

**ESTIMATION OF HAND ANTHROPOMETRY AMONG  
BANGLADESHI ADULTS LIVING IN FOUR DIFFERENT  
AREAS**



By

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## **Statement of Authorship**

Except where is made in the text of the thesis, this thesis contains no materials published elsewhere or extracted in whole or in part from a thesis presented by me for any other degree or diploma or seminar.

No others person's work has been used without due acknowledgement in the main text of the thesis.

This thesis has not been submitted for the aware of any other degree or diploma in any other tertiary institution.

The ethical issues of the study has been strictly considered and protected. In case of dissemination the finding of this project for future publication, research supervisor will highly concern and it will be duly acknowledged as undergraduate thesis.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

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## **Acknowledgement**

At the very first I am obligated to Almighty Allah for giving me the potentiality & helping me to successfully complete this dissertation in time. This thesis is intended to fulfill the requirement to achieve the degree of Occupational therapy. Hopefully, through this thesis I can give contribution to the richness of the knowledge, especially in the field of Ergonomics.

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## Abstract

**Background:** An anthropometric study of hand dimensions in Bangladeshi origin living in America was carried out of 165 participants. They were found some significant differences of hand dimensions and compared with other populations. The male and female hand dimensions were differently identified and showed some significant comparisons between Asian with European and American males and females. In the present study there were 186 participants were selected conveniently. Both males and females at the age between 18 to 60 years were included. Standard hand anthropometric measurement of 24 hand dimensions were taken from the participants by using a standard digital slide caliper and measure tape. The study analyse the result about significant difference between the hand dimensions of male and female and the comparison of 24 hand dimensions. This study data will show an idea of inter-population hand anthropometry of Bangladesh and this data will also help to differentiate with those ethnic groups living in Bangladesh and also for the other population in different countries.

**Objectives of the study:** The objectives of this paper were to find out the hand anthropometric measurements of 24 dimensions among participants living in Bangladesh and were also compared between two genders according to the measurement of twenty four dimensions that was gathered.

**Methodology:** This study was conducted by using quantitative cross sectional analysis of quantitative method. The participants were selected conveniently in the study areas with in age range of 18 to 60. The data was collected by using consent form, slide calipers. The data was analysed by using SPSS (Statistical Package of Social Science).

**Result and Discussion:** There are many significant differences between male and females in adult Bangladeshis. After analysing data, it was found that. The significant t-test showed that the 4 of 24 dimensions of differences in mean were statistically significant of p-value ( $P < 0.05$ ). The major 19 of 24 hand dimensions shows that the differences in mean were highly significant ( $P < 0.01$ ) and the rest of one dimension is greater than ( $P < 0.05$ ). In the present study there were collected 186 samples. Where the male participants were 83 and female participants were 103 out of 186. At the end of the findings the researcher found that the female hand length and maximum hand breadth is shorter and narrower than the male hand dimensions.

**Conclusion:** This study has shown a recent data of hand dimensions of Bangladeshi populations. Hand anthropometry deals with the measurement of hand size, shape, and work capacity. The hand anthropometries are frequently used by the protection tools of ergonomically designed safe equipment and ergonomic work stations. This study has to provide a preliminary hand data among Bangladeshis.

**Key words:** *Hand Anthropometry, Hand Dimension, Hand (length, breadth, finger lengths, phalanges), hand tool design, Bangladeshi adult (Both male and female).*

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## **List of Acronyms**

- BHPI:** Bangladesh Health Professions Institute
- BK:** Breadth of knuckle
- BT:** Base of thumb
- CRP:** Centre for the rehabilitation of the paralysed
- DH:** Depth of hand
- DK:** Depth of knuckle
- HA:** Hand anthropometry
- HL:** Hand length
- MCP:** Metacarpophalangeal
- MHB:** Maximum hand breadth
- MM:** Millimetre
- MSD:** Musculoskeletal disorder
- OT:** Occupational therapy
- SPSS:** Statistical Package for social science
- UK:** United Kingdom
- US:** United States
- WMSD:** Work related musculoskeletal disorder



# CHAPTER 1 INTRODUCTION

## 1.1. Background

The term “anthropometry” comes from the actual Ancient Greek term “anthropo” which means “human” and “metron” which means “measure” (Ulajaszek, 2005). The actual anthropometry may be the technology associated with calculating the body and the components. Anthropometry is the key factor of work place design. Anthropometric data is determining type of modification. To fit equipment and tasks to persons of various hand sizes requires anthropometric data and proper procedures. Anthropometry is the measurement of human morphology and also very essential for research contexts. In assessment of physical compositions, physical performance and fitness the anthropometry is widely used in those areas.

The hand is a specialized distal part of the upper extremity. At skilled work, it is necessary for precision movement and grasping. Fingers are the distal part of hand. Some literature shows that the determination of sex is valuable to know about hand anthropometry (Aboul-Hagag, 2011) and its dimensional differences (Krishan, Kanchan and Asha, 2011). The scientific measurement of hand dimension is called hand anthropometry. There are 24 hand dimensions measured significantly in this study. Those hand anthropometric dimensions are found in different studies (Mandahawi *et al.* 2008; Imrhan, Sardar and Mandahawi, 2009). Studies have shown that hand anthropometry is necessary for hand tool design which promotes task productivity and maintains proper health of workers. It is also necessary for the working population to promote acquisition, design, and re-design manual tools (Garcia-Caceres *et al.* 2012).

The study of hand anthropometric data is useful for the design of hand tool and for selecting appropriate sized tools that will be imported from industrialized countries (Mandahawi *et al.* 2008). Various researchers have shown the importance of using relevant hand anthropometric data for equipment design (Abeysekara and Shahnava, 1989; Kar *et al.* 2003). A study shows that there are eight important hand dimensions of eastern India which influence agriculture equipment design, and similarly, 18 hand dimensions from rural farm workers in Ibadan, Nigeria enabled better fitting manual farming equipment. Other data shows that hand anthropometric measurement is

essential for the design of hand tools, gloves, machine access spaces, hand held devices and selection appropriate hand tools for use (Chandra, Chandna and Deswal, 2011; Imrhan, Sardar, Mandahawi, 2009; Saengchaiya and Bunternngchit, 2004; Ismaila, 2009). Another study showed that, the importance of hand anthropometric data is applicable for ergonomic & biomechanical approach and also very helpful for various anthropologists and security experts (Corlett and Clark, 2003).

Another anthropometric study of hand dimensions is off Hong Kong Chinese female workers at the basis of age and ethnic groups. They studied 100 workers of 4 different age groups and compares results with the UK, Japan and USA. The study shows that Hong Kong Chinese females have smaller hands than UK and American females and larger hands than Japanese females (Courtney, 2007). Other studies found that, the hand anthropometry of Indian women according to hand lengths, breadths and depths including finger joints are smaller than American, British and West Indian women (Nag, Nag, and Desai, 2001). Another study compared hand dimensions of Asian American with American and European females. Their result shows that the dimensions of hand of American European women were larger than that of Asian American women (Gnaneswaran and Bishu, 2011). A study was completed on descriptive hand anthropometric statistics of the Colombian floriculture workers of Bogota plateau. This article studied 33 hand measurements of 120 adult female workers of the Colombian flower industry found that, systematically using tools which inadequately fit their HA and may cause unnecessary mechanical loads to the users (Garcia Caceres *et al.* 2012). An anthropometric study of 24 measurement of hand dimensions were taken of 50 female adults at average age of 26.7 years from India now living in USA. The result compares with the other countries and shows that, more than half of the Indians hand dimensions are smaller than Vietnamese Americans and Vietnamese and that 5 of the 6 lengths and widths and all 6 of the hand depths are smaller in Indians. Those countries have border and thicker hands than Indians and U.S. female have significantly longer, broader and thicker fingers than Indians (Imrhan, 2000).

An anthropometric study of 51 female and 50 male adults of Bangladeshi origin (mean age 41.3 years), living in the United States are measured by 24 hand dimensions. This study shows significant differences in palm and finger segment lengths, breadths and depths between genders in Bangladeshis and also within each

gender between Bangladeshis and other populations. This study also compares with the inter-population comparison of hand anthropometry among the Bangladeshi population (Imrhan, Sardar and Mandahawi, 2009). Similarly, a study was conducted about hand anthropometric dimensions among male industrial workers of Haryana States in India, shows that. However the young and middle aged industrial workers hand dimensions were founded to be greater than 56 and above ages of the industrial workers (Chandra, Chandna and Deswal, 2011).

An anthropometric study was done among the Jordanian population of the hand from a sample of 120 female and 115 male adults. This study compares twenty four hand dimensions between Jordanians and other populations. This study found that female Jordanian finger segments were generally longer than those of Bangladeshis, Nigerians, Vietnamese, and Mexicans but not so longer than those of Hong Kong Chinese or United Kingdom nationals. Jordanian female fingers are also thicker than those of Bangladeshis, Vietnamese, Mexicans, Hong Kong Chinese, and United Kingdom nationals, and significantly broader than those of Nigerians, Hong Kong Chinese and United Kingdom nationals (Mandahawi *et al.* 2008). A study about the sexual dimorphism of hand dimensions in a North Indian population confirmed that genders can be established from hand and palm dimensions with a reasonable accuracy. Hand index and palm index are poor indicators of sex (Nag, Nag and Desai, 2003).

A study was conducted in SSR Medical college students at Mauritius, where the participant of both males and females has been categorized in to three different age groups like: less than 20 years, 20–22 years, and above 22 years. These measurements of hand were taken by using anthropometric sliding and spreading calipers, and measuring tape (Agnihotri *et al.* 2008). The hand length was measured as straight distance between distal crease of wrist joint and the most anterior projecting point. The breadth of hand was measured as straight distance from the most laterally placed point on the head of 2nd metacarpal to the most medially placed point located on the head of 5th metacarpal (Agnihotri *et al.* 2008). In a study conducted Khammam medical students in India, 100 of male and female participants were equally selected from 200 participants. The results shows the significant difference ( $P < 0.001$ ) length

of fingers of male and female subjects and also indicate that finger lengths can be used effectively to calculate living stature of an individual (Suseelamma *et al.* 2014).

The hand anthropometry is varying from different demographic factors such as age, sex, ethnicity etc. The difference within populations like gender difference and age difference are not always considered in the design of equipment (Okunribido, 2000). A study shows that, fingers can be good characteristics of a sex determination (Kanchan and Krishan, 2011). A total width of the index finger and phalanx are statistically significant by age and sex characteristics. Many studies show that the lengths of male fingers are longer than females. Similarly a study found that a sex difference in the length of ring finger is larger than the length of index finger and the length of little finger is shorter than index finger of male (Kanchan and Krishan, 2011). The research showed that the Egyptian average mean value of HL in male for right side was  $18.2 \pm 1.9$  and for left side  $17.94 \pm 0.5$  and the female HL of mean value was  $16.9 \pm 0.79$  and  $16.02 \pm 0.76$ . On the other side HB of male a mean value of  $8.09 \pm 0.01$  and  $8.02 \pm 0.1$  and female HB mean value of  $7.87 \pm 0.7$  and  $7.57 \pm 1.8$  for right and left sides consequently (Mohamed, 2013). The study found that the proportion of different hand dimensions had significant difference between male and female students of Maharashtra accordingly to right & left hand. In male the correlation with right hand length was  $r=0.829$  and  $p=0.0001$  and left hand length was  $r=0.824$  and  $p=0.0001$ . In female right hand length was  $r=0.743$  and  $p=0.0001$  and left hand length was  $r=0.734$  and  $p=0.0001$  (Mulla, Kulkarni and Gangane, 2014).

