

Estimation of hand index and sex variations among the University students of Malaysia – An Anthropometric study

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Abstract: *The hand is the most preferable and resourceful part of the body for anthropometric measurement of hand length, breadth and indices. Hand index which is derived from hand dimensions can be used to estimate differences related to sex, age and race in forensic and legal sciences. The aim of the present study is to provide a statistical data of hand index in males and females. The hand breadth and hand length of 400 students (200 males and 200 females) between the ages of 18-25 years of SEGi University, Malaysia were measured using a vernier caliper. The hand index was calculated as the percentage of hand breadth over the hand length. The statistical data has been achieved by SPSS. The mean of right hand length (18.6471) and left hand length (18.6160) of male hand is higher than right hand length (16.9244) and left hand length (16.9411) of female. The right hand breadth of male (8.1630) and left hand breadth (8.0509) is much broader than the right hand breadth (7.2555) and left hand breadth (7.1052) of female.*

The statistical inspection of data showed that the right hand index of males (44.0272) is larger than the left hand index (43.1512) and the right hand index of females (43.0110) is larger than the left hand index (42.4815). The right hand index of males (44.0272) is larger than that of females (43.0110) and left hand index of males (43.1512) was larger than that of females (42.4815).

Key words: *Hand Length, hand breadth, hand indices and sex variations.*

I. Introduction

Anthropometric measurements were used in the field of forensic science and medicine [1]. Anthropometric data is a collection of the dimensions of the human body such as shape, strength, work capacity and body size [2, 3, 4].

Hand anthropometry can be defined as the study of comparative measurement of the human hand, involving parameters such as hand length and hand breadth [5, 6]. Hand bones have been archived as good anthropometric parameters, to exhibit immense sexual dimorphism [7] thereby can help forensic scientists in identifying human remains [8]. A recovered individual's hand when brought for examination can provide important information about the stature, sex and age of the person. The depth and breadth of each segment of the hand were measured at points that were spaced at equal distance between the joints of the hand [9]. Hand anthropometry is found to be useful in industrial machineries for the design of equipment [10,11] and stature estimation and correlation can be done using hand length, hand breadth and sole length [12]. It has been found that variations between male and females and between ethnicities is due to differences in nutrition and their levels of physical activity [13].

The length of human hand is about one-quarter the length of the upper limb and one-tenth the height [14]. The stature can be estimated from body parts [15], from hand Anthropometry [16] and somatometry of hand is related to height [17]. During a study to determine the sex of a Mauritian population through hand measurements, it was found that a hand index of more than '44' is suggestive of a male and less than '44' is that of a female [18]. Anthropometric measurements for right and left handed and for males and females for the Jordanian subjects [19] and estimation of stature from hand length has been reported [20].

The purpose of this research is to calculate hand indices and to interpret the differences between males and females which can be used in Forensics.

II. Materials and Methods

The present work is carried out randomly on 400 healthy university students of SEGi University, Malaysia, of which 200 males and 200 females. The students are from different Faculties and between the ages of 18-25 years.

The hand measurements were recorded to the nearest millimeter [9] using a mechanical vernier caliper. While measuring, proper care was taken to prevent the abduction and adduction at the wrist joint and to make

sure that forearm is directly in line with the middle finger. The hand length is measured vertically from the distal crease of wrist to the tip of the third middle finger while the hand is straight and stretched out. The hand breadth is measured as the horizontal straight distance between the end projections of second metacarpal and fifth metacarpal of hand while fingers extended together [Fig.1]



Figure.1 Measurement of hand Length Measurement of hand breadth

The hand indices were calculated using the following equation,

$$\text{Hand Index} = \frac{\text{Hand breadth}}{\text{Hand length}} \times 100$$

The results were then analyzed statistically using Statistical Package SPSS.

III. Results

The mean, minimum and maximum hand length, breadth and index of both right hand and left hands are shown in TABLE. 1 and TABLE. 2. The mean index for right hand of male is 44.0272 and left hand of male is 43.1512. The mean index for right hand of female is 43.0110 and left hand index is 41.9520.

