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Abstract.

This quantitative study was done to identify the normative data level of hand grip strength among normal adult population at HUSM, Malaysia. In addition, this study also tries to confirm whether factors of age, weight, height, and BMI can influence the grip strength at both hands. A local normative data on grip strength is important as a reference to set realistic treatment goals but currently no study on normal grip strength among adult population in Asian (Kamarul et al, 2006, p173). 200 samples of male and female normal adult population were tested their grip strength.

This study conducted by using survey technique with the use of Jamar Dynamometer to collect grip strength data. Beside that questionnaire was used to collect samples background and health status. The study showed that male grip strength was stronger than female grip strength in all level of age. At the same time the study showed age is not the factors that can influence the grip strength in both gender. The study also revealed male right and left hand dominant hand were significantly stronger than non-dominant hand. The result of this study also revealed that weight, BMI, height, are the factors that can influences the hand grip strength for both gender.

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CHAPTER 1: Introduction

One of the Occupational therapy (OT) treatments is hand rehabilitation, the concept of hand rehabilitation are aimed towards the recovery of the maximal function and work capacity of hand. Hand rehabilitation process can be objectively evaluated by using hand grip assessment tools. Hand grip strength is important as an index of general health and as a screening test (Bohannon et al, 2005, p28). Grip strength is the force applied by the hand to pull on or suspend from objects and is a specific part of hand strength. The hand is an amazing human instrument and can be used to grip objects in several ways. Therefore the accurate treatment and assessment should be use when handling every patient who has hand problem to ensure that they get a better rehabilitation.

The hand is essential body part that helps human to achieve their daily functions. Current concept of hand rehabilitation and surgery are aims towards the recovery of the maximal function and work capacity of hand. This recovery process can be objectively evaluated by using hand grip assessment tools. Grip strength has come to be regarded as the most reliable clinical measurement of human strength. It is widely used in adult as indicator of strength of fitness test and as such is seen as the single item most reasonability representative of total body strength. According Lau and Ip (2006, p16) hand grip strength has been suggested as a predictor of postoperative complication and as a predictor of disability in older people. According to those factors a valid base of grip strength and a study on the local grip strength is very important when handling a local patient.

The best rehabilitation is a rehabilitation that include all the perfect assessment tools and an accurate base which is it will help a therapist to make a goals more realistic and more accurate. Here the accurate base means we cannot use a different population as a base to another population. Currently in Asia, practitioners often use a western baseline of hand grip strength to a local patients even it is not suitable with Asian people. The situation happens because currently the local normative data still not available (Kamarul et al, 2006, p173). So this study is crucial need in Occupational Therapy profession at

Malaysia. Reflect to the above scenario this study was bring up and at the same time the major reason of making this study is to improve Occupational Therapy rehabilitation.

The next reason is in my department of rehabilitation hand injuries is the highest case that was referred to us. By the way when the local hand grip strength not available we often to use the western hand grip strength as a base when set a goals to the patients. So this study is a solution to find an accurate base when evaluate and set goals to our patient beside improve our services. Beside that hand problems should be treating and get the best rehabilitation treatment because hand is an essential body part that helps human to achieve their daily function. It is a vital to human appearance and function and it perform a thousand movement of flexes, extends, grasp and others daily to do daily activities (Kasch cited from Pedretti, 1996, p661). According to Trombly and Scott (1977, p235) 'the human hand is closely associated with man's adaptive skills, his creative and emotional expression as well as his independence in caring for himself and others'. Occupational Therapy treatment goals are to enhance all these aspect of human functioning. The loss of hand function is a great handicap for anyone. This study is very important because the findings of this study will give a lot of benefit to the patient and also to the practitioners. From this study we can get local baseline grip strength and we can use it to ensure that our patient get the accurate rehabilitation in all the things of rehabilitation. Measurement of grip strength is very useful in Occupational therapy evaluation because it including in the assessment of individuals who have impairment in performing their daily life task (Richards, 1997, p1154).

The idea to conduct this study also comes because of the grip strength is very important and useful in rehabilitation process. Grip strength is a measure of gross motor power and function in the upper extremities (Beaton et al 1995, p 293). By testing the grip strength of individuals we can evaluate their hand and upper limb function, level of impairment and physical impairment (Coldham et al,2006, p318). Furthermore it was proven that data derive from western population cannot be applied to a comparable Malaysian population because according to Kamarul et al (2006, p175) the hand grip strengths of Malaysian population were significantly weaker compare with the hand grip strength of

Western populations. To overcome this problem this study very related because purpose of this study is to find out the local hand grip strength among adult population at Hospital University Sciences of Malaysia (HUSM) and factors that influences grip strength. Trough these studies it can develop Occupational Therapy profession and make patient get better treatment.

