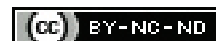


# Measurement of Perfusion Index of all the Fingers of Both the Hands in Healthcare Volunteers: A Cross-sectional Study

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## ABSTRACT

**Introduction:** Perfusion Index (PI) is an indirect, non invasive and continuous method to measure peripheral perfusion. In case of circulatory shock, the peripheral tissue bed is assumed to be sacrificed first and reperfused last in resuscitation.

**Aim:** To measure the peripheral PI from different fingers of both hands in healthy healthcare workers of a tertiary care hospital.

**Materials and Methods:** A cross-sectional study was conducted in Coronavirus Disease-2019 (COVID-19) designated healthcare hospital in January 2021. In this study, healthy volunteers with the age of 18-60 years were included. All the volunteers were evaluated with a pulse oximeter in all extremities of both the hands to check their PI. For significant results of repeated measure of ANOVA, post-hoc Bonferroni test were used to

evaluate all multiple comparisons. All p-values <0.05 were considered significant.

**Results:** A total of 96 healthcare volunteers with the mean age of 35.25±11.074 years were included in the present study. Majority of the population were male (80.2%). The highest perfusion was recorded in the right hand ring finger (8.59±4.03%). The lowest reading was noted in the right hand thumb (6.27±2.89%). The PI noted in the right thumb was significantly less than all the other fingers (p-value <0.05) except left thumb and left little finger (p-value >0.05).

**Conclusion:** From this study, authors more emphasis on the choice of the finger during the measurement of PI because both highest and lowest perfusions were reported in the dominant hand.

**Keywords:** Healthy volunteers, Peripheral perfusion, Pulse oximetry

## INTRODUCTION

A ratio between pulsatile and non pulsatile strength at a specific monitoring site like fingers of hands or foot is known as Perfusion Index (PI). It is a simple non invasive, indirect, and continuous method to measure peripheral perfusion. In case of any kind of circulatory shock, the peripheral blood flow decreases initially to preserve perfusion in the vital organs [1]. The peripheral tissue bed is assumed to be sacrificed first and reperfused last in resuscitation [2,3]. The evaluation of tissue perfusion can be done either clinically by studying parameters like skin coldness (temperature), paleness, mottling, and prolongation of capillary refill time or biochemically by serum lactate and central venous oxygen saturation [4].

Now-a-days, it is usually calculated with the use of pulse oximetry by expressing the pulsatile signal as a percentage of that of the non pulsatile signal [5]. Both the pulsatile and non pulsatile signals are determined at two wavelengths, and the oxygenation of blood is calculated from the difference in absorption at two wavelengths by the pulse oximeter [6]. It is expressed as percentage ranging from 0.02-20%. A higher value indicates stringer pulsatile signal and better perfusion at the sensor site. The universal availability of a pulse oximeter in operating rooms and intensive care units, the PI can be monitored easily in any circumstances. It can efficiently measure microcirculatory changes rapidly [7]. In the present study, we have evaluated volunteer healthy healthcare workers for primary objective of comparing the peripheral PI from different fingers of both hands in Coronavirus Disease-2019 (COVID-19) designated hospital.

## MATERIALS AND METHODS

This was a cross-sectional study conducted at a COVID-19 healthcare facility centre in India in January 2021. A written informed

consent form was signed by all volunteers. The study protocol was approved by Institutional Ethics Committee.

**Inclusion criteria:** All the healthcare worker and essential staff (doctors, nurses, medical assistants, non medical assistants and house keeper staffs) who performed their duty for more than three months in a COVID-19 designated ward, age between 18-60 years of either gender were included in this study.

**Exclusion criteria:** Absence of any finger/nail bed and presence of any co-morbid conditions like chronic obstructive pulmonary disease, bronchial asthma, history of smoking, diabetes mellitus, hypertension, peripheral vascular disease, cardiovascular disease, obesity (body mass index >30), immunocompromised condition. The healthcare workers on steroids, chemotherapy and radiotherapy were also excluded.

## Study Procedure

All the healthy volunteers were evaluated for PI by placing a pulse oximeter on all extremities of both the upper limbs. The measurements were taken for all the healthcare volunteers at the beginning of their shifts. They were asked to rest for 10 minutes and after that the measurements were taken in sitting upright position. All the reading were taken with same measurement device in ambient lighting. The measurements were repeated three times in each finger of each participant and average of those readings were considered. Other basic demographic details were also noted along with PI.

## STATISTICAL ANALYSIS

Categorical variables were expressed as percentages and continuous variables were expressed as mean±standard deviations. Continuous variables were compared using repeated measure of Analysis of Variance (ANOVA). For significant results of repeated measure of

ANOVA, post-hoc Bonferroni test were used to evaluate all multiple comparisons. All p-values <0.05 were considered significant. Statistical analysis was performed using Statistical Package for Social Science, version 20.0 (SPSS, Inc., Chicago, IL).

## RESULTS

A total of 96 healthcare volunteers were included in this study. The mean age of the study population was 35.25±11.074 years. Majority of the population consisted of male (80.2%). Total 93.8% study population had dominant right hand. The demographic details are shown in [Table/Fig-1].

| Parameters                 | N=96         |
|----------------------------|--------------|
| Age (years, mean±SD)       | 35.25±11.074 |
| Male (n,%)                 | 77 (80.2%)   |
| Dominant right hand (n,%)  | 90 (93.8%)   |
| Pulse (beats/min, mean±SD) | 80.67±10.360 |

[Table/Fig-1]: Demographic data and hemodynamic values of volunteers.

