MEASUREMENT OF HAND GRIP STRENGTH BY DIGITAL JAMAR HAND DYNAMOMETER: A STUDY ON CRP STAFFS & BHPI STUDENTS

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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.

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PARENTS

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Along with all hard working and respected

TEACHERS

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LIST OF ABBREVIATIONS

ASHT: American society of Hand Therapist

BHPI: Bangladesh Heath Professions Institute

BMI: Body Mass Index

CRP: Centre for the Rehabilitation of the Paralysed

GS: Grip Strength

HGS: Hand Grip Strength

OT: Occupational Therapy

PT: Physiotherapist

OTs: Occupational Therapists

SLT: Speech & Language Therapist

SPSS: Statistical Package for the Social Science

UL: Upper Limb

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ABSTRACT

Background: Hand grip strength is a useful measurement for individuals. The aim of the study was to describe normative data for hand grip strength in Bangladeshi adult population. The objectives were to explore association between dominant HGS with age, gender, height, weight, Occupation, BMI, Hand length, Hand breadth and compare between dominant HGS with the group of high manual occupational strain and low manual occupational strain.

Methodology: This study was done by quantitative method. The nature of the study is cross sectional study. The participants were selected purposively. The study participant areas within age range of 18 to 40 years. For HGS analysis, the 384 participants were divided into four categories. based on age: (a) 18–23years; male ,(n=84) ; female, (n=154); (b) 24–29 years ; male ,(n=45); female, (n=34); (c) 30–35 years; male ,(n=13); female, (n=11); and (d) 36-40 years; male ,(n=25); female, (n=18).The data was collected by using Jamar hand dynamometer, consent form, tape measurement, information sheet.

Result: In the present study there were 384 participants were selected. Where the male participants were 167and female participants were 217. Result from our study indicated a positive strong association of anthropometric measurement. Such as- hand length, hand breadth, height, weight, BMI. This study show correlation is significant when the P value is 0.01.The study sample was divided into two groups, as follows: 1.High manual occupational strain that was composed of 305 participants, 2. Low manual occupational strain that was composed of 79 participants. In our study the result was identified significant difference exist in dominant grip strength between the high manual occupational strain and low manual occupation group. Based on our study result it is confirmed that grip strength is higher in the high manual occupational group than low manual occupational strain group.

Conclusion: This study explored the great importance for identifying impairments, establishing realistic goals, and determining the efficacy of interventions for patients with hand or upper extremity injuries or disabilities. HGS is used widely in clinical practice and research to assess the impact of a variety of disorders on hand function.

Key words: Hand Grip Strength, Jamar Hand dynamometer, Normative data.

CHAPTER I
INTRODUCTION

1.1 Introduction

Measurement of grip strength (GS) is a significant component of hand rehabilitation because it assesses the patient's initial limitation as compared with norms. Its utility continues throughout the treatment process because it provides a rapid reassessment of the patient's progress (Manjula, Kaur, Malik, & Joshi, 2014). There have no normal range of hand grip strength (HGS) in our country that is apply for assessing or evaluating patient. As no study in Bangladesh, so health professionals would not get any evidence for normative value of HGS (Shim, Kim, Lee, Jeon, & Lee, 2012). If any kind of injury and the history of fracture in hand, after the rehabilitation then measure the hand function based on this normative value of HGS. There are many studies in other country but not any literature in Bangladesh (De, Sengupta, Maity, Pal & Dhara, 2011). Poor grip strength predictive of increased mortality from cardiovascular disease (Kamarul, Ahmad, & Loh, 2016). HGS measurement is an essential part of upper limb. HGS measurement is essential component of hand rehabilitation as it assess the initial limitation of person then compared with norms. HGS is generally influenced by the health status and level of physical activity of person (Mitsions et al., 2009). Normal hand GS is positively related to normal bone mineral density in postmenopausal women, with several researchers suggesting that GS is screening tool for women at risk of osteoporosis (Kamarul et al., 2016). Various studies also show that Hand grip strength (HGS) is influenced by several factors such as age; gender; height, weight, BMI, hand length, hand breadth, posture; hand size (Shim et al., 2012). Longitudinal studies suggest that poor GS is prognostic of increased mortality from cardiovascular disease (Manjula, 2014). Activities of daily life like eating, bathing, brushing, combing hair, ironing clothes, getting medicines primarily require holding of any tool in hand. If the person has not enough grip force then the person will not be able to do his daily living activity (Mitsions et al., 2009). It is recommended that grip forces, especially when applied repetitively, may produce significant muscular strains in the hand and should be avoided. Therefore, one needs to understand the nature of hand gripping in order to prevent manual muscle overexertion and enhance task performance (Manjula, 2014).

HGS, commonly evaluated with the handgrip dynamometer, is a good indicator of upper limb (UL) function (Flinn, Trombly, Latham, & Robinson, 2008). Researchers have recommended that the factor linked to frailty and disability in shortly life is the manner in which muscles are used, and this can be measured by hand dynamometry (Phillips, Lindstrom, Swantek, & Catalano, 2013). The evaluation of hand HGS is of significant importance in the assessment of upper limb impairment, in determining the effectiveness of various treatment modalities, and in evaluating work capacity of patients with either local hand injuries or general clinical entities that influence hand strength such as muscular dystrophy (Flinn et al., 2008).In particular, the establishment of norms in hand strength is essential. It is important in decision making in hand rehabilitation. GS measurement interprets evaluation data, to establish realistic treatment goals; and assess a patient's ability to return to work (Kamarul et al., 2016). Published normative data for HGS is available from many countries but there have no reference value for Bangladeshi adult population (Flinn et al., 2008). For this reason Researcher wanted select this topic. This study establishes baseline HGS values for Bangladeshi adult population (Phillips et al., 2013).Hand strength is a good component of physical strength and frailty among the elderly (Flinn et al., 2008). However, there are no published hand strength references for Bangladeshi aged 18-40 years. This study aim is to establish normative data for HGS for Bangladeshi aged 18-40 years, and explore the relationship between anthropometric measurements (Roush, Gombold & Bay, 2017).

1.2 Justification of study

HGS are typical form of overall hand function (Phillips et al., 2013). HGS helps the person to perform meaningful activity. It is very important for Occupational Therapist (OTs) to measure a person's HGS (Cuesta-Vargas & Hilgenkamp, 2015). HGS is a fundamental procedure used by occupational therapists to assess patient status following injuries, and treatment procedures to the hand and upper extremity. The dynamometers have been established as reliable tools for measuring strength (Patel, 2012). This instrument is an appropriate for measuring HGS and it provides accurate, quantifiable assessment of HGS. It helps the OTs to establish realistic treatment goals (Flinn et al., 2008). It provides treatment outcome data, and is normally utilized during purpose of hand disability ratings. In Bangladesh there is no finding of the GS of both male and female adult at the age of 18-40.

This study finding will be helpful for the medical researcher and health professionals by knowing the data of HGS at the specific ages (Patel, Tanna, & Kalele, 2012). This study will show the correct data of HGS measurement of the Bangladeshi population. In future, any further study relating to HGS measurement will be a very useful for literacy source. This research will also emphasize the health professional evidence based practice (Kamarul et al., 2006). This is very essential facility in various sectors. Such as- ergonomics sector, Patient satisfaction level, medical side, Health professionals. It is also very important for designing ergonomically sound workplace equipment so that occupational therapist knowing their correct hand dimensions (Shim et al., 2012). Jamar Hand Dynamometer is appropriate for this study because several studies show the reliability and validity of the tools. This tool provides appropriate measurement of HGS which is valid and reliable (Kamarul et al., 2006). This measurement value has been demonstrated to be a reliable and valid screening tool in the assessment of frailty risk. HGS is an important fundamental component essential to carry out our daily living tasks, and establishing current norms (Patel, 2012). It is important to ensure comparison is in alignment with providing evidence based practice (Kolber & Cleland, 2005).

1.3 Operational definition

Normative data: Normative data is data from a reference population that establishes a baseline distribution for a score or measurement, and against which the score or measurement can be compared. Normative data is typically obtained from a large, randomly selected representative sample from the wider population.

Hand Grip Strength: HGS is the force applied by the hand to pull on or suspend from objects and is a specific part of hand strength. Optimum-sized objects permit the hand to wrap around a cylindrical shape with a diameter from one to three inches.

High Manual Occupational strain: (high demand, low control) such as jobs held by waiters, waitresses, and nurses' aids, housewife, Day labourer.

Low Manual Occupational strain: (low demand, high control) such as jobs held by architects and natural scientists, student, Desk Worker, Teacher.

Jamar Hand Dynamometer: Handgrip Dynamometers for measuring the maximum isometric strength of the hand and forearm muscles.

Parameter of Hand Grip Strength: A limit or boundary which defines the scope of a particular process or activity such as: variable. This study includes two types of variables.

Independent variable: Age, Sex, Height, Weight, Gender, Hand length, Hand breadth, BMI.

Dependent variable: Measurement of HGS (Right & Left).

