Original Research Article

Prehensile Variations in the Extensive Use of Mobile Phones Among Medical Students of the 2020 Class of the Medical Faculty of Udayana University

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ABSTRACT

Humans can see the whole world just through cellphones, gadgets, or other media, which means that people can access anything easily just by using the latest available technologies related to how to hold the cellphone itself comfortably and maximum. This research uses observational descriptive research. The sample in the study was determined using the method of simple random sampling. The Lemeshow formula was used to measure the total sample that must be obtained in this research which resulted in 100 samples. Researchers took pictures of how to use a cell phone, measured hand anthropometry, and collected demographic data using a questionnaire that was filled out using Google Forms. The Kolmogorov-Smirnov test was performed to determine whether the data was normal or not. There were 18 prehensile groups found in this study which were then alphabetically divided into groups from A to R group, with type A 34%, type B 15%, type C 1%, type D 3%, type E 4%, type F 5%, type G 7%, type H 2%, type I 6%, type J 4%, type K 6%, type L 1%, type M 3%, type N 3%, type O 3%, type P 1%, type Q 1% and type R 1%. From anthropometric measurements, the research got results that the size of hand dimensions among the samples are larger than a standard smartphone in the study.

INTRODUCTION
The advent of modern technology has transformed the world into a "virtual globe", where people can effortlessly explore the entire planet using their smartphones, laptops, or other digital devices. This means that individuals have easy access to virtually anything they desire. [1] Smartphone is one of the most usable devices by people all over the world. Some people use it for work, while other people use it to entertain themselves. But, sometimes smartphones also have some negative impact on their users, such as forcing their users to use them extensively, no matter how long the users should use them. [2] This prolonged use of smartphones made the author want to find out whether there is a certain hand posture for holding a smartphone comfortably, considering that in everyday life, one object can be held using one hand, but it is not uncommon for other people to have to hold it with 2 hands so that it will result in a different way of holding. This is related to the concept of prehensile (the ability to use the hands effectively) which consciously or unconsciously will result in different prehensile variations for each person.[3] The author also wants to know the characteristics of each respondent's hands using hand anthropometric measurements with 25 variables used, where this is related

to the concept of ergonomics which talks about work safety.

MATERIALS & METHODS

Study Design

This research uses descriptive observational research method with research samples taken from students of the 2020 undergraduate medical study program at the Faculty of Medicine, Udayana University. The data collection technique that will be used in this research is the simple random sampling method. The sample size that will be used in this research is measured using the Lemeshow formula which results in 100 samples who have agreed to participate as research subjects.

Samples

The data collection was done by taking a picture showing the hand posture of each sample when holding the smartphone and classifying them into groups which divided alphabetically. Demographic data was taken using Google Form filled with demographic questions. The questionnaire used in this study was a questionnaire made by the author of this research.

STATISTICAL ANALYSIS

The data that had been collected were then processed and analyzed descriptively to find the mean and standard deviation using the IBMM SPSS Statistic Version 27 application and presented in the form of tables with narrative descriptions.

RESULT AND DISCUSSION

Characteristics of Respondents

Characteristic of samples obtained from demographic data through demographic questionnaire. The results showed in Table 1.

Table 1 Distribution of Demographic Characteristics of Respondents

Variable	Percentage (%)
Gender	
Male	48%
Female	52%
Smartphone Usage	
Yes	100%
No	0%
Smartphone Types	
Android	54%
IOS	46%
Smartphone Size	
> 3 inch (12 cm)	90%
< 3 inch (12 cm)	10%
Usage Time	
< 5 years	0%
> 5 years	100%
Frequency of Use in a Day	
< 3 times	0%
> 3 times	100%
Duration of Use	
< 2 hours	11%
2-4 hours	48%
> 4 hours	41%

Research found that more smartphone users are women (52%) than men (48%). This is in line with research conducted by Ripa et al which found data that out of 199 respondents, it was found that more smartphone users were women (87.9%) than men (12.1%). [4] Meanwhile, a study conducted by Mawarda et al showed that out of 267 respondents, it was found that more smartphone users were women(65.2%) than men (34.8%).[5]

This study found that all respondents involved had used smartphones for more than 5 years. These findings are in line with research conducted by Lee et al, where in the study it was found that 46.3% of the total male respondents and 61.6% of the total female respondents had used smartphones for more than 2 years.[6]

