RESEARCH

COMPARISON OF WRIST AND FOREHEAD TEMPERATURE MEASUREMENTS AS SCREENING METHODS DURING THE COVID-19 PANDEMIC

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Abstract

Background: Temperature screening checkpoints have become prevalent in all public places during the COVID-19 pandemic. Contactless screening methods have been adopted for the early detection and isolation of febrile patients. The tympanic method closely resembles the body core temperature, however, they are not in use due to the disposal charges. This study aims to compare the efficacy of wrist and forehead temperature methods with the standard tympanic temperature. In light of the fact that a large population require rapid screening and that forehead temperature measurement being influenced by the environment, we investigated the accuracy and benefits of wrist temperature measurement in various environments. **Materials and Methods:** This study was conducted in a tertiary care hospital in Perundurai, Tamilnadu. All the visitors who presented to the OPD between 6th April-13th May 2020 were included in the study. The exclusion criteria were those with ear discharge and tympanic membrane perforation. All the participants were made to wait for 10 minutes in the waiting hall to ensure temperature-controlled settings. We consecutively collected wrist, forehead, and tympanic temperature readings of all participants using infrared thermometers. Fever was defined as a temperature above 37.5°C. The data was analyzed using the Bland-Altmann plot in MS Excel 2016. **Result:** A total of 514 participants were enrolled in the study. The mean difference ranged from 2.10 to -2.00 for the forehead measurements and 2.00 to -2.00 for wrist measurements. The agreements for each method with tympanic temperature were calculated. (Forehead temperature: 1.23 to -1.17; Wrist temperature: 1.23 to -1.13). **Conclusion:** The study concluded that the wrist temperature was more stable than the forehead temperature. However, these methods did not provide any diagnostic cut-off value. Furthermore, the asymptomatic nature of some COVID-19 cases reduced the sensitivity of these tests. Further studies are advised to explore the validity of wrist temperature.

INTRODUCTION

In late December 2019, a novel coronavirus SARS-CoV 2 emerged in Wuhan, China spreading into a global pandemic. Fever, fatigue, and dry cough are identified as some of the common symptoms of the disease.[1] The COVID-19 era has imposed the need for contactless measurement of temperature to screen the public for early detection and isolation of febrile patients.[2]

During the pandemic, infrared tympanic thermometers and non-contact infrared thermometers were used for screening at entry points of public places. However, infrared tympanic thermometers are not a preferred screening tool as it demands more cost due to the disposal of the plastic probes after every use.[2] The forehead and wrist temperature measurements have proven to be suitable in terms of safety, efficacy, and cost-performance. Forehead temperature is influenced by physiological and environmental conditions and subjects may have to be screened after acclimatization to the indoor temperature. However, this might not be suitable for mass screening. The wrist temperature is found to be stable, as the wrist area is often covered with clothing.

Therefore, this study aims to compare the efficacy of these two temperature methods- forehead and wrist with the standard tympanic temperature.

MATERIALS AND METHODS

The study is a prospective observational study, which enrolled 514 participants who attended the outpatient department of a tertiary care hospital between 6th April, 2020 and 13th May, 2020. The exclusion criteria included those with ear discharge and tympanic membrane perforation.

The subjects were patients attending the clinic and accompanying family members. All the participants were made to wait for 10 minutes in the waiting hall to ensure temperature-controlled settings. For every participant, three temperature readings were each taken from the tympanic region, wrist region and forehead region respectively. The temperature readings were taken by trained nurses. The subjects were considered to be febrile if any of the temperature readings were ≥ 37.5 °C.

Measurement of Temperature

The tympanic temperature is considered equivalent to the core temperature as the tympanic membrane lies in close proximity with the hypothalamus and internal carotid artery.[3] Hence the tympanic temperature is considered as a standard temperature.