CHAPTER II
LITERATURE REVIEW

2.1 Hand Grip Strength

Hand is a fundamental and essential organ for humans. HGS is the force that is applied by the hand to pull on or suspend from objects and is a specific part of hand strength (Massy-Westropp, Gill, Taylor, Bohannon & Catherine, 2011). Optimum-sized items allow the hand to wrap around a cylindrical shape with a diameter from one to three inches. It functions begin from a fine to gross motor activities. Many daily functions and sports events require high activity of hands. Hand and forearm muscles are important in HGS (Martins, Aguiar, Lara, Teixeira-Salmela & Faria, 2014). The American society of hand therapist (ASHT) suggested testing procedure in which the subject is seated upright against the back of a chair. From sports like cricket, hockey, tennis, football, basketball, and baseball to daily activities such as carrying, turning a doorknob, and vacuuming, some extent of GS is necessary to be successful. Weak GS golf players may face the risk of developing medial epicondylitis. It is also known as golfer's elbow (Dodds, Syddall, Cooper, Benzeval, Deary & Steptoe, 2014). The strength of one's grip plays important role in prevention of injury and strength development. It is crucial for any human. Studies of GS usually examine maximum strength during a single repetition, but this type of effort is relatively rare in the workplace. Tasks frequently involve repeated forceful dynamic grasping or prolonged static holding (Massy et al., 2011). The dominant hand was significantly stronger than the opposite hand. It also cause fatigued more rapidly. This trend was more prominent in females than in males. GS is a broad term also used by physical strength of an athlete's (Martins et al., 2014). It referring to the muscular power and force that they can produce with their hands. In athletics, it is important for rock climbers and in competition such as the World's Strongest Man. HGS training is also a major feature in martial arts, and can be useful in various professions where people must work with their hands. The hand can be used to grip objects in several different positions. These different positions require different types of GS which are typically quantified based on the way the hand is being used (Massy et al., 2011). For developing GS and forearm growth it is important to train three types of HGS. Such as: crush, pinch and support.

Crush grip: The crush grip is most commonly thought of as "grip". It involves a handshake-type grip, where the object being gripped rests firmly against the palm and all fingers. A strong crush grip is useful in bone-crushing handshakes or for breaking objects with pressure (De, Sengupta, Maity, Pal & Dhara, 2011).

Pinch grip: The fingers are on one side of an object, and the thumb is on the other. Typically, an object lifted in a pinch grip does not touch the palm. This is generally considered a weaker grip position. The pinch grip is used when grabbing something like a weight plate or lifting a sheet of plywood by the top edge. Care must be taken to avoid cramping the muscles in the hand (De et al., 2011).

Crushing and pinching movements

The Crush Grip is the grip between fingers and palm. This includes fat-grip exercises, plate pinching drills, towel pull-ups, shelf or mountain climber pull-ups, rope climbing, rope pulling, and hex dumbbell pinching exercises (Sengupta et al., 2011).

Heavy complex movements that emphasize support- Grip Strength

It is the ability to maintain a grasp on something for pull ups or long and productive shopping trips. This includes overhand-grip, snatch-grip, weighted pull-ups, heavy rows, single-arm dead hang holds, heavy shrugs, and farmer's walks. A great deal of muscular endurance is necessary to have a good carrying grip (Sengupta et al., 2011).

Dimensions of Grip Strength

1. **Prime mover**: It is where the power coming from, thumb or other 4 fingers.

Crushing: 4 fingers provide the power, as when shaking hands

Pinching: the thumb provides the power, as when lifting a Blob

2. **Hand position**: Hand is open or closed.

Crushing – closed hand e.g. when you are finishing off a gripper.

Crushing – open hand e.g. when you are lifting a thick bar, such as Rolling Thunder.

Pinching – closed hand: e.g., when you are pinch gripping a thin object, like a narrow barbell plate.

Pinching – open hand: e.g., when you are pinch gripping a thick object, like a Blob.

3. **Intensity**: It is endurance.

Factor influencing Grip Strength

Various factor of might be visible during GS. Such as- Age, Muscle strength, Occupation, Gender, Dexterity, Endurance, Muscle power, Hand length, Hand breadth.

Gender

Males and females are intrinsically different in many ways. These two aspects of gender differences are relevant to the performance of GS tests with Jamar handgrip dynamometers. There is presently a lack of studies involving the upper limb that have related forearm and hand neuro-muscular factors to maximal isometric GS (Dodds et al., 2014). Anthropometric difference of the hand: There is significant difference in the size of male and female hands develop. Hand size naturally relates to GS (Sengupta et al., 2011).

Hand length

Hand length was defined as the direct linear distance between the distal wrist crease and the distal end of the most anterior projecting point, tip of the middle finger. The subject were asked to place their hands supine on a flat hard horizontal surface with fingers extended and adducted, following which the hand length was measure carefully to see that there was no abduction or adduction at the wrist joint, i.e., the forearm was directly in line with the middle finger. Hand lengths were taken independently on left and right sides of each individual using a sliding caliper capable of measuring the nearest 0.01 mm (Dodds et al., 2014).

Hand breadth

Measure the straight distance between the metacarpal radialis to metacarpal ulnaris. Hand breadth was measured between radial side of the second metacarpo phalangeal joint and ulnar side of the fifth metacarpo phalangeal joint (Sengupta et al., 2011).

Physical dexterity

The greater muscular strengths of males were due to a more efficient motor control system. It would be expected that men would also possess greater dexterity than women. Only studies involving adult participants were located. Mac Dermid, Fehr and Lindsay (2002) found that gender was “inconsistently related to dexterity times, but women tended to be faster than men” (Dodds et al 2014).

Hand GS can be quantified by measuring the amount of static force that the hand can squeeze around a dynamometer (Roush et al., 2017). The force has most commonly been measured in kilograms and pounds, but also in milliliters of mercury and in Newton's. GS is also related to prognostic of other health conditions. Normal hand GS is positively related to normal bone mineral density. Reliable and valid assessment of hand strength can provide a purpose index of general upper body strength (Liao et al., 2016). The power grip is the effect of forceful flexion of all finger joints. It is the maximum voluntary force that the subject is able to apply under normal bio kinetic conditions. The synergistic action of flexor and extensor muscles and the interaction of muscle groups. This is an important factor in the strength of the resulting grip. (Roush et al., 2017).Several factors influence the strength of the grip, including muscle strength, fatigue, and time of the day, age, nutritional status, restricted motion, and pain. GS is often used in medicine as a specific type of hand strength. (Liao et al., 2016).The purpose of this testing is different to document progression of muscle strength and to provide feedback during the rehabilitation process as a measure indicating the level of hand function. It can be used as a measure of fatigue. It is also able to predict a decline in function in old age (Rantanen et al., 1999). HGS not only is a symbol of body tip muscle mass but also may be used in combination with serum albumin as a nourishment monitoring tool in patients. People are usually limited by their strength when exerting force (Miller, MacDougall, Trarnopolky & Sale, 2013). Strength is a muscle‘s power to exert maximal effort or counter maximal opposing force. GS is correlated with the strength of the upper extremity, general strength of the body and some anthropometric measurements (Rantanen et al., 1994). Therefore is often adopted in clinical practice as an objective measure of upper extremity function. In 1992, the ASHT formed a revised standardized protocol for GS testing. It requires the elbow to be held in 90 degrees of flexion. Therefore, using the ASHT standards Richards (1997) adopted this protocol to examine GS, finding no significant difference in GS between sitting and supine. GS had an important association with the muscle strength of 45 degrees shoulder abduction and external rotation in the affected side (Dopsaj et al., 2007). It confirmed that men showed significantly better maximal hand grip force in both dominant and non-dominant hands than women. A number of studies have shown that HGS is both extremely important and related to anthropometric measurement (Liao et al., 2016).

Jamar Hand Dynamometer

The Jamar hydraulic dynamometer is the standardized and instrumental tool in GS testing equipment (Lam, Goh, Kamaruzzaman, Chin, Poi, & Tan, 2016). Not only does it provide accurate results, but the outcomes can be easily established and repeated. This is important in both therapeutic clinics. It set up baselines of strength. It also track progress as well as job settings looking to evaluate for job ability and skill. The history of the Jamar Hand Dynamometer 1954: Jamar, 2008: Jamar Plus, 2015: Jamar Smart. The Jamar hand dynamometer is reliable tools because it provides valid result. Various types of Studies measuring hand strength across a lifespan. The groups of 12 studies were published in the Journal (Lam et al., 2016). A peer-reviewed open access journal attempted to explain that weaker GS in later life is associated with disability, morbidity, and mortality. The published findings combined 60,803 observations from 49,964 participants (26,687 female) of 12 general population studies in Great Britain. Out of these 12 studies, 7 Studies used the Jamar Hydraulic grip dynamometer to carry out the GS testing (Ploegmakers, Hepping, Geertzen, Bulstra, & Stevens, 2013). Among the use of the Jamar dynamometer, scientists were capable to pinpoint 3 different periods for strength: an increase to peak in early adult life, maintenance during to midlife, and decline from midlife onwards (Leyk, Rohde, Erley, Gorges, Wunderlich, Rüther, & Essfeld, 2006). Not only repeatable results showed that males were on average stronger than females beginning in teenage years forward. For example, males' peak median grip was 51 kg between ages 29 and 39 and females peak median grip was 31 kg between ages 26 and 42 (Martins, Aguiar, Lara, Teixeira-Salmela, & Faria, 2014). Moreover, study results showed that weak GS increased sharply with age. It reaches a decrease in strength by at least 23% in males and 27% in females by age 80. With the breadth of these types of studies, with different participants of various strengths, it is significant that the Jamar dynamometer was selected as the strength testing tool for most of these studies (El-Sais & Mohammad, 2014). In fact that the Jamar dynamometer is easy to apply definitely played a role in making it the GS tool of choice for the majority of these studies (Ploegmakers et al., 2013). The Jamar hand dynamometer has been used successfully in studies. It shows to establish universal testing protocols to ensure accuracy of strength testing results (Kumar, Parmar, Ahmed, 2008).

