



The Influence of Body Mass Index (BMI) and Physical Activity on Hand Grip Strength in Tangerang Society

Dyan Puspita Hanung Pratiwi¹, Winati Nurhayu¹, Iffa Afiqa Khairani¹, Andy Darmawan¹, Gres Maretta¹, and Jeane Siswitasari Mulyana¹

¹Sumatera Institute of Technology
winati.nurhayu@bi.itera.ac.id

Abstract. Humans require good physical support to ensure the smooth running of their activity. Lack of physical activity can lead to weight gain and increase in Body Mass Index (BMI). Increasing weight on the body can affect motor performance, including postural balance and muscle strength. Therefore, BMI can affect muscle quality and can predict hand grip strength. This study aims to determine how BMI and physical activity affect hand grip strength and the influence of demographic factors that affect hand grip strength. The study was conducted by collecting data through physical activity interviews and measuring hand grip strength, body weight and height of Tangerang society. The total of 121 people with an age range of 20–60 years were assessed. This study found that BMI and physical activity significantly influenced the results of hand grip strength (p -value < 0.05). Hand grip strength was affected by age (p -value < 0.05 ; age estimate = -0.0013). The female gender had lower hand grip strength than the male age (p -value < 0.05 ; estimate female gender = -0.12). The construction worker was found to affect hand grip strength compared to other occupations. In addition, cigarette consumption had no effect on hand grip strength (p -value > 0.05).

Keywords: Physical activity; BMI; hand grip strength; and Tangerang

1 Introduction

Fitness and health of adults are important issues which affects productivity. The level of fitness is an important factor in determining the level of individual health. Good physical support is required daily activities will run well. Body Mass Index (BMI) can indicate health problems. Obesity, metabolic disorders and musculoskeletal problems are health problems which emerged in Indonesia and are related to relative high BMI [1].

The amount of calories consumed, without equal physical activity, will result in gaining weight and increasing BMI. High BMI will hinder daily activities and is closely related to disease and decreased muscle mass. BMI can have an impact on muscle quality and hand grip strength, because increased body weight can also affect motor performance, especially postural balance and muscle strength. Hand grip strength is often used to grasping, throwing, catching or lifting objects. Hand grip strength can be used

as a parameter of physical condition, fitness, and nutritional status [2]. Because, it is considered as marker of muscle quality.

Tangerang City is an urban area located adjacent to the capital city of DKI Jakarta. According to BPS data, approximately 61.9% of its population works as employees or civil servants, while only 3.9% are self-employed. This diversity in occupation contributes to a wide range of activities and lifestyles in Tangerang City, including easy access to high-calorie foods and various physical activity habits. In rural areas, grip strength is often correlated with physical activities, as a significant portion of the population still engages in daily tasks that require hand strength. However, in urban areas where activities tend to be sedentary, the effect of hand grip strength on activity is expected to be different. Thus, this study was conducted to determine the influence of Body Mass Index (BMI) and physical activity level on people in Tangerang society.

2 Subject and Method

2.1 Subject

The population in this study is the general people in Tangerang city with an age range from 20-60 years old. The total of 121 respondent live in Tangerang City involved in this study. Sampling was conducted through interviews and measurements on individuals who met the inclusion criteria which is no prior upper extremity injuries or fractures. Informed Consent Form was explained at the beginning and only the agreed participant that were assessed. Their weight, height, and hand grip strength were measured, and their physical activity during the last week were recorded. This research has been approved by the Health Research Ethics Committee of the Faculty of Medicine, University of Lampung 969/UN26.18/PP.05.0200/2023.

2.2 Measurements

Measurements taken include measuring grip strength, height, weight, BMI and collecting physical activity data for the past 7 days.

Hand grip strength: handgrip strength measurement were assessed and showed in Fig. 1. Hand grip strength was measured using a handgrip dynamometer. Respondents were asked to grip the tool in a standing position, with elbows fully extended with maximum force for three seconds. This measurement was taken three times for each the right and left hand, then the results were averaged.



