Journal of Rangpur Medical College, March 2021; Vol. 6, No.1:26-30

Original Article

Anthropometric Measurements of Hand Parameters of Male and Female of Both Sides of Medical Students

Riada Sultana[1], Selina Anwar[2], Mohsena Parvin[1], Munnujan Begum[3]

Abstract:
Background: Human hand is the most used and versatile part of the body and have great scientific importance. Studies have established racial identification, sexual dimorphism and height and age estimation from hand dimensions. The relationship between body segments has been the focus of anatomists, anthropologists and scientists for many years. Prediction of the dimensions of hand is useful in many areas of modern science. Data of this study would help to compare sex differentiation (male/female) and to observe variations of hand of anthropometric measurement in different geographical areas. It would also help to compare measurements between right and left hand. **Objective:** To find out the variations of different hand anthropometric dimensions the students of both sexes of Rangpur Medical College. **Methods:** This cross-sectional, analytical study was performed in Department of Anatomy, Rangpur Medical College, Rangpur, from January 2018 to December 2018 on 700 medical students (350 male and 350 female) of Rangpur Medical College. Anthropometric measurements, e.g. hand length, palm length, hand breadth, wrist circumference, hand span of both hand were measured with the help of standerd anthropometric equipment's. Hand and palm idices were calculated. Paired and unpaired student's t' test were done for statistical analysis by SPSS Version 15 for the results. **Results:** Study revealed that all the measured hand parameters and indices were significantly higher in male than female ($p<0.001$). When comparison was done between right and left sides, whereas hand length, palm length, hand span was significantly higher in left side in both sex but hand breadth, hand index and palm index was significantly higher on right side. Again wrist circumference was significantly higher in left side in male but in female it was significantly higher in right side. **Conclusion:** It was concluded that all hand measurements are sexually dimorphic, higher in males and differences were found on both sides which may be due to nature of functions they perform.

Key words: Sexual dimorphism, Hand parameters, Handand palm index, Anthropometry.

Introduction:
Hands are one of the most used and versatile part of the human body. They are specialized appendages at the distal end of the upper limbs and are the manual part of the upper limb, distal to the forearm. The hand acts as a chief tactile apparatus involved in maintaining or restoring its activities; free motion, power grasping and pinching[1], and are endowed with gripping and precision movements for skilled works[2]. Hand anthropometry can be defined as the study of comparative measurements of human hand, involving the variables such as hand length, hand breadth, palm length etc.

Sex, age, stature and ethnicity are big fours of anthropometry[3]. Among these 'big fours' of anthropometry, determination of sex is one of the foremost criteria in establishing the identity of an individual to Anthropologist, Anatomist, Ergonomist, Obstetrician and in medico-legal practice. Sex determination from hand dimensions can immensely help the forensic scientists in identification of human remains. An individual's hand when recovered and brought

1. Lecturer, Dept. of Anatomy
Rangpur Medical College
2. Professor, Dept. of Anatomy
Rangpur Medical College
3. Assistant Professor, Dept. of Anatomy
Army Medical College, Rangpur

for examination can provide valuable information about the stature, sex and age of the person[4]. Accurate sexing of the remains primarily narrows down the pool of possible victim matches. But the magnitude of sex difference is found to be varying from population to population. Variations in the hand dimensions are influenced by various factors like nutritional status, socio-economicstatus and climate[5].

Many authors have been working on body anthropometry to find out sex differences by hand dimensions. Dimensions of hand are more in males compared to females. Again in adults, sexual differences are evident in hand length and in width to length ratios[6]. Hand dimensions have been found to show high accuracy in sex determination when compared to indices. Of all hand dimensions, hand breadth has been reported to have the highest accuracy in sex determination[5].

Anthropometric data of hand have valuable applications in different areas of design of hand tools and hand equipment's. The assessment of the physical dimensions of the human hand provides a metric description to ascertain human–machine compatibility in the design of manual systems for the bare and gloved hand e.g. design of hand tools, workplace, clothes, knobs and controls, personal equipment, consumer appliances in the home, industry and many products for human use[7]. It is also important for determining various aspects of surgical and other machineries related to medical sciences so as to design the equipment and machines for better efficiency and more human comfort. Mismatch between hand anthropometric dimensions and equipment's are known to be contributing factor in decreased productivity, discomfort, accidents, biomechanical stresses, fatigue and injuries. These ultimately results in occupational trauma disorders associated with the improper use and cumulative exertion of hand and wrist, include osteoarthritis, dislocations or subluxations, synovitis, ligament strains, ganglia, tenosynovitis, trigger finger, intrinsic muscle strains and carpal tunnel syndrome may occur in people performing repetitive hand works[8].Hence to achieve better efficiency, performance, safety and more human comfort, hand anthropometric database is a prerequisite.