One of the options most handheld dynamometers offer is the capacity to use different hand grip positions. Accuracy is so significant in both rehabilitation and professional capacities (Wong et al., 2016). A study published in the Journal of Hand Surgery evaluated the significance of different hand grip positions on the measured GS .The ability to gain maximum strength (Keevil, Mazzuin Razali & Chin, 2013). The study found GS results using the Jamar dynamometer is easier and faster if a single. Standard handle position is used when testing a subject rather than testing using multiple different handle positions. The use of a single handle position there is a decline in a subject's fatigue (Ploegmakers et al., 2013). The use of single, standard handle position, it's possible to compare the results between testing subjects to get a reliable average and fair comparison. The reliability of the Jamar Hand dynamometer is very high, because it is widely used to investigate the GS in a large sample of people with intellectual disabilities (Miler et al., 2013). The purpose of that study was to establish reference values for adults with intellectual disabilities (ID) which can be used as a baseline reference for the medical community and be used for comparison to adults without intellectual disability (Wong et al., 2016).

Measuring HGS is important for many reasons, including:

- GS is the simple way to assess overall strength
- Using GS is the easiest method to assess and compare muscle function across populations
- Indicates overall upper extremity muscle strength.
- Correlates with lower extremity strength and power
- Can be used to assess infirmity for hospital admission
- Can be used to evaluate progression of wasting conditions.
- Valid screening tool for overall fitness
- Identify potential deficits
- Progress pathway for effective rehabilitation process.

The Benefits of the Jamar Hand Dynamometer

The Jamar Hand dynamometer remains a great choice for scientific studies because it's long-lasting and trustworthy. The Jamar dynamometer provides practitioners with accurate HGS test results that can be simply and efficiently replicated (Blomkvist, Andersen, Bruin & Jorgensen, 2016).

This dynamometer remains one of the best GS testing devices on the market today.

- The Jamar hand held dynamometer offers practitioners many options for performing GS testing. It increases the reliability of results with adjustable 5-position handle and indicates maximum strength that remains after each reading until reset (Blomkvist et al., 2016).
- Easily measures isometric grip force and strength to establish a baseline and to track increases in rehabilitation and physical therapy programs (Blomkvist et al., 2016).
- Ideal for routine screening of GS for job task applicants or evaluations as well as initial and ongoing evaluations of hand trauma and dysfunction in rehabilitation.
- The adjustable handle makes it easy for practitioners to test different sized objects and accommodates small and large hands (Blomkvist et al., 2016).
- The dynamometer was designed with a peak hold needle that retains highest reading until reset. It is easy to chart test results.
- Unit comes with a certificate of calibration and one-year assurance (Martins et al., 2014).

The Jamar hand dynamometer remains one of the medical sectors pinnacle choices for HGS testing. It supplies dependable and efficient results for diverse patient populations. From medical studies and rehabilitation to job task testing and evaluation, you can trust the Jamar hydraulic dynamometer for GS results (Han, Nam, Cho & Ryu, 2011).

Protocol

HGS was measured according to a standard protocol based on the recommendations of the ASHT (Ibegbu, David, Hamman, Umana, & Musa, 2015). The second handle position has been assumed to be the most reliable and consistent position and produce maximal GS (Roberts et al., 2011). HGS tested for all body positions of all subjects were conducted in a randomized order to prevent dependent ordering outcome. The subject position in ASHT testing protocol is seated upright against the back of a chair with feet flat on the floor. The shoulder adducted and neutrally rotated, the elbow flexed at 90° and the forearm in neutral and wrist between 0° and 30° of extension (Fess et al., 1992). In the sitting position, the testing position recommended by the ASHT was used.

The subject was instructed to be seated with shoulder adducted and neutrally rotated, elbow flexed 90°, forearm in mid-prone and wrist in neutral to 30° extension (wrist in slightly extended position), with neutral radioulnar deviation for optimal performance in power grip ASHT (Fess et al., 1992). In supine position, the same upper extremity position was used, but the subject was lying with his tester held the dynamometer at the base and around the body aligned. The readout dials to prevent accidental dropping. In prone position, the same upper extremity position was used, but the subject was lying on his abdomen with his forearm outside bed. In side-lying position, the same upper extremity position was used, but the subject was lying on his side with the tested hand above. In standing position, the same upper extremity position was used, but the subject was standing with the forearm unsupported (Mathiowetz, Kashman, Volland, Weber, Dowe & Rogers, 2005). Before testing, the examiner demonstrated how to hold the handle of the dynamometer. The same instructions were given for each trial. After the subject was positioned with the dynamometer, the examiner instructed the subject to squeeze the handle maximally and to sustain this for 3–5 seconds with a rest of 15–20 seconds between measurements (Tsang et al., 2005). The examiner told the subject to squeeze the dynamometer as hard as possible and gave verbal encouragements to squeeze harder during the test (Richards et al., 1997). Three successive measurements were taken for dominant hand and the maximum of the three grips recorded, as the dominant hand has a 10% stronger grip than the non-dominant hand (Roy et al., 2009) for right handed people .The maximum value was taken instead of the average value for many reasons; to avoid problem could arise due to fatigue of the muscle (Haidar et al., 2004), also the maximum value used to test reliability of handgrip as well as the maximum method has commonly been used by other investigators (Roberts et al., 2011).

Proper GS Testing Procedures with the Jamar Hand Grip Dynamometer

- At first make sure the patient is in a comfortable sitting position with their shoulder abducted and neutrally rotated and angle of the elbow should be kept as close to 90 degrees as possible.(Mathiowetz et al., 2005)
- The forearm should also be in a neutral position with the wrist between 0 and 30 degrees dorsi flexion while also between 0 and 15 degrees ulnar deviation (Mathiowetz et al., 2005)

- Initiate the patient to grip the hand dynamometer with their fingers around the second handle with the readout dial pointing away from their body (Gerodimos et al., 2012).
- The administrator of the test should lightly grip the readout dial in order to prevent and accidental dropping of the apparatus (Roberts et al., 2011).
- Once the patient is simple instruct them to grip the device as hard as they can for 4-5 seconds and relax. It is best to perform this part of the test 3 times or more to generate an average GS reading (Mathiowetz et al., 2005).
- Repeat the same steps with the patients other hand and use the chart below for normative data for men and women ages 6 - 75+ (Mathiowetz et al., 2005).

The objective of this test is to measure the most isometric strength of the hand and forearm muscles. HGS is important for any sport in which the hands are used for catching, throwing or lifting. In addition as a general rule people with strong hands tend to be strong elsewhere, so this test is often used as a general test of strength (Lam et al., 2016).

- It is also helpful to record whether the athlete is left or right handed, as this may help in the interpretation of results. The non-dominant hand frequently scores about 10% lower (Gerodimos et al., 2012).
- The forearm muscles are easily fatigued, so the best scores are usually achieved in the first or second trial (Ibegbu et al., 2015).
- Results are expected to differ between male and females, between left and right (dominant and non-dominant) hands, and with age. The results can also be affected by the position of the wrist, elbow and shoulder, so these should be standardized. There are many other factors to consider (Roberts et al., 2011)

Procedure: The subject holds the dynamometer in the hand to be tested, with the arm at right angles and the elbow by the side of the body. The handle of the dynamometer is adjusted if required - the base should rest on first metacarpal (heel of palm), while the handle should rest on middle of four fingers. When ready the subject squeezes the dynamometer with maximum isometric effort, which is maintained for about 5 seconds. No other body movement is allowed. The subject should be strongly encouraged (Lam et al., 2016).

- Validity: The validity of this test as a measure of general strength has been questioned, as the strength of the forearm muscles does not necessarily represent the strength of other muscle groups (Blomkvist et al., 2016).
- Reliability: the dynamometer may need to be calibrated regularly to ensure consistent results. Having consistent technique and adequate rest is required to ensure reliability (Keeevil et al., 2013).
- Advantages: This is a simple and commonly used test of general strength level, well researched and many norms are available (Blomkvist et al., 2016).
- Disadvantages: The dynamometer must be adjusted for hand size, how successfully this is done will affect the accuracy of the measurement (Lam et al., 2016).

Normative data

Normative data, data that describe is usual in a defined population at a specific point or period of time, are of enormous importance to primary care physicians (De et al., 2011). For some purposes, normative data may be quickly obtained in cross-sectional studies. Normative research differs from descriptive studies because the target is not only to gather facts but also to point out in which respects the object of study can be improved (Martins t al.,2014).Usually the project even includes planning an approach for carrying out the necessary improvements .Conforming to a standard of correctness through prescribed norms, rules, or recommendations, as opposed to mere description or statement of facts; evaluative, not descriptive (Leyk et al.,2006). For example, normative data is collected not just to describe ("What is this?") but to understand ("What is going on?") the underlying phenomenon (Dodds et al., 2014). Normative data, data that characterize what is usual in a defined population at a specific point or period of time, are of enormous importance to primary care physicians. Such data, which seek to describe rather than explain phenomena, are essential for: a) describing the natural history of clinical conditions in the community; b) developing standards of care for primary physicians; and c) establishing illness nosology appropriate for primary care research. In all studies designed to obtain normative data, methodological issues need careful attention (Massy et al., 2011). For some purposes, normative data may be quickly obtained in cross-sectional studies. When age effects are to be described or when time is an important consideration, longitudinal study designs may be needed to evaluate potential cohort effects and period effects (Kumar et al., 2008).