Fig. 1. Hand grip strength measurement

Weight and height: Weight and height measurement were assessed and showed in Fig. 2. Body weight measurements were taken by standing upright on a digital scale without using footwear, then the result was seen on a digital scale in kilograms (Kg). Height measurement was done by standing upright against the wall without using footwear. The microtoise was pulled until it touched the head, then the result was seen on the microtoise in centimeter (cm)

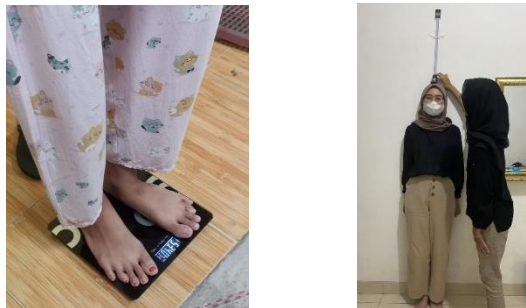


Fig. 2. Body weight & height measurements

Body mass index (BMI): The results of the weight in kilograms (Kg) and height in meter (m) measurements were calculated into Body Mass Index (BMI). The formula is:

$$BMI = \frac{Weight}{height^2}$$

Physical activity data: Respondent's physical activity data were collected through interviews based on International Physical Activity Questionnaire (IPAQ). Respondents were asked to report physical activity including vigorous physical activity, moderate physical activity, and light physical activity during the last 7 days. Physical activity data calculated as MET-minutes/week. The criteria for grouping physical activity questionnaires are based on physical activity related to work, physical activity related to

transportation, physical activity related to household chores, body care, and family life, and physical activity related to recreation, sports, and physical activity during recreation [3].

Analysis data: Data analysis was performed using the generalized linear model in R program version 4.2.2 to examine the influence of BMI, physical activity, age, sex, and occupation on hand grip strength.

3 Results and Discussion

The total respondents of this study were 121 individuals (71 females and 50 males). The age from 20 to 60 years old, with the average age of respondents around 34 years old. This study involved 13 sub-districts in Tangerang city, with the majority of respondents from Larangan (52 people), Ciledug (13 people) and Pinang (12 people) sub-districts. Respondents who smoked were 34 people and dominated by males. The highest income of respondent in the range of Rp. 1,000,000 to Rp. 3,000,000. This study found that there was an effect of income on physical activity. The high income was directly proportional to the high physical activity (p value < 0.05). However, there was no association between income and BMI (p -value $> 0,05$).

The results of the measurements indicated that the average hand grip strength among males was greater compared to females (Table 1). The measurement results of hand grip strength show that the right hand has higher results compared to the left hand. This is because most of the respondents had a dominant use of the right hand. Also, in this study, males were found to be heavier and taller than female. However, the average body mass index (BMI) for female is higher than the average BMI for males. Further measurements of physical activity showed that males were more active than females. Across all types, including light physical activity (3,374.910 \pm 2,990.324) moderate physical activity (1,2726 \pm 7,569,542) and vigorous physical activity (2,720 \pm 3,551,538).

Table 1. Average measurement of hand grip strength, (BMI), physical activity.

Measure- ments	average (standard deviation)		overall
	Gender		
	male	female	
HGR	30,70 (\pm 7,23)	19,55 (\pm 4,40)	24,16(\pm 7,94)
HGL	25,78 (\pm 7,72)	17,24 (\pm 4,34)	20,77 (\pm 7,29)
Weight	64,55 (\pm 12,80)	58,44 (\pm 13,77)	60,97 (\pm 13,43)
Height	167,74 (\pm 5,36)	157,68 (\pm 5,85)	161,84 (\pm 7,51)
BMI	22,94 (\pm 4,37)	23,53 (\pm 5,26)	23,29 (\pm 4,91)
MeT	18820,91(\pm 10032,18)	10526,10(\pm 8468,20)	13953,71(\pm 9987,47)

The data was tested for normality. In the measurement data found that BMI, physical activity, hand grip strength, age and sex were not normally distributed, so the variable

values were transformed into data in logarithm (log) form for further analysis [4]. Measurement variables are declared not normally distributed because they have a significant value below 0.05, therefore logarithmic transformation is used to improve data distribution [5].