At the moment the previous study about Hand Grip Strength in the Adult Malaysian Population done by Kamarul et al 2006 was recognized some limitations that can interrupt the result of the study. This study is also carrying out to overcome that's limitations. The limitations that exist in that study included researcher did not use standardize positioning and instructions while taking a measurement and the average of the three trials did not use (Kamarul et al, 2006, p173). However 'the mean of three trials has been shown to be the most reliable measure of grip strength' (Mathiowetz et al, 1984 & Stratford, 1992 cited from Beaton et al 1995, p294). The researcher also use a LIDO kinetic work set as a measurement tool for measure of all samples not JAMAR Dynamometer (Kamarul et al, 2006, p173). According to Radomski and Latham (2008, p1137) 'Jamar Dynamometer is one of the best instrument to assess grip strength because of its reliability, face validity, and accuracy'. By the way in this study the Jamar Dynamometer has been used to collect all the grip strength from samples. Researcher also used a Newton meter (Nm) as a measurement scale not a Kilogram (Kg/F) (Kamarul et al, 2006, p173). This condition will create a problem for the purpose to compare hand grip strength score when using a different assessment measurement tool and measurement scale.

Meanwhile, this study also tries to confirm whether the factors of age, weight, height, and BMI can influence hand grip strength at both hand. These factors very important because every person will not have same grip strength so some factors should be considered when examine their grip strength.

CHAPTER 2: Review of the Literature

A lot of study has been collected and reviewed as a literature review in the making of this study. A lot of journal and books has been identified as references in this study. It is comes by searching in the local library and from the online resources. Here the literature was being classified and arranged by three major sections. The first section is all about the use of hand grip strength and the important of hand grip strength. Furthermore this section also will discuss about the best equipment to use as a measurement tool to measure grip strength by the different reseacher from their journal and books. The second section is the reason of the need for local hand grip strength and the important of local hand grip strength. Lastly is section that will discuss about the factors that influencing hand grip strength.

Strength is one of the occupational performance components that underlie the performance of daily life tasks especially in our self-care activities, work, and leisure. In medicine grip strength is always used as a specific type of hand strength. The purpose of testing the grip power is variety. It is include diagnosing a disease, to monitor and document progression of muscle strength, to evaluate and compare treatment, to establishing treatment goals in rehabilitation, to predicting future performance, to determining treatment outcomes and to provide feedback during the rehabilitation process as a measure indicating the level of hand function (Noreau et al, 1998, p716). Reliable and valid evaluation of grip strength also very useful and greatly important in determine the effectiveness of various surgical and treatment process (Mathiowetz et al, 1985, p69). Here the establish local hand grip strength should build up and use when giving a treatment to a local patient. Currently the local grip strength still not available so this study is crucial need because by this study the local hand grip strength will be produces. Hand function Measurement of grip strength is frequently included in the initial assessment as one way to determine gross motor power and function in the upper extremities (Richard, 1997, p1154). Those statement also supported by Beaton et al (1995, p293) where the researchers said the instrumentation to measure grip strength

requires the clinical practicality, reliability and validity because grip strength has been used as a measure of gross motor power and function in the upper extremity.

Hand rehabilitation has a lot of instruments available for evaluating grip power (Schechtman et al, 2005, p339). According to the study that was done by Kamarul et al, (2006, p173) the researchers were used a LIDO kinetic work set as a measurement tool for measure of all samples not Jamar Dynamometer measurement tools. The others equipment can be used to measure hand grip strength are including Dynex Electronic Hand Dynamometer and Baltimore Therapeutic Equipment Primus. Meanwhile many researchers have used the Jamar Dynamometer as a decisive factor to validate other instruments that measure grip strength. According Mathiowetz et al (1985, p69) Jamar Dynamometer is the most accurate measure of grip strength. The American Society of Hand Therapist (ASHT) recommends use of the Jamar Dynamometer because it is well documented reliability and validity. American Society of Hand Therapist also reported and recommended that The Jamar dynamometer is the most accurate for measure grip strength (Fess 1992 cited from Radomski & Latham, 2008, p174). Reflect of that I was used the Jamar Dynamometer in this study for data collection.