The aim of this study was to provide the authentic databaseof some hand parameters for Anatomist, Anthropologist, Ergonomist, and forensic investigators and to determine the relationship between sex and both hands in a sample of Bangladeshi young adult population(medical students of Rangpur Medical College).

Methods:

The cross-sectional study was conducted on 700 students (350 male and 350 female) of Rangpur Medical College. This study was done in the Department of Anatomy, Rangpur Medical College from January 2018 to December 2018 afterapproval by Protocol review and Ethical Commitee of Ranngpur medical college, Rangpur Samples were collected by convenient purposive sampling as per inclusion and exclusion criteria.

The hand dimensions were taken by digital slide calipers in mm on the palmer aspect of hand with fingers fully extended, adducted on the flat surface and thumb extended. The hand length, hand breadth, palm lengthwere measured and hand index and palm index was calculated using formula following standard protocols. Hand span, wrist circumference and arm span also measured in cm.

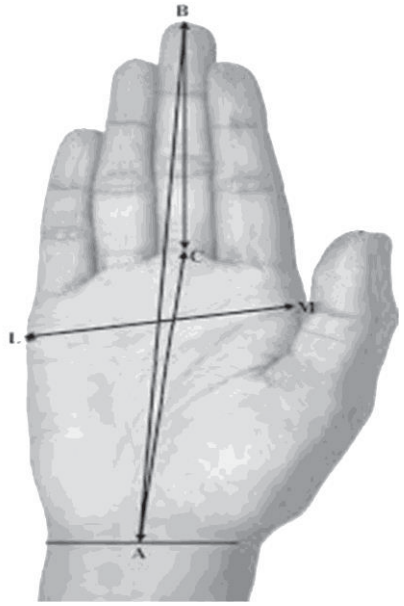


Figure- 1: Human hand illustrating the land marks of different hand dimensions

A to B: Hand length; A to C: Palm length; L to M: Hand breadth[9].

Hand length: Distance between mid-point of the distal transverse crease of the wrist to the most anterior projection of the skin of the middle finger[4].

Hand breadth: Distance between the most lateral point on the head of 2nd metacarpal to the most medial point on the head of 5th metacarpal[4].

Palm length: Distance from the mid-point of the distal transverse crease of the wrist to the midpoint of proximal flexion crease of the middle finger[10].

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

Palm Index: $\text{Palm index} = \frac{\text{Hand breadth}}{\text{palm length}} \times 100$

Hand span: tip of the thumb to the tip of the little finger with the hand opened as wide as possible[11].

Wrist circumference: Subjects hand was extended, with the tape perpendicular to the long axis of the forearm, measure the circumference of the wrist at the level of the wrist crease[12].

All the values of measurement and calculation were compared between male and female by unpaired "t" test and between right and left sides by Paired "t" test. In all the statistical analysis, the significance level was set at $p<0.05$.The statistical analysis was carried out using the statistical package for social sciences (SPSS version 15.0).

Results:

Table I shows results of comparison of hand parameters of male and female in right and left side. It was observed that hand length, hand breadth, palm lemgth, hand span and wrist circumference was significantly higher in males than females. Again hand and palm indices were also significantly higher in males than females.

Table I again shows whereas hand length, palm length, hand span was significantly higher in left side in both sex but hand breadth, hand index and palm index was significantly higher on right side. Again wrist circumference was significantly higher in left side in male but in female it was significantly higher in right side.

Table I: Comparison of hand parameters between male and female students of both hands

Variables	Side	Male		Female		p value
		Mean	Range	Mean	Range	
Hand Length(mm)	Right	185.62±8.58	165-220	170.40 ±8.98	143-195	<0.001
	Left	187.22 ±8.58	170-218	171.33 ±9.08	145-200	<0.001
	p value	<0.001		<0.001		
Hand breadth(mm)	Right	83.45±4.06	72.25-96.55	72.38±4.06	56.75-84.25	<0.001
	Left	83.30±3.98	72.80-96.77	72.23±4.07	56.75-84.5	<0.001
	p value	<0.001		<0.001		
Hand index	Right	45.01±2.33	43.51-45.52	42.53±2.38	39.69-44.7	<0.001
	Left	44.54±2.16	42.82-45.47	42.21±2.22	39.14-43.44	<0.001
	p value	<0.001		<0.001		
Palm Length (mm)	Right	105.42 ±5.10	91.59-119	93.93 ±5.74	73.86-109.15	<0.001
	Left	105.69 ±5.12	92.85-120	94.16 ±5.76	72.75-109.16	<0.001
	p value	<0.001		<0.001		
Palm index	Right	79.28±4.29	78.09-84.83	77.22±4.66	75.75-81.91	<0.001
	Left	78.94±4.19	69.70-81.66	76.87±4.62	75.86-82.79	<0.001
	p value	<0.001		<0.001		
Hand Span(cm)	Right	21.49±1.58	18.1-25.00	19.05±1.16	15-22.7	<0.001
	Left	21.67±1.55	18.5-25.3	19.20±1.16	14.5-22.7	<0.001
	p value	<0.001		<0.001		
Wrist Circumference (cm)	Right	16.72±0.86	14.5-19.5	14.85±0.94	12.5-18.0	<0.001
	Left	16.76±0.86	14-19.5	14.83±0.97	12-18.5	<0.001
	p value	<0.001		<0.001		