Especially important in studies which seek normative data are precise characterization of the study population, clear definition and measurement of phenomena, and appropriate interpretation and generalization of results (Miler et al., 2013).

The primary goal of normative data is to allow the comparison of an individual patient, to a large group of people, matched for their age, gender and level of education, allowing for something to be said about the individual's level of impairment at a particular time point (Sengupta et al., 2011). The aim of normative data is to find out not only how things are, but how they should be, which means that it will be important to define the subjective point of view so that to select the people who shall evaluate the proposals which aim at improving the object of study (Han et al .,2011). It describe is usual in a defined population at a specific point or period of time, are of enormous importance to primary care physicians (Ploegmakers, 2013). For some purposes, normative data may be quickly obtained in cross-sectional studies. Normative research differs from descriptive studies because the goal is not only to gather facts but also to point out in which respects the object of study can be improved (Roberts et al., 2011). Conforming to a ordinary of accuracy during prescribed norms, rules, or recommendations, as different to mere description or statement of facts; evaluative, not descriptive. For example, normative data is not just to explain ("What is this?") also what is going? Normative data, which seek to describe rather than describe phenomena, are essential for describing the natural history of clinical conditions in any community, developing standard of care for primary physicians; and establish correct dimension which is appropriate for primary care research (Mitsions et al., 2009). In all studies designed to obtain normative data, methodological issues need careful attention. Normative data may be rapidly obtained in several cross-sectional studies (Dodds et al., 2014).When age effects are to be described or when time is an important consideration. Longitudinal study designs may be needed to evaluate possible cohort effects and period effects. Especially important in studies which seek normative data are accurate. It characterizes the study population, clear definition and measurement of phenomenon, and suitable interpretation and generalization of results (Sengupta et al., 2011). The primary goal of normative data is to permit the association of an individual patient, to a large group of community, matched for their age, gender and level of education, allowing for something to be said about the individual's level of impairment at a particular time point (Massy et al., 2011).

CHAPTER III
METHODOLOGY

Research Methodology is the logic through which a researcher address the research questions (Mason, 2002) and gains data for the study (Denzin & Lincoln., 2000). According to Brynard & Hanekom, (1997) research methodology is about explaining how data will be collected and processed. Therefore, it is important to determine the methods to be used to collect data and related factors that influence the quality of collected data.

3.1 Research Question

What is the normative value in HGS by using Jamar Hand dynamometer of CRP staffs and BHPI students?

3.2 Study Aim and Specific Objective

3.2.1 Aim: To identify the normative value/data of hand grip strength in CRP staffs and BHPI students.

3.2.2 Specific objectives:

i. To identify the descriptive data of hand GS.
ii. To explore association between dominant HGS with age, gender, height, weight, Occupation, BMI, Hand length, Hand breadth.
iii. To compare between dominant HGS with the group of high manual occupational strain and low manual occupational strain.

Table 1: Variables of the Study

Variables	Measures	Data points	Scale
Age	Age calculator	Years	Nominal
Gender	Identified	1 or 2	Ordinal
Weight	Weight machine	K.G.	Nominal
Weight Category	Weight machine	1-8	Ordinal
Height	Tape measurement	Cm	Nominal
BMI	BMI calculator	Kg	Nominal
Occupation	Identified	1 or 2	Nominal
Hand length	Tape measurement	Cm	Ordinal
Hand breadth	Tape measurement	Cm	Ordinal
Hand dominance	Identified	Right or left	Ordinal

3.3 Conceptual Framework

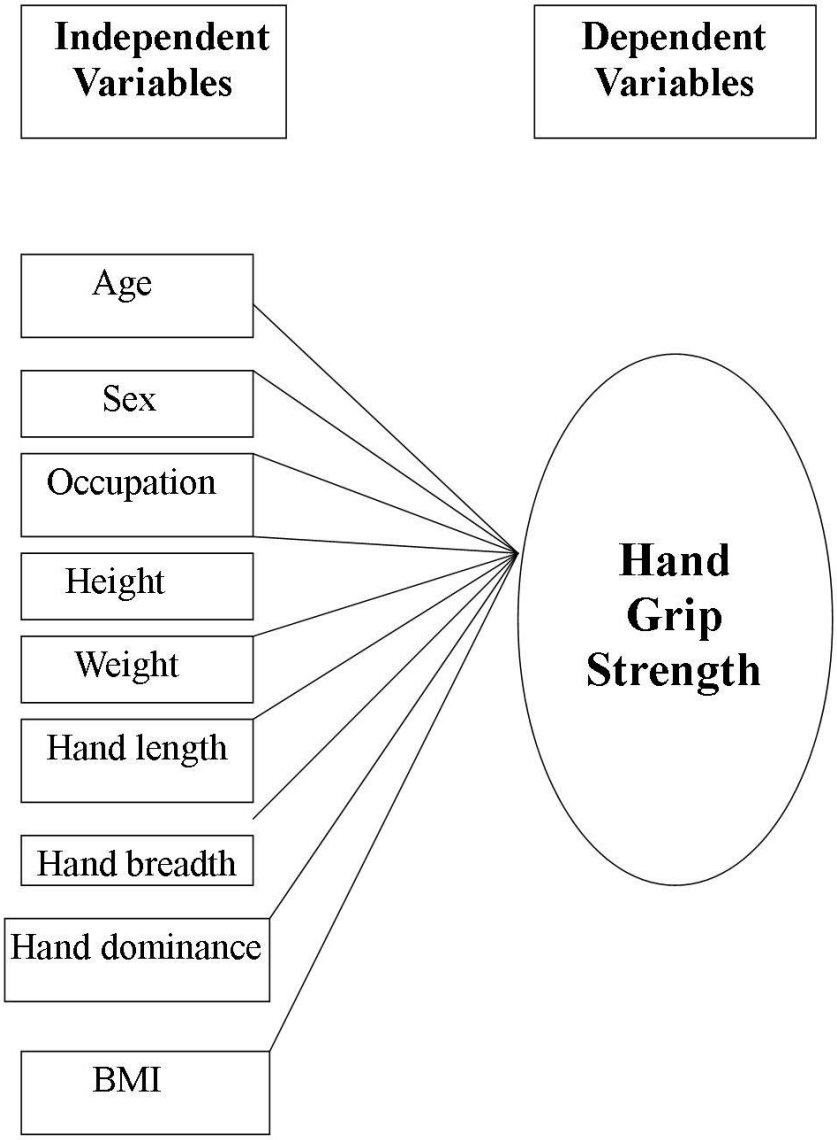

Figure 1: Conceptual Framework

3.4 Study Design

The study was done by using quantitative method. The Researcher used this method to fulfill the aim and objectives of the study. Data were collected from participant by using socio-demographic questionnaire and had a face to face interview with participant (Bailey et al., 1997). The nature of the study is cross sectional study. It was very easy and takes short time to conduct this type of study. Cross sectional study provides a snapshot of parents' opinion in quantitative way at one point in time.

3.5 Study Population

The area of CRP is included such as-staffs of BHPI, students of BHPI, Clinical Therapist, Paper technology unit, Wood shop, Nursing Station. Most of them participants are involved in table top activities. This called low manual occupational strain.

3.6 Study Setting

The study was conducted in the CRP who is one of the most renowned non-governments, non-profit organization. The Centre for the Rehabilitation of the Paralyzed is the largest rehabilitation Centre in Bangladesh, even in south-Asian region. The study site was through the CRP.

3.7 Study Period

The Research study has been done as the part of the academic education of B. Sc. in Occupational Therapy. The period of this study was from October 2017 to May 2018. The Study was conducted included data collection, data analysis and overall thesis writing. In particular, data collection was conducted from December 2017 to February 2018.

3.8 Inclusion and exclusion criteria

3.8.1 Inclusion criteria

- ❖ Staffs and students of CRP whose age range between 18-40 years.
- ❖ People who have five fingers without any deformity in both hand.

3.8.2 Exclusion criteria

- ♦ The person who have any kind of hand injury & limitation in hand function.
- ♦ Hand surgery

3.9 Sampling techniques

Sampling technique is the first step in defining the validity of the study. The Researcher had used purposive sampling method which is a type of non-probability sampling. Purposive sampling technique is used to fill up the aim and objectives of the study (Bailey, 1997). Using this sampling technique for collect data in 18-40 years age range within the given time period.

3.10 Data collection tools/materials

Jamar Hand Dynamometer

The Jamar Handgrip Dynamometer is an instrument for measuring the maximum isometric strength of the hand and forearm muscles. The Jamar dynamometer was introduced in 1954 (Bechtol, 1954). It consists of a sealed hydraulic system with adjustable hand spacing that measures handgrip force in pounds per square inch (PSI). A similar device is also marketed under the name 'Baseline'. The dynamometer is used for assess the GS and tracking improvements with strength training and during rehabilitation.

Figure 2: Digital Jamar Handgrip Dynamometer

Features of the Jamar Handgrip Dynamometer

- Hydraulic system
- Adjustable handle, with five handle positions.
- Measurements in kg.

Tape measure: A tape measure is a strip of metal, plastic, or cloth which has numbers marked on it and is used for measuring. A tape or length of metal marked off in inches, centimeters, etc. It is used for measure of hand length and hand breadth.