The validity and reliability of Jamar Dynamometer also has been found to be the standard of objective grip strength measurement (Harkonen et al 1993, Mathiowetz et al 1984, and Swanson et al 1990 cited from Ashford et al 1996, p402). According to Randomski & Latham (2008, p174) test–retest reliability of Jamar Dynamometer was found to be 0.88 and inter-rater reliability is 0.99. Jamar Dynamometer is a hydraulic tool with five different handle positions that registers static grip strength in pounds and kilograms of force (Shechtman et al, 2005, p339). Several studies have standardized the use of the dynamometer in relation to patient's position, timing, instructions, and repetition to improve the results (Ashford et al, 1996, p402). According to Bahannon et al (2005, p11) the ASHT have standardize the used of the Jamar Dynamometer with it handle in the second position and the individuals tested should be seated with their shoulder adducted, their elbow flexed 90 degree and their forearm in neutral. However, it is recommended that three trials of grip strength be obtained and the mean of these numbers represents

the most reliable result (Beaton et al, 293, p294). In this study all the suggestion above has been use to ensure that this study was carried out by enough literature review. It is because this study is to overcome the limitation occurred in the study that was done by Kamarul et al (2006).

One screening assessment questionnaire used to confirm whether each sample have any upper limb disability or not. The screening assessment questionnaire used was Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire. The DASH questionnaire is an upper- extremity specific outcome measure that was introduced by the American Academy of Orthopedic surgeon in collaboration with a number of other organizations. The rationale behind the used of this questionnaire is to screen all sample before they can participate and give their grip strength. This process will ensure that all samples are healthy adult population. The DASH questionnaire is suitable to be a screen assessment tool because of its property of being mainly a measure of disability.

DASH questionnaire is a self-administered region-specific outcome instrument developed as a measure of self-rated upper extremity disability and symptoms in single or multiple disorders (Beaton et al 2001, p 128). The DASH consists mainly of a 30-item disability or symptom scale, scored 0 (no disability) to 100 (Gummesson et al, 2003, p1). The items ask about the degree of difficulty in performing different physical activities because of the arm, shoulder, or hand problem (21 items), the severity of each of the symptom of pain, activity related pain, tingling, weakness and stiffness (5 items), as well as the problem's impact on social activities, work, sleep, and self-image (4 items). Each item has five response options. A previous study by Gummesson et al (2003, p4) proved DASH is very reliable and the Cronbach alpha coefficient value was above 0.9 for the DASH disability or symptoms scale, indicating good internal consistency.

Currently in Asian especially Malaysia doesn't have a local normative data of hand grip strength. Today we as therapist often compare our patients' grip strengths with normative data derived from western literature, but we need to be confident that the data we use are applicable to our patient population (Schwartz cited from Tyler et al 2005, p4-9).

According to Bahannon et al , (2001,p28) 'judgments about whether an individual is impaired are best determined by comparing his or her performance to reference values obtained from a relevant population'. Relevant population here means obtaining the comparison from Malaysia own population as we resided in the particular country. Reference values are essential if decisions are to be made about the normality of an individual's status relative to the population (Bahannon et al, 2006, p11). 'Such values are particularly important when it comes to hand grip dynamometry, as grip strength is used not only to describe the status of the hand but also to characterize overall upper extremity strength' (Bahannon et al, 2006, p11).

According to Incel et al (2002, p234) to determine the affectivity of different treatment implementation is based on the reliability and validity of particular hand evaluation. Thus, the subject samples of the studies contributing to each consolidated norm can be considered to be part of the same population. Appropriate normative data to make a comparison with patient ability must be in the same population instead of using a different population (Bahannon et al 2006, p12). In interpreting information extracted from grip strength evaluation we able to set realistic treatment goals and to assess a patient's ability to return to work which is based on the normative data (Mathiowetz et al, 1985, p69). By this study the phenomena that use a western base to a local population can be overcome and the local normative data can be use as a base when handling local patient.

Furthermore a baseline grip strength value for the normal population is needed to evaluate hand and upper limb function, level of impairment and physical impairment. But currently in Asian country, the study of the normal hand grip strength is still not available specifically from Malaysia (Kamarul et al 2006, p173). Most normative data are based on the western literature and may not apply to Asians. Data derived from western populations cannot be applied to a comparable Malaysian population because in western populations, the mean grip strength can be as much as 1.5 times greater than in the Malaysian population (Kamarul et al 2006, p176). This suggests that grip strength norms from the western populations may not accurately represent the local population and that

is the reason why we have to initiate norms from local reference. According to Kamarul et al (2006,p177) he concluded that normative data extract from local hand grip strength would serve as objective values for the purpose of rehabilitation in Malaysian population. So this study is very relevant with the current situation.

