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A Preliminary Study on the Hand Grip and Pinch Strength among Adults in an Indigenous People Community in Royal Belum Forest, Malaysia

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Abstract— Handgrip strength is a general indicator of muscle strength and nutritional status of an adult population and is linked with premature mortality as well as physical disabilities. In this preliminary study, handgrip strength among adults in an indigenous community in Malaysia is measured using a cross-sectional study design. Structured questionnaire on sociodemographic characteristics, medical history, and hand strength measurements were taken. Overall, 28 adults aged 25 years and older participated in this study with 64.23% are males and all of them are from Jahai tribe. The overall sample mean (standard deviation) age are 39.8 (13.2) years. As expected, males have significantly higher recorded measurement than females ($p < 0.05$) both in handgrip and hand pinch strength with mean (standard deviation) of 30.6 (10.5) and 6.1 (2.4) respectively.

Keywords—hand grip strength; hand pinch strength; indigenous people; sociodemographic; t-test;

I. INTRODUCTION

Handgrip strength is a general indicator of muscle strength and linked with premature mortality. The conditions of our muscle can be caused by many health problems. It ranges from very common to very rare, minor to serious, temporary or permanent, reversible or not. For example, muscle fatigue is commonly caused by influenza, hepatitis C and dengue fever. While muscle weakness, a more serious muscle condition can be caused by common disease such as diabetes, or uncommon disease such as stroke or rare disease such as muscular dystrophies [1]. Although muscle weakness is rarely the only sign of serious underlying disease however, it can be a good indicator of our health status.

Several studies [2-10] have been conducted in investigating the relationship between human grip and pinch strength with multiple chronic diseases. For example, people with rheumatic disease will have severe gripping difficulty due to their hand

deformation. Common diseases that have direct relationship with hand grip strength are such as chronic kidney disease [4-5], osteoarthritis [6-7], malnutrition [8], coronary artery disease after-surgery [9] and De Quervain Tenosynovitis [10] as well as predicting a decline in function in old age [11]. In all investigations, it has been concluded that hand grip strength can be an independent predictor in assessing multiple chronic disease of a patient. There is also close correlation made between grip strength and pinch strength [3]. A study by [4] shows that pinch strength can be an alternative assessment to hand grip strength in haemodialysis patients. Handgrip strength is also a reliable screening tool in the assessment of nutritional risk and can be an indicator for nutritional status in individuals with chronic malnutrition [12-14].

Many studies have been done on the characteristics of both hand grip and hand pinch in Malaysia population [15-17] from urban and rural area. However, only one (1) study has been conducted on the indigenous people of Malaysia in Pahang but the findings on the indigenous people is inconclusive [17]. The indigenous people are locally known as Orang Asli in Malaysia that live in inaccessible areas and depend heavily on the natural and forest resources in the ecosystem for their daily livelihood. There are three main groups of Orang Asli; Negrito, Senoi and Proto Malay. The differences between these groups can be seen from their languages, living lifestyle and physical appearances. Despite the differences, the Orang Asli generally are socio-economically and politically disadvantaged especially in health and nutritional intake with high prevalence of malnutrition among Orang Asli children has been investigated in many literatures. Poverty, insufficient nutritional intakes, local diseases, unsanitary surrounding and daily practices contributed to the high number of health problem among Orang Asli population [18-20]

This study focuses on sociodemographic characteristics and the hand grip measurement of Orang Asli Jahai, one of the tribe

from Negrito group. Although many data can be derived from western population, it is not applicable to Malaysia population due to western population having larger mean grip strength (1.5 times) than Malaysian population [15]. This data collection is a preliminary study on the hand grip strength characteristics of the indigenous people in Malaysia. This data is also useful in the development of a comprehensive database on the relationship between hand grip and pinch strength and multiple chronic diseases in Malaysia population.