A study was conducted on an anthropometric estimation of Egyptian population. They were found a significant correlation between stature and lengths of hands and phalanges on left and right sides in both sexes. In this study all hand measurements were statistically significant correlate with stature ( $p < 0.05$ ). However the little finger dimensions of males and distal phalanges of females were not statistically correlated with stature (Habib and Kamal, 2010). This result is in consistency with Abdel-Malek *et al.* who stated a statistically significant correlation among stature and hand length. They were also achieved the same results.

There is little anthropometric research conducted in Bangladesh, but almost none of them are conduct specifically hand anthropometric dimensions of Bangladeshi population. In Bangladesh there have been a study conduct of the hand length and

correlation with the stature of Bengali Muslim female (Zamila *et al.* 2009) and another is studied in hand anthropometry in Bangladeshis living in America. Through my study I want to compare of the inter population hand anthropometry of Bangladeshis and also enhance the understanding of hand anthropometry among Bangladeshi people.

## **1.2. Aim**

To determine the hand anthropometric measurements of Bangladeshi people living in four different areas (both male & female, around 18-60 years of age).

## **1.3. Objectives**

- To determine the hand anthropometric measurements of Bangladeshi adults age between 18-60 years in 24 hand dimensions.
- To determine the hand anthropometric comparison of Bangladeshi adults age between 18-60 years among male and female participants.

## **1.4. Study significances**

An important implication to conduct this study of the hand anthropometry for any target populations in manufacturing organizations to design tools and also to make hand held tools, gloves, machine access spaces, hand held devices and so on. This study will show the correct data of hand anthropometric measurement of the Bangladeshi population so that further study of this research will be a very helpful for literary source. This study will also make easy for the hand anthropometric data related research to conduct. On the other hand occupational therapy profession is growing day by day .This research will also highlight the Occupational Therapy professional evidence based practice facility in this sector. It is also very important for designing ergonomically sound workplace equipment by knowing their correct hand dimensions.

However, in Bangladesh there is no finding of the hand dimensions of both male and female adult at the age of 18-60. This study finding will be definitely helpful for the medical researcher and forensic experts by knowing the data of hand dimensions at the specific ages (Patel, Tanna, and Kalele, 2012). This data of evidence also made a guideline for the workers to prevent musculoskeletal symptoms of hand and also to make source of sound equipment or tools for uses by conserving ergonomic solutions.

Therefore understanding the hand anthropometric dimensions will be very significant for the person who lives in Bangladesh. For this intention I have much interested to conduct this thesis.

## CHAPTER 2 LITERATURE REVIEW

### 2.1. Anthropometry

Anthropometry is the science that deals with the measurements of the size, weight and proportion of the human body and skeleton. Anthropometry as a technique to take measurements on the human body, as well as on skeletal remains has been widely issues of the identification of an individual (Kanchan and Krishna, 2011). So the anthropometry is the science of measurement and the art of application that emphasizes the physical geometry, mass properties, and strength capabilities of the human body (Prado-Lu, 2007). Studies estimated that internal biomechanical loads of the hand from external loads and finger lengths that were themselves estimated from measured hand length and breadth and found that hand anthropometric measurements, especially palm width, are better predictors of hand strength than stature and body weight (Chandra, Chandna and Deswal, 2011).

In the field of forensic science, hand is an important tool for measuring clinical examination, surgical procedures and diagnostic test and to prediction of height of person, hand breadth (Kaur *et al.* 2013). The ring finger is the second most ulnar finger and the fourth digit of a human hand derived between the little and middle finger. In other index finger are the second digit and the first finger of a human hand. It is also located between the thumb and middle finger and in the most sensitive finger of hand (Kanchan and Krishan, 2011). It has been shown many researchers in their research that the men have relatively shorter index finger than ring fingers (Krishan *et al.* 2012).

The biological profile of a person such as age, sex, ethnicity and stature can be determined with the help of anthropometry (Numan, 2013). The dimensional and anatomical features of the human hand and the factors such as the size, shape, texture of object being held etc., influence the functional aspects of hand uses. The cultural factors lead to be variation in two sexes in and also have an effect on development & growth of North Indians (Krishan, and Sharma, 2007) The women who are forced to frequently use cutters, strippers and other tools, which are not optimally designed to their hand dimensions and strength range, might have higher prevalence of clinical symptoms and disorders of the hand (Nag *et al.* 2001). A study shows that, the

measurement landmark and positioning of the hand noted that the relaxed hands are significantly shorter than the dimensions of a straight and flat hand. Garrett also indicated that wrist crease is the best landmark for easy identification of the hand measurement. In adults, sexual differences are evident in hand length measurements and in hand width to length ratios (Garrett, 1971). Although the several researchers indicated that the standards of morphological and morphometric sex differences in the skeleton of hand may differ with the population sample and those cannot be applicable universally (Kaur *et al.* 2013).

One of the most significant developments during the long period of early human evolution was man's achievement of upright posture. Since that time, the human hand has been one of the most important parts of the body (Okunribido, 2000). There is a huge value of human hands of its functional activities such as- grasping, manipulating, and writing etc. The dimensions or sizes of the human hand are important for two primary reasons: protection and function. Regardless of the type of hand wear, however, dimensional information on the hands to be fitted is needed for the effective sizing of hand wear (Damon *et al.* 1963).

The sizes or dimensions of hands are also important in any consideration of hand function. Handles of tools implements to be grasped with the hands as well as handles for lifting or for turning must be suitably sized. The anthropometric hand data are essential for design machines compatibility, equipment and hand gloves for design hand tools and personal equipment. The range of variation in the sizes and dimensions of the human hand are the basic knowledge of the human body. That represented by anthropometric data. In spite of the importance of the human hand and the need for data on the dimensions of the hand in the adult civilian population of the United States, a very little reliable and definitive information is available on the hands of men and women (Denion *et al.* 1972; Chandra, Chandna and Deswal, 2011)

Finger/phalange bones lengths are the part of biomechanical research but evaluating physical hand performance are predict by human hand anthropometry. As for example phalange bones are tied with the phalange surface. Hand grip strength can be determined by phalange bone length (Chang *et al.* 2013). The finger bone length significant with the simulation of biomechanical hand modelling. Stature varies with race and is determined by genetics of a person, geographical location and climate



condition (Corlett and Clark, 2003). The variations observed in different populations among three ethnic groups of Nigeria named Hausa, Igbo and Yoruba. Therefore relationship between stature and hand dimension among those major ethnic groups in Nigeria were conducted (Numan *et al.* 2013)

Hand and finger force data are used in many settings, such as industrial design and indicating progress during rehabilitation. During the design of tools and workstations within the workplace the application of appropriate work design principles that involve the use of the hand and fingers may minimize upper extremity injuries. Individuals use their hands and fingers every day at work and in the home. Adequate knowledge of the force capabilities of the hand and fingers can facilitate the design of better tools and controls. It also provides valuable data for comparison between the extent of an injury and the level of injured workers (Mandahawi *et al.* 2008)

The differences between the sexes and hand laterality were investigated. The results showing that the strength differences between the sexes are slight in children, greatest in adults, and decrease slightly in the elderly. Therefore, pinches with the right hand are slightly greater (106%) than pinches produced by the left hand of right hand dominant individuals. Finally, no significant correlations between strength and anthropometry (stature, body weight, hand length, hand breadth) were found (Imrhan, 1989).

Recent literature has confirmed that anthropometry of the hand has considerable assurance for the exact estimation of stature; though the technique has only been tested in a comparatively limited range of populations (Ishak, Hemy and Franklin, 2012). Recent literature demonstrated that anthropometry of hand in all fingers; among all five the ring finger is best suited for individual height (Suseelama, 2014). On the other hand the bone is good anthropometric parameters for sexual determination (Ibeachu, Abu and Didia, 2011)

In a study of Indian populations conducted by (Kanchan and Rastogi, 2009) shows each and every time a hand and palm are the poor indicators of determination of sexual characteristics, in that case the morphometric parameters of the hand shows the differences between genders. In another study of (Tagi and Lai, 2012; Ibeachu, Abu and Didia, 2011) describe the measurement of hand length and breadth. The position of the hand placed in a flat horizontal surface with adducted fingers. The hand length is

measured in a linear distance between the inter styloid to the anterior projection of mid finger. On the other the hand breadth in a linear distances between the radial side of the 2<sup>nd</sup> MCP joint and ulnar side of the 5<sup>th</sup> MCP joints. In a study of (Sen *et al.* 2014) mentioned that the length of the index and ring fingers were measured. The linear distance between the midpoint of the proximal-most flexion crease of the base, and the anterior-most points (tip) of the index and ring finger respectively.

Hand anthropometry is necessary for determining many aspects of industrial machineries. Therefore design the machines and equipment for better performance and more human comfort. Ignoring anthropometric differences between populations a developing nation may have potentially harmful effects. For example, imports equipment from a developed nation after that they re-design their equipment based on the anthropometric data of their own population. Reliable data are almost absent in the developing countries on the basis of association between hand injuries or disorders and hand anthropometry (Imrhan *et al.* 1993).

The Thai females have narrower fingers and wider knuckles than the females from Hong Kong, British and Indians. In a study shows that, there are forty three dimensions of hands and arms were significantly identified and computerized by digitizing. After that, 41 dimensions were calculated and tabulated the mean value of 5<sup>th</sup> and 95<sup>th</sup> percentiles & standard deviation among those dimensions. The 18 of variables mean values that were compared with the same values with mean of Hong Kong, British and Indian female populations. This result shows that, the statistical difference of Thai females hand dimensions compared with the Hong Kong, British and Indians. In the significant two tailed t-test 5 % level of significance (Saengchaiya and Bunternghit, 2004)

Many researcher shows that the anthropometric dimensions of the populations of the importing countries for equipment design may help to alleviate the problems. Only a limited work has been reported in connection of hand anthropometry data for the populations of developing countries (Chandra, Chandna and deswal, 2011).

## **2.2. Hand anthropometric dimensions**

The right hand tends to be slightly larger in both length and breadth dimensions than the left. The right hand usually is measured in most surveys involving measurements

of the hands. The anthropometric data on hands are presented in a unique format in order to facilitate ready and convenient reference. Comparative anthropometric data on the hand may be compared and analysed in order to indicate ranges of variation in the sizes and dimensions of the hand. Whether on the hands or on any other parts of the human body, however, the reduction and processing of any anthropometric data, involves the use of statistical procedures (Okunribido, 2000)

In most of the studies Researcher's used hand dimension table by the following procedures of Davies *et al.* 1980. But this article is unavailable to access. So that I will cited the reference in Davies et al. (1980, cited in Courtney, 1984, p.1169-1180). The following hand dimension is measured by this table:

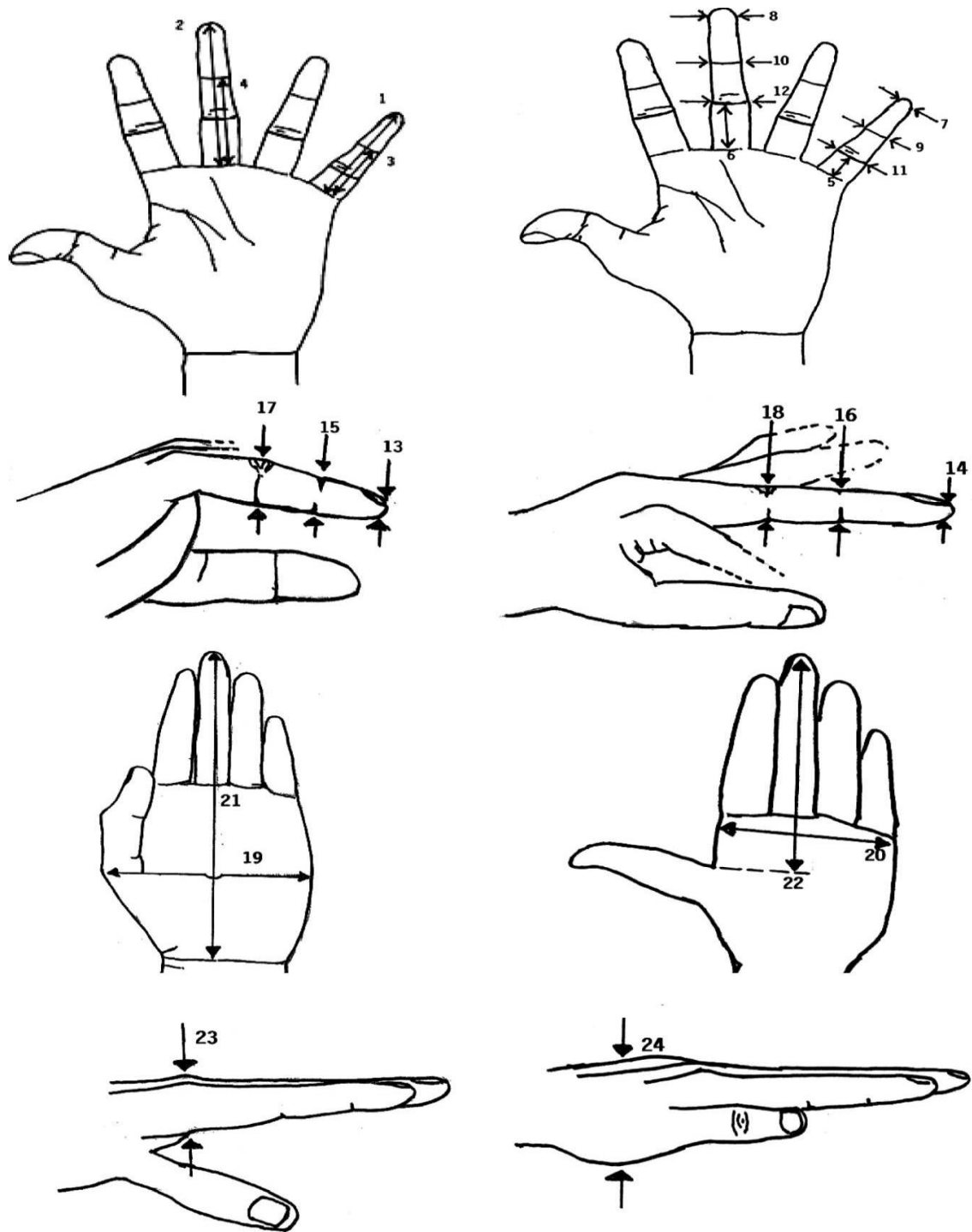
**Table: Hand dimension definitions**

<b>Hand dimension</b>	<b>Definition</b>
1. Fingertip to root digit 5	Hand is extended and the palm is facing up. The distance along vertical the axis of digit 5, from the midpoint of the tip of this digit to the root of the hand.
2. Fingertip to root digit 3	Hand is extended and the palm is facing up; the distance along the vertical axis of digit 3, from the tip of digit 3 to the root of the hand
3. First joint to root digit 5	Hand is extended and the palm is facing up; the distance along the vertical axis of digit 5, from the midpoint of the first joint of digit 5 to the root of the hand
4. First joint to root digit 3	Hand is extended and the palm is facing up; the distance along the vertical axis of digit 3, from the midpoint of the first joint of digit 3 to the root of the hand
5. Second joint to root digit 5	Hand is extended and palm is facing up; the distance along the vertical axis of digit 5 from the midpoint of the joint of digit 5 to the root of the hand
6. Second joint to root digit 3	Hand is extended and palm is facing up; the distance along the vertical axis of digit 3 from the midpoint of the joint of digit 3 to the root of the hand
7. Breadth at tip digit 5	Hand is extended and palm is facing down; the breadth at the tip of digit 5
8. Breadth at tip digit 3	Hand is extended and palm is facing down, the breadth at the tip of digit 3
9. Breadth at first joint of digit 5	Hand is extended and palm is facing down; the maximum breadth of the first joint of digit 5
10. Breadth at first joint of digit 3	Hand is extended and palm is facing down; the maximum breadth of the first joint of digit 3
11. Breadth at second joint of digit 5	Hand is extended and palm is facing down; the maximum breadth of the second joint of digit 5
12. Breadth at second joint of	Hand is extended and palm is facing down; the maximum breadth of the second joint of digit 3

	digit 3	
13.	Depth at tip digit 5	Hand is extended and palm is facing down; the depth at the tip of digit 5
14.	Depth at tip digit 3	Hand is extended and palm is facing down; the depth at the tip of digit 3
15.	Depth at first joint digit 5	Hand is extended and palm facing is down; the maximum depth of the first joint of digit 5
16.	Depth at first joint digit 3	Hand is extended and palm is facing down; the maximum depth of the first joint of digit 3
17.	Depth at second joint digit 5	Hand is extended and palm is facing down; the maximum depth of the second joint of digit 5
18.	Depth at second joint digit 3	Hand is extended and palm is facing down; the maximum depth of the second joint of digit 3
19.	Maximum breadth of the hand	Hand is extended and palm is facing down; fingers are together while the thumb is held loosely against the hand. This dimension is measured horizontally at the widest section of the hand
20.	Breadth of the Knuckles	Hand is extended and palm is facing down. This dimension is measured across the palm of the hand at the junction between the palm and the fingers, not including the thumb. The hand and fingers must be held flat, palm uppermost
21.	Length of hand	Hand is extended and palm is facing up. This dimension is measured from the wrist crease directly below the pad of muscle at the base of the thumb to the tip of the middle finger. The hand and fingers should be held straight and flat, palm uppermost.
22.	Third digit to base of the thumb	Hand is extended and palm is facing up, thumb is held away from the sides of the hand with its axis about 45 degrees to the long axis of the hand. The measurement is taken along the long axis of the hand from crotch1 to dactylion.
23.	Depth of knuckles	Hand is extended; thumb held away from the hand but the other fingers close together. This measurement is taken as the depth of the hand at the distal ends of the metacarpals of digits 2–5
24.	Maximum depth of the hand	Hand is extended with palm facing down; fingers are close together with the thumb held against the side of the hand. This measurement is the maximum depth from the volar side of the thenar pad to the dorsal surface of the hand.

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Davies et al. (1980, cited in Courtney, 1984, p.1169-1180).



**Figure:** Diagram of hand dimensions defined in the pre-mentioned table (Imrhan, Sardar, Mandahawi, 2009).

Most research has shown that, the hand anthropometry for purposes of design and sizing, more than one dimension is required. In the case of hand wear, for example, information is needed on both hand circumference and hand length for sizing purposes. The ranges of variation shown by the two hand dimensions must be

considered together. In other words, the interrelationships between two dimensions must be examined in order to provide a more meaningful description of the situation (Abeysekera and shahnavaz, 1989).

The human anthropometric dimensions and equipment dimension measurement mismatches are a contributing factor in decreased productivity, discomfort, accidents, biomechanical stresses, muscular fatigue, injuries, and cumulative traumas. Therefore, many researchers noted that using relevant anthropometric data is importance for equipment design (Mandahawia *et al.* 2008). This study describes 24 hand dimensions.

### **2.3. Bangladeshi adult**

"Bangladesh" is a combination of the Bengali words, Bangla and Desh, meaning the country or land where the Bangla language is spoken. The age at which a person is considered an adult varies significantly in the different countries of the world. A person who by virtue of attaining a certain age, generally eighteen, is regarded in the eyes of the law as being able to manage his or her own affairs is called adult (West's Encyclopedia of American Law, 2008). In Bangladesh the adult age is near about 18 and over 55 years. Bangladesh is the most densely populated nation in the world. With approximately 125 million populations are living in an area of 55,813 square miles. The majority of the population (98 percent) is Bengali and other 2 percent tribal or non-Bengali groups (Bangladesh Demographic Profile, 2013; CIA World Factbook, 2014). Bangladesh is one of the poorest countries in the world. The only significant natural resource is natural gas. Approximately 75 percent of the workforce is involved in agriculture, and 15 percent and 10 percent are employed in the service and industrial sectors, respectively and rest of all are students. Bangladesh is a small agrarian nation. All the people in rural areas are involved in the production or processing of agricultural goods. The majority of the rural population engages in agricultural production, primarily of rice, jute, pulses, wheat, and some vegetables (Culture of Bangladesh, 2014)

Hand anthropometric data for ergonomic designs are differences within populations (e.g. age, gender differences) Anthropometries are no less severe in developing countries than in developed ones based on their study on garment manufacturing in Bangladesh (Sarder and Ali, 1996). Research has shown that there are hand

anthropometric differences between different populations all over the world (Abeysekera and Shahnava, 1989). The present study represents the 24 dimensions of hand anthropometry data for male and female adult Bangladeshis.

## **CHAPTER 3 METHODOLOGY**

### **3.1. Study design**

Under this, a Quantitative cross sectional survey method were used to carry out the research aim and objectives. The cross-sectional studies defined the random cross section of the population at one particular point or a period of time. The cross-sectional survey is appropriate to conduct this study because a large number of people are survey relatively quickly and the data are easily coded. According to this, the random cross section of Bangladeshi population is point out the estimation of hand anthropometric dimension in a period 2014-2015. A cross sectional study can evaluate a large number of participants at little cost or effort and ways to provide a still picture of outcome and also the characteristics associated with it within a specific period of time (Levin, 2006). The cross sectional design is appropriate because the research analyses the present estimation of Bangladeshi population's anthropometric measurement aged between 18-60 years of 24 hand dimensions. The study aim is to find out the present hand anthropometry estimation of the Bangladeshi adults both male & female and also find out the statistical associations between variables. So the cross-sectional method is appropriate for this study (Bowling, 1997).

### **3.2. Participants**

Study participants were selected conveniently both male and female in Centre for the Rehabilitation of Paralyzed (CRP) and others convenience place (Chittagong, Dhaka, Savar, and Mymensing) in Bangladesh. Sample should be representing the population as closely as possible. For survey research, it is better to get many subjects as possible with the consideration of the size of ideal population (Bowling, 1997). The participants were collected conveniently from urban areas in different occupations according to their free time in a suitable place of pre-mentioned areas. To conduct the study 186 participants were selected willingly at the age range Between 18 to 60. It was ensured that, all district population of Bangladeshi origin in Bangladesh was included of this study as a sample. Study sample size and the measurement were varied from each and individual. The data of the participants also collected after their verbal consent and signature.



### 3.3. Sample size

The researcher was selected the participants or research samples that was convenient to the researcher. According to standard sample size calculation, appropriate sample size is 384. Due to my study time limitation according to my course content I was taken approximately 186 studies sample to conducted my research. Study sample size and the measurement were varied from each and individual. The data of the participants also collected after their verbal consent and signature.

For calculating sample size the investigator was used the principle of sample size determination:  $n = z^2 \cdot pq / r^2$  (Hicks, 2000). The investigator was used 95% confidence interval for this study, thus the confidence interval,  $z = 1.96$  and 5% sampling error for this research, thus the sampling error,  $r = 0.05$ . The investigator did not know the anthropometric measurements of hands in Bangladeshi population, so the prevalence  $p = 50\% = 0.5$  &  $q = (1 - p) = (1 - 0.5) = 0.5$ , so  $q = 0.5$ . Then, if investigator calculated the sample size ( $n$ ) and it was stand for:

$$\begin{aligned}n &= \frac{(1.96)^2 \times 0.5 \times 0.5}{(0.05)^2} \\ &= \frac{0.9604}{0.0025} \\ &= 384.16\end{aligned}$$

$$\therefore n = 384.16$$

In these circumstances, the investigator was selected and collected data from 186 participants rather than 384 at (95% confidence interval and 5% error level) because of the time limitation of academic course curriculum.

