authors disclose that they do not have any conflicting interests. Funding: none.

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