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## COMPARISON OF SpO<sub>2</sub> IN DIFFERENT FINGERS OF DOMINANT AND NON-DOMINANT HAND OF RIGHT AND LEFT-HANDED SUBJECTS

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### ABSTRACT

Pulse oximetry is a frequently used tool in measuring SpO<sub>2</sub>. It gives valuable information about arterial oxygen content, tissue perfusion and heart beat rate. This study compares capillary haemoglobin oxygen saturation (SpO<sub>2</sub>) values among every finger of the two hands in subjects with different handedness. SpO<sub>2</sub> measurement from the fingers of the both hands with the pulse oximetry, the middle finger and thumb have statistically significant higher value when compared with others fingers of the hand. But no statistically significant difference is found in between dominant and non- dominant hand.

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### Key Words

Pulse Oximetry, SpO<sub>2</sub>, handedness.

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### INTRODUCTION

The human eye is poor at recognizing hypoxemia. Even under ideal conditions, skilled observers cannot consistently detect hypoxemia until the oxygen (O<sub>2</sub>) saturation is below 80%. Peripheral capillary oxygen saturation (SpO<sub>2</sub>) measured by pulse oximeter, is a simple and reliable objective measurement in routine medical practice that approximates the level of oxygen in arterial blood. Measurements with this inexpensive and non-invasive method also provide heart rate and an indication of tissue perfusion (pulse amplitude). Low perfusion (due to hypothermia, low cardiac output, increased systemic vascular resistance, profound anaemia or etc.), venous pulsations in a dependent limb, nail polish, excessive ambient light or motion can cause pulse oximetry artifact. Also, carboxy-hemoglobinemia, methemoglobinemia and intravenous dyes can cause false SpO<sub>2</sub> readings (Butterworth et al. 2013; Chan et al. 2013; De Meulenaere 2007)<sup>1,2,3</sup>. There have been few studies suggesting use of right middle finger and



right thumb gives the most accurate value that reflect the arterial oxygen saturation in right-handed volunteers (Basaranoglu 2015)<sup>4</sup>. There has been no study comparing the effect of handedness on SpO<sub>2</sub> values from different fingers.

The aim of this study is to determine if there is difference of SpO<sub>2</sub> values in different fingers of dominant and non-dominant hand of right and left-handed subjects.

## METHODS AND MATERIAL

This is a cross sectional study which was conducted at Late Shri Lakhiram Agrawal Memorial Govt Medical College, Raigarh after obtaining approval from institutional Ethical committee. 70 healthy volunteer of age group 18 to 30 were enrolled for the study after obtaining written informed consent. The subjects were selected after completion of Edinberg Handedness inventory (Figure-1). All subjects with score of > +40 were considered to be Right-handed, -40 to +40 were considered to be ambidextrous and < -40 score were considered to be left-handed. Subjects with history of smoking, undergoing menstruating, having positive Allen test showing ulnar or radial artery failure, having hypotension, anaemia, haemoglobinopathy or bradycardia were excluded from the study.

## STUDY PROTOCOL

1. Subjects were asked to observe 8 hours of fasting before the test. Subjects were asked to remove any nail paint if present on the fingers.
2. After 5 minutes of resting blood pressure, Heart rate and bod temperature was recorded.
3. Pulse oximetry was recorded in each finger in ambient light with 1-minute waiting between each finger. The subjects were asked to keep the hand steady during the procedure to prevent motion artifacts. Abbreviations used for various fingers in used is shown in table-1.

Table 1 - Abbreviations used for various fingers

Finger	Abbreviations
Right Thumb	R1
Right Index finder	R2
Right Middle Finger	R3



Finger	Abbreviations
Right ring finger	R4
Right Little Finger	R5
Left Thumb	L1
Left Index Finger	L2
Left Middle Finger	L3
Left Ring Finger	L4
Left Little Finger	L5

### STATISTICAL ANALYSIS

Repeated Anova test was used to compare measurements. If there was significant result a post hoc Bonferroni test was used to evaluate all multiple comparisons ( $p < 0.05$  was considered to be statistically significant).

### RESULTS

A total of 70 volunteers participated in the study. In 70 volunteers 35 were right-handed, 20 left-handed and 15 ambidextrous. The demographic profile of the subjects is given in table -2. SpO<sub>2</sub> was recorded of all the 10 fingers of each participant hand and total of 700 fingers were evaluated. Comparison of mean SpO<sub>2</sub> values in different fingers of right-handed, left-handed and ambidextrous subjects is given in table-3.

Table 2 Demographic profile of the subjects.

Parameters	Right-Handed	Left-handed	Ambidextrous
Subjects	35	20	15
Male	20	12	8
Female	15	8	7



Parameters	Right-Handed	Left-handed	Ambidextrous
Age(years)	23.26 ± 3.2	24.21 ± 2.4	23.61 ± 3.6
SBP (mm/Hg)	118.6 ± 9.6	117.4 ± 7.6	118.3 ± 10.5
DBP (mm/Hg)	76.4 ± 12.3	75.6 ± 9.3	76.5 ± 8.6
Heart Rate(/min)	74 ± 5.4	75 ± 6.3	74 ± 8.2
Temp(°C)	36.03 ± 0.2	36.01 ± 0.4	36.07 ± 0.5

Table 3: - Mean SpO<sub>2</sub> in various subjects.