The right thumb had showed 6.2±2.9%, lowest PI value in the right hand. The highest mean perfusion was noted in the right hand ring finger, 8.6±4.0%. In the similar way, left hand was also subjected for measurement of PI in all extremities. The lowest perfusion in the left hand was noted in the little finger and left thumb which was 7.2±3.2%. [Table/Fig-2] shows the PI data in both the upper limbs.

| Finger                 | Mean±SD |
|------------------------|---------|
| Right thumb, %         | 6.2±2.9 |
| Right index finger, %  | 6.9±3.5 |
| Right middle finger, % | 7.9±3.7 |
| Right ring finger, %   | 8.6±4.0 |
| Right little finger, % | 8.2±3.9 |
| Left thumb, %          | 7.2±3.2 |
| Left index finger, %   | 7.5±3.2 |
| Left middle finger, %  | 7.8±3.4 |
| Left ring finger, %    | 7.8±3.5 |
| Left little finger, %  | 7.2±3.2 |

[Table/Fig-2]: Peripheral Perfusion Index (PI) in different fingers.

The multiple comparison of repeated measure of ANOVA by Bonferroni test was conducted and the PI noted in the right thumb was significantly less than all the other fingers (p-value <0.05) except left thumb and left little finger (p-value >0.05). A detailed comparison of the PI between the fingers is shown in [Table/Fig-3].

| Fin-gers | Perfusion Index (PI) | R1     | R2     | R3 | R4    | R5    | L1 | L2 | L3 | L4 | L5 |
|----------|----------------------|--------|--------|----|-------|-------|----|----|----|----|----|
| R1       | 6.2±2.9              | -      |        |    |       |       |    |    |    |    |    |
| R2       | 6.9±3.5              | 0.039  | -      |    |       |       |    |    |    |    |    |
| R3       | 7.9±3.7              | <0.001 | 0.027  | -  |       |       |    |    |    |    |    |
| R4       | 8.6±4.0              | <0.001 | <0.001 | NS | -     |       |    |    |    |    |    |
| R5       | 8.2±3.9              | <0.001 | 0.027  | NS | NS    | -     |    |    |    |    |    |
| L1       | 7.2±3.2              | NS     | NS     | NS | 0.001 | 0.037 | -  |    |    |    |    |
| L2       | 7.5±3.2              | 0.004  | NS     | NS | NS    | NS    | NS | -  |    |    |    |
| L3       | 7.8±3.4              | 0.003  | NS     | NS | NS    | NS    | NS | NS | -  |    |    |
| L4       | 7.8±3.5              | 0.004  | NS     | NS | NS    | NS    | NS | NS | NS | -  |    |
| L5       | 7.2±3.2              | NS     | NS     | NS | NS    | NS    | NS | NS | NS | NS | -  |

[Table/Fig-3]: Multiple comparisons of repeated measure of Analysis of Variance (ANOVA) by Bonferroni test.

NS: Not significant; R1: Right thumb; R2: Right index finger; R3: Right middle finger; R4: Right ring finger; R5: Right little finger; L1: Left thumb; L2: Left index finger; L3: Left middle finger; L4: Left ring finger; L5: Left little finger

## DISCUSSION

In the present study, all the volunteer healthcare workers were evaluated for PI in all extremities of both upper limbs. Choosing the monitoring site is important factor in evaluation of PI. A site at which the pulse amplitude is higher is considered an optimal monitoring site for measurement of PI. Fingertip is usually considered a standard site for measurement in adults [8]. The use of PI has emerged as an important parameter in recent times of COVID-19 pandemic. It is also a great monitoring tool with a very wide application in variety of clinical settings including anaesthesiology (surgical and obstetric), neonate acute care etc.

In the present study, the volunteers were younger with the mean age of 35.25±11.07 years. The fingers in the right hand showed higher perfusion than the fingers in the left hand. The possible explanation for such is that, majority of volunteers had dominant right hand. Likewise, a study conducted by Basaranoglu G et al., evaluated blood oxygen saturation in all the fingers of both the hands and also reported similar results where dominant hand showed better oxygen saturation [9]. It further reported that the middle finger of dominant hand had highest perfusion. The possible reason for high perfusion in middle finger is due to the fact that it gets blood supply from both the radial and ulnar arteries. Contrary to that, the present study reported the highest perfusion in the ring finger of right hand.

Considering majority of the volunteers in present study had dominant right hand, the middle finger of the right hand should have showed highest perfusion. This was also surprising to us as we could not find any study reporting such phenomenon where ring finger had higher perfusion. In the present study, authors measured PI in all the volunteers when they were sitting in upright position. The measurements were more accurate when subject is sitting in upright position after post-hoc analysis, as stated by Ceylan B et al., [10]. The thumbs and the little fingers should not be used for measurement of PI as both showed lesser perfusion values in each hand compared to the other fingers.

### Limitation(s)

As the present study only included healthcare volunteers and hospital staff, the study was limited by its small number of population.

## CONCLUSION(S)

Peripheral Perfusion Index (PI) is an important tool to investigate pulsatile strength non invasively. While measuring PI, choice of the finger is of utmost importance as both the highest and the lowest perfusions were noted in the dominant hand.

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