Figure 3: Tape measure

3.11 Data collection methods

Digital Jamar Handgrip Dynamometer

HGS was measured according to a standard protocol based on the recommendations of the ASHT (Fess, 1992), using the second handle of the Jamar dynamometer. The second handle position has been assumed to be the most reliable and consistent position and produce maximal GS (Roberts et al., 2011). HGS tested for all body positions of all subjects were conducted in a randomized order (randomly assigning each subject to one of five measurement position) to prevent dependent ordering effect. The subject position in ASHT testing protocol is seated upright against the back of a chair with feet flat on the floor. The shoulder adducted and neutrally rotated, the elbow flexed at 90° and the forearm in neutral and wrist between 0° and 30° of extension. In the sitting position the testing position recommended by the ASHT' was used. The subject was instructed to be seated with shoulder adducted and neutrally rotated, elbow flexed 90o, forearm in mid-prone and wrist in neutral to 30 degree extension (wrist in slightly extended position), with neutral radio ulnar deviation for optimal performance in power grip ASHT (Fess, 1992).

Figure 4: Position during measurement of Grip Strength

Hand length: Measure from the top of middle finger to wrist joint.

Figure 5: Hand length measurement

Hand breadth: A linear measurement approximating the width of the palm of the hand.

Figure 6: Hand breadth measurement

3.12 Data management and analysis

Data Management: The researcher had a detail planning for data management-accumulate the resources for data collection, data entry and data processing. Developing a coding system for identification due to reduce overlap and missing data. All data are incorporated in the data view in statistical software after completing the variable view for analysis. Data were analyzed using SPSS version 20.0.

Data Analysis

Due to the normal distribution of data, Pearson correlation coefficient is done to analyze the data. Pearson correlation coefficient and independent sample t-test is done because data is normally distributed. Descriptive analysis are used to found Descriptive data for demographic characteristics .The study findings were analyzed by finding the frequency, mean, mood, medium, standard deviation and range of each item individually. The data were analyzed through chi-square test to see the relationship between independent and dependent variables. The correlation between dependent and independent variables was analyzed Pearson correlation coefficient .Result will be presented in frequency tables, Bars and pie-chart. For comparing between two groups is analyzed through t-test.

3.13 Quality control & quality assurance

The method of data collection will be accurate and interpret carefully according to guidelines before initiating the data collection .It ensures the reliability and validity of dynamometer is understandable by the participants. Researcher carried out a field test before collecting the final data because it helps the researcher to refine the data collection plan and find out the limitation. Then the researcher will get chance to rearrange the demographic questionnaires to make it more understandable, clear and enough for the participants and the study. Procedure of data collection and ethical consideration of the thesis is maintained to ensure quality.

3.14 Ethical Consideration

At first the ethical approval had been taken from the Institutional Review Board (IRB) of BHPI for the conduction of the study. Researcher took permission from the Occupational Therapy Department in BHPI. Researcher will maintain confidentiality about service information of the institutes. Informed consent will be collected from the participants.

Researcher will ensure that the confidentiality is maintained about the participants. All participants will be informed about the aim of the study. The participant will allow leaving from the study at any time. Ethical consideration parts also included by information sheet and consent form, which are given below:

3.14.1 Information sheet

Researcher used an information sheet to inform about study aims and rights of the participant. Confidentiality of all participants must be highly maintained. In the Information sheet participant well known of the study goal and why it is done. Participant also must be concern of the study and for his volunteer participation he or she will not take any advantage in future.

3.14.2 Consent form

A consent form was also used to take written consent from the participant. It was very important to take consent from participants who were interested to participate in the study. If they were concern about the aim and objective of the study then they signature in the concern form with volunteer participation.

CHAPTER IV
RESULTS

This section focuses on the findings which explore the association of variables. This study has done by using quantitative method. The socio-demographic background of the participants in this study was also identified. Each of the table represents the collected data.

4.1. Socio-demographic characteristics of the participants (n=384)

Table 2: Socio-demographic characteristics of the participants

Characteristics		n (%)	Mean±SD
Sex	Male	167 (43.5)	---------
	Female	217 (56.5)	
Age	18-23 year	238 (62.0)	
	24-29 year	79 (20.6)	**24.78±6.39**
	30-35 year	24 (6.3)	
	36-40 year	43(11.1)	
Weight	35-44 kg	45 (11.7)	
	45-54 kg	129 (33.6)	
	55-64 kg	115 (29.9)	**57.22±11.43**
	65-74 kg	65 (16.9)	
	75-84 kg	25 (6.5)	
	85-115 kg	5 (1.4)	
Education	Below S.S.C	36 (9.4)	
	S.S.C-H.S.C	40 (10.4)	
	B.Sc. Student	270 (70.3)	
	Graduate	29 (7.6)	---------
	Post-Graduate	9 (2.3)	
Dominant Hand	Right	371 (96.6)	---------
	Left	13 (3.4)	
Occupation	Low Manual Occupational Strain	305 (79.4)	
	High Manual Occupational Strain	79 (20.6)	---------
BMI	17.50-18.49 (Underweight)	48(12.4)	
	18.50-24.99 (Normal)	237 (61.2)	**22.25±3.76**
	25.00-29.99 (Over weight)	84 (21.7)	
	30.00-35.00 (Obese)	18 (4.7)	
Hand Length	16.00-16.99	42(10.9)	
	17.00-17.99	132(34.4)	
	18.00-18.99	122(31.8)	
	19.00-19.99	56(14.6)	**17.75±1.12**
	20.00- above	32(8.4)	
Hand Breadth	6.00-6.90	16(4.2)	
	7.00-7.90	121(31.5)	**7.79±8.3**
	8.00-8.90	171(44.5)	
	9.00-above	76(19.8)	
Height	---------	384	**159.91±10.25**
Dominant Hand	---------	384	**24.96±10.12**
Non dominant Hand	---------	384	**25.90±9.94**

Demographic data of participant are listed in Table 1. The Table showed that among 384 participants, most of were 56.5% female (n=217) and 43.5% were male (n=167) where 96.6 (n=317) participant were right handed and rest of the participant only 3.4% (n=13) were left handed. The participant's age ranges were from 18-40 years and 62.0% (n=238) were of 18-23 years, 20.6% (n=79) were of 24-29 years, 6.3 (n=24) were of 30-35 years, 11.1% (n=43) participants' age were 36-40 years.

In this table, among all the participants (n=384), 9.4% (n=36) were below S.S.C, 10.4% (n=40) S.S.C-H.S.C, 70.3% (n=270) B.Sc. students, 7.6% (n=29) graduate, and 2.3% (n=9) were post-graduate. With regard to their occupation most of the participants were involve in low manual occupational strain 79.4% (n=305), and rest of the engage in high manual occupational strain 20.6% (n=79). Again, table 1 shows that most of the participant's Body mass index 20-30 were 64.3% (n=247), 33.4% (n=128) BMI 10-20 and rest of the 31-40.

Hand length of the participant between 16 to 20 cm where maximum 34.4% (n=132) participant's hand length was 17 cm and most of the participants 44.5% (n=171) hand breath was 8 cm.

Table 3: Mean and Standard deviation of participant according to HGS

Gender	**N**	**Hand Grip Strength Mean±SD**	
		Right	**Left**
Male	167	34.86 ±7.33	33.86±7.78
Female	217	19.18 ±5.08	17.98 ±4.94
Overall participant	384	26.00±9.92	24.88±10.11

4.2 Gender distribution

The study was conducted on 384 participant with normal hand function and without any hand deformity and among them 147 (43%) were male and female were 217 (57%).

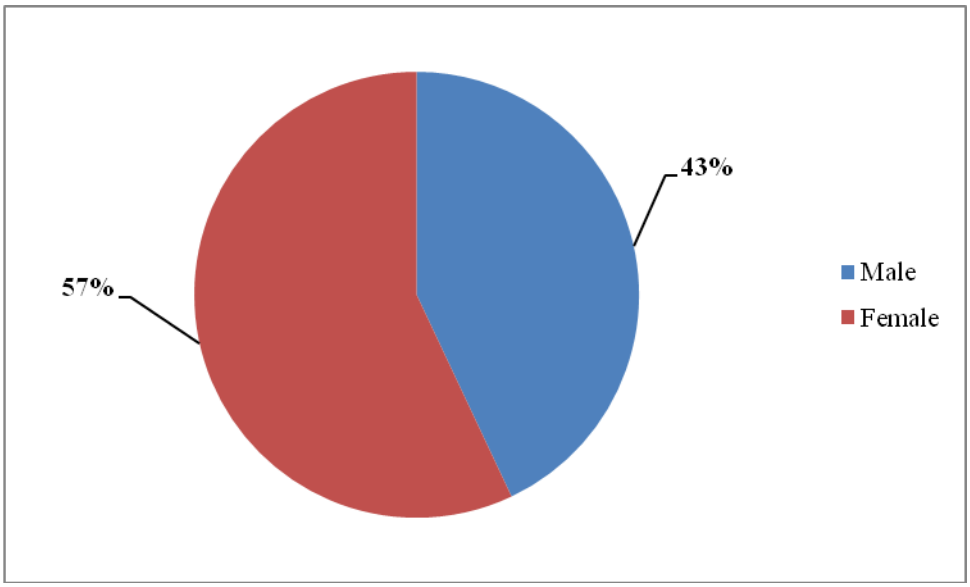

Figure 7: Gender distribution

4.3 Age of participants

Among 384 participant, highest number of participant were in age range of 18-23 years and the number was 62 % (n=238), 20.60% (n=79) were in age range 24-29 years.