This research shows that the majority of respondents use smartphones > 3 inches in

size. Other research even shows the use of smartphones in 3 size categories, namely small, medium, and large, with large being the size of smartphone most used by the majority of respondents in the study, namely 45.9% of the 109 respondents. [7]

This study found that the largest data amount for the frequency of smartphone use in a day is > 3 times, namely 100%, with the highest duration of use being 2-4 hours with a percentage of 48%. This finding is in line with research conducted in Korea which took data from 1.236 respondents consisting of 725 males and 511 females and found that the majority of respondents which includes men (41.4%) and women (33.5%) used their smartphones for 2-<4 hours. [6] Another study showed that 86.3% of respondents used smartphones for 5 hours or more, while 13.7% of respondents used smartphones for less than 5 hours. [8] Another study conducted by Nadhifah et al even found that 54% of the total 949 respondents used smartphones for more than 7 hours.[9]

Prehensile Variation
Research found that there are 18 prehensile variations obtained from 100 samples. These variations were then divided into groups alphabetically from group A to group R. The distribution of those variations is shown in Table 2.

Table 2 Distribution of Prehensile Variations

Prehensile Group	Percentage
A	34%
B	15%
C	1%
D	3%
E	4%
F	5%
G	7%
H	2%
I	6%
J	4%
K	6%
L	1%
M	3%
N	3%
O	3%
P	1%
Q	1%
R	1%

Those prehensile variations are then specified as described below:

1. Group A
The first two digits (pollux; thumb) are used to type or move the screen, while the other 4 fingers support the smartphone on the back of the smartphone.
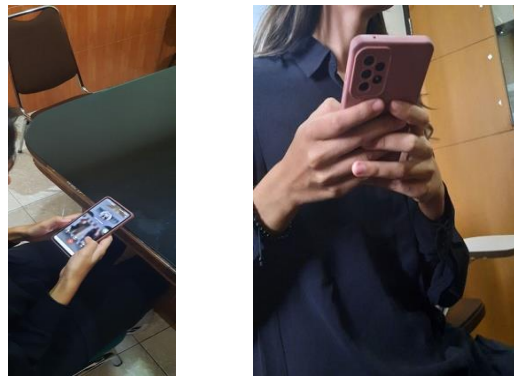

Figure 1 Group A Prehensile Type

2. Group B
The first two digits (pollux; thumb) are used to type or move the screen, the index finger is on the right and left side of the smartphone and the other 3 fingers support the smartphone on the back.

Figure 2 Group B Prehensile Type

3. Group C
The first two digits (pollux; thumb) are used for typing or moving the screen, index fingers are on the right and left sides of the smartphone, digits 3-5 support the smartphone at the back except digit 5 of the left hand which supports the smartphone at the bottom.

Figure 3 Group C Prehensile Type

4. Group D

The first two digits (pollux; thumb) are used for typing or moving the screen, index fingers are on the right and left sides of the smartphone, and digits 3-4 support the smartphone at the back except digit 5 which supports the smartphone at the bottom.
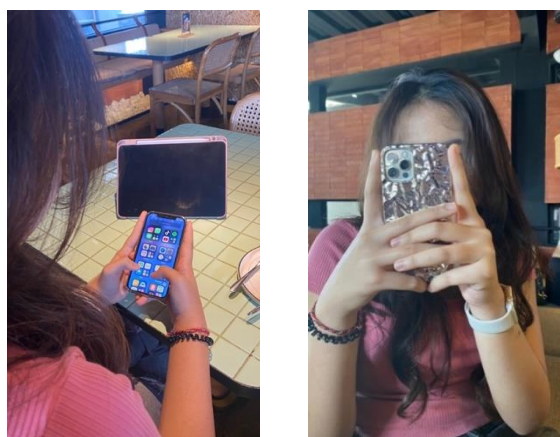

Figure 4 Group D Prehensile Type

5. Group E

The first two digits (pollux; thumb) are used for typing or moving the screen, the index finger left is on the left side of the smartphone, digits 2-5 of the right hand, and digits 3-4 of the left-hand support the smartphone on the back, while digit 5 sinistra supports the smartphone at the bottom.

Figure 5 Group E Prehensile Type

6. Group F

The first two digits (pollux; thumb) are used to type or move the screen, the other 4 fingers support the smartphone at the back of the smartphone except for the 5th digit finger which supports the smartphone at the bottom.