Table.1 Mean, minimum and maximum values of hand Length, hand Breadth and hand Index

		Right Hand Length	Left Hand Length	Right Hand Breadth	Left Hand Breadth	Left Hand Index	Right Hand Index
N	Valid	400	400	400	400	400	400
Mean		17.7858	17.7785	7.7093	7.5781	42.5516	43.5191
Minimum		13.32	8.41	3.93	5.53	32.47	36.72
Maximum		43.00	20.94	9.61	9.81	49.56	61.21

Table.2 Hand length, hand breadth and hand index of male and female.

Gender			Right Hand Length	Left Hand Length	Right Hand Breadth	Left Hand Breadth	Right Hand Index	Left Hand Index
F	N	Valid	200	200	200	200	200	200
	Mean		16.9244	16.9411	7.2555	7.1052	43.0110	41.9520
M	N	Valid	200	200	200	200	200	200
	Mean		18.6471	18.6160	8.1630	8.0509	44.0272	43.1512

The dimensions based on different age groups and the gender are shown in TABLE.3

Table.3 Hand Length, Hand Breadth and Hand index of male and female (18-25 years).

Age	Gender		Right Hand Length	Left Hand Length	Right Hand Breadth	Left Hand Breadth	Right Hand Index	Left Hand Index
18	F	N	Valid	24	24	24	24	24
		Mean		16.8067	16.6788	7.2521	7.1325	42.9450
	M	N	Valid	11	11	11	11	11
		Mean		18.6309	18.7873	8.1718	8.0555	44.3745
19	F	N	Valid	16	16	16	16	16
		Mean		16.8206	16.7419	7.2700	7.0925	43.4413
	M	N	Valid	27	27	27	27	27
		Mean		18.3204	18.5226	8.1326	8.0663	44.7585
20	F	N	Valid	60	60	60	60	60
		Mean		16.7948	16.8435	7.2495	7.1173	43.2303
	M	N	Valid	42	42	42	42	42
		Mean		18.2340	18.3112	8.0479	7.9524	44.3179
21	F	N	Valid	45	45	45	45	45
		Mean		16.8633	16.9338	7.2860	7.0400	43.3020
	M	N	Valid	48	48	48	48	48
		Mean		18.7792	18.7450	8.2419	8.0688	43.6285
22 to 25	F	N	Valid	55	55	55	55	55
		Mean		17.1975	17.2258	7.2345	7.1371	42.4373
	M	N	Valid	72	72	72	72	72
		Mean		18.9250	18.7167	8.1878	8.0900	43.7961

In the 18 year old group the right hand index of male is 44.3745 and left hand index of male is 42.8782, the right hand index of female is 42.9450 and the left hand index of female is 42.8092. In 19 year old group, the right hand index of male is 44.7585 and left hand index of male is 43.4833, right hand index of female is 43.4413 and left hand index of female is 42.2013. In the 20 year old group, the right hand index of male is 44.3179 and left hand index of male is 42.9188, right hand index of female is 43.2303 and left hand index of female is 42.2440. In the 21 year old group, the right hand index of male is 43.6285 and left hand index of male is 43.0706, right hand index of female is 43.3020 and left hand index of female is 41.6116. In the 22-25 year old group, the right hand index of male is 43.7691 and left hand index of male is 43.2578, right hand index of female is 42.4373 and left hand index of female is 41.4656.

The graphical representations are shown in the bar graphs (Fig.1-3).