Finger	Right-Handed	Left-handed	Ambidextrous
R1	98.02 ± 1.04	97.74 ± 1.15	97.89 ± 1.17
R2	97.79 ± 1.21	97.56 ± 1.34	97.67 ± 1.64
R3	98.29 ± 1.3	97.72 ± 1.65	98.05 ± 1.94
R4	97.71 ± 1.4	97.65 ± 1.3	97.58 ± 1.20
R5	97.20 ± 1.19	97.21 ± 1.33	97.41 ± 1.33
L1	97.69 ± 1.13	98.03 ± 1.14	98.01 ± 1.04
L2	97.24 ± 1.34	97.79 ± 1.21	97.89 ± 1.41
L3	97.85 ± 1.94	98.21 ± 1.2	98.09 ± 1.2
L4	97.58 ± 1.20	97.71 ± 1.3	97.61 ± 1.5
L5	97.21 ± 1.23	97.30 ± 1.29	97.30 ± 1.39

The highest SpO<sub>2</sub> in right-handed subjects was found in right middle finger followed by right thumb and left middle finger while lowest was found in right and left little finger. The mean SpO<sub>2</sub> in right middle finger was found to be statistically significant as compared to left and right little finger. With Rest of the fingers the difference was not statistically significant in right-handed subjects.



In left-handed subjects highest SpO<sub>2</sub> was recorded in left middle finger followed by left Thumb. The mean SpO<sub>2</sub> in left middle finger was found to be statistically significant with right little finger. With rest of the fingers the difference was not statistically significant.

In ambidextrous highest SpO<sub>2</sub> was found in left middle finger followed by right middle fingers and no difference in SpO<sub>2</sub> between fingers was found to be statistically significant.

## DISCUSSION

According to our study 70 volunteers participated in which 35 subjects were with right hand dominance, 20 subjects with left hand dominance and 15 subjects were ambidextrous. In right and left-handed subjects, middle finger of the dominant hand had the highest average SpO<sub>2</sub> value with the pulse oximetry while in ambidextrous subject's highest average SpO<sub>2</sub> was recorded in right middle finger. This is in concurrence with Basaranoglu et al where highest average SpO<sub>2</sub> was recorded in right middle fingers of right-handed participants.

According to Mizukoshi et al. 2009<sup>5</sup> Perfusion Index (PI) value gave different results in each finger (ANOVA, p and the PI value of the middle finger was measured as the highest both during normo-perfusion and hypoperfusion, but no remarkable difference was found in SpO<sub>2</sub> values between fingers. Index finger dominantly is fed from deep palmar arcus created from radial artery. But middle fingers receive both ulnar and radial artery blood supply, so due to increase perfusion Index it shows higher recorded SpO<sub>2</sub>. The difference of SpO<sub>2</sub> recordings between different fingers may not be clinically important, but this knowledge may be valuable in conditions with poor peripheral perfusion. Dominant hand and higher perfusion may explain the highest value in middle finger.

According to Basaranoglu et al in the non-dominant hand, the size of the finger may become a negative contributing factor that determines the SpO<sub>2</sub> recording. But in our study the difference in mean SpO<sub>2</sub> recording between middle finger of dominant and non-dominant hand was not significant.

Higher perfusion in the middle finger seems reasonable to expect the highest and most accurate SpO<sub>2</sub> value. According to the results of our study, we believe that the middle finger of the



dominant hand has the highest and possibly the most accurate SpO<sub>2</sub> measurements. The main limitation of our study the SpO<sub>2</sub> measure by pulse oximetry was not corroborated by arterial blood gas analyses and PI parameters.

**Figure-1 Edinburgh handedness inventory**

**Edinburgh Handedness Inventory<sup>1</sup>**

Your Initials: \_\_\_\_\_

Please indicate with a check (✓) your preference in using your left or right hand in the following tasks.

Where the preference is so strong you would never use the other hand, unless absolutely forced to, put two checks (✓✓).

If you are indifferent, put one check in each column (✓ | ✓).

Some of the activities require both hands. In these cases, the part of the task or object for which hand preference is wanted is indicated in parentheses.

Task / Object	Left Hand	Right Hand
1. Writing		
2. Drawing		
3. Throwing		
4. Scissors		
5. Toothbrush		
6. Knife (without fork)		
7. Spoon		
8. Broom (upper hand)		
9. Striking a Match (match)		
10. Opening a Box (lid)		
Total checks:	LH =	RH =
Cumulative Total	CT = LH + RH =	
Difference	D = RH - LH =	
Result	R = (D / CT) × 100 =	
Interpretation: (Left Handed: R < -40) (Ambidextrous: -40 ≤ R ≤ +40) (Right Handed: R > +40)		

<sup>1</sup> Oldfield, R. C. (1971). The assessment and analysis of handedness: The Edinburgh inventory. *Neuropsychologia*, 9, 97-113.

**CONCLUSION**

In conclusion, SpO<sub>2</sub> measurement from the fingers of the both hands with the pulse oximetry, the middle finger and thumb of dominant hand have higher average value when compared with non-dominant hand but this difference is not statistically significant. We assume that middle finger is most appropriate for measurement of SpO<sub>2</sub> by pulse oximeter as compared to Index or little finger but no difference between middle finger of dominant and non-dominant hand.



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