### 3.4. Inclusion criteria

- Both male and female participants within 18-60 years age range.
- Normal hand function.
- People who have five fingers without any deformity.
- Bangladeshi origin people.

### **3.5. Exclusion criteria**

- The person who have congenital deformity in the hand, e.g. thumb hypoplasia, transverse arrest, gigantism, constriction ring etc.
- The person have multiple fracture in hand, e.g. fractures Of the Phalanges, middle or intermediate phalanges, proximal phalange, distal phalange, metacarpal fracture, scaphoid fracture.
- The person who have a burn contracture in hand e.g. sever burn scar contracture, dupuytren's contracture etc.
- The person who have a bonny deformity in metacarpal and phalangeal joint because in this situation the bones are not aligned in proper position.
- If missing any digit or finger (congenital, acquired- trauma), so that the measurement may obviously disrupted.
- The person who have wrist drop, so that the proper hand length measurement should be difficult.
- The person who have arthritis of hand, such as rheumatoid arthritis.

The pre-mentioned criteria population was excluded from this study, because of those conditions and deformities creates disruption to measure normal hand dimensions.

### **3.6. Study setting**

The study were carried out in Centre for the Rehabilitation of the Paralyzed (CRP) & others convenience place (Chittagong, Dhaka, Savar, and Mymensing) in Bangladesh.

In Savar, CRP has an academic institute named Bangladesh health profession institute (BHPI) & the number of student approximately 350-400. The student are comes from different district in Bangladesh both male and female student studied here.

In Bandar Thana near the south middle Haliashahar is the most crowded area in Chittagong. It is located at the Karnaphuli River in south-eastern Bangladesh. It faces the Bay of Bengal to its west. Chittagong is the second-largest city and principal seaport of Bangladesh. The city has a population of over 6.5 million people. It is near CEPZ and over 35, 000 populations are live here.

The city of Mymensingh stands on the bank of Old Brahmaputra River. The population is around 225,811 and the literacy rate is about 65%. Charpara is one of the main points in Mymensingh. Mymensingh is one of the districts of Dhaka

division. In there the Mymensingh medical is located. Over 10,000 populations are live around there

Dhaka is also one of the world's most densely populated cities. This is the city located on the Buriganga River and population of more than 15 million people. It is known as the City of Mosques. Dhaka is the capital of Bangladesh. The Uttara, Gulshan, Shahjadpur, Bashundhara, Dhanmondi is the place where more than 50,000 people are lived (CIA World Factbook, 2014).

### **3.7. Study period**

The study project was started from June, 2014 by starting with writing a proposal. This project was completed at March, 2015 by the submission of final thesis paper.

### **3.8. Data collection procedure**

First of all, the researcher was fixed a date to gathering data from the sample group of participants in a convenient place for his available time schedule which is given in project time frame. After that all the eligible participants were informed by an informed consent before starting data collection. Then the researcher was measured the hand dimensions according to the table listed below in a procedural manner. All the measurement of hand was collected in well lighted environment. To start data collection by researcher it is important to list out about their demographic profile. The researcher was collected data by following procedures of (Davies, cited in Courtney, 1984) hand dimension measurement table that were used in many different studies. This data was collected in a sound place and all the measurement should be collected accordingly by slide calipers, measuring tape etc. in a procedural manner. During data collection all the ethical issues were strictly maintained.

### **3.9. Data collection instrument**

To collect the data, the researcher was used some data collection instruments including:

#### **Measuring tape**

The researcher was used an appropriate measuring tape to measure the hand dimensions. The measure tape was very flexible to measured data and should be understandable by shown easy reading. The measuring tape reading must has an opportunity to convert as inch, centimetre and millimetre.

### **Consent form**

Informed consent is a written document outlined the risks of the experiments and their possible benefits. The two part of consent form Information sheet and Consent form to have informed consent. A written consent form must be obtained from participants and it documented that participants understood the information sheet, aware about the potential benefits and risks, their participation voluntarily and their signature. So it was considerable for participants to take consent from those peoples who were interested to participate in the study. Before starting the interview, signatures were obtained from each participant on a consent form. In this study researcher was used both Bangle and English Consent form.

### **The hand dimension measurement table**

To describe the hand dimensions and application, the hand anthropometry dimension of measurement table was used by following procedures of (Davies et al. 1980) hand dimension measurement table that used in many different studies. This table has 24 hand dimensions. All dimensions were defined. The table is given in detail in the appendix section.

### **Slide caliper**

A digital slide caliper was used to measure individual joints of finger, finger length, hand width, length, and knuckle height. It was used to find out the accurate measurement. Sometimes the measurements were not being found accurately because of the following instruments error (technical). So to solve this error the researcher was used the equipment appropriately.

### **Demographic questionnaire**

Demographic information of the participants was collected each and individual participants before collecting the measurement. The self-demonstrated demographic questionnaire was designed by the researcher with different variables (age, sex, stature, living area, educational status, marital status and occupation) related to studies. Demographic questionnaire identified the person and his personal features. The demographic questionnaire format is attached in the appendix section.

### **3.10. Data analysis**

Data entry and analysis was performed by using the Statistical Package for social science (SPSS) version: 17. To reduce the impact of the missing value and increase the reliability of the analysis, the total analysis process was carried out using the SPSS computer package. At first the researcher was selecting the variable & then inputting the data into SPSS. Every questionnaire had a code number to input into the SPSS software (Landau and Everitt, 2004). Quantitative data can be effectively analysed by using descriptive statistics. It is used when investigator has collected a quantity of data (Hicks, 2000). In this regard descriptive statistical techniques bar graph, pie chart, table and histogram were used for this study to represent the study findings (Najenson *et al.* 2010; Hicks, 2000).

Descriptive analysis was also used to find out the frequency and percentage of different socio-demographic data such as, age, sex, educational level, marital status, living area & occupation. The researcher was also calculated hand dimensions mean values (descriptive analysis) & standard deviation (SD). The researcher was also finding out the 5<sup>th</sup>, 50<sup>th</sup> & 95<sup>th</sup> percentile values.

### **3.11. Ethical considerations**

The researcher gained permission from the authority of BHPI & authorities were informed about the purpose of the study. Informed consent was given for the participant's data. The researcher ensured that the confidentiality was maintained regarding the participant's data. Participants were not individually identified. Each participant was informed about the study before beginning and was given written consent. The researcher was ensure the participant safety when take measurement. Female data was collect by female data collectors. All participants were informed about the aim of the study.

**4.1. Socio-demographic characteristics of the participants**

The demographic characteristic of the studies shows that there are 83 male participants in different ages. There are numbers male single were 25 & rests of 55 were married. At the same age group of 18-60 there 103 female samples were collected and among them 61 of 103 were single and rests of 42 out of 103 were married.

In table-2 shows that the percentile values of, mean & standard deviation of the hand dimensions of Bangladeshis in different areas. Here the data table also shows that three percentile values (5, 50 & 95<sup>th</sup>) of 24 hand dimensions among males and females respectively. The mean & standard deviation values are also aligned with the right most columns in table-2 and also shows to determine the proportion of the populations. This percentile values will help to made furthermore comparisons with other populations. In the table-3 the Independent sample T-test for the difference of hand dimensions between males and female.

A total number of 186 (83 males and 103 females), were primarily identified as a sample for conduct the study. Where different Tables are structured for showing demographic percentiles, descriptive analysis and significant t-test result. Those are given-

Table 1 was studied for Socio-demographic characteristics of the participants (N)

Table 2 shows Mean, SD and percentile value for 24 hand dimensions of Bangladeshi people male (n=83) & female (n=103). All dimensions in mm.

Table 3 presents The Mean & percentile differences for Bangladeshi male & female (N=186). All dimensions in mm.

Table 4 shows t-test and significant findings between male and female differences in mean

**Table-1: Socio-demographic characteristics of the participants  
(N=186)**

Variables		Mean age of male	Mean age of female	Male (n=83)	Cumulative (%)	Female (n=103)	Cumulative (%)
Age group	18-25			20	24.01	46	44.07
	26-33			20	24.01	41	39.08
	34-41	35.32	27.30	19	22.09	08	7.8
	42-49			18	21.7	03	2.9
	50-60			06	7.2	05	4.9
Marital- status	Single			28	33.7	61	59.2
	Married			55	66.3	42	40.8
Living area	Rural			35	42.2	76	26.2
	Urban			48	57.8	27	73.8

#### **4.2. Anthropometric hand dimensions & differences between genders living in Bangladesh**

In Table-1 the difference of important parameters are summarized. By standardized calculation of mean age of male and female were identified 35.32 and 27.30 respectively. The differences between genders in respect of hand length were found to be highly significant ( $P < 0.01$ ). The hand lengths in mean of female were shorter than that of males ( $P < 0.01$ ). The descriptive statistics of an analysis shows in table-2. In there the mean, standard deviation and percentile values of 5<sup>th</sup>, 50<sup>th</sup>, & 95<sup>th</sup> were shown significantly according to the 24 hand dimensions. The result shows that all of the 24 hand dimensions of mean value were greater than female. The dimension of the hand such as depth at tip digit 5 and depth as tip digit 3 were almost same of the males and females. The large difference shows in the dimensions of third digit to base of thumb and length of the hand between two genders.

Table-4 shows the significant differences between males and females percentiles of the measurement of hand dimensions. The independent t-test showed that the 4 of 24 dimensions of differences in mean were statistically significant of p-value ( $P < 0.05$ ). The major 19 of 24 hand dimensions shows that the differences in mean were highly significant ( $P < 0.01$ ) and the rest of one dimension is greater than ( $P < 0.05$ ). In this the dimension of depth at tip digit 3 p-value was 0.53.

The statistical interpretations have been summarized on various parameters, that given in Table 2 and Table 3. These are given below with showing chart-



**Table 2: Mean, ( $\pm$ SD) and percentile value for 24 hand dimensions of Bangladeshi people male (n=83) & female (n=103). All dimensions in mm.**