7. Group G

The first two digits (pollux; thumb) are used for typing or moving the screen, the left index finger is on the left side of the smartphone, while the other fingers are on the back of the smartphone.

8. Group H

The first digit (pollux; thumb) of the right hand is used to type or move the screen, while the other 4 fingers support the smartphone on the back. The left hand is not used.

9. Group I

The first two digits (pollux; thumb) are used for typing or moving the screen, the index finger dextra is on the right side of the smartphone, while the other fingers support the smartphone on the back.

10. Group J

The first two digits (pollux; thumb) are used to type or move the screen, the two digits 2-4 fingers support the smartphone at the back, while the 5th digits support the smartphone at the bottom.

11. Group K

The first digit (pollux; thumb) of the dextra hand is used to type or move the screen, dextra digits 2-4 support the smartphone at the back, while dextra digit 5 supports the smartphone at the bottom. The fingers of the left hand are not used.

12. Group L

The first digit (pollux; thumb) of the dextra hand is used to type or move the screen, the dextra index finger is on the right side of the smartphone, the dextra digits 3-5 support the smartphone on the back. The left hand's fingers are not used.

13. Group M

The first two digits (pollux; thumb) are used for typing or moving the screen, the left index finger is on the left side of the smartphone, the 2-4 dextra digits and 3-4 digits support the smartphone on the back,

while the 5 dextra digits support the smartphone at the bottom and the left 5 digits are not used.

14. Group N

The first two digits (pollux; thumb) are used for typing or moving the screen, the other 4 fingers support the smartphone at the back of the smartphone except for the left 5th digit which supports the smartphone at the bottom.

15. Group O

The first two digits (pollux; thumb) are used for typing or moving the screen, the index finger is on the right and left side of the smartphone and the other 3 fingers support the smartphone on the back, except for the 5th digit finger supporting the smartphone on the back.

16. Group P

The first two digits (pollux; thumb) are used for typing or moving the screen, the index finger dextra is on the right side of the smartphone, the 2nd and 4th digits sinistra and the 3-4 dextra digits support the smartphone on the back, while left digit 5 supports the smartphone at the bottom and right digit 5 is not used.

17. Group Q

The first two digits (pollux; thumb) are used for typing or moving the screen, the index finger is on the right and left side of the smartphone, left digits 3-5 and dextra digits 3-4 support the smartphone on the back, while digit 5 sinistra supports the smartphone at the bottom and the 5 dextra digit finger is on the right side of the smartphone.

18. Group R

The first two digits (pollux; thumb) are used for typing or moving the screen, the left index finger is on the left side of the smartphone, the left 2-4 digits and the left 3-4 digits support the smartphone on the back, while the second 5th digit finger supports the smartphone at the bottom.

Hand Anthropometry

Hand anthropometry was measured using 25 variables, which consists of Width of thumb (Lij), Width of the index finger (Ljt), Width of the middle finger (Ljtg), Width of the ring finger (Ljm), Width of the little finger (Ljk),

Length of thumb (Pij), Length of the index finger (Pjt), Length middle finger (Pjtg), ring finger length (Pjm), little finger length (Pjk), hand metacarpal thickness (Ttm), thumb hand thickness (Ttij), thumb thickness (Tij), finger thickness (Tj), hand length grip (Ptm), Width of the gripping hand (Ltm), Length of the hand (Pt), Length of the palm (Ptt), Width of the hand metacarpal (Ltmk), Width of the hand to the thumb (Ltij), Distance of the little finger (Jjk), Diameter maximum grip (Dgmak), minimum grip diameter (Dgmin), fist width (Lkt), and fist height (Tgkt).[10] The data were tested using the *Kolmogorov-Smirnov* test to know whether the data distribution was normal or not. Then, the data is processed descriptively to display the mean, median, and mode of each anthropometric variable and uses selected percentiles, namely 5, 25, 50, 75, and 90, then selects the 50th percentile as the selected percentile which displays the middle value of hand anthropometric measurements of the 100 samples. The result is shown in Table 3.