II. METHODOLOGY

A. Data Collection

This is a cross-sectional study conducted in Kampung Sungai Tiang, Royal Belum Forest, Perak. The indigenous people of Royal Belum is selected for this study because this village very remote and inaccessible by land. A four hour trip from the Banding Island public jetty to the village is only possible using a boat. Therefore, the interaction between the indigenous people and the local people is very limited. All subjects aged from 24 years old and above, from Jahai tribe were invited to participate in this study. The exclusion criteria for participation were upper limb injury, limb deformity, dysfunction of the elbow joint, had undergone surgery related to hand within the last three months.

Before the start of the study, subjects need to answer structured questionnaire related to their background history, demographic data such gender, ethnicity, age, weight, dominant hand, health status, hand functionality and lifestyle practices. The subjects were interviewer-administered in Bahasa Malaysia throughout the interview session. Height is estimated based on ulna length and age in years of the subject. The ulna length is measured between the point of the elbow and the midpoint of the prominent bone of the wrist. This value is then compared with a standardized height conversion chart [21]. The estimated body mass index (BMI) was calculated using the body weight measured in kilogram (kg) divided by the square of the estimated body height in meters (m).

For hand grip strength and pinch strength, a Jamar hydraulic hand dynamometer and Baseline® pinch gauge from ErgoKit® were used throughout the data collection. This dynamometer is a precision instrument specifically designed to measure accurately the strength and endurance of the hand and individual fingers. This allows the accurate monitoring and assessment of hand function throughout physiotherapy, drug treatment or surgical management. The dynamometer provides force values in kilograms or pounds.

For hand grip strength measurement, due to the difficulty in obtaining a seated area, standing position is opted. Subjects are instructed to be in standing position with the shoulder adducted and neutrally rotated, the elbow flexed at 90 degrees, wrist and forearm in a neutral position, the feet hip width apart with toes pointing forward, the head is straight and the eyes are looking straight ahead. Shoulders back and chest up, knees comfortable but not bent and neither the hand nor dynamometer should touch the body or any other object during the test. For pinch strength test, the same positions are maintained but subjects will have to squeeze the pinch dynamometer. The hand grip

and pinch measurements were repeated 3 times on dominant hand only with 3 seconds of maximal hand gripping and pinching. Subjects received no feedback but were given consistent verbal encouragement for each test to ensure maximal effort.

B. Data Analysis

All statistical analysis are performed using SPSS and Microsoft Excel. Descriptive statistics e.g. frequencies, percentages, means and standard deviations (SD) were used to analyze the characteristics of the participants. A paired t-test was used to determine the relationship between the hand grip and hand pinch strength measurement of the male and female populations. Most statistical analyses were classified by gender due to the difference in hand grip strength in gender as previously observed by other studies [13, 14, 22]. A $p \leq 0.05$ probability level was used to indicate significance in all of the statistical analyses.

III. RESULTS AND DISCUSSIONS

The results of this study are discussed based on the questionnaire categories.

A. Demographic Characteristics

Table 1 shows the sociodemographic characteristics and occupation history of the study sample. There were a total of 28 participants (18 males and 10 females) aged above 24 years old (mean = 39.82, SD = 13.24 years). The male mean (SD) age is 38.94 (12.84) years with an age range of 24 to 70 years. Meanwhile, the female mean (SD) age is 41.4 (14.49) years with an age range of 25 to 69 years. The youngest and oldest participant were a 24 and 70-year old male respectively. Majority (92.86%) of the participants are married with mean (SD) of 5.25 (3.00) number of children. Single participants are of age 25 and 30 years. The highest and lowest number of children (from the same parents) recorded were 12 and 1 respectively. For the latter, the young parents purposely decided to have a very small family instead of the traditionally large and extended families of the indigenous community.