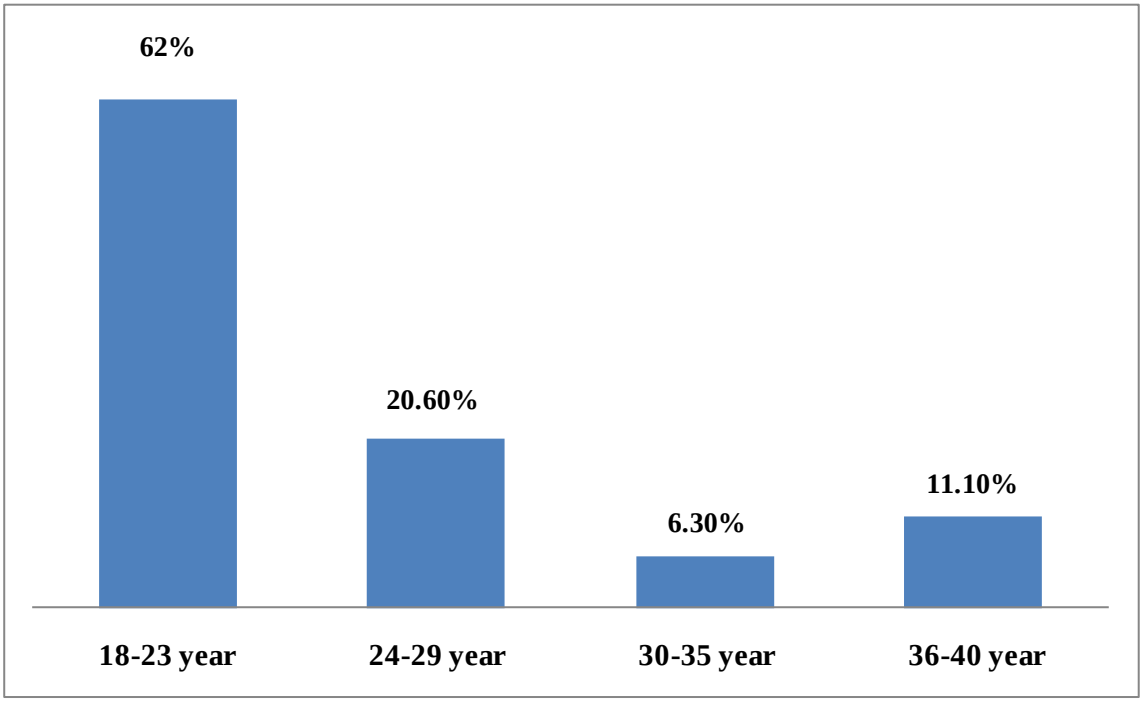

Figure 8: Age of participants

4.4 Occupation

Most of the participants were involving low manual occupational strain where number was 79 % (n=305).

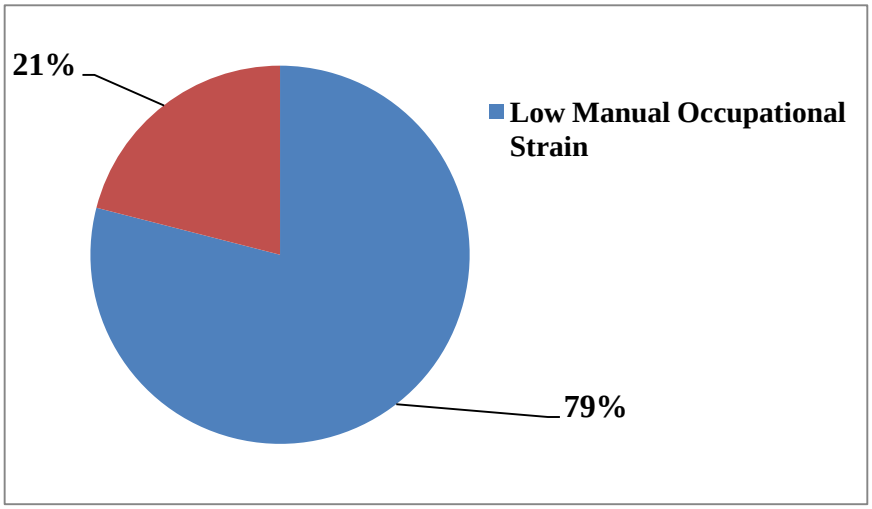

Figure 9: Occupation of participant

4.5 Correlation between dominant hands with their demographic factor

The researcher found a weak negative association of age with GS of the dominant hand (r = -.112, p = 0.028). The negative association was more prominent in analysis by group of sex (r = -.783, p =.000). The researcher observed a moderate positive association of height and weight with dominant hand (r = 550, p = .000; r = .462, p =.000). This study also observed positive strong association of hand breadth, right grip strength with the dominant hand (r = .604; p = .000; r = .934, p = .000). A weak negative association was observed between education and dominant hand (r = -.065, p = .203). No association was observed between BMI and dominant hand GS in total study sample (r = 121, p =.018).

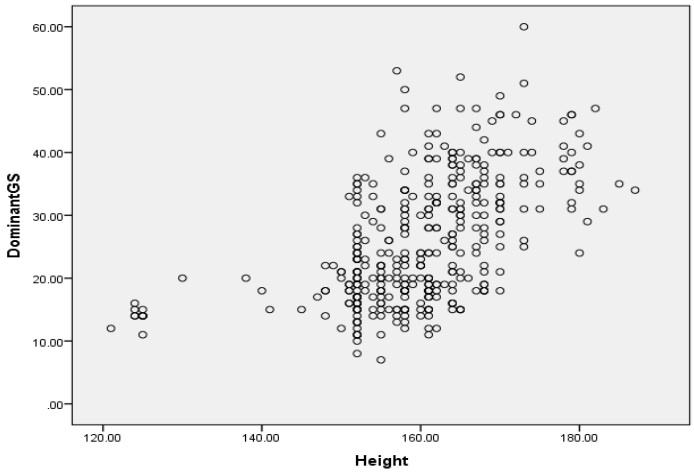

Figure 10: Scatter plot showing the moderate association of height with dominant hand grip strength

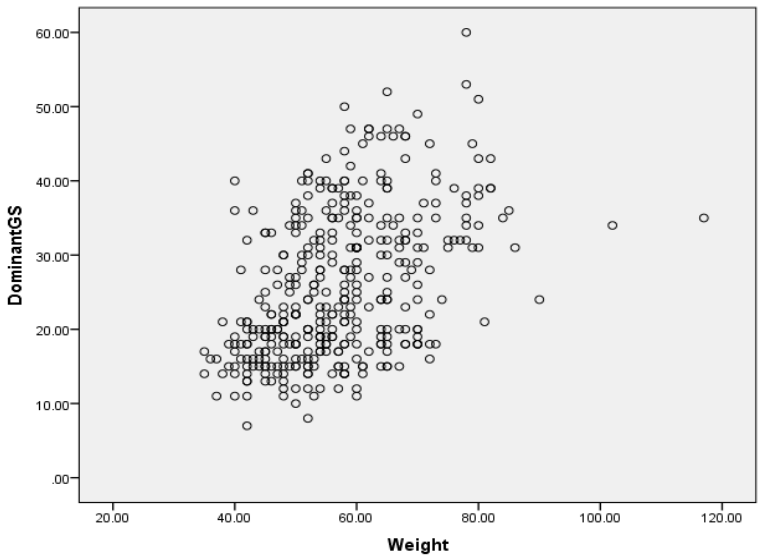

Figure 11: Scatter plot showing the moderate association of weight with dominant hand grip strength

4.6 Comparison between groups with Dominant hand grip strength

The four groups are significantly different from each other (p=.953) and focus on the result of the t-test. For the t-test, p=.000 (which is 0.05). So Researcher concludes that the four means are significantly different from each other. Significant difference between groups is describes the patterns in the data. Dominant grip strength in the group of occupation is statistically significant. The grip strength is higher in the male rather **t**han female group. The grip strength is also higher of high manual occupational strain rather than the group of low manual occupational strain. The mean of low manual occupational strain group is 24.6328 and the high manual occupational strain group is 30.7975.

Table 4: Comparison between Sex & Occupations with Dominant Hand Grip Strength

Variable	Groups	N	Mean	P
	Male	167	34.7665	.000
Dominant Hand	Female	217	19.0783	.000
Grip Strength	Low Manual occupational Strain	305	24.6328	.000
	High Manual Occupational Strain	79	30.7975	.000
*p <0. 05 (significant level)				

4.7 Comparison between groups with hand grip strength by ANOVA Test

This table describe of age group which is split into four categories, Weight group which is divides into 6 categories and BMI group (Under weight, normal, overweight, obese).Each group compare with HGS by separately.

Table 5: Mean and standard deviation of group difference with grip strength by ANOVA test

Group		N	Mean±SD	F	P-value
Age group	18-23	239	25.83±10.19		
	24-29	73	24.60±10.02	2.65	.048
	30-35	25	22.64±9.04		
	36-40	47	21.76±9.78		
		384	**24.8932±10.11**		
Weight group	35-44	45	18.60±6.64		
	45-54	129	22.65±7.64	16.22	.000*
	55-64	115	27.82±9.90		
	65-74	65	29.56±9.90		
	75-84	25	37.72±8.21		
	85-115	5	35.33±6.02		
		384	**26.00±9.92**		
BMI	17.5-18.5	48	20.47±7.41	6.11	.000*
	18.5-24.9	237	26.66±10.02		
	25.0-29.9	84	26.53±9.45		
	30.0-34.9	15	29.41±12.83		
		384	**25.94±9.90**		

In table shown that grip strength is significantly different in age group. HGS is higher in one age group where mean is 25.83.Lowest HGS mean is 21.76. The overall age group of HGS mean is 24.89.