Every people will not have same grip strength and this will be according to some of the factors. This study will test some factors that may influence hand grip strength such as age, gender, hand dominance, weight, height and BMI. According to Mathiowetz et al (1985, p74) scores obtained from the grip strength evaluation should be compared to the appropriate age and sex for interpretation. Based on previous research they found that grip strength is different among gender, grip strength different between left and right sides, and grip strength changes with age (Bahannon et al, 2006,p12). This statement is parallel with my research hypothesis. According to Incel et al (2002, p236) factors including fatigue, hand dominance, time of day, age, weight, height and sensory loss can influence the grip strength. Kasch cited from Petretti (1996, p666) also said that age will affect the strength. But there are also a few studies on grip strength give a different result either age will influence the grip strength or not. Rantanen et al (1998, p2052) conclude that strength was decrease due to old age, weight lost and chronic condition.

Generally, grip strength peaked within the 25 to 39 age group for both men and woman subjects and gradually declined thereafter (Mathiowetz et al, 1984,p71). According Rantanen et al (1998, p2047) 'hand grip strength was found to increase up until the thirties and to start to decrease with accelerated speed after the forties'. This scenario happened parallel with the aging process, muscle mass is lost due to motoneuron death and muscle shrinking due to inactivity (Rantanen et al, 1998,p 2047).According to Yim et al (2003, p553) a study on elementary school children was showed significant that age and gender influence grip strength. But the other study on frail elderly shows that age and gender are not the main factors that influence grip strength (Shechtman et al 2004, p826). By looking after all the journal above we can see that there has a contra result, so here this study will test again either age can influence the grip strength among local adult population.

While, Reed (1991, p258) said 'the person demonstrate grip strength within normal range for his or her sex, age, and type of work'. According to Richard (1997, p1155) male participants demonstrated significantly greater strength than female participants. This statement is related with my hypothesis. People with right-handed dominant people tend to have a 10 percent stronger grip in the right hand than the left but different with left-handed dominant people tend to have equal strength (Reed 1991, p258). According to Incel et al (2002, p237) a left-handed people are provisionally required to use their non dominant hand for daily activities and this situation will influence their grip strength. By knowing the factors that can influence the grip strength a realistic treatment goals can be set up to every client depends to their truly ability. Because of valuable of the hand grip strength, the reliability and validity of the hand strength evaluation should be improve by compare the score to the appropriate age and gender (Mathiowetz et al,1985, p74). Consequently this study will help all practitioners more accurate in making treatment goals for local adult population.

Grip strength which is easily implemented and serves as important prognosis is often used to characterize the strength of elderly individuals and furthermore predicts the disabilities (Bahannon and Schaubert , 2005, p426). It is therefore important to account for such other factors, not age alone, to predict grip strength. According Kamarul et al (2006, p174) 'a multiple regression analysis was used to compare left and right grip strength taking into account factors that may influence grip strength such as gender, age, weight, height, body mass index, race and occupation. Only age, weight, height, occupation and gender were correlated with grip strength'. From this study the factors of grip strength including age, weight, height, and BMI will be tested either it can influence hand grip strength at both hand or not.

CHAPTER 3: Research Methods and Procedures.

3.1 Methodology

In this study a quantitative research model has been used by using survey research technique. All participants are come from staff of Hospital University sciences of Malaysia, all the visitors and caregiver of the patient at rehabilitation unit HUSM. All of them will be introduce with this project and if they are interest they were given the consent form to fill up. After their sign the consent form their health status were assessed by using DASH questionnaire. From the result of DASH questionnaire if they get '0'score they were chosen to give their grip strength in this study. But if they get more than '0' score they were advised to see a doctor to evaluate and get further treatment for their problem. DASH questionnaire was stand as a screening tool for the entire participant before they can give their grip strength. A souvenir was given to every one of participant as an appreciation for their cooperation after finish all the process. A detail methodology of this research will be discussing more at one by one section below.

3.2 Research Design

This research is quantitative research model which is survey research was selected. This study will be conduct using survey technique with the use of hand grip measurement tool (Jamar Dynamometer) to collect grip strength data and questionnaire is to collect samples background and demographic data. According to Stein and Cutler (2000, p113) the main purpose of survey research is to obtain accurate objective description about the specific of people. Survey research also the most popular among non-experimental research especially in social sciences domain because it can obtain the data collection from sample directly and faster compare with other research (Piaw, 2006, p107).

For this study demographic data including age, gender, weight ,height, BMI, the dominant hand and grip strength among normal adult population will be analyze to find the factors that influence grip strength. The demographic data was obtained from the Data collection

form / measurement scoring form. The measurement scoring form was included Part A and Part B. Part A consist of demographic data which is need to fill up by the participant and Part B is the measurement grip strength score which is fill up by the researcher who were taken their grip strength . See appendix 3 for more details.