Hand Dimensions	Male Percentile					Female Percentile				
	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	Mean	$\pm$ SD	5 <sup>th</sup>	50 <sup>th</sup>	95 <sup>th</sup>	Mean	$\pm$ SD
1.Fingertip to root digit 5	53.32	57.61	66.24	58.76	4.205	44.98	53.06	58.59	53.16	3.88
2.First joint to root digit 5	31.64	35.57	42.41	36.11	3.010	25.66	32.75	38.75	32.36	3.98
3. Second joint to root digit 5	16.45	19.36	23.49	19.50	2.094	13.78	17.64	21.93	18.20	5.66
4.Breadth at tip digit 5	9.25	11.13	13.02	11.15	1.107	7.68	9.72	11.97	9.76	1.27
5.Breadth at first joint of digit 5	11.54	13.07	14.81	13.11	1.053	10.50	11.83	13.25	11.88	0.83
6.Breadth at second joint of digit 5	13.45	15.27	17.46	15.16	1.170	12.32	13.91	15.34	13.81	0.87
7.Depth at tip digit 5	7.35	9.06	10.87	9.11	1.204	6.41	8.53	10.56	8.61	1.49
8.Depth at first joint digit 5	8.66	10.22	11.98	10.87	5.256	8.46	9.69	11.37	9.67	0.85
9.Depth at second joint digit 5	11.84	13.71	15.79	13.56	1.580	10.45	12.25	13.78	12.20	0.98
10.Fingertip to root digit 3	68.61	76.73	84.77	75.84	8.361	64.62	70.96	77.59	71.13	4.06
11.First joint to root digit 3	45.52	51.63	60.45	52.44	8.191	43.09	47.96	54.80	48.57	3.65
12. Second joint to root digit 3	22.54	28.76	33.92	28.84	2.976	22.39	26.84	31.88	26.86	2.73
13.Breadth at tip digit 3	12.15	13.58	15.85	13.84	1.602	10.41	12.42	14.78	12.44	1.29
14.Breadth at first joint of digit 3	13.77	15.18	17.26	15.36	1.022	12.27	13.87	15.29	13.86	0.97
15.Breadth at second joint of digit 3	16.72	18.38	20.54	18.40	1.132	15.13	16.48	18.07	16.48	0.89
16.Depth at tip digit 3	8.80	10.54	12.13	10.52	1.140	8.00	9.94	12.42	10.16	1.30
17. Depth at first joint digit 3	10.88	12.24	14.16	12.32	1.060	9.71	11.07	13.17	11.21	0.95
18.Depth at second joint digit 3	14.21	16.37	18.56	16.38	1.391	12.84	14.72	16.37	14.70	1.05
19.Maximum breadth of the hand	88.33	95.99	103.60	96.34	5.012	78.81	85.38	98.24	86.05	6.16
20. Breadth of the Knuckles	75.91	81.22	89.07	81.48	4.220	65.96	72.24	81.54	72.68	4.64
21.Maximum depth of the hand	29.15	37.01	43.27	36.36	4.448	29.50	34.76	39.41	34.56	3.29
22.Depth of knuckles	22.52	26.02	29.26	26.23	2.090	19.52	23.18	26.93	23.47	5.37
23.Third digit to base of the thumb	131.68	143.00	162.80	145.40	9.266	110.38	127.00	145.00	127.52	10.66
24. Length of hand	170.61	185.00	203.80	185.32	9.419	153.43	170.00	183.00	168.57	10.12

**Table 3: The mean average of male-female in 24 hand dimensions & mean differences for Bangladeshi male & female (N=186). All dimensions in mm.**

<b>Hand Dimensions</b>	<b>Mean average between gender</b>	<b>±SD</b>	<b>Gender difference in mean</b>	<b>5<sup>th</sup> percentile(s)</b>	<b>50<sup>th</sup> percentile(s)</b>	<b>95<sup>th</sup> percentile(s)</b>
1.Fingertip to root digit 5	55.66	4.89	5.59	47.88	55.67	64.32
2.First joint to root digit 5	34.03	4.03	3.74	27.65	34.22	39.87
3. Second joint to root digit 5	18.78	4.48	1.30	14.40	18.52	23.05
4.Breadth at tip digit 5	10.38	1.38	1.39	8.30	10.37	12.72
5.Breadth at first joint of digit 5	12.43	1.11	1.22	10.69	12.27	14.24
6.Breadth at second joint of digit 5	14.41	1.21	1.35	12.72	14.28	16.83
7.Depth at tip digit 5	8.84	1.39	0.50	6.97	8.79	10.84
8.Depth at first joint digit 5	10.21	3.60	1.20	8.52	9.89	11.76
9.Depth at second joint digit 5	12.81	1.44	1.36	10.76	12.78	14.95
10.Fingertip to root digit 3	73.23	6.75	4.70	65.21	73.15	83.61
11.First joint to root digit 3	50.29	6.39	3.87	44.20	50.27	58.49
12.Second joint to root digit 3	27.75	3.00	1.97	22.47	27.73	32.45
13.Breadth at tip digit 3	13.06	1.59	1.40	10.97	13.01	15.29
14.Breadth at first joint of digit 3	14.53	1.24	1.49	12.64	14.49	16.77
15.Breadth at second joint of digit 3	17.34	1.38	1.91	15.26	17.25	19.61
16.Depth at tip digit 3	10.32	1.24	0.35	8.23	10.35	12.31
17.Depth at first joint digit 3	11.70	1.14	1.10	10.04	11.60	13.74
18.Depth at second joint digit 3	15.45	1.47	1.68	13.03	15.45	18.06
19.Maximum breadth of the hand	90.65	7.64	10.29	80.58	90.25	102.46
20.Breadth of the Knuckles	76.60	6.24	8.79	66.53	76.61	86.73
21.Maximum depth of the hand	35.36	3.94	1.79	29.54	35.40	41.94
22.Depth of knuckles	24.70	4.44	2.75	19.87	24.49	28.73
23.Third digit to base of the thumb	135.50	13.42	17.88	115.00	136.00	160.00
24.Length of hand	176.04	12.86	16.75	153.50	175.00	200.00

ND = normally distributed. Here, N= 186 for each variable

**Table 4: t-test and significant findings between male and female differences in mean**

Body Dimension	95% CI		t-Test	
	Lower	Upper	t value	p
1.Fingertip to root digit 5	4.60	6.58	9.32	.000
2.First joint to root digit 5	2.90	4.59	7.30	.000
3. Second joint to root digit 5	0.29	2.30	2.15	.049
4.Breadth at tip digit 5	1.10	1.68	7.97	.000
5.Breadth at first joint of digit 5	0.98	1.45	8.61	.000
6.Breadth at second joint of digit 5	1.10	1.61	8.76	.000
7.Depth at tip digit 5	0.17	0.82	2.53	.014
8.Depth at first joint digit 5	0.23	2.17	2.06	.023
9.Depth at second joint digit 5	1.03	1.69	6.85	.000
10.Fingertip to root digit 3	3.04	6.69	4.70	.000
11.First joint to root digit 3	2.26	6.36	3.99	.000
12. Second joint to root digit 3	1.27	2.67	4.66	.000
13.Breadth at tip digit 3	1.04	1.76	6.45	.000
14.Breadth at first joint of digit 3	1.25	1.74	10.15	.000
15.Breadth at second joint of digit 3	1.66	2.16	12.56	.000
16.Depth at tip digit 3	0.05	0.65	1.97	.053
17. Depth at first joint digit 3	0.86	1.35	7.40	.000
18.Depth at second joint digit 3	1.37	1.98	9.11	.000
19.Maximum breadth of the hand	8.93	11.64	12.56	.000
20. Breadth of the Knuckles	7.72	9.87	13.51	.000
21.Maximum depth of the hand	0.82	2.76	3.06	.002
22.Depth of knuckles	1.80	3.71	4.77	.000
23.Third digit to base of the thumb	15.46	20.30	12.23	.000
24. Length of hand	14.37	19.12	11.66	.000

ND = normally distributed, 2 tailed t-test at 95% Confidence Interval (CI)

## CHAPTER 5 DISCUSSION

There is no any published article specifically in hand anthropometry among Bangladeshi people. This study results shown some baseline findings those are related to hand anthropometry and also some differences than other studies. There are many research published about this topic and discussed about the 24 dimensions of hand. The comparisons with this study along with other studies are given below according to the findings-

In a published article which was conducted with the origin of Bangladeshi people living in America, the study found that the number of finger dimensions such as (length, breath, depth of digit 5, depth of digit 3 were significantly smaller than this study findings in basis of those dimensions. In the present study the dimensions of mean in female such as fingertip to root digit 5, first joint to root digit 5, first joint to root digit 3, second joint to root digit 3, length of the hand were significantly greater than the study conducted in Bangladeshis living in America. The rest of the dimensions were significantly smaller than the Bangladeshis living in America.

Another study shows the results of Jordanian hand anthropometric dimensions compared with other nationalities. The male and female Jordanian finger segments were greater than the Bangladeshis and the Jordanian female fingers are also thicker than Bangladeshis (Mandahawi *et al.* 2008).

Study shows that the hand dimensions vary in different races. In a study of (Rastogi, Nagesh and Yoganarasimha, 2008) investigate the stature from hand dimensions of 20-30 years ages of medical students in north and south Indians. In that study the avg. hand length of males and females is 180.89 & 170.03 respectively. On the other hand breadth was found 80.05 & 70.19 respectively in between males and females. This study is compared to the present study in Bangladeshi population age around 18-60. This study shows that the Bangladeshi males and female's length of the hands are 185.32 & 168.57. The breadth of Bangladeshi male and female hand was 90.34 & 86.05 respectively. It shows that the large difference between male and female hand length and breadth of adult population in Bangladesh rather than 18-30 years medical students in north and south Indians.

In a concept of (Agnihotri *et al.* 2008) the age between 18-30 years populations of SSR Medical College, living in Mauritius, where mean hand length of males and females were 180.89 & 170.22 and the breadth are 80.45 & 70.48 in males and females respectively. In this study the higher mean value of male shows in each anthropometric dimension than female. In the present study the significant differences between hand length and breadth was also identified between males and females. The percentiles differences between male and female means in hand length were 16.75 mm. on the other hand the percentiles difference between male and female means in hand breadth were 10.29 mm.

In another study of Thai female hand dimensions conducted by (Saengachaiya and Bunternghit, 2004). There were 41 hand dimensions measured. In this study the Thai females have wider and thicker fingers but narrower knuckles than the females of Hong-Kong, U.K. and India. This result is also related with the people of Bangladesh. In the present study, it was found that the Bangladeshi females have less wide & thicker finger than Thai females. In this the Fingertip to root digit 5 and depth at tip digit 5 of Bangladeshi females were 53.16 and 8.61 where the Thai females were 55.89 and 9.04 subsequently. On the other the Bangladeshis have also wider knuckles of (knuckle depth 75.91) than the females of Thai (Knuckle depth 70.16), Hong-Kong, British and Indian.

There are different studies were published based on hand anthropometry along with co-relation to other variables, such as- stature, ethnic group, industrial workers, female farm workers, and floriculture workers and so on. In a study of Hong Kong Chinese female of hand dimensions where they have a shorter, narrower hands compared to other ethnic groups of Hong Kong living in United Kingdom, United States of America, and Japan (Courtney, 1984). But the present study shows that the Bangladeshis have a shorter and narrower hand in a mean value rather than Hong Kong Chinese female.

In another similar studies found that the female Jordanian hand length in respectively mean value 171.27 mm were greater than the hand length of Bangladeshi female in mean 168.57 mm. and also shorter than Nigeria and Mexico in mean value respectively 175.5 mm and 171.6 mm (Okunribido, 2000; Imrhan and Contreras, 2005).

### **5.1. The significant difference between male and female among Bangladeshis**

The analyses were done on the basis of 24 hands of those Bangladeshis who were over 18 and up to 60 years of age. In all 24 hand dimensions there is a significant difference than one another. The difference between males and females hand dimensions in mean were tested by using a significant two tailed t-test with number of non-equal variances. In this research the researcher found a significant variance among the dimensions of finger segments, hand length, breadth, and 3rd digit to base of thumb, hand depth and breadth, knuckle depth and breadth. These data of the dimensions between male and females were different. In the 5<sup>th</sup>, 50<sup>th</sup> and 95% values there were observed a significant comparison in mean values among two genders in Bangladesh.

In this paper the sample size were collected 186 samples. Where the male participants were 83 and female participants were 103 out of 186. At the end of the findings the researcher found that the female hand length and maximum hand breadth is shorter and narrower than the male hand dimensions. Some significant differences are shown as fingertip to root digit 5, where the male mean value were 58.77 mm and the female means 53.20 mm. fingertip to root digit 3 the male mean value were 75.90 mm and the female mean were 71.13 mm. third digit to base of thumb the male and female ratio of mean value were 145.40 mm and 127.52 mm. The maximum hand breadth of male means 96.34 and the female was 86.10 mm. The hand length of male value in means was 185.32 mm and the female means were 168.60 mm.

