ORIGINAL ARTICLE

# Correlation of Hand Grip Strength and Body Height Amongst Young Adults in Indonesia

Peppy Nawangsasi[1], Viskasari P. Kalanjati[2], Rudi Irawan[1], Risdiansyah[1], Ni Wajan Tirthaningsih[2]

[1] Magister Program of Basic Medical Science, Faculty of Medicine, Universitas Airlangga, Jl. Mayjen. Prof. Dr. Moestopo 47, Surabaya 60132 Indonesia
[2] Department of Anatomy and Histology, Faculty of Medicine, Universitas Airlangga, Jl. Mayjen. Prof. Dr. Moestopo 47, Surabaya 60132 Indonesia

## ABSTRACT

**Introduction:** Hand grip strength (HGs) is an anthropometric measure of musculoskeletal performance, which might predict any functional limitation and disability. Increased body height (Ht) is arguably correlated to the increase in number and length of the muscle fibers may modify the HGs. We determine correlation between the HGs and the Ht among seemingly healthy Indonesian young adults. **Methods:** The HGs of both hands (using CAMRY EH101 digital hand dynamometer) and the Ht (using GEA stature meter for height) of 16 males and 16 females aged 20 to 26 years old were measured. Data were analyzed using SPSS 25.0 (variables differences between genders were tested using Mann-Whitney U test; correlation between variables with Pearson or Spearman correlation tests). Level of significant was p< 0,05. **Results:** The correlation between Ht and HGs was moderate (r = 0.545, p < 0.05) for dominant hand and (r = 0.597, p < 0.05) non-dominant hand. There is no significant correlation between dominant HGs with Ht in males (r = -0,292, p 0,273) and females (r = -0.266, p 0,319), and also happens in non-dominant HGs with Ht in males (r = -0,396, p 0,129) and females (r = -0,005, p 0,985). **Conclusion:** HGs had significant correlation with Ht; hence in determining and assessing results of HGs in the young adults, body height should be considered.

**Keywords:** Hand grip strength, Young adults, Body height

**Corresponding Author:**
Viskasari P. Kalanjati, PhD
Email: viskasari-p-k@fk.unair.ac.id
Tel: +(031) 5020251

## INTRODUCTION

Hand grip strength (HGs) is an anthropometric measurement that is usually used to determine the functional limitations in the older patients and to determine muscle function in healthy young adults (1,2). A simple HGs measurement is harmless and low cost, this is why HGs is often used to evaluatethe hand strength and function (3,4). Neuromuscular and skeletal systems would be the predominant regions determining the HGs (5-7). HGs measurement, however, may also use as a hand exercise in rheumatoid arthritis of the hands, and as a physical rehabilitation for the recovery after hand's lesion. Furthermore, this exercise is often used to monitor the post-surgical hand surgery i.e. trigger finger and others clinical cases (8,9). The HGs is often related to anthropometric factors; men have 50-70% more strength compared to women at any age, the hard and the soft tissue components in the later are arguably in a lesser size generally (1,4). Studies have reported correlation between the HGs to other factors including: the body weight (2), anthropometric traits i.e. fat percentage (10), nutritional status (3,5), forearm diameter, middle finger length (6) and levels of physical activity (11). Whilst previous study has been focusing on the HGs in correlations to specific clinical conditions, not many studies have been conducted in the seemingly healthy young adults as in the current study; not to mention its correlation analysis to the body heights. To the best of our knowledge, such study in our region has yet widely reported whilst these would be useful for both patients and clinicians. Furthermore we also aimed to assess the influence of laterality on the hand grip strength subdividing by sex as a proxy to the hand muscle strength, thus function, between the dominant and the non-dominant hands in males and females; which has yet been largely studied. Any pathology of body growth and development that altering the body height may adversely affect the HGs in the later life, which might compromise the quality of life, especially related to the daily chores dependent to the HGs (4,9,12).