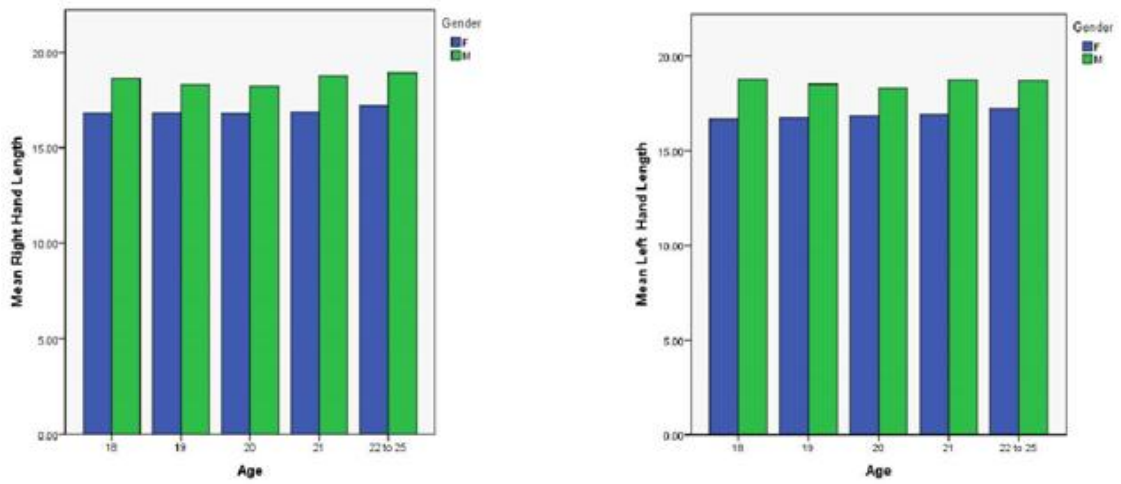


Figure. 1 Bar charts shows the mean right hand length and left hand length for all age groups of both genders.

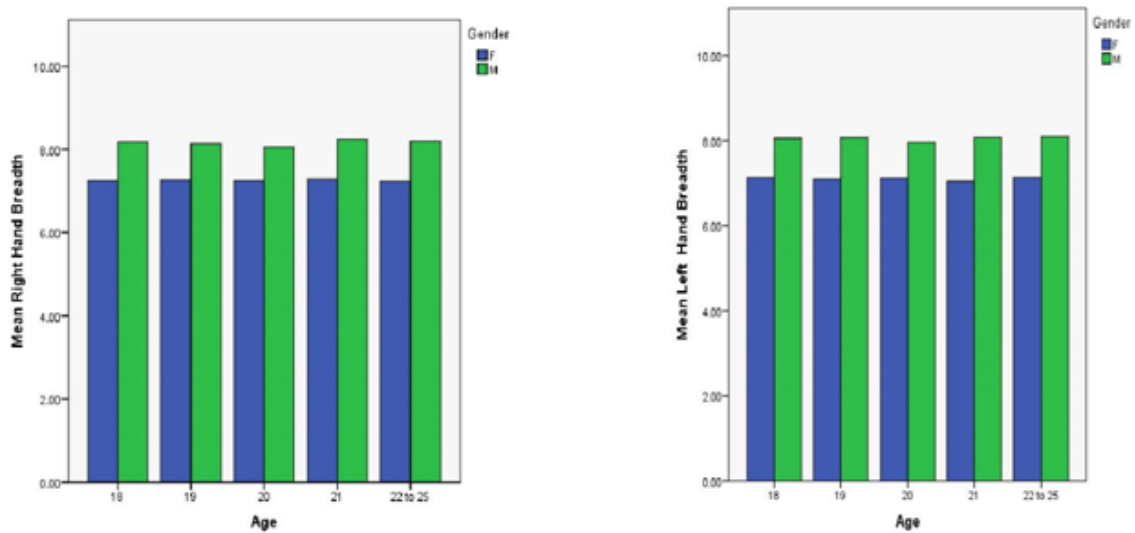


Figure. 2 Bar charts shows the mean right hand breadth and left hand breadth for all age groups of both genders