About 15 (53.57%) of participants attended school in early age while 13 (46.43%) participants did not go to school. The lowest and highest level of education achieved by the male (n (%) = 9 (32.14%) participants) are primary Year 1 and secondary Year 3. Meanwhile for the female (n (%) = 6 (21.43%) participants), the lowest and highest level of education are primary Year 3 and secondary Year 2. Half of the male (n (%) = 9 (32.14%) participants) study sample never attended school. From the questionnaire, the age range of participants who have never attended are 30 to 70 years for male, and 44 to 69 years for female. Majority of the participants (n (%) = 24 (85.71%)) were working to support their daily lives. Only 1 (3.57%) participant aged 50 years old from the male sample is not working. The age range of the female who are not working is between 27 to 46 years old. The male and female mean (SD) income are RM238.33 (RM348.50) and RM23 (RM21.1). It can be seen that the male has significantly higher income mean than the female ($p < 0.05$).

TABLE I. SOCIODEMOGRAPHIC CHARACTERISTICS AND OCCUPATION HISTORY OF THE STUDY SAMPLE

Variables	Value		
	Total; n (%)	Male; n (%)	Female; n (%)
Sample size	28 (100%)	18 (64.29%)	10 (35.71%)
Age:			
24 – 30 years	10 (35.71%)	8 (28.57%)	2 (7.14%)
>30 – 40 years,	6 (21.43%)	3 (10.71%)	3 (10.71%)
> 40 – 50 years,	6 (21.43%)	4 (14.29%)	2 (7.14%)
> 50 years	6 (21.43%)	3 (10.71%)	3 (10.71%)
Mean (SD), years	39.82 (13.24)	38.94 (12.84)	41.4 (14.49)
Marital Status:			
Married:	26 (92.86%)	16 (57.14%)	10 (35.71%)
Single:	2 (7.14%)	2 (7.14%)	0
No of children:			
Mean (SD), children	5.25 (3.00)	4.94 (3.37)	5.8 (2.25)
Education Status:			
Attended school:	15 (53.57%)	9 (32.14%)	6 (21.43%)
Never attended school:	13 (46.43%)	9 (32.14%)	4 (14.29%)
Working experience:			
Working:	24 (85.71%)	17 (60.71%)	7 (25.00%)
Never work:	4 (14.29%)	1 (3.57%)	3 (10.71%)
Income			
Mean (SD), RM	166.23 (300.57)	238.33 (348.50)	23 (21.1)

B. Hand Grip and Pinch Strength Measurement

Table II shows the anthropometry as well as hand grip and pinch measurements for both male and female participants. The mean (SD) of the study sample is 52.09 (11.05) kg with the males having higher mean (SD) of 56.87 (10.04) kg compared to female weight of mean (SD) 43.48 (6.9) kg ($p < 0.001$).

The estimated height was calculated using ulna measurement and age (in years) of the participants. The mean (SD) of the study sample is 1.70 (0.08) m with the males having higher mean (SD) of 1.73 (0.06) m compared to female height of mean (SD) 1.63 (0.04) m ($p < 0.001$). This is also reflected on the BMI calculation where the BMI mean (SD) of the male is higher at 18.88 (2.78) kg/m^2 than the female BMI mean (SD) of 16.37 (2.51) kg/m^2 ($p < 0.05$). The male BMI falls in the normal and healthy weight category ($\text{BMI} > 18.5 \text{ kg/m}^2$) while the female BMI falls in the underweight category ($\text{BMI} < 18.5 \text{ kg/m}^2$). Majority of the participants ($n=15$ (53.57%)) are right-hand dominant with 2 (7.14%) are left-hand dominant. Moreover, 11 (39.29%) participants can use both hands equally well and all of them are male.

There is a statistically significant difference on hand grip strength measurement between male and female, $t(26) = 5.174$, $p < 0.001$. Hand grip strength mean (SD) for male (36.09 (8.354) kg) is statistically higher than the mean (SD) of female hand grip strength (20.80 (5.516) kg). This could be related to the greater amount of muscle mass among male population.