## MATERIALS AND METHODS

This study was started after obtaining ethical approval by the Health Ethic Committee of the Universitas Airlangga, no. 172/HRECC.FODM/III/2020. All participants were recruited after they had agreed and signed the written informed consent and consent for information. A cross-sectional study wasconducted on the 32 healthy young males and females in Surabaya, Indonesia (16 males and 16 females); aged 20-26 years. The exclusion criteria were ambidexterity, musculoskeletal and neurological deformity or any condition that can interfere the hand when uses a dynamometer. The HGs was measured using CAMRY EH101 digital hand dynamometer designed for auto capturing the maximum grip strength and recorded it in kilograms (China). Each participant was in relax sitting position with both feet on the floor, the elbow was in approximately 900 flexion. Participants were asked to keep the body in a neutral position. They were instructed to grip the hand dynamometer in each hand per time, as hard as possible and repeated it three times with one-minute rest between trials. Body height was measured using GEA stature meter (Indonesia), record to the nearest 0.1 cm, according to the standardized method (7). All steps were recorded and monitored by the medical doctor trained for this study. Data were tested for normal distribution using the Shapiro-Wilk test and reported as mean ± standard deviations (SD) and non-normal data were reported as medians with interquartile range. A Pearson correlation test was used to identify the relationship between the independent variables (HGs) and the dependent variables (Ht). Data were analyzed using SPSS 25.0 (USA) with level of significant p<0,05.

## RESULTS

The mean age of all participants was 21.06 years old with a standard deviation of 1.318 years old. The hand grip strength (HGs) of males is significantly greater than female in both hands; similar pattern was seen for the comparison of males and female body height (Table I).

Both side HGs had significant correlations to the body height of all participants (Table II). When analyzed separately however, no significant differences were found between the HGs and the Hts of the dominant and the non-dominant hands in either males or females (data not presented).

**Table I : The handgrip strengths and body height in all participants**

| | Mean ± SD | Shapiro-wilk p value | Levene test p value | Mann-Whitney p value | Mean Difference (95%CI) |
|---|---|---|---|---|---|
| **Dominant hand** | | | | | |
| Male (n=16) | 35.40 ± 9.68 | 0,101 | 0,0001 | 0.0001[a] | 13.90 (8.61-19.20) |
| Female (n=16) | 21.49 ± 3.72 | 0,643 | | | |
| Total (n=32) | 28.44 ± 10.09 | 0,003 | | | |
| **Non-dominant hand** | | | | | |
| Male (n=16) | 32.77 ± 8.19 | 0,817 | 0,0001 | 0.0001[a] | 14.01 (9.54-18.48) |
| Female (n=16) | 18.76 ± 3.06 | 0,692 | | | |
| Total (n=32) | 25.77± 9.36 | 0,009 | | | |
| **Body Height (Ht)** | | | | | |
| Male (n=16) | 170.50 ± 6.48 | 0,697 | 0,0001 | 0,0001[a] | 13.70 (9.62-17.78) |
| Female (n=16) | 156.80 ± 4.61 | 0,922 | | | |
| Total (n=32) | 163.65 ± 8.89 | 0,746 | | | |

[a]Significantly different between males and females.

**Table II : Correlation analysis of the HGs and the Ht in healthy young adults**

| | Body height | |
|---|---|---|
| | r | p |
| **Dominant hand** | | |
| Male | -0,292* | 0,273 |
| Female | -0,266* | 0,319 |
| Total | 0.545** | 0.001*** |
| **Non-dominant hand** | | |
| Male | -0,396* | 0,129 |
| Female | -0,005* | 0.985 |
| Total | 0.597** | 0.0001*** |

*Pearson; **Spearman, ***Significantly correlated.

## DISCUSSION

In this study, the handgrip strength of both hands and the body height in males were significantly greater than in females. We also found that taller people would have greater handgrip strength. Previous study showed that the handgrip strength and the height growth rate are age dependent (10). Taller people tend to have greater size of arm thus greater handgrip strength, this is shown in a study where taller people would have longer arms and greater force power (4).

There is a different in the growth spurt between males and females. The peak of the growth spurt in females is reached earlier than males. Hence, the handgrip strength is tended to be greater in females than males in their childhood. However, this would be inversed in the later life (9). In our study the difference of the HGs between males and females of the same age is about 13.90 (8.61-19.20) kg in the dominant hand whilst 14.01 (9.54-18.48) kg in the non-dominant hand. This is in accordance to other previous study conducted in the Caucasian people with similar age (7). In one study, it was reported that every 5 cm increase in the body height would increase the handgrip strength by approximately 1 kg in females and 1.5 kg in males (4). In other study, it was reported that the body height was closely correlated to the hand size. It was observed that the body height was approximately 9 times of the height of the hand length. With the increase of the hand size, arguably, the HGs would be increased as well (13). Handgrip strength is modulated by the musculoskeletal mass and function. Sarcopenia and frailty are two examples of pathology in older adults that could adversely affect the HGs, with alteration not only in the muscle size and volume, but also affecting the muscle functions. In the clinical cases such as sarcopenia and the frailty of the elderly patients, the declining mass and muscle function of the hands would impair the activities of daily life and the instrumental activities of daily life, especially in males. This sex-specific difference is yet clearly explained and needs further study (8,14). Further study with larger sample would be beneficial to confirm the current study finding, which came out from a relatively small participant number due to the physical distancing regulation during the pandemic of covid-19 era in 2020.