The earlier study shows that the index & ring finger length were significantly larger in male rather than female adolescents (Krishan et al, 2011). The people of Bangladesh are working in different sectors with different type of works done by the hands and uses equipment in various sizes and shapes. There were many things those are poorly designed such as tools and devices that are frequently used in workplace and industrial settings. In another earlier studies found that the women who uses cutter, stripper, and other hand held tools for a long time those were not designed well can cause musculoskeletal symptoms and disorder in hand (Nag, Nag and Desai, 2003).

In the present study which provides a recent data of hand dimensions that are useful for the Bangladeshi women those were related to such type of works by using hand held tools and devices. The anthropometry data of hand is very important for determining in various aspects of industrial or garments machineries involved by hand held tools and devices (Chandra, Chandna and Deswal, 2012). This result shows an important data of hand and useful resource for the further research of these topics and also a very useful source to understand about hand anthropometry of Bangladeshis.

## **CHAPTER 6**

### **LIMITATIONS & RECOMMENDATIONS**

#### **6.1. Limitations of the study**

This paper has some imperfections at very first of collecting data and the end of the collection process. In a very short limited time this study was conducted with faced lots of difficulties and to maintain appropriate uses of modern devices such as anthropometer. The dimensions such as hand length and maximum hand breadth were assumed by the tape measure in mm. not in slide calipers. The male sample size of different age groups were not equally collected similarly that collected by the females. In some cases the actual age were not accurately measured by the elderly people who have 40 or more years of age. The researcher were also involved some data collectors, those are helped by the researcher when collecting data from a sample group. So that the collected data had bit differ with the normal range of dimensions according to age. This study results is only show the population of those areas because of low sample size, and not focuses the whole anthropometric hand data in Bangladesh.

#### **6.2. Recommendations**

The direction of further research should be conducted by the large group of populations in most of the cities in Bangladesh. The findings of this study are only shows the differences between male and female but not in a small age group of the large sample in a long periodic time frame which is strongly recommended for the further studies. The furthermore study could be done among different ethnic group and religious in Bangladesh, different occupations such as- agricultural, households, constructional, female garments workers. The further study would also recommended of using a small anthropometer for measuring hand lengthy and breadth easily with consuming time. It is also recommended to use hand anthropometric database to design products of mobile phone companies. The correlation between stature and hand length and the study is recommended for the children those are below 18.



## **CHAPTER 7 CONCLUSION**

To conclude this study has shown a recent data of hand dimensions of Bangladeshi populations. The results show the significant difference of 24 hand dimensions between male and female in Bangladeshi population. Though the sample sizes were small, for that the convenient sampling among the population was done only to focus the data of hand dimensions (Hossain *et al.* 2010). This is current result for the Bangladeshi population in those mentioned area not focuses the whole country. So to this data can be useful for remodelling the environmental tools and devices after understanding the dimensions of hand and hope to prevent possible musculoskeletal symptoms, design and fitted equipment with the workers and stuffs about after knowing hand dimensions of individual. Hand anthropometry deals with the measurement of hand size, shape, and work capacity. The hand anthropometric data are frequently used and appropriate for requirements of latest product design, making decision about evidence based design gloves and manufacturing (Williams, 2004).

Furthermore the data also contribute to develop design guidelines of hand held tools, equipment's, production machineries for not develop of any musculoskeletal disorder in hand. This anthropometric data of hand should improve the understanding of the well-being and increase the level of performance. This study has to provide a preliminary hand data among Bangladeshis. This study should encourage others to conduct further research in this field.

## References

### Harvard Referencing Style (Leabharlann UCD, UCD Library; March 2014)

- Aboul-Hagag, K.E. Mohamed, S.A. Hilal, M.A. and Mohamed, E.A (2011) ‘Determination of sex from hand dimensions and index/ring finger length ratio in Upper Egyptians’, *Journal of Forensic Sciences*, 1, pp. 80-86. Available at: [http://ac.els-cdn.com/S2090536X11000025/1-s2.0-S2090536X11000025-main.pdf?\\_tid=417971a8-caed-11e4-928f-00000aab0f27&acdnat=1426408288\\_a1ae6960e001ac5698fc65710ea6f3fe](http://ac.els-cdn.com/S2090536X11000025/1-s2.0-S2090536X11000025-main.pdf?_tid=417971a8-caed-11e4-928f-00000aab0f27&acdnat=1426408288_a1ae6960e001ac5698fc65710ea6f3fe) [Accessed on 23 November 2014].
- Agnihotri, A.K. Agnihotri, S. Jeebun, N. and Googoolye, K. (2008) ‘Prediction of stature using hand dimensions’, *Journal of Forensic and Legal Medicine*, 15, pp. 479-482. Available at: [http://ac.els-cdn.com/S1752928X08000498/1-s2.0-S1752928X08000498-main.pdf?\\_tid=cef9eb58-cb0f-11e4-b3ee-00000aab0f6b&acdnat=1426423128\\_53a24c3a933051f1593dbbe8cb00b4b7](http://ac.els-cdn.com/S1752928X08000498/1-s2.0-S1752928X08000498-main.pdf?_tid=cef9eb58-cb0f-11e4-b3ee-00000aab0f6b&acdnat=1426423128_53a24c3a933051f1593dbbe8cb00b4b7) [Accessed on 8 November 2014].
- Bangladesh PEOPLE. (2014) ‘COUNTRIES of the WORLD’, Available at: [http://www.theodora.com/wfbcurrent/bangladesh/bangladesh\\_people.html](http://www.theodora.com/wfbcurrent/bangladesh/bangladesh_people.html). [Accessed on 8 July 2014].
- Bowling, A. (1997) *Research Methods in Health: Investigating Health and Health Services*. United States of America: Open University Press.
- Chandra, A. (2011) ‘Analysis of Hand Anthropometric Dimensions of Male Industrial Workers of Haryana State’, *International Journal of Engineering (IJE)*, 5 (3), pp. 242–256. Available at: <http://www.cscjournals.org/library/manuscriptinfo.php?mc=IJE-286> [Accessed on 10 June 2014].
- Chandra, A. Chandna, P. and Deswal, S. (2013) ‘Estimation of hand index for male industrial workers of Haryana State’, *International Journal of Engineering, Science and Technology*, 5(1), pp. 55-65. Available at: <http://www.ajol.info/index.php/ijest/article/download/85055/75028> [Accessed on 15 October 2014].
- Chang, J. Kong, Y. Freivalds, A. Kang, H. and Cho, J. (2013) ‘Investigation of Relationships between Hand Surface Dimensions and

- Hand Bone Dimensions’, *Ergonomics*, 57(1), pp. 948-952. Available at: <http://hinarilogin.research4life.org/uniqueisigpro.sagepub.com/uniqueisig0/content/57/1/948.full.pdf+html> [Accessed on 8 June 2014].
- Corlett, E.N. and Clark, T.S. (2003) *The Ergonomics of Workspaces and Machines: A Design Manual*. United Kingdom: CRC Press. Available at: <http://www.amazon.com/The-Ergonomics-Workspaces-And-machines/dp/0748403205> [Downloaded on 23 November 2014].
  - Courtney, A.J. (1984) ‘Hand Anthropometry of Hong Kong Chinese females compared to other ethnic groups’, *Ergonomics*, 27(11) pp. 69-1180. Available at: <http://www.dx.doi.org/10.1080/00140138408963598> [Accessed on 13 July 2014].
  - Culture of Bangladesh. (2014) ‘Countries and Their Cultures’, Available from: <http://www.everyculture.com/A-Bo/Bangladesh.html>. [Accessed on 5 July 2014].
  - Damon, A. and Stoudt, H.V. (1963) ‘The Functional Anthropometry of Old Men’, *Human Factors*, 5(5), pp. 485-491. Available at: <http://hinarilogin.research4life.org/uniqueisighfs.sagepub.com/uniqueisig0/content/5/5/485.full.pdf+html> [Accessed on 16 September 2014].
  - Danborn, B. and Elukpo, A. (2007) ‘Sexual Dimorphism in Hand and Foot Length, Indices, Stature-ratio and Relationship to Height in Nigerians’, *The Internet Journal of Forensic Science*, 3(1), pp. 9-17. Available at: <http://www.https://ispub.com/IJFS/3/1/3916> [Accessed on 9 July 2014].
  - Davies, B.T. Benson, A.K. Courtney, A.J. and Minto, I. (1980) ‘A comparison of hand anthropometry of females in three ethnic groups’, *Ergonomics*, 23(2), pp. 179-182. Available at: <http://hinarilogin.research4life.org/uniqueisigwww.tandfonline.com/uniqueisig0/doi/pdf/10.1080/00140138008924731> [Accessed on 15 August 2014].
  - Garcia-Caceres, R. G. Felknor, S. Cordoba, J. E. Caballero, J. P. and Barrero, L. H. (2012) ‘Hand anthropometry of the Colombian floriculture workers of the Bogota plateau’, *International Journal of Industrial Ergonomics*, 42(2), pp.183–198. Available at: <http://www.sciencedirect.com/science/article/pii/S0169814111001363> [Accessed 7 May 2014].

- Garrett, J.W. (1971) 'The Adult Human Hand: Some Anthropometric and Biomechanical Considerations', *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 13(2), pp.117-131. Available at: <http://hinarilogin.research4life.org/uniquestighfs.sagepub.com/uniquestigh0/content/13/2/117.abstract> [Assessed on 29 November 2014].
- Gnaneswaran, V. and Bishu, R.R. ( 2011) 'Anthropometry and hand performance evaluation of minority population', *International Journal of Industrial Ergonomics*, 41(6), pp.661–670. Availabe at: <http://www.sciencedirect.com/science/article/pii/S0169814111000850> [Accessed 11 May 2014].
- Habib, S.R. and Kamal, N.N. (2010) 'Stature estimation from hand and phalanges lengths of Egyptians', *Journal of Forensic and Legal Medicine*, 17, pp. 156-160. Available at: [http://ac.els-cdn.com/S1752928X09002145/1-s2.0-S1752928X09002145-main.pdf?\\_tid=62958742-cafb-11e4-8a88-00000aab0f6b&acdnat=1426414356\\_52422bc4f7a6d52cfd141ba80324df5a](http://ac.els-cdn.com/S1752928X09002145/1-s2.0-S1752928X09002145-main.pdf?_tid=62958742-cafb-11e4-8a88-00000aab0f6b&acdnat=1426414356_52422bc4f7a6d52cfd141ba80324df5a) [Accessed on 19 January 2014].
- Hossain, S. Begum, J.A. Banu, Mst.L.A. Rahman, Md.F. and Akhter, Z. (2010) 'Prediction of Stature from Hand Length and Breadth – An Anthropometric Study on Christian Garo tribal Bangladeshi females', *Bangladesh Journal of Anatomy*, 8(1), pp. 21-27. Available at: <http://www.banglajol.info/index.php/BJA/article/view/6105/4764> [Accessed on 5 November 2014].
- Ibeachu, P.C. Abu, E.C. and Didia, B.C. (2011) 'Anthropometric Sexual Dimorphism of Hand Length, Breadth and Hand Indices of University of Port-Harcourt Students', *Asian Journal of Medical Sciences*, 3(8), pp.146–150. Available at: <http://maxwellsci.com/print/ajms/v3-146-150.pdf>. [Accessed on 5 April 2014].
- Ilayperuma, I. Nanayakkara, G. and Palaphepitiya, N. (2009) 'Prediction of personal stature based on the hand length' *Galle Medical Journal*, 14(1), pp. 335-703. Available at: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.430.7496&rep=rep1&type=pdf> [Accessed on 20 January 2014].

