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Research Article

**COMPARISON OF INFRARED FOREHEAD AND TYMPANIC  
THERMOMETRY WITH GLASS MERCURY THERMOMETRY  
IN ADULTS**<sup>1</sup>Dr. Maaz Moin Khan, <sup>2</sup>Dr. Madeeha Nazar, <sup>3</sup>Dr. Nida Anjum<sup>1</sup>Medical Officer, THQ Hospital, Gujar Khan, Rawalpindi<sup>2</sup>Senior Registrar, Medical Unit II, Holy Family Hospital, Rawalpindi<sup>3</sup>Senior Registrar, Medical Unit II, Holy Family Hospital, Rawalpindi**Abstract**

**Purpose:** The purpose of our study was to compare temperature readings taken from skin and ear using infrared thermometer with readings taken from axilla with glass mercury thermometer (GMT). If significant correlation is found between the readings of two devices, then infrared thermometer can be used to record body temperature in adult patients. **Methods:** The study was conducted in the wards, OPD and Emergency Department of Holy Family Hospital, Rawalpindi. 50 patients within age group 12-75 years were enrolled who fulfilled the inclusion criteria i.e. had clinical suspicion of fever. Temperature was measured using glass mercury thermometer (GMT) and infrared thermometer (IT) using skin and tympanic probes. In order to avoid variability both GMT and IT were used at the same time to check the temperature of the patients. **Results:** In our study the male to female ratio was 30:20. 24 patients (48%) were in age group 12-30, 17(34%) were in 31-45, and 7(14%) were in 46-60 and 2(4%) were in 61-75 age group. The mean temp for forehead by IT was  $100.31 \pm 1.68$ . Mean temp for ear route by IT was  $98.36 \pm 4.59$  and mean temperature for axilla by GMT was  $100.41 \pm 1.05$ . The mean difference between temperature recording of GMT and IT at axilla and forehead respectively (0.10) was not statistically significant but there was significant difference between the recording of GMT and IT at axilla and ear respectively. ( $p \leq 0.05$ ). There was weak correlation between forehead and ear measurements by IT ( $r = 0.370$ ) but was statistically significant ( $P$ -value 0.008). There was moderate correlation between forehead measurement by IT and axillary measurement by GMT ( $r = 0.555$ ) which was statistically significant ( $P$ -Value 0.001). **Conclusion:** Infrared thermometer can be considered a quick, accurate and non-invasive tool for recording body temperature in adults. However, more studies are needed to prove its efficacy in recording accurate temperature in adult population.

**Keyword:** Glass Mercury Thermometer (GMT), Infrared Thermometer (IT).**Corresponding author:****Dr. Maaz Moin Khan,**

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**INTRODUCTION:**

Body temperature is a measure of the body's capability to produce and remove heat. Normal body temperature is around 98.6°F (37°C) but varies to some extent during the day. Various thermometers are used to record body temperature in adults and children, such as Glass mercury thermometer, liquid glass forehead thermometer, digital electronic thermometer, infrared forehead, and tympanic membrane thermometer. The efficiency of these devices to detect correct body temperature is not certain [1].

Increase or decrease in body temperature is a sign of some pathological process that needs to be halted through treatment to avoid permanent damage [2]. An ideal thermometer should record correct body temperature regardless of age, should be easy to use, and should be safe and cost effective. Moreover, it should not be affected by the changes in environmental temperature [3].

The traditional devices used to record body temperature are glass mercury thermometer (GMT) and electronic digital thermometer (EDT). The former is inexpensive and easy to use but has a long dwelling time, a risk of breakage resulting in injury to patient, and is difficult to read. The latter is affected by aging [4]. Infrared thermometers (IT) are easier to use and they give temperature readings in few seconds as compared to GMT. They can be used to take reading from skin of mid forehead and above superficial temporal artery or they can be used to record core body temperature by placing the sensor in external auditory canal near the tympanic membrane [5].

Many studies have been done on these various temperature recording devices but have yielded conflicting results [6]. Some studies that compared infrared thermometer with GMT and EDT showed it to be more accurate and easier to use [7]. However, a few other studies showed Infrared Thermometer to be less reliable and less accurate as compared to GMT and EDT [8-10].

The purpose of our study was to compare temperature readings taken from skin and ear using infrared thermometer with readings taken from axilla with glass mercury thermometer. If significant correlation is found between the readings of two devices then infrared thermometer can be used to record body temperature in adult patients. This can be especially be useful in ER and OPD settings where large number of patients are to be seen in a short period of time.