## CONCLUSION

The handgrip strength of both hands and the body height in males were significantly greater than in females. There was a strong significant correlation between HGs of both hands to the body height of all participants, although this was not the case if analyzed separately.


## ACKNOWLEDGEMENT

We would like to thank Department of Anatomy and Histology, Faculty of Medicine, Universitas Airlangga, Faculty of Medicine, Hang Tuah University for all supports.


## REFERENCES


1. Rodrнguez-Garcна WD, Garcна-Castaceda L, Orea-Tejeda A, Mendoza-Nьcez V, Gonzбlez-Islas DG, Santillбn-Dнaz C, et al. Handgrip strength: Reference values and its relationship with bioimpedance and anthropometric variables. Clin Nutr ESPEN. 2017;19:54–8.
2. Eidson CA, Jenkins GR, Yuen HK, Abernathy AM, Brannon MB, Pung AR, et al. Investigation of the relationship between anthropometric measurements and maximal handgrip strength in young adults. Work. 2017;57(1):3–8.
3. Kim CR, Jeon Y-J, Kim MC, Jeong T, Koo WR. Reference values for hand grip strength in the South Korean population. Mogi M, editor. PLoS One. 2018;13(4):e0195485.
4. Steiber N. Strong or Weak Handgrip? Normative reference values for the German population across the life course stratified by sex, age, and body height. Kiechl S, editor. PLoS One. 206;11(10):e0163917.
5. Budziareck MB, Duarte RRP, Barbosa-Silva MCG. Reference values and determinants for handgrip strength in healthy subjects. Clin Nutr. 2008;27(3):357–62.
6. Abaraogu UO, Ezema CI, Ofodile UN, Igwe SE. Association of grip strength with anthropometric measures: Height, forearm diameter, and middle finger length in young adults. Polish Ann Med. 2017;24(2):153–7.
7. Chandrasekaran B, Ghosh A, Prasad C, Krishnan K, Chandrasharma B. Age and anthropometric traits predict handgrip strength in healthy normals. J Hand Microsurg. 2016;02(02):58–61.
8. Cruz-Jentoft AJ, Baeyens JP, Bauer JM, Boirie Y, Cederholm T, Landi F, et al. Sarcopenia: European consensus on definition and diagnosis. Age Ageing. 2010;39(4):412–23.
9. Ploegmakers JJW, Hepping AM, Geertzen JHB, Bulstra SK, Stevens M. Grip strength is strongly associated with height, weight and gender in childhood: A cross sectional study of 2241 children and adolescents providing reference values. J Physiother. 2013;59(4):255–61.
10. Sartorio A, Lafortuna CL, Pogliaghi S, Trecate L. The impact of gender, body dimension and body composition on hand-grip strength in healthy

children. J Endocrinol Invest. 2002;25(5):431–5.
11. Gьnther CM, Bьrger A, Rickert M, Crispin A, Schulz CU. Grip Strength in healthy caucasian adults: Reference values. J Hand Surg Am. 2008;33(4):558–65.
12. Zaccagni L, Toselli S, Bramanti B, Gualdi-Russo E, Mongillo J, Rinaldo N. Handgrip strength in young adults: Association with anthropometric variables and laterality. International Journal of Environmental Research and Public Health. 2020;17(12):1–12.
13. Pawar PK, Dadhich A. Study of correlation between human height and hand length in residents of Mumbai. Int J Biol Med Res. 2012; 3(3):2072 - 2075.
14. Meskers CGM, Reijnierse EM, Numans ST, Kruizinga RC, Pierik VD, Ancum JM va., et al. Association of handgrip strength and muscle mass with dependency in (instrumental) activities of daily living in hospitalized older adults - The empower study. J Nutr Heal Aging. 2019; 23(3):232.