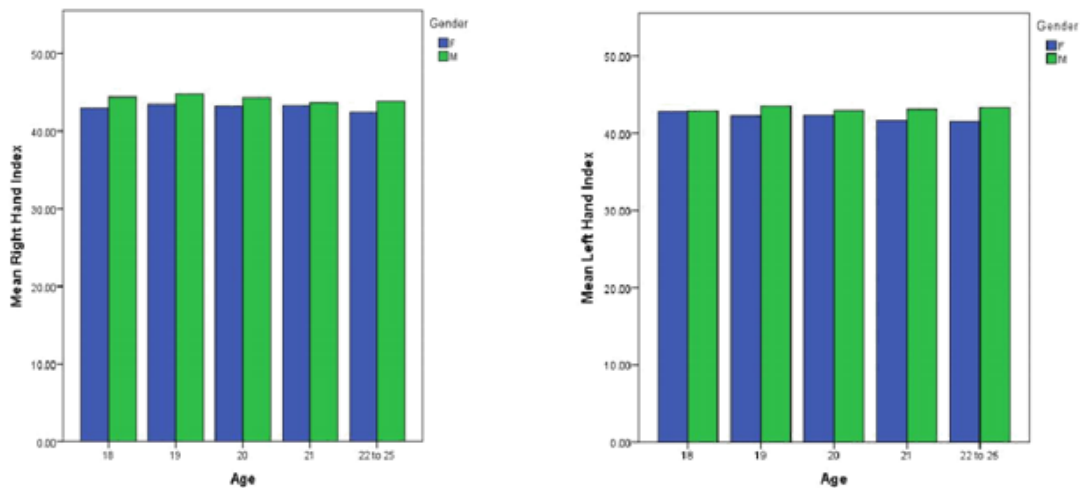


Figure. 3 Bar charts shows the mean right hand index and left hand index for all age groups of both genders.

IV. Discussion

Asymmetry of hand is more prominent in adults than children. The right side tends to be larger than left [21]. Our results are consistent with this study (in relation to hand index). Significant sexual differences are evident in hand length measurements and in hand width to length ratios [22]. In our present study the male hand length, breadth and indices are larger than that of females which are in line with the findings of Ibeachu et al [11]. When sex differences are observed they are larger for the right hand than the left in humans [22].

In the present study, the mean right hand length among the females was 16.9244cm, among males was 18.6471cm. Mean left hand length among females was 16.9411cm and that of males was 18.6160 cm. For males, right side being larger is in agreement with the study of Krishan and Sharma [27], but contradictory to that of Kulaksiz and Gozil [24] and Danborno & Elukpo [28]. The values were slightly higher on the left side of females which is in consonance with the studies of Kulaksiz and Gozil [23], Oomen et al [25], Danborno & Elukpo [27] and Ibeachu et al [11]. Mean right hand breadth among females was 7.2555cm and males was 8.1630cm. Mean left hand breadth of females was 7.1052cm and among males was 8.0509cm. Hand breadth in males is found to be larger than in females as proven by Kulaksiz and Gozil [24], Kar et al [24], Agnihotri et al [18], Danborno and Elukpo [27], Ibeachu et al [11], Krishan et al [28]. However it is contradictory with that of Tarsem et al 2015 [29]

The disparity in the dimensions between the sexes maybe the result of genetic expressions of male being bigger than **that of** females [11, 14]. The human hand is known to be the most used and resourceful part of the body, which is important in the field of anthropometry, forensic pathology, orthopedic, plastic surgery and ergonomics [11]. If the hand length is known, foot length can be predicted and vice versa [30], therefore investigations regarding hand length have been proved to be very useful. The estimate of hand index has been proved to be beneficial in the design of hand tools, knobs, controls, personal equipment, artificial aids, medical gloves and much more [11,14]. Ducharme (1977) [31] reported that women workers had many complaints about soldering tools, pliers and wire strippers due to dimensional incompatibilities.

The fact that hand measurements tend to vary between different ethnic groups has been found in previous studies [32]. Another study by Martin and Soldo [33] reveals that these data have significant variations among age groups. **There are** differences in hand dimensions and performance between left and right handed individuals as stated by Li et al 2000 [34], Laeng and Park 1999 [35], Yasin and Agostini 1991 [36]. The differences in body dimensions among populations is a result of variations in nutrition and physical activity [13].

V. Conclusion

The hand indices show the values of 44.0272 for the right hand of a male and 43.1512 for the left hand of a male. However the female hand indices were only 43.0110 for the right hand and 41.9520 for the left hand, showing greater hand ratio of the male compared to female hand ratio. The findings can be of use in designing suitable clothing, hand tools or even equipment that can be controlled by hands. The values can be applied to identify a person in the events of crime investigations and also in accidents and natural disasters in which the anthropometric data are provided.

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