The results in Table 2. show that BMI and physical activity affect the results of hand grip strength. The increasing of BMI and physical activity led to increasing, hand grip strength significantly (p value <0.05; estimate BMI = 0.12; estimate physical activity = 0.02). The grip strength and BMI is influenced by physical activity. The high level of physical activity will have an impact on increasing muscle strength, so it can increase hand grip strength. furthermore, hand grip strength is also influenced by muscle mass. The bigger and stronger the muscles will produce greater hand grip strength. Bone mass also indirectly affects grip strength. Bone density and bone length provide structure and support for the muscles to produce great grip strength [6].

Table 2. Linear model test results of BMI, physical activity, age, gender and lifestyle on grip strength

<i>Variable</i>	<i>Estimate</i>	<i>Std. Error</i>	<i>T value</i>	<i>P-value</i>
<i>(Intercept)</i>	0,6238	0,1333	4.678	7.96e ⁻⁰⁶ ***
BMI	0,1283	0,0343	3.738	0.000291 ***
Physical activity	0,0216	0,0091	2.374	0.019247 *
Age	-0,0013	0,0006	-2.182	0.031149 *
sex				
Female	-0,1208	0,0206	-5.866	4.37e ⁻⁰⁸ ***
<i>Lifestyle</i>				
Smoking	0,0035	0,0235	0.148	0.882780

There was a decrease in grip strength along with older age (p-value <0.05; age estimate = -0.0013). The average age of the participants in this study was 34 years old, which is the age at which hand grip strength begins to decrease. Peak handgrip strength occurs until the age of 30 and then decreases due to loss of muscle mass [4]. With increasing age, strength and muscle mass decrease. The decrease in muscle mass during aging is due to a decrease in the number of fibers and motor units in the muscle and a decrease in the number of muscle fibers. The loss of muscle fibers affects the ability to generate strength in the muscles and can reduce muscle metabolism, lead to an increase of muscle damage risk [7]. Anabolic hormones such as testosterone, estrogen, human growth hormone (HGH), DHEA, and IGF-1 also decrease with age, which can lead to a decrease in muscle strength and muscle mass [8]. Other causes of decreased hand grip strength include decreased physical activity [9].

female have lower handgrip strength, significantly (p value of <0.05; estimate -0.12). This finding is consistent with previous research showing that males have significantly higher handgrip strength compared to female [10]. The difference may be explained by the fact that male generally have greater muscle mass than females, which is influenced

by testosterone levels. Testosterone plays a crucial role in the development and maintenance of muscle mass [11]. Differences in daily physical activity between the sexes may also have an effect on handgrip strength, as measured by Metabolic Equivalent of Task (MET) values. This research shows that males tend to be more physically active than female, thus, males had higher handgrip strength.

Cigarette consumption had no effect on handgrip strength (p value > 0.05). Respondents who smoked in this study were found had high physical activity such as construction workers. This result is not in line with previous research, that shows a significant decrease in smokers [12]. In addition, research on the relationship between smoking status and physical fitness conducted on males in Taiwan found that there were differences in cardiorespiratory fitness and flexibility in smokers is lower than that of non-smokers [13]. Smoking can affect muscle mass depends on the activity. Lack of activity will cause a weakening of muscle function [14].

The type of work that affects hand grip strength in this study was construction worker compared to other types of work. Research conducted by Saremi (2019) which shows that manual work such as construction worker have stronger hand grip strength compared to non-manual work groups because manual workers more often use muscle strength in their daily activity [15]. Movements that require strength and are repeated can increase muscle strength and muscle mass, causing the results of the measurement of hand grip strength to be large. So, the more often a person participates in physical activity, the more muscles are trained, which increase hand grip strength [16].

In this study, it was found that as income increases, physical activity also increases, especially in the category of occupation and vehicle use. The results of this study reflect a similar pattern to research that has been conducted in the United States, the research that a high increase in income is associated with high individual physical activity. However, in this study, respondents were more active in the recreation and sports category. Individuals who have a high income have willingness to do sports activities such as gym and buy sports equipment needed in doing other physical activities [17].

4 Conclusion

It can be concluded that there is an influence of BMI and physical activity on hand grip strength. The higher the BMI and physical activity, the higher the hand grip strength. Demographic factors such as age, gender, and occupation also play a role in influencing hand grip strength. The higher the age, the lower the hand grip strength, the higher the hand grip strength of male than female, and the type of work that affects hand grip strength in this study is construction workers. However, there was no significant effect of cigarette consumption on hand grip strength.

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