Discussion:

The present study was done with aim to develop sex estimation standards from hand measurements specifically for population in and around geographical region of Bangladesh. Another aim was that these values may be used as standard by producers of different products used for medical scientists, surgeons and other medical personals.

It is observed by reviewing of literature that many works have been carried out on anthropometric measurement of hand in foreign countries. But so far it is known, there is no published work on hand anthropometry conducted on Bangladeshi Medical students. So, the result of the present study was compared with the findings of other researchers which showed some similarities as well as dissimilarities with the findings of different study by other researcher.

Hand length and Hand Breadth: Present study has found that mean of hand length and hand breadth is significantly higher in males than females. Such finding was also observed in Australian, Thai, Kayastha (India) and Rajput (India) population in the study done by Ishak et al., Laulathaphol et al, Srivastava et al respectively[13-15].

To explore bilateral variation, it was observed that some workers found higher value in right but others found it on left side, while some found similar value on both sides. In the present study, significantly higher value of hand length was found in left side but hand breadth was significantly higher on right side in both sexes though the difference was very small.

Most of these studies show significant bilateral difference in hand dimensions except study done by Ishak et al[13] andVaru et al[16], which are showing significant bilateral difference in hand breadth. However, bilateral difference in hand breadth found by both these studies was small.

Hand index: Several studies have found that hand index are significantly larger in males compared to females ($p<0.05$), which means that hand index are showing sexual dimorphism and therefore they are useful parameters to discriminate sex. Abdul-Hagag et al[4] revealed that hand index ≤40.55 is suggestive of female and >40.55 is suggestive of male. In the present study mean of hand index in female was 42.53 and in male it was 45.01.

Palm length and palm index: The palm length in the present study showed significant higher value in male as compared to female in both hands. This feature was also seen in the studies of Kanchan and Rastogi[10] and Dhawan et al[5] done in various Indian population.

Present study showed mean palm length was significantly higher in left hand both in male and female, which was similar with other study done by Dhawan et al[5].

In the present study palm index was more in male than female and mean value of right palm index was higher than that of left hand which was similar to other studies done by Kanchan and Rastogi[10]. Values of palm index in the present study were more than the above mentioned studies.

Hand span: In the present study, mean of hand span of male of both right and left sides was significantly higher than female ($p<0.001$). So, it was observed that mean of left hand span was significantly higher than right hand span in both male and female in the present study. In contrary to this, Mohammadian et al[23]reported mean hand span of both hands was significantly higher than the findings of present study. In a study by Afrin[24] on Potters and sedentary workers (both male) in Dhaka Medical College, it was found that Potters had significantly higher hand span than sedentary workers (23cm vs 21.05cm). According to her, Potters hand span value was highest among the studies found.

Wrist circumference: In present study mean wrist circumference was significantly higher in male than female. In male, left wrist circumference was higher than right but in female right wrist circumference was higher than left. Didomenico and Nussbaum[25] reported mean wrist circumference was higher than the findings of the present study. However Chandra et al[7] found wrist circumference was lower in male industrial workers of Haryana, India than the present study.

Conclusion:

In the present study males showed higher mean values in all the parameters studied, than among females and the differences in these measurements was found to be statistically significant ($p<0.001$).These statistical significant differences may be due to the early pubertal growth spurt in girls that stops early, under the

influence of estrogen, which causes early fusion of epiphysis. In males although the growth spurt occurs comparatively later, they continue to grow for a longer period under the influence of testosterone.

Again whereas hand length, palm length, hand span was significantly higher in left side in both sex but hand breadth, hand index and palm index was significantly higher on right side and wrist circumference was significantly higher in left side in male but in female it was significantly higher in right side. Differences between both sides in both sexes may be due to nature of functions they perform.