In table shown that grip strength is significantly different in weight group. The highest HGS mean is 37.72. Lowest HGS mean is 18.60. The overall Weight group mean is 26.00.

In table shown that grip strength is significantly different in BMI group. Researcher found in the study using ANOVA test HGS strength higher in obese group of BMI. The mean of highest HGS is 29.41. Lowest HGS mean is Underweight group where mean is 20.47. The overall BMI group mean is 25.94.

CHAPTER V
DISCUSSION & CONCLUSION

5.1 Discussion

Hand is very important and essential part of human being. It complete several complicated detailed operations that permit humans to complete such tasks as writing, computing, and other activities (Blomkvist et al., 2010). Grip strength has been explained as the power of the combined contraction of the extrinsic muscles of the hand which flex the joints of the hand (Han et al., 2011). For grip strength evaluation there are several devices available. The hand dynamometer are inexpensive easy to administer and to provide correct measurements in clinical settings as well as for research purposes (Lam et al., 2006). It is the gold standard for the handgrip strength test. It is also used widely cited instrument in the literature. Grip strength testing is likely to be increasingly used in clinical settings (Roush et al., 2017).

5.1.1 Demographic Information of Participant

This study acknowledges the profile of the teacher and student of Bangladesh Health Professions Institute (BHPI) and clinical OT, PT, SLT. This study also acknowledges the staff of vocational training and other staff of CRP selected area. Most of them participant are engaged in CRP of low manual occupational strain and some of them are high manual occupational strain.

5.1.2 Socio-demographic characteristics

The final study population comprised 384 participants (167 males and 217 females) ranging in age from 18 to 40 years. For hand grip strength analysis, the 384 participants were divided into four categories based on age: (a) 18–23 years (male, n=84; female, n=154); (b) 24–29 years (male, n=45; female, n=34); (c) 30–35 years (male, n=13; female, n=11); and (d) 36-40 years (male, n=25; female, n=18). Besides the literature was found that 380 adult subjects (156 male and 224 female) having the age range of 20 years to 60 years (De et al., 2011).Values for grip strength according to age, hand dominance, and gender. For both the dominant and the non-dominant hand, the variables age, height, weight, and gender had a significant association with grip strength ($p = < 0.05$) (Ploegmakers, et al., 2013). Table 1 shows descriptive analysis of height, weight, hand length, hand breadth, Occupation and BMI of all the participants expressed as mean.

The weight of the participants was presented in the table. Most of the participant weight was 45-54kg; n=129 (33.6%). It provide grip strength by dividing participants into gender groups, age groups and then into left and right-handed groups, as the number of left handed participants was only 13 and right hands was 371 in total. Thus the values for left hand and right hand grip strength, regardless of hand dominance, are presented in Table 1. There was significant value in gender, weight, BMI, hand length, hand breadth where is (p=0.000). This study measure the grip strength by using jamar hand dynamometer. There are many studies used the Jamar Hydraulic grip dynamometer to carry out the grip strength testing (Wong et al., 2016). No studies were included if participants had the history of any injury or illness of hand. The lowest and highest results were obtained from the USA, but the strongest were recruited in public places and the lowest were recruited from doctor's offices (Mass et al., 2011). This study presents the two group of occupation where a show the high manual occupational strain was 79 (20.6%) and low manual occupational strain was 305(79.4%). In this study the participants 96.6% were right-handed, 3.4% were left-handed.

5.1.3 Association between dominant hands with their demographic factor

Result from our study indicated a positive strong association of hand breadth, right grip strength with the dominant hand. Due to the normal distribution of data in the data, in this study association is done by using Pearson Correlation coefficient(r) test. A recent study in the Chinese population has found a correlation between GS and anthropometric factors such as forearm circumference, body height, and weight (Lam et al., 2016). Correlation is significant when the P value is 0.01.Using the Pearson test, significant correlations were noted (pearson r.604p=.000; pearson r .934, p=.000).

In our study perspective, moderate positive association between height and weight with the dominant grip strength. In other study found HGS is negatively associated with physical weakness even when the effect of Body mass index (BMI) and arm muscle circumference are removed (Han et al.,2011). In this study there is positive weak relationship between BMI. Same results were found in other study where there is weak relationship with BMI (Kamarul et al., 2006). In our study it is also found that negative relationship of gender with dominant hand grip strength. Scatter plot showing the moderate association of height and weight with dominant hand grip strength.

5.1.4 Comparison between Groups with dominant hand grip strength

The four groups are significantly different from each other (p=.953) and focus on the result of the t-test. For the t-test, p=.000(which is, 0.05). So Researcher concludes that the four means are significantly different from each other. This study include two group of gender where male were 167 and female group were 217. For compare the two group of sample t-test is done to see the mean of dominant HGS. The mean of dominant HGS of male was 34.76 and female was 19.07. The study sample was divided into two groups, as follows: 1. High manual occupational strain that was composed of 305 participants, 2. Low manual occupational strain that was composed of 79 participants. In our study the result was identified significant difference exist in dominant grip strength between the high manual occupational strain and low manual occupation group. Based on our study result it is confirmed that grip strength is higher in the high manual occupational group than low manual occupational strain. Due to the normal distribution of data and the number of subjects in the dominant hand grip strength , a parametric test (t-test) was performed .In the comparison with the data for the general population, this study demonstrates that people with high manual occupational strain have very low levels of grip strength during their entire life (Vargas et al., 2015).

5.2 Limitation of the study

During the research work it is observed that some limitations and barriers. So the researcher acknowledges in these limitations and barriers investigation. These include:

- There are very limited published literatures available in Bangladesh regarding hand grip strength.
- A limitation of our study was that we recruited subjects from one institute, which may not be representative of the whole country.

5.3 Conclusion

This study explored the great importance for identifying impairments, establishing realistic goals, and determining the efficacy of interventions for patients with hand or upper extremity injuries or disabilities. Hand strength depends on various factors. Such as- patient's age, sex, and hand dominance. The importance of HGS is very essential in every aspect of our life. From morning to night there is many function is done by the HGS. Grip strength may also play a role in injury prevention and rehabilitation. Therapists will benefit from the results of this study by better assessing the hand of the patients, developing better goals for their patients and providing better education to their patients on this aspect of upper limb rehabilitation. Based on results information of the normative data on hand grip strength will be very helpful for the evaluation and treatment of hand or upper extremities injuries.

5.4 Recommendation

In spite of these limitations, this study contributes the standardized assessment tool for the clinical settings. It provides overall view of measurement of grip strength data in the selected area of CRP at Savar. Based on the given limitation of the study here focused on the possible recommendation and further studies regarding the measurement of grip strength of population are incorporate below-

a. There are many factors that may influence the measurement of HGS; however, this study primarily focused on grip strength and socio-demographic factor. Future studies may be focused on identifying other influential factors. It also focused how this factor impact on measurement of grip strength on various age ranges.

b. Identify the predictors and contributing factors that has significant impact to the measurement of HGS. HGS is higher in the group of high manual occupational strain rather than low manual occupational strain group to enrich this study Findings.

c. Evaluation the result of various therapeutic interferences. HGS plays an important role in these settings. It is reliable and valid tools. A baseline grip strength value is very essential for normal population. Normative data is very important reference for the purpose of effective rehabilitation.

d. Future studies should seek to determine potentially variable risk factors for reduced hand strength. The direction of further research should be conducted by the large group of populations and pinch strength measure in most of the cities in Bangladesh. Further study also should be included to compare the group of age, sex with dominant HGS. Carrying out such a study on measurement of grip strength that will represent and possible to generalize at country level.

We concluded that measurement of grip strength depends on several demographic factors. These factors may greater influence the HGS. It has crucial relation with the measurement of grip strength by Jamar hand dynamometer.

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Appendix 1

Permission Letter of Institutional Review Board

বাংলাদেশ হেল্‌থ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)

Bangladesh Health Professions Institute (BHPI)

(The Academic Institute of CRP)

BANGLADESH HEALTH PROFESSIONS INSTITUTE

Ref. CRP-BHPI/IRB/11/17/138

Date: 04/11/2017

To
Sharmin Akter
B.Sc. in Occupational Therapy
Session: 2013-2014, Student ID: 112130118
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: "Measurement of grip strength by hand dynamometer: A normative study in Bangladesh."

Dear Sharmin Akter,

The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application on 02/10/2017 to conduct the above mentioned dissertation, with yourself, as the Principal investigator. The Following documents have been reviewed and approved:

Sr. No.	Name of the Documents
1	Dissertation Proposal
2	Questionnaire (English and Bengali version)
3	Information sheet & consent form.

Since the study involves "Measurement of grip strength" and "Sociodemographic" questionnaire that takes 5 to 10 minutes and have no likelihood of any harm to the participants. The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 09:00 AM on October 08, 2017 at BHPI.