Statistical Analysis

The data analysis was performed in Microsoft Excel 2016. The categorical variables were expressed in frequency and percentage, and the continuous variables were expressed as mean +/- standard deviation. The agreements for wrist and forehead temperature with tympanic temperature were analyzed by Bland-Altmann plot. Yellow dashed line marked the mean bias among all the paired measurements. Red dashed line highlighted the upper and lower 95% limits of agreement.

RESULTS

In this study, a total of 514 participants were included. The mean age of the participants was 45.39 +/- 18.18 years. The demographic characteristics of the participants are as shown in Table 1.

Observed Values: The mean temperature using the tympanic method was 36.16 +/- 0.53, using the wrist method was 36.10 +/- 0.62 and by the forehead method was 36.19 +/- 0.49.

Wrist Temperature: The bias for wrist temperature and the standard was 0.14 +/- 0.92 with a range from 2.00 to -2.00. The agreement limits for wrist and tympanic temperature were between 1.23 and -1.13.

Forehead Temperature: The bias for forehead temperature and the standard was 0.03 +/- 0.61 with a range from 2.10 to -2.00. The agreement limits for forehead and tympanic temperature were between 1.23 and -1.17.

From the limits of agreement, we conclude that the wrist temperature is a better indicator of the standard method than the forehead temperature.

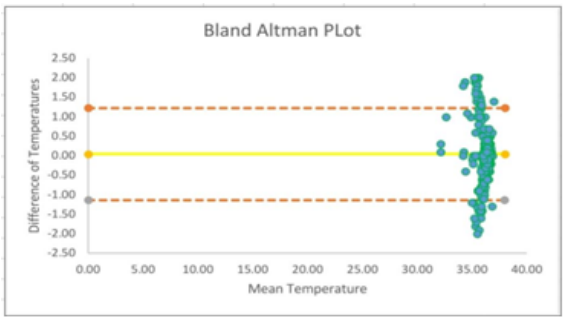

Figure 1: Bland-Altmann plot for tympanic and wrist temperature

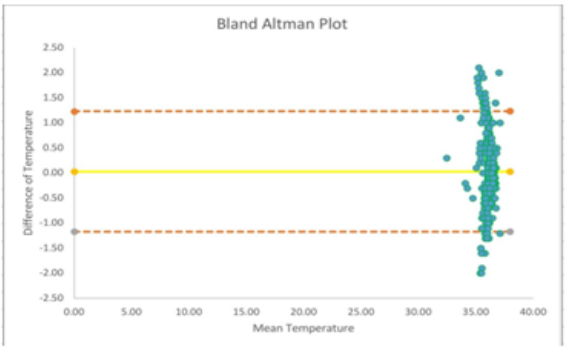

Figure 2: Bland-Altmann plot for Tympanic and Forehead temperature

Table 1: Demographic characteristics of the participants.

Variables	Total (n=514)
Age (years)	45.39 +/- 18.18
Gender, male	232 (45.13%)
Forehead temperature (°C)	36.19 +/- 0.49
Wrist Temperature (°C)	36.10 +/- 0.62
Tympanic Temperature (°C)	36.16 +/- 0.53

All categorical variables are expressed in frequency and percentage [n(%)] and continuous variables are expressed in Mean ± Standard deviation[M±SD].

DISCUSSION

In this study, we found that wrist temperature is more accurate than the forehead temperature. According to a previous study by Gasim et al., tympanic temperature can be used in clinical practice, especially in emergency settings.[4] However, less invasive and economically feasible tools are in need. In a study by Chen et al., wrist temperature was found to be more stable than forehead temperature under different transportation settings.[2]

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The strengths of the study include large sample size and similar time period of the day for temperature measurements over a week. The study is limited by use of tympanic temperature as a standard method.[5]

CONCLUSION

The results from our study showed that the wrist temperature readings are more stable than the forehead temperature readings, with tympanic temperature as the reference method.
However, it should be emphasized that the temperature that were measured using infrared thermometers did not provide any diagnostic cut-off value.[5] The asymptomatic nature of some COVID-19 cases reduced the sensitivity of these methods.[6]

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