Table 3 Distribution Data of Hand Anthropometry in 50th Percentile

Variable	Value
Pij	6.00
Pjt	7.70
Pjtg	8.50
Pjm	7.80
Pjk	6.10
Ptm	11.35
Ltm	7.79
Pt	17.50
Ptt	10.20
Ltmk	7.40
Ltij	8.63
Jijk	16.85
Dgmak	4.92
Dgmin	2.50
Tgkt	6.01
Lkt	7.51
Lij	1.62
Ljt	1.60
Ljtg	1.60
Ljm	1.52
Ljk	1.31
Ttm	2.51
Ttij	3.58
Tij	1.47
Tj	1.53

If the results of the anthropometric findings are illustrated in a picture of a hand and then compared with the standard size of a

smartphone in this study (12 cm), it can be seen that the dimensions of the hand obtained are larger than the standard size of a smartphone, as seen in Figure 6 which mentioned 4 variables (Figure 6) out of 25 variables measured.
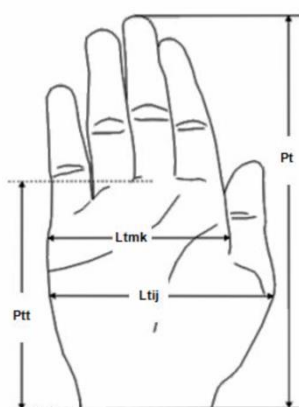

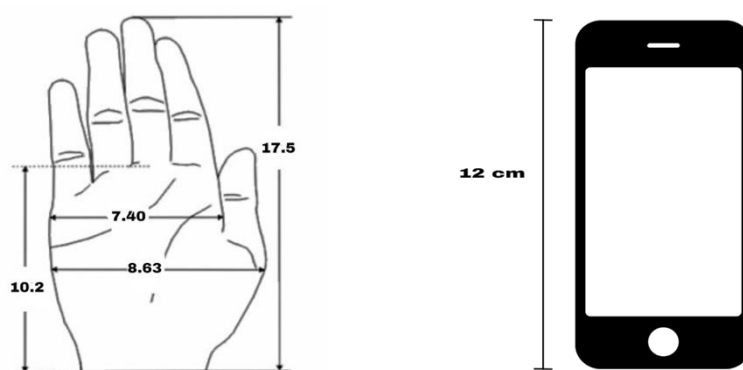**Figure 6 Variables Of Hand Anthropometry (Ltmk, Ltij, Pt, Ptt)**

Figure 7 Smartphone and Hand Anthropometry Comparison

Based on other research to determine the most preferred mobile phone based on hand anthropometry that took data from 233 respondents, the average size of each variable was obtained: Pt = 15.49 cm; Ltij = 8.47 cm; Ltmk = 7.13 cm; Ptt = 8.68 cm. Based on these findings, a conclusion was reached that the selected smartphone was the one with the following dimensions: H: 13.8 cm; W: 7 cm.[11] Other research even found that the ideal smartphone size is 14 cm high and 6.5-7 cm wide.[12]

These findings can be related to the concept of ergonomics which talks about work safety, which according to Dempsey defines ergonomics as the design and engineering of human-machine systems that aim to improve human performance.[13] Referring to the opinion expressed by Purnomo, if someone wears shoes that do not match the size of their feet, of course, that person will feel uncomfortable when wearing those shoes.[10] This is supported by a study that found that smartphone use turned out to be a risk factor for musculoskeletal disorders that occur in the neck and shoulder area.[14] Furthermore, other research even shows that using smartphones for long periods without an ergonomic hand prototype can cause musculoskeletal disorders in the neck and shoulder area due to increased muscle activity and discomfort in the neck and shoulders.[15]

CONCLUSION AND SUGGESTION

Based on research carried out at the Faculty of Medicine, Udayana University regarding prehensile variations in the extensive use of mobile phones among undergraduate medical students, the following conclusions were obtained:

1. There are a total of 18 prehensile groups in the extensive use of mobile phones
2. It was found that the characteristics of the hand, namely human anthropometry, were larger than the standard smartphone size in the study (12 cm).

This research certainly still has several shortcomings, namely respondents who seem to just fill in the demographic questionnaire given, anthropometric measurements that are not 100% accurate, respondents who make up ways to hold a smartphone, and limited studies that address prehensile and ergonomic concepts. The hope is that this research can be used as a reference or literature review for studies that raise the prehensile concept. Researchers also hope that the information contained in this research can be used as a reference for ergonomic studies in smartphone use.

Declaration by Authors

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