3.3 Subjects / Sampling

This study use non-probability sample design where samples were selected by non-randomize system. The convenience or accidental sampling is a method that has been used. This type of method is the most conveniently available for people or subject to participate in a study (Berg & Latin, 2008, p252). Samples will come from whoever at the rehabilitation department of Hospital University Sciences of Malaysia (HUSM) either staff of HUSM and caregiver of the patient which is suitable with the inclusion criteria. The samples population age only range between 18 to 35 years old. The samples must be an adult population which is with score '0' (no disability of upper limb) in Disability Arm, Shoulder and Hand (DASH) screening test and don't have any history of fracture at both hands, inflammatory joint disease at hands, neurological disorder, open wound or wound at area of both hands and arms and no history of acute pain at arms or hands.

The samples were involved of 200 persons (100 male and 100 female). All the adult population who enter to department has been introduced by the researchers and staff of the department about this study and they were asked about their interest to enter in this study. The protocol of the study has been informed to the sample that they need to be screen before they become a sample in this study by using the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaire. If they get '0' score they will be a participant in this study but if the score not '0' they are not eligible to be a participant. Consent has been obtained from every sample and they need to fill up the consent form to prove that they agreed to participant in this study. See appendix 1for more details of consent form.

Before start all the data collection process the ethical approval was applied from School Research Governance and Ethics Committee (RG&Ec) of the School of Health and

Social Care University of Teesside to ensure this study will not give any harm to the samples. The ethical approval was approved by the 16 October 2009 by the School Research Governance and Ethics Committee (RG&EC) of the School of Health and Social Care University of Teesside. See appendix 5 to see the ethical approval form.

3.4 Procedures

The samples were recruited by using a voluntary method. After that they need to read and complete the consent form given. Then samples need to write and tick such as, age, weight, height, gender, body mass index (BMI) and dominant hand in measurement scoring form before grip strength will take. The researcher will tell samples about the introduction and purpose of the study during the measurement session. Demonstrate will be doing to ensure samples understand the procedure. The standard protocol for grip strength measurement according to the JAMAR Hydraulic Dynamometer User Manual has been used in this study which is samples need to sit comfortably in a straight-backed chair, arms at the side but not touch body, shoulder joint in slightly abduction position and neutrally rotated, elbow in 90 degree flexion, wrist at 0-30 degrees extension and 0-15 degrees ulnar deviated and sample feet must flat on the floor. The handle of the dynamometer will set the second position (Mathiowetz et al 1984, 1985 cited from Radomski & Latham 2008, p175). According to Su et al (1994), cited from Radomski & Latham (2008, p 175) standardize position is important because grip strength varies with elbow position.

After samples were positioned appropriately, researcher will instruct sample to squeeze the dynamometer. Researcher will take the measurement on the dominant hand and follow with non-dominant hand. Three successive measurements were taken. The time between trials was about 15 seconds, which was the time needed to read and record each scored. Scores were read on the needle side of the red readout marker. The mean of the three trials was used for data analysis. Results were recorded as kilograms. One-minute rests were given between each attempt and hands were alternated to minimize fatigue affects.

3.5 Data Analysis

The Statistical Package of Social Science, version 11.5 (SPSS) was used to analyze all data including descriptive and inferential statistic analysis.

3.5.1 Descriptive Statistic Analysis

The descriptive statistical analysis was used to calculate variables like gender, age, body weight, body height, body mass index (BMI), dominant hand and mean measurement score of grip strength of both hands. From descriptive analysis, it will allow researcher and reader of the research report to get an accurate first impression of what the research look like and what the research all about (Salkind, 2006, p151). It also use to find the mean, minimum, maximum and standard deviation of the data, the sample will be selecting cases use a descriptive statistic frequencies (Salkind, 2006, p152-159)

3.5.2 Kolmogorov-Smirnov Test

Kolmogorov-Sminov Test was used to confirm whether data that going be used in inferential statistic were in normal distribution. The hand grip strength, body mass index (BMI), body height and body weight data were used this statistical test to confirm about the normality distribution.

3.5.3 Mann Whitney U Test

Mann Whitney U Test was one of the non parametric test that was used to find out the significant different of hand grip strength scored between male and female adult population.

3.5.4 One Sample T-Test

The One Sample T-Test was used to find out the significance difference of hand grip strength scored between dominant and non-dominant hand among male and female adults population. To interpret the test result of the Mann-Whitney U Test and One