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring in the course of the study, any revision in the protocol and patient information or informed consent and ask to be provided a copy of the final report. This Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

Best regards,

Muhammad Millat Hossain
Assistant Professor, Dept. of Rehabilitation Science
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

সিআরপি-চাপাইন, সাভার, ঢাকা-১৩৪৩, বাংলাদেশ, ফোন ঃ ৭৭৪৫৪৬৪-৫, ৭৭৪১৪০৪ ফ্যাক্স ঃ ৭৭৪৫০৬৯
CRP-Chapain, Savar, Dhaka-1343, Tel : 7745464-5, 7741404, Fax : 7745069, E-mail : contact@crp-bangladesh.org, www.crp-bangladesh.org

Appendix 2
Permission letter for data collection

November 18, 2017
To
Principal
Bangladesh Health Professions Institute (BHPI)
CRP, Savar, Dhaka-1343

Through
Head of the Department,
Department of Occupational Therapy,
BHPI, CRP, Savar, Dhaka-1343

Subject: Application for the permission of data collection for undergraduate thesis.

Sir,
With due respect, I would like to draw your kind attention, I am a 4th year student of B.Sc. in Occupational Therapy, studying in Bangladesh Health Professional Institute (the academic institute of CRP) which is affiliated by faculty of Medicine, University of Dhaka. According to my academic course curriculum, I have to conduct research project in 4th year of my study. My thesis project is entitled as "**Measurement of grip strength by hand dynamometer: A normative study in Bangladesh**," which is a cross-sectional observational study under honorable supervisor Salma Akter, lecturer in Occupational Therapy. Self-demonstrated survey questionnaire and Jamar Dynamometer will be used on data collection instrument that take about 5-10 min appropriately for each participants (all student and staff of BHPI). It is also ensure that there has no likelihood of any harm to the participant. All participant will receive information sheet from data collection and through completing inform consent by participants maintain the ethical issue and all data will be kept confidential. This finding will be useful for our profession.

Therefore, in this regard, I request your permission to conduct data collection of my thesis.

Yours sincerely,
Sharmin
Sharmin Akter
Session: 2013-14
B.Sc. in Occupational Therapy
ID: 122130118
Bangladesh Health Professions Institute (BHPI)
CRP, Savar, Dhaka-1343

Approved
Nasirul Islam
Associate Professor
Principal-Acting
BHPI, CRP

Appendix 3
Information Sheet

The name of the researcher is Sharmin Akter. I am the student of 4th year, Department of Occupational Therapy, Bangladesh Health Professions Institute (BHPI). As a part of my academic issues, I have to conduct a dissertation in this academic year. So the researcher would like to invite you to participate in this study. The title of the study is **"Measurement of Hand Grip Strength by Digital Jamar Hand Dynamometer: A Study on CRP Staffs & BHPI Students"**. The name of the study supervisor is Salma Akter. The aim of the study is to identify the normative value/data of hand grip of Bangladeshi adult's population. The purpose of the study is to identify the descriptive data of hand GS and explore association between anthropometric measurements.

Confidentiality of all records will be highly maintained. The gathered information from you will not be disclosed anywhere except this study and supervisor. The study will certainly never reveal the name of participants.

If you have any query regarding the study, please feel free to ask to the contact information stated below:

Sharmin Akter
Session: 2013-2014
Student ID: 122130118
B.Sc. in Occupational Therapy
Bangladesh Health Professions Institute (BHPI),
Centre for the Rehabilitation of the Paralysed (CRP),
Chaplain, Savar, Dhaka-1343

Appendix 4
Consent Form

Participant Name: …….

This research is part of Occupational Therapy course and the name of the researcher is Sharmin Akter. She is a student of Bangladesh Health Professions Institute (BHPI) in B.Sc. in Occupational Therapy. The study is entitled as **"Measurement of Hand Grip Strength by Digital Jamar Hand Dynamometer: A Study on CRP Staffs & BHPI Students"**. The aim of the study is to find out the measurement of GS by hand dynamometer in Bangladesh.

Please tick ✓ to confirm	
I confirmed that I have read & understand the information sheet for the above study	
I have been clearly informed about the purpose and aim of the study	
I will have the right to refuse in taking part any time at any stage of the study	
My name and address will not be published anywhere. Only the researcher and supervisor will be eligible to access in the information for his publication of the research result. Your name and address will not published anywhere of this study	
All information should be confidential & information used only for research purpose	
My participation is totally voluntary	
I am willing to participate in the study with giving consent	

Signature of the Participant:	Date:
Signature of the Researcher:	Date:
Signature/Finger print of the witness:	Date:

Appendix 5

তথ্য পত্র

গবেষণাকারীর নাম শারমিন আক্তার। আমি বাংলাদেশ হেলথ প্রফেশন্স্ ইনস্টিটিউটের (সিআরপির শিক্ষা প্রতিষ্ঠান) অকুপেশনাল থেরাপি বিভাগ এ ৪র্থ বর্ষে অধ্যয়নরত। আমার প্রাতিষ্ঠানিক কাজের অংশ হিসেবে আমাকে একটি গবেষণা মূলক কাজ করতে হবে যার শিরোনাম হচ্ছেঃ "ডায়নামোমিটার এর মাধ্যমে মুষ্ঠিবদ্ধ হাতের শক্তি পরিমাপ করা:বাংলাদেশর একটি আদর্শ গবেষণা"।

গবেষণার প্রশিক্ষক এর নাম সালমা আক্তার। গবেষণার উদ্দেশ্য হল বাংলাদেশের প্রাপ্ত বয়স্ক মানুষের মুষ্ঠিবদ্ধ হাতের শক্তির সাথে শারীরিক গঠন এবং হাতের কাঠামোর সম্পর্ক বের করা। আপনার কাছ থেকে প্রাপ্ত তথ্যসমূহের সর্বোচ্চ গোপনীয়তা রক্ষা করা হবে। গবেষণা এবং গবেষণার সমন্বয়কারী ব্যতীত এই তথ্যগুলো অন্য কোথাও প্রকাশিত হবে না এবং গবেষণার কোথাও অংশগ্রহনকারীর নাম প্রকাশ করা হবে না। গবেষণা সম্পর্কিত যেকোনো ধরনের প্রশ্নের জন্য নিম্নলিখিত ব্যক্তির সাথে যোগাযোগ করার জন্য অনুরোধ করা যাচ্ছে।

শারমিন আক্তার
শিক্ষা বর্ষ: ২০১৩-২০১৪
ক্রমিক নং: ১২২১৩০১১৮
বি এস সি ইন অকুপেশনাল থেরাপি
অকুপেশনাল থেরাপি বিভাগ
বাংলাদেশ হেলথ প্রফেশন্স্ ইনস্টিটিউট
সিআরপি, চাপাইন , সাভার, ঢাকা-১৩৪৩

Appendix 6

সম্মতি পত্র

অংশগ্রহনকারীর নামঃ

এই গবেষণাটি অকুপেশনাল থেরাপির একটি অংশ এবং গবেষণাকারীর নাম শারমিন আক্তার। আমি বাংলাদেশ হেলথ প্রফেশন্স্ ইনস্টিটিউটের অকুপেশনাল থেরাপি বিভাগ এ ৪র্থ বর্ষে অধ্যয়নরত।এই গবেষণাটির শিরোনাম হচ্ছে: "ডায়নামোমিটার এর মাধ্যমে মুষ্ঠিবদ্ধ হাতের শক্তি পরিমাপ করা: বাংলাদেশর একটি আদর্শ গবেষণা"।

অনুগ্রহ করে ঠিক চিহ্ন ✓ দিবেন	
আমি উপরোক্ত তথ্যগুলো ভালোভাবে জেনে নিজ ইচ্ছায় এই গবেষণায় অংশগ্রহন করছি।	
এই গবেষণাতে আমি একজন অংশগ্রহনকারী এবং পরিস্কারভাবে এই গবেষণার উদ্দেশ্য সম্পর্কে আমি অবগত।	
আমার যেকোনো সময়ে এই গবেষণা থেকে নিজেকে সরিয়ে আনার অধিকার আছে।	
আমার নাম এবং ঠিকানা কোথাও প্রকাশ করা হবে না। শুধুমাত্র গবেষণাকারী এবং গবেষণার সমন্বয়কারীর সাথে এই গবেষণার পদ্ধতি সম্পর্কে অথবা যে কোন প্রশ্নের উত্তর জানার জন্য কথা বলতে পারব।	
সমস্ত তথ্যাবলি নিরাপদে ও গোপন রাখা হবে এবং তথ্যাবলি গবেষণাটির উদ্দেশ্যে ব্যবহার করা হবে।	
আমার অংশগ্রহন সম্পূর্ণভাবে স্বেচ্চাসেবী।	
আমি নিজ ইচ্ছায় এই গবেষণায় অংশগ্রহন করছি।	

অংশগ্রহনকারীর স্বাক্ষর	তারিখঃ
গবেষণাকারীর স্বাক্ষর	তারিখঃ
সাক্ষ্যপ্রধানকারীর স্বাক্ষর	তারিখঃ

Appendix 7
Socio-Demographic Questionnaire

Date: ……. /……. / 2017 Code No: ……..

- Name of the participant:
- Gender: Male / Female
- Age (in years) :
- Weight (in kg.):
- Height (in feet) :
- BMI:
- Education:
- Occupation of participant:
- Dominant hand:
- Others: …..……

Hand anthropometric measurement

- Hand length:
- Hand breadth:
- Key pinch:
- Tripod grip:

Measurement of Grip Strength by Hand Dynamometer

Grip Strength	Left hand (kg)	Right hand (kg)
01		
02		
03		
Mean		