References:

1. Moore KL, Dalley AF, Agur. Clinically Oriented Anatomy 7th ed. 2014. P.679-807.
2. Chaurasia BD. The forearm and hand, 3rd ed. Human anatomy,1. CBS publishers and Distributors, 1995, New Delhi, India, p:106-124 (Reprint 2003)
3. Krishan K, Kanchan T, Sharma A. Multiplication factor versus regression analysis in stature estimation from hand and foot dimensions. Journal of Forensic and Legal Medicine. 2012; 19(4):211-214.
4. Aboul Hagag KE, Mohamed SA, Hilal MA, Mohamed EA.Determination of sex from hand dimensions and index/ring finger length ratio in upper Egyptians. Egyptian Journal of Forensic sciences. 2011; 1:80-86.
5 Dhawan V, Bala M, Galhotra S. Sexual dimorphism in hand dimensions; an anthropometric study in North Indian Haryanvi adolescents. International journal of Anatomy and Research. 2016; 4(1):2102-07.
6 Mcfadden D, Shubel E. Relative lengths of fingers and toes in human males and females. Hormones Behavior. 2012; 42:492-500.
7. Chandra A, Chandna P, Deswal S. Analysis of hand anthropometric dimensions of male industrial workers of Haryana state. International journal of Engineering (IJE). 2011; 5(3):242-256.
8. Nag A, Nag PK, Desia H. 2003. Hand anthropometry of Indian woman. Indian Journal of Medical Research. 2003; 117:260-269.
9. Pal A, De S, Sengupta P, Maity P, Dhara PC. Estimation of stature from hand dimensions in Bengalese population, West Bengal, India. Egyptian journal of Forensic sciences. 2016;6:90-98.
10. Kanchan I, Rastogi P. Sex determination from hand dimensions of North and South Indians. Journal of Forensic science. 2009; 54(3):546-550.
11. Lyle V. Jones. “The nature of measurement” In: Robert L. Thorndike (ed.), Educational Measurement. 1971; 2nd ed. Washington, DC: American council of Education, pp.335-355.
12. Garrett WJ.Anthropometry of the Air Force Female Hand.Journal of aerospace Medical Research Laboratory. 1970; 11-48.
13. Ishak NI, Hemy N, Franklin D. Estimation of stature from hand and hand print dimensions in a Western Australian population Forensic science international. 2012; 199. e 1-199. e. 7.
14. Laulathaphol P, Tiensuwan M, Riengrojpitak S. Estimation of stature from hand measurements in Thais. SDURES 2013; 6(1):37-47.
15. Srivastava A, Yadav VK. International journal of Engineering sciences and emerging technologies. 2014; 6(4):400-404.
16. Varu PR, Gajera CN, Mangal HM, Modi PM. Determination of sex using hand dimensions. International journal of Medical toxicology and Forensic Medicine. 2016; 6(1):23-28.
17. Varu PK, Manvar PJ, Mangal HM, Kyada HC, Vadgama DK, Bhuva SD. Determination of stature from hand dimensions. The journal of Medical Research 2015; 1(3):104-107.
18. Moorthy TN; Zulkifly NRB.Regression analysis for stature determination from hand anthropometry of Malaysian Malays for Forensic investigation. Srilanka journal of Forensic Medicine, Science and law. 2014; 5(2):8-15.
19. Akhlaghi M, Hajibeygi M, Moradi B. Estimation of stature from upper limb anthropometry in Iranian population. Journal of Forensic and legal Medicine. 2012; 1-5.
20. Danborno B, Elukpo A. Sexual dimorphism in hand and foot length, indices, stature-ratio and relationship to height in Nigerians. The internet journal of Forensic science. 2007; 3(1):1-5.
21 Zulkifly NR, Wahab RA, Layang E, Ismail D, Desa WNSM, Hisham S, Mahat NA.Estimation of stature from hand and handprint measurements in Iban population in Sarawak, Malaysia and its applications in forensic investigation. Journal of Forensic and legal Medicine. 2018; 53:35-45.
22. Tandon R, Yunus SM, Faruqi NA, Asghar A. Measurements of hand and foot- A predictor of stature in adult human population of Uttar Pradesh. International journal of Anatomy: Radiology and Surgery. 2016; 5(1):12-15.
23. Mohammadian M, ChoobinehA, Haghdoost AA, Nejad NH.Investigation of grip and pinch strengths in Iranian adults and their correlated anthropometric and demographic factors. Work 2016; 53:429-437.
24. Afrin T. Hand anthropometry of Bangladeshi male potters, thesis (M phil), 2018; Anatomy Department, Dhaka Medical College.
25. Didomenico A, Nussbaum AM. Measurement and prediction of single and multi-digit finger strength. Ergonomics. 2003; 46(15):1531-1548.