- Imrhan, S.N. (2000) 'Comparison of Hand Dimensions among Various Nationalities', *Human Factors and Ergonomics Society*, 44(33), pp. 6–284. Available at: <http://hinarilogin.research4life.org/uniquesigpro.sagepub.com/uniquesig0/content/44/33/6-284.full.pdf+html> [Accessed on 12 July 2014].
- Ishak, N.I. Hemya, N. and Franklin, D. (2012) 'Estimation of stature from hand and handprint dimensions in a Western Australian population', *Forensic Science International*, 216, pp. 199.e1–199.e7. Available at: [http://ac.els-cdn.com/S0379073811004579/1-s2.0-S0379073811004579-main.pdf?\\_tid=2e9fa5bc-cb4b-11e4-8d77-0000aacb361&acdnat=1426448629\\_d6a6d7f9f43b261e43753b0023737c03](http://ac.els-cdn.com/S0379073811004579/1-s2.0-S0379073811004579-main.pdf?_tid=2e9fa5bc-cb4b-11e4-8d77-0000aacb361&acdnat=1426448629_d6a6d7f9f43b261e43753b0023737c03) [Accessed on 8 September 2014].
- Ismaila, O.S. (2009) 'Anthropometric Data of Hand, Foot and Ear of University Students in Nigeria', *Leonardo Journal of Sciences*, (15), pp.15–20. Available at: [http://ljs.academicdirect.org/A15/015\\_020.pdf](http://ljs.academicdirect.org/A15/015_020.pdf). [Accessed on 5 June 2014]
- Kanchan, T. and Krishan, K. (2011) 'Anthropometry of hand in sex determination of dismembered remains - A review of literature', *Journal of Forensic and Legal Medicine*, 18(1), pp.14–7. Available at: <http://www.sciencedirect.com/science/article/pii/S1752928X1000185X> [Accessed on 24 August 2014].
- Kar, K.S. Ghosh, S. Manna, I. Banerjee, S. and Dhara, P. (2003) 'An Investigation of Hand Anthropometry of Agricultural Workers', *J. Hum. Ecol.*, 14(1), pp. 57-62. Available at: <http://krepublishers.com/02-Journals/JHE/JHE-14-0-000-000-2003-Web/JHE-14-1-001-03-Abst-PDF/JHE-14-1-057-03-Kar-S-K/JHE-14-1-057-062-03-Kar-S-K-Tt.pdf> [Accessed on 24 October 2014].
- Kaur, D. Shukla, L. Jain, S. Pandey, S.M. and Choudhary, S. (2013) 'Hand: a scientific tool of measurement', *J. Morphol. Sci.*, 30(3), pp. 167-169. Available at: <http://jms.org.br/PDF/v30n3a05.pdf> [Accessed on 26 November 2014].
- Krishan, K. and Sharma, A. (2007) 'Estimation of stature from dimensions of hands and feet in a North Indian population', *Journal of Forensic and Legal Medicine*, 14, pp. 327-332. Available at:

<http://www.sciencedirect.com/science/article/pii/S1353113106002240>

[Accessed on 18 November 2014].

- Kanchan, T. and Krishan, K. (2011) 'Anthropometry of hand in sex determination of dismembered remains - A review of literature', *Journal of Forensic and Legal Medicine*, 18(1), pp. 14-17. Available at: [http://ac.els-cdn.com/S1752928X1000185X/1-s2.0-S1752928X1000185X-main.pdf?\\_tid=81b4953c-d00a-11e4-9cea-00000aacb362&acdnt=1426970607\\_fc44e36c523719fa754653a7bb590162](http://ac.els-cdn.com/S1752928X1000185X/1-s2.0-S1752928X1000185X-main.pdf?_tid=81b4953c-d00a-11e4-9cea-00000aacb362&acdnt=1426970607_fc44e36c523719fa754653a7bb590162) [Accessed on 23 October 2014].
- Krishan, K. Kanchan, T. and Asha, N. (2012) 'Estimation of stature from index and ring finger length in a North Indian adolescent population', *Journal of forensic and legal medicine*, 19(5), pp. 285–90. Available at: <http://www.sciencedirect.com/science/article/pii/S1752928X11002587> [Accessed May 13,2014].
- Laila, S.Z.H. Ferdousi, R. Nurunnobi, A.B.M. Islam, A.T.M. Holy, S. and Yesmin, F. (2009) 'Anthropometric Measurements of the hand length and their correlation with the Stature of Bengali adult Muslim females', *Bangladesh Journal of Anatomy*, 7(1), pp. 12. Available at: <http://www.banglajol.info/index.php/BJA/article/download/3010/2478> [Accessed on 4 June 2014].
- Landau, S. and Everitt B.S. (2003) *A handbook of statistical analyses using SPSS*. Boca Raton: Chapman and Hall/CRC. pp. 1–354. Available at: [http://www.amazon.com/Handbook-Statistical-Analyses-Using-SPSS/dp/1584883693/ref=sr\\_1\\_1?s=books&ie=UTF8&qid=1426462885&sr=1-1&keywords=A+handbook+of+statistical+analyses+using+SPSS](http://www.amazon.com/Handbook-Statistical-Analyses-Using-SPSS/dp/1584883693/ref=sr_1_1?s=books&ie=UTF8&qid=1426462885&sr=1-1&keywords=A+handbook+of+statistical+analyses+using+SPSS) [Downloaded on 18 December 2014].
- Levin, K.A. (2006), *Study design III: cross sectional studies, dental health services research unit*. University of Dundee: Dundee, Scotland, UK. Available at: <http://www.nature.com/ebd/journal/v7/n1/full/6400375a.html> [Downloaded on 9 October 2014]
- Mandahawi, N. Imrhan, S. Al-Shobaki, S. and Sardar, B. (2008) 'Hand anthropometry survey for the Jordanian population', *International Journal of Industrial Ergonomics*, 38(11-12), pp. 966-976. Available at: <http://ac.els->

cdn.com/S0169814108000280/1-s2.0-S0169814108000280-  
main.pdf?\_tid=350e79f0-cd35-11e4-8019-  
00000aab0f6b&acdnat=1426659093\_9511afea417dc4faeb765ba987bebc96  
[Accessed on 27 December 2014].

- Mohamed, M.H. (2013) ‘Measurement of foot and hand dimensions and their correlation with height in adult upper Egyptians’, *AAMJ*, 10(4). Available at: <http://www.aamj.eg.net/journals/pdf/1057.pdf> [Accessed on 21 November 2014].
- Mulla, N.G. Kulkarni, P.G. and Gangane, S.D. (2014) ‘A study of correlation between stature and hand length in students of Maharashtra’, *International Journal of Recent Trends in Science and Technology*, 12(1), pp. 215-218. Available at: [http://statperson.com/Journal/ScienceAndTechnology/Article/Volume12Issue1/12\\_1\\_52.pdf](http://statperson.com/Journal/ScienceAndTechnology/Article/Volume12Issue1/12_1_52.pdf) [Accessed on 28 January 2014].
- Nag, A. Nag, P.K. and Desai, H. (2003) ‘Hand anthropometry of Indian women’, *Indian Journal of Medicine*, 11(7), pp. 260-269. Available at: <http://www.humanicsergosystems.com/0606.pdf> [Accessed on 12 July 2014].
- Numan, A.I. Idris, M.O. Zirahei, J.V. Amaza, D.S. and Dalori, M.B. (2013) ‘Prediction of Stature from Hand Anthropometry: A Comparative Study in the Three Major Ethnic Groups in Nigeria’, *British Journal of Medicine & Medical Research*, 3(4), pp. 1062-1073. Available at: <http://connection.ebscohost.com/c/articles/90541132/prediction-stature-from-hand-anthropometry-comparative-study-three-major-ethnic-groups-nigeria> [Accessed on 3 December 2014].
- Okunribido, O.O. (2000) ‘A survey of hand anthropometry of female rural farm workers in Ibadan, western Nigeria’, *Ergonomics* 43 (2), pp. 282–92. Available at: <http://hinarilogin.research4life.org/uniqueSIGwww.tandfonline.com/uniqueSIG0/doi/pdf/10.1080/001401300184611> [Accessed on 17 November 2014].
- Patel, P.N. Tanna, J.A. and Kalele, S.D. (2012) ‘Correlation between Hand Length and Various Anthropometric Parameters’, *International Journal of Medical Toxicology and Forensic Medicine*, 29(2), pp.61-63. Available at:

<http://journals.sbmu.ac.ir/ijmtfm/article/download/IJMTFM.3254/pdf>

[Accessed on 17 September 2014].

- Pheasant, A. and Haslegrave, C.M. (2005) *Bodyspace: Anthropometry Ergonomics and the design of work*. United States of America: CRC Press. Available at: <http://www.amazon.com/Bodyspace-Anthropometry-Ergonomics-Design-Second/dp/0748403264/> [Downloaded on 9 September 2014].
- Prado-Lu, J.L.D. (2007) 'Anthropometric measurement of Filipino manufacturing workers', *International Journal of Industrial Ergonomics*, 37, pp. 497-503. Available at: <https://web.njit.edu/~sengupta/IE665/anthropometry%20of%20philipine%20workers.pdf> [Accessed on 5 November 2014].
- Rastogi, P. Nagesh, K.R. and Yoganarasimha, K. (2008) 'Estimation of stature from hand dimensions of north and south Indians', *Journal of Legal Medicine*, 10, pp. 185-189. Available at: [http://ac.els-cdn.com/S1344622308000229/1-s2.0-S1344622308000229-main.pdf?\\_tid=14d212f0-cb69-11e4-9558-00000aab0f01&acdnat=1426461471\\_1701d8a3f0c1f937b0e2f81fb8f55bc9](http://ac.els-cdn.com/S1344622308000229/1-s2.0-S1344622308000229-main.pdf?_tid=14d212f0-cb69-11e4-9558-00000aab0f01&acdnat=1426461471_1701d8a3f0c1f937b0e2f81fb8f55bc9) [Accessed on 21 October 2014].
- Saengchaiya, N. and Bunternngchit, Y. (2004) 'Hand Anthropometry of Thai Female Industrial Workers', *The Journal of KMITNB*, 14(1), pp. 72-185. Available at: <http://www.Journal.kmutnb.ac.th/journal/212910255015423.pdf> [Accessed on 17 December 2014].
- Sen, J. Kanchan, T. Ghosh, A. Mondal, N. and Krishan, K. (2014) 'Estimation of stature from lengths of index and ring fingers in a North-eastern Indian population', *Journal of Forensic and Legal Medicine*, 22, pp. 10-15. Available at: [http://ac.els-cdn.com/S1752928X13003132/1-s2.0-S1752928X13003132-main.pdf?\\_tid=df033a2a-cae9-11e4-96b1-00000aab0f27&acdnat=1426406834\\_54d784a69b78ea5538bb75ce05953ee7](http://ac.els-cdn.com/S1752928X13003132/1-s2.0-S1752928X13003132-main.pdf?_tid=df033a2a-cae9-11e4-96b1-00000aab0f27&acdnat=1426406834_54d784a69b78ea5538bb75ce05953ee7) [Accessed on 19 December 2014].
- Suseelamma, D. Gayathri, P. Deepthi, S. Chandramohan, M. Udaykumar, M. and Amarnath (2014) 'Study of Correlation between Stature and Length of Fingers', *Scholars Journal of Applied Medical Sciences*, 2(2D), pp. 773-784.



Available at: <http://saspublisher.com/wp-content/uploads/2014/03/SJAMS-22D773-784.pdf> [Accessed on 6 December 2014].