**MATERIALS AND METHODS:**

This comparative descriptive study was carried out in the wards, OPD and emergency of Holy Family Hospital, Rawalpindi for a period 3months from 1<sup>st</sup> September 2017 to 30<sup>th</sup> November 2017. Sample size was calculated using WHO sample size calculator, age of patients included in this study ranges from 12 to 75 years. Only those patients who had clinical suspicion of fever based on history and examination were included in this study. Patients excluded in this study were those who were irritable or had some axillary or fore head skin disease. After approval from ethical review board informed consent was taken from the patients. Patients fulfilling the inclusion criteria were included in the study. Temperature was measured using glass mercury thermometer (GMT) and infrared thermometer (IT) using skin and tympanic probes. Axillary and fore head regions were dried using a towel before measurement. GMP was shaken before use in order to decrease the reading below 35°. The GMP was placed in the left axilla with instructions to keep the thermometer in contact with the skin while in place and was kept there for 2minutes. Infrared thermometer was kept at room temperature for 15 minutes before use. Temperature was recorded using skin probe of infrared thermometer by placing the sensor on mid fore head and above right and left superficial temporal artery for 3 seconds each. The temperature was also recorded by pulling the left ear upwards and backwards to straighten the ear canal and placing tympanic probe of infrared thermometer in the left ear for a period until a beep was heard.

**RESULTS:**

In our study, 24 patients (48%) were in age group 12-30, 17(34%) were in 31-45, and 7(14%) were in 46-60 and 2(4%) were in 61-75 age group. There were 30(60%) male patients and 20(40%) female. The mean temp for forehead by IT was 100.31±1.68. Mean temp for ear route by IT was 98.36±4.59 and mean temperature for axilla by GMT was 100.41±1.05. There was significant difference in temperature measurements (P-Value 0.001) taken at forehead, ear and axilla by IT and GMT (P-Value=<0.001). The mean difference between temperature recording of GMT and IT at axilla and forehead respectively (0.10) was not statistically significant but there was significant difference between the recording of GMT and IT at axilla and ear respectively. (p ≤0.05). (Table 1).

There was weak correlation between forehead and ear measurements by IT (r= 0.370) but was statistically significant (P-value 0.008). There was moderate

correlation between forehead measurement by IT and axillary measurement by GMT ( $r= 0.555$ ) which was statistically significant (P-Value 0.001). There was weak correlation between temperature measures in ear by IT and axillary measurement by GMT ( $r=0.318$ ) which was statistically significant (0.024)

(Table 2) The mean difference between temperature recording of GMT and IT at axilla and forehead respectively (0.10) was not statistically significant but there was significant difference between the recording of GMT and IT at axilla and ear respectively. ( $p \leq 0.05$ ).

Table 1. Demographic variable

		n (%)
Gender	Male	30 (60.0%)
	Female	20 (40.0%)
Age	12-30	24 (48.0%)
	31-45	17 (34.0%)
	46-60	7 (14.0%)
	61-75	2 (4.0%)
Mean Temperature measurement	forehead	100.31±1.68
	ear	98.36±4.59
	Normal thermometer	100.41±1.05
Mean Difference between Mercury Thermometer and infrared thermometer at forehead	0.10±1.41 (P-value= 0.63)	
Mean difference between Mercury and infrared thermometer at ear	2.05±4.37 ( P-value = 0.01)	

Table 2. Correlation

Correlation between	r	P-Value
Forehead and Ear by IT	0.370	0.008
Forehead by IT and axilla by GMT	0.555	0.001
Ear by IT and axilla by GMT	0.318	0.024

### DISCUSSION:

It is a common practice, throughout the world, to check and record temperature of patients presenting indoor and outdoor with various health related issues and especially with complaint of fever. Patients who have documented fever need workup to know the cause of fever so that appropriate treatment can be given. Glass Mercury Thermometer (GMT) is being used to record temperature for quite a long time [2].

The disadvantages of GMT such as risk of breakage, possibility of spread of hospital acquired infections, difficulty in reading the recorded temperature values, long placement time of GMT to record temperature have created the need for thermometer that is accurate, speedy, safe to use and easy to read.<sup>2,12,13</sup>

Infrared thermometer (IT) have evolved to replace the mercury thermometer because of its speedy and safe usage.<sup>3</sup> But its accuracy in adult population is still questionable. Few studies have been done to find

whether the difference between temperature recordings of GMT and IT in adults is statistically significant or not.

The present study was conducted to find the concordance of the infrared thermometer with the glass mercury thermometer with the hypothesis that there are statistical significant mean differences in temperature result between mercury thermometer and infrared thermometer.

In our study, the mean difference between temperature recording of GMT and IT at axilla and forehead respectively (0.10) was not statistically significant.<sup>1</sup>but there was significant difference between the recording of GMT and IT at axilla and ear respectively. ( $p \leq 0.05$ ). There was moderate correlation between mercury and infrared thermometer readings at forehead ( $r=0.55$ ) which was statistically significant ( $p$  value = 0.01).The weak

correlation between the readings at axilla by GMT and at ear by IT could be due to wax in ear or insufficiently straightened ear canal or low sensitivity of ear sensor in the respective model of IT. The insensitivity of IT for temperature recording through ear has been documented in another study as well [10]. Through another study has shown strong correlation between readings of GMT at axilla and IT at forehead [11].

In conclusion, infrared thermometer can be considered a quick, accurate and non-invasive tool for recording body temperature in adults. However, more studies are needed to prove its efficacy in recording accurate temperature in adult population.

### CONCLUSION:

Infrared thermometer is nearly as accurate as mercury thermometer and is safer as well. However, further studies are required with a larger sample size to determine the accuracy and usage of infrared thermometer.

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