This is consistent with many other studies in the literature [13, 23, 24]. However, compared to other indigenous community in Pahang, the mean hand grip measurement in this study is significantly lower for both male and female [17]. This could be because of the living lifestyle and dietary intake. There is also a statistically significant difference on the hand pinch strength measurement between male and female, $t(25.5) = 6.945$, $p < 0.001$. Hand pinch mean (SD) for male (7.42 (1.924) kg) is statistically higher than the female hand pinch strength mean (SD) (3.72 (0.893) kg). This is also consistent with other study [25].

TABLE II. ANTHROPOMETRY, HAND GRIP AND PINCH MEASUREMENT OF THE STUDY SAMPLE

Variables	Value		
	Total (n = 28)	Male (n=18)	Female (n=10)
Current weight in kg, mean (SD)	52.09 (11.05)	56.87 (10.04)	43.48 (6.9)
Estimated height in m - mean (SD)	1.70 (0.08)	1.73 (0.06)	1.63 (0.04)
Estimated BMI in kg/m^2 , mean (SD)	17.98 (2.91)	18.88 (2.78)	16.37 (2.51)
Dominant hand:			
Right	15 (53.57%)	6 (21.43%)	9 (32.14%)
Left	2 (7.14%)	1 (3.57%)	1 (3.57%)
Both	11 (39.29%)	11 (39.29%)	0
Hand grip strength in kg, mean (SD)	30.63 (10.48)	36.09 (8.35)	20.80 (5.52)
Hand pinch strength in kg, mean (SD)	6.10 (2.42)	7.43 (1.92)	3.72 (0.89)

Table III and Table IV show the mean and standard deviation of 3 measurements for hand grip strength and hand pinch strength respectively. A paired t-test was employed to both measurement to evaluate the association of readings of hand grip and pinch strength between:

- First and second readings
- First and third readings
- Second and third readings

Results show that there is no significant difference in mean of hand grip reading for the first measurement, second measurement and third measurement for male and female. Similar results can be seen in hand pinch strength measurement where no significant difference in mean of hand pinch reading for the first measurement, second measurement and third measurement for male and female. This means that the measurements are reproducible and reliable.

TABLE III. MEAN AND STANDARD DEVIATION OF HAND GRIP STRENGTH FOR ALL MEASUREMENTS

Gender	Measurement of hand grip strength						P-value
	1 st reading		2 nd reading		3 rd reading		
	Mean	SD	Mean	SD	Mean	SD	
Male	36.11	8.86	36.39	8.75	-	-	0.746
Female	21.0	6.73	20.6	4.90	-	-	0.674
Male	36.11	8.86	-	-	35.78	8.00	0.674
Female	21.0	6.73	-	-	20.8	5.51	0.842
Male	-	-	36.39	8.75	35.78	8.00	0.286
Female	-	-	20.6	4.90	20.8	5.51	0.823

TABLE IV. MEAN AND STANDARD DEVIATION OF HAND PINCH STRENGTH FOR ALL MEASUREMENTS

Gender	Measurement of hand pinch strength						P-value
	1 st reading		2 nd reading		3 rd reading		
	Mean	SD	Mean	SD	Mean	SD	
Male	7.31	2.07	7.28	2.01	-	-	0.929
Female	3.85	0.88	3.7	1.18	-	-	0.656
Male	7.31	2.07	-	-	7.69	1.96	0.074
Female	3.85	0.88	-	-	3.6	1.29	0.591
Male	-	-	7.28	2.01	7.69	1.96	0.065
Female	-	-	3.7	1.18	3.6	1.29	0.785

IV. CONCLUSION

This study has been conducted on the indigenous people from Jahai tribe of Negrito group in Royal Belum, Perak, Malaysia. Sociodemographic data, anthropometric data and hand grip and pinch strength measurement were recorded for both male and female Orang Asli. It is found that the hand grip and pinch strength has statistically significant difference between male and female with the male having higher hand grip and pinch strength. The male are also having higher BMI and fall in the normal and healthy weight category. However, the female fall in the underweight category. The measurements are reproducible and reliable.

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