- The World Factbook. (2014) 'Central Intelligence Agency', Available at: <https://www.cia.gov/library/publications/the-world-factbook/geos/bg.html> [Accessed on 13 August 2014].
- Ulijaszek, S. J. (2005) *Anthropology: The Individual and the Population*. United States of America: Cambridge University Press. Available at: [http://assets.cambridge.org/97805214/17983/frontmatter/9780521417983\\_frontmatter.pdf](http://assets.cambridge.org/97805214/17983/frontmatter/9780521417983_frontmatter.pdf) [Downloaded on 9 June 2014].
- Williams, G.L. Torrens, G.E. and Hodgson, A.R. (2004) 'Integration of anthropometric data within a computer aided design model', *Journal of Engineering Manufacture*, 18(10), pp.1417-1421. Available at: <http://hinarilogin.research4life.org/uniquesigpib.sagepub.com/uniquesig0/content/218/10/1417.abstract> [Accessed on 12 November 2014].

## Appendix

### APPENDIX 1: Permission letter for conducting study

Date: 23<sup>rd</sup> July, 2014


To  
The Head of the Department  
Department of Occupational Therapy  
Bangladesh Health Professions Institute  
C.R.P, Chapain, Savar  
Dhaka-1343

Subject: An application for seeking permission to conduct the research project.



Madam,

With due respect and humble submission to state that I am seeking permission to conduct the research project as a part of my 4<sup>th</sup> year course module. My research title is "Estimation of hand anthropometry among Bangladeshi people living in four different areas". The aim of this study is to determine the hand anthropometric measurement of the Bangladeshi population (both male & female, around 18-60 years of age). Now I am seeking for your kind approval to start my research project and I would like to ensure that anything's of my study will not bring any harm to the participants.

So I therefore pray and hope that you would be kind enough to grant me the permission to conduct the research and will help me to conduct a successful study as a part of my course module.

Sincerely yours,  
Md. Zobair Hossain  23.07.14  
4<sup>th</sup> year B.Sc. in Occupational Therapy  
BHPI, CRP, Savar, Dhaka-1343.

Attachment: Proposal of the study.

Signature and comments of the supervisor	Signature and comments of the Head of the department
<p data-bbox="336 1456 821 1545"><i>This proposal can be approved for further proceeding.</i></p> <p data-bbox="518 1657 614 1713"></p> <p data-bbox="399 1713 758 1850">Md. Monjurul Habib Lecturer in Occupational Therapy Dept. of Occupational Therapy BHPI, CRP, Savar, Dhaka-1343</p>	<p data-bbox="829 1456 1375 1612"><i>It may allow to conduct this study as per supervisor's recommendation.</i></p> <p data-bbox="997 1624 1157 1713"></p> <p data-bbox="829 1713 1332 1850">Nazmun Nahar Assistant Professor &amp; Head of the Department. Dept. of Occupational Therapy BHPI, CRP, Savar, Dhaka-1343</p>

## **Informed consent**

During the interview the researcher will gain written consent from each participant with signature on a written consent form of the participants who is interested in taking part in the study. The researcher will clarify the role of the participants in the study and ensure that it will not cause any harm to them. Future Occupational Therapy practice will be benefited from the study. Any obtained data will remain confidential. The researcher will explain to the participants how the interview data will be used in the study and that their identity will be kept confidential in the study. The researcher will also explain the benefits of the study and that the participant has a right to decline answering any questions during the interview and the right to withdraw from the study at any time.

## APPENDIX 2: CONSENT FORM (English)

### APPENDIX 2: CONSENT FORM (English)

Assalamu-alaikum/ Namaskar. My name is Md. Zobair Hossain Student of B.Sc. in Occupational therapy at Bangladesh Health Professions Institute (BHPI), CRP. I am conducting a study for partial fulfillment of Bachelor of Science in Occupational Therapy degree, titled, "Estimation of hand anthropometry among **Bangladeshi population in four different areas**". Through this research, I will measure the 24 hand dimensions of Bangladeshi adults. For this regard, I would need to collect anthropometric data of hand from the Bangladeshi adults.

Considering the area of research, you have met the inclusion criteria and I would like to invite you as a subject of my study. If you participate in this study, I will measure your hand dimensions. The measurements that would be given are safe and will not cause any harm.

I want to meet you a sessions during your free time. Your participation will be voluntary. You have the right to withdraw consent and discontinue participation at any time. If you have any query about the study or your right as a participant, you may contact with, researcher Md. Zobair Hossain or Md. Monjurul Habib lecturer Department of Occupational Therapy, BHPI, CRP, Savar, Dhaka-1343.

Do you have any questions before I start?

So may I have your consent to proceed with the participation?

Yes:

No:

Signature of the Researcher

Zobair Hossain  
12-11-14

I Md. Rafiqul Islam .....have read and understand the contents of the form. I agree to participant in the research without any force.

Signature of the participant

Rafiqul Islam  
12/11/14

## APPENDIX 3: CONSENT FORM (Bangle)

### APPENDIX 3: CONSENT FORM (Bangle)

এই গবেষণাটি অকুপেশনাল থেরাপীর একটি অংশ এবং গবেষণাকারীর নাম মোঃ জোবায়ের হোসেন। সে বাংলাদেশ হেলথ প্রফেশন ইন্সটিটিউট এর বি.এস.সি ইন অকুপেশনাল থেরাপীর ৪র্থ বর্ষের ছাত্র। এই গবেষণাটির শিরোনাম বিভিন্ন স্থানে বাংলাদেশী জনগনের হাতের এড্রুপয়েমেট্রিকাল পরিমাপ এবং এই গবেষণার উদ্দেশ্য বাংলাদেশের জনগনের হাতের এড্রুপয়েমেট্রিকাল পরিমাপের ডাটা বের করা।

এই গবেষণাতে আমি একজন অংশগ্রহনকারী এবং আমি পরিস্কার ভাবে এই গবেষণার উদ্দেশ্য সম্পর্কে অবগত। আমার যে কোন সময় এই গবেষণা থেকে নিজেকে সরিয়ে আনার অধিকার আছে। এজন্য আমি প্রশ্নের উত্তর প্রদান করার জন্য কারো কাছে দায়বদ্ধ না। এই গবেষণাটির সাথে আমার কোন সম্পৃক্ততা নেই এবং আমার চিকিৎসার সাথে বর্তমানে এবং ভবিষ্যতে কোনভাবে সম্পৃক্ত না।

আমি আরও অবগত আছি যে, এই কথোপকথন থেকে নেওয়া সমস্ত তথ্যাবলি নিরাপদে এবং গোপন রাখা হবে। আমার নাম এবং ঠিকানা কোথাও প্রকাশ করা হবে না। শুধুমাত্র গবেষণাকারী এবং তার সমন্বয়কারী এই তথ্যাবলী দেখার ক্ষমতা রাখেন।

আমি এই গবেষণাকারীর এবং তার গবেষণার সমন্বয়কারীর সাথে এই গবেষণার পদ্ধতি সম্পর্কে অথবা যে কোন প্রশ্নের উত্তর জানার জন্য কথা বলতে পারব।

আমি উপরোক্ত তথ্যগুলো ভালোভাবে জেনে নিজ ইচ্ছায় এই গবেষণা অংশগ্রহণ করছি।

অংশগ্রহনকারীর স্বাক্ষর/ টিপসই মোহাঃ জোবায়ের হোসেন	তারিখঃ ২৭-১০-১৪
গবেষণাকারীর স্বাক্ষর মোহাম্মদ জোবায়ের হোসেন	তারিখঃ ২৭-১০-১৪
সাক্ষ্যপ্রদানকারীর স্বাক্ষর/ টিপসই মোহাঃ জোবায়ের হোসেন	তারিখঃ ২৭-১০-১৪

## APPENDIX 4: Socio-Demographic Questioner

Code no:                      Age:  
 Sex:                              Stature:                      Living area: Rural/Urban  
 Weight:  
 Educational status:  
 Marital status: Single/Married/Divorced/Widow  
 Occupation: Public service/Private service/Student/Housewife/ Unemployed

## APPENDIX 5: Hand Dimension measurement table

Hand dimension	Definition	Acquired measurement
1. Fingertip to root digit 5	Hand is extended and the palm is facing up. The distance along vertical the axis of digit 5, from the midpoint of the tip of this digit to the root of the hand.	
2. Fingertip to root digit 3	Hand is extended and the palm is facing up; the distance along the vertical axis of digit 3, from the tip of digit 3 to the root of the hand	
3. First joint to root digit 5	Hand is extended and the palm is facing up; the distance along the vertical axis of digit 5, from the midpoint of the first joint of digit 5 to the root of the hand	
4. First joint to root digit 3	Hand is extended and the palm is facing up; the distance along the vertical axis of digit 3, from the midpoint of the first joint of digit 3 to the root of the hand	
5. Second joint to root digit 5	Hand is extended and palm is facing up; the distance along the vertical axis of digit 5 from the midpoint of the joint of digit 5 to the root of the hand	
6. Second joint to root digit 3	Hand is extended and palm is facing up; the distance along the vertical axis of digit 3 from the midpoint of the joint of digit 3 to the root of the hand	
7. Breadth at tip digit 5	Hand is extended and palm is facing down; the breadth at the tip of digit 5	
8. Breadth at tip digit 3	Hand is extended and palm is facing down, the breadth at the tip of digit 3	
9. Breadth at first joint of digit 5	Hand is extended and palm is facing down; the maximum breadth of the first joint of digit 5	
10. Breadth at first joint of digit 3	Hand is extended and palm is facing down; the maximum breadth of the first joint of digit 3	
11. Breadth at second joint of digit 5	Hand is extended and palm is facing down; the maximum breadth of the second joint of digit 5	
12. Breadth at second joint of digit 3	Hand is extended and palm is facing down; the maximum breadth of the second joint of digit 3	
13. Depth at tip digit 5	Hand is extended and palm is facing down; the depth at the tip of digit 5	
14. Depth at tip digit 3	Hand is extended and palm is facing down; the depth at the tip of digit 3	

15. Depth at first joint digit 5	Hand is extended and palm facing is down; the maximum depth of the first joint of digit 5
16. Depth at first joint digit 3	Hand is extended and palm is facing down; the maximum depth of the first joint of digit 3
17. Depth at second joint digit 5	Hand is extended and palm is facing down; the maximum depth of the second joint of digit 5
18. Depth at second joint digit 3	Hand is extended and palm is facing down; the maximum depth of the second joint of digit 3
19. Maximum breadth of the hand	Hand is extended and palm is facing down; fingers are together while the thumb is held loosely against the hand. This dimension is measured horizontally at the widest section of the hand
20. Breadth of the Knuckles	Hand is extended and palm is facing down. This dimension is measured across the palm of the hand at the junction between the palm and the fingers, not including the thumb. The hand and fingers must be held flat, palm uppermost
21. Length of hand	Hand is extended and palm is facing up. This dimension is measured from the wrist crease directly below the pad of muscle at the base of the thumb to the tip of the middle finger. The hand and fingers should be held straight and flat, palm uppermost.
22. Third digit to base of the thumb	Hand is extended and palm is facing up, thumb is held away from the sides of the hand with its axis about 45 degrees to the long axis of the hand. The measurement is taken along the long axis of the hand from crotch1 to dactylion.
23. Depth of knuckles	Hand is extended; thumb held away from the hand but the other fingers close together. This measurement is taken as the depth of the hand at the distal ends of the metacarpals of digits 2–5
24. Maximum depth of the hand	Hand is extended with palm facing down; fingers are close together with the thumb held against the side of the hand. This measurement is the maximum depth from the volar side of the thenar pad to the dorsal surface of the hand.

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Davies et al. (1980, cited in Courtney, 1984, p.1169-1180).

## APPENDIX 6: Permission from the author



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**Title:** Hand anthropometry of Hong Kong Chinese females compared to other ethnic groups

**Author:** A. J. COURTNEY

**Publication:** Ergonomics

**Publisher:** Taylor & Francis

**Date:** Nov 1, 1984

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