Relative Handgrip Strength, But Not the Absolute Handgrip, Correlates with HOMA-IR in Non-Diabetic Young Adults

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ABSTRACT:

Introduction: Insulin resistance is a metabolic disorder that many people with obesity suffer from and is a trigger for diabetes in the future. Insulin resistance can be measured by various parameters, one of which is HOMA-IR. Reduced handgrip strength has been associated with insulin resistance.

Objectives: This study aims to determine the relationship between absolute handgrip strength and relative handgrip strength with insulin resistance measured by HOMA-IR.

Methods: A total of 165 non-diabetic young adult subjects were recruited into this cross-sectional study. Absolute and relative handgrip strength were measured and their relationship with HOMA-IR was evaluated.

Results: Relative handgrip strength was negatively correlated with HOMA-IR, both normalized by BMI (r = -0.163, p = 0.036) and BW (r = -0.230, p = 0.003) while absolute handgrip strength was not correlated with HOMA-IR (r = 0.110, p = 0.158).

Conclusions: Relative handgrip strength is associated with insulin resistance while absolute handgrip strength is not correlated with insulin resistance. Relative handgrip strength normalized by BW had a stronger negative correlation with HOMA-IR than that normalized by BMI. In assessing insulin resistance, relative handgrip strength measurements should be used rather than absolute handgrip strength.

1. Introduction

Insulin resistance is a global problem associated with increased incidence of metabolic and cardiovascular diseases.[1] The reported prevalence of insulin resistance varies from 40 to more than 50%. Reports from the United States show that the prevalence of insulin resistance in 2015-2018 was 40.3%.[2] Its prevalence in Indonesia is estimated at 44.2% while the prevalence of insulin resistance in Southeast Asian countries is estimated at 44.3%.[3]

Assessment of insulin resistance can be done using various methods. The gold standard method for assessing insulin resistance is the euglycemic hyperinsulinemic clamp (EHC). The EHC method is difficult and somewhat complicated to carry out, so various other methods of measuring insulin resistance

have been developed, such as calculating the homeostasis model of assessment of insulin resistance (HOMA-IR), which is simpler to carry out.[4] Handgrip strength, which reflects skeletal muscle strength, can provide an overview of resistance. insulin. Several studies report a link between handgrip strength and insulin resistance and prediabetes in various populations, including children, adolescents, adults, and the elderly. The greater the handgrip strength, the lower the incidence of insulin resistance.[5-7]

2. Objectives

Handgrip strength can be measured directly (absolute) or relatively (normalized by body mass index (BMI) or body weight (BW)). This study aims to evaluate the

relationship between absolute and relative handgrip strength and insulin resistance (assessed by HOMA-IR).

3. Methods

A total of 165 adult volunteers aged between 18 and 40 years were recruited into this cross-sectional study. The inclusion criteria were adult subjects who did not have diabetes mellitus (DM) or were not taking DM medications. The exclusion criteria were if the study subjects were proven to have DM based on the results of fasting blood glucose and oral glucose tolerance test (OGTT) according to the American Diabetes Association (ADA) criteria.[8] This study was conducted after obtaining ethical recommendations from the Ethics Committee of the Faculty of Medicine, Hasanuddin University with number: 556/UN4.6.4.5.31/PP/2023.

The study subjects fasted from 10 pm and went to the laboratory at 8 am the next morning for examination. Weight, height, and body mass index (BMI) were measured, and then the absolute handgrip strength of the dominant arm was assessed using a CAMRY-type EH101 device. The mean absolute handgrip strength after two measurements was used in the subsequent analysis. Two kinds of relative handgrip strength measurements were performed; the first divided the absolute handgrip strength results by BMI; and the second divided the absolute handgrip strength results by BW. Furthermore, venous blood was drawn and then centrifuged to obtain serum. Serum was used to check fasting glucose levels by enzymatic colorimetry method (ABX Pentra 400) and fasting insulin (Elecsys 2010). HOMA-IR was then calculated using fasting insulin and glucose data.[4] The Statistical Package for the Social Sciences (SPSS) Version 21 program was used to conduct the statistical analysis.

4. Results

A total of 165 volunteers were recruited into this study consisting of 98 (59.4%) females and 67 (40.6%) males. A total of 153 (92.7%) subjects had a right dominant arm and 12 (7.3%) subjects had a left dominant arm. Table 1 shows the baseline characteristics of the study subjects. BMI and fasting plasma glucose (FPG) parameters were normally distributed, while the other parameters were not normally distributed. Table 2 shows the correlation test between absolute and relative handgrip strength with HOMA-IR and other parameters. There was no significant correlation between absolute handgrip strength and HOMA-IR (p = 0.158), but relative

handgrip strength was correlated with HOMA-IR, both normalized by BMI (r = -0.163, p = 0.036) and BW (r = -0.230, p = 0.003).

Table 1. Basic Features of the Subjects

Variables	Subjects (n = 165)	
	Median (Min-Max)	Mean±SD
Age (year)	32 (19-40)	31.59±5.18
BW (Kg)	62 (28-130.1)	64.03±14.46
BMI (Kg/m2)	25.06 (15.32-45.02)	25.07±4.85
Glucose (mg/dL)	95 (58-123)	95.37±9.54
Insulin (μU/L)	10.09 (2.74-43.23)	12.59±8.20
HOMA-IR (Unit)	2.43 (0.53-9.93)	2.97±1.97
Absolute handgrip strength (kg)	25.55 (10.15-54.10)	27.61±9.39
Relative handgrip strength (kg/BMI)	1.04 (0.8-2.54)	1.13±0.43
Relative handgrip strength (kg/BW)	0.42 (0.15-0.90)	0.44±0.15

Table 2. Correlation of Absolute and Relative Handgrip Strength with HOMA-IR and Other Variables

Variable	Absolute handgrip strength		Relative handgrip strength (BMI)		Relative handgrip strength (BW)	
	p*	r	p*	r	p*	r
Glucose	0.037	0.163	0.352	0.073	0.703	0.030
Insulin	0.300	0.081	0.020	-0.181	0.002	-0.238
HOMA-IR	0.158	0.110	0.036	-0.163	0.003	-0.230
Age	0.294	-0.082	0.008	-0.207	0.010	-0.200

*Spearman Correlation Test

5. Discussion

This study shows that insulin resistance can be assessed by handgrip strength, the stronger a person's handgrip strength the lower their insulin resistance. This is consistent with previous reports that have reported similar results. A study in a population of children and

adolescents in South Korea found that the risk of developing insulin resistance increases as relative handgrip strength decreases.[5] A study in an adult population in Korea also found that the risk of developing prediabetes and diabetes decreases as handgrip strength increases.[6] Another study reported that the ability of handgrip strength to predict insulin resistance can only be applied to male subjects, not to women.[9] In the elderly population, the prevalence of insulin resistance is also reported to increase as handgrip strength decreases.[7] The risk of metabolic syndrome, which is one of the consequences of insulin resistance, also increases as handgrip strength decreases.[10] Insulin resistance can occur in various organs including the liver, muscle, and adipose tissue, which causes disruption of glucose metabolism in these organs resulting in hyperglycemia.[11] Muscle strength, which in this case is assessed by handgrip strength, reflects the condition of skeletal muscles. The stronger the muscle strength the better the insulin sensitivity.[12]

This research also shows that handgrip strength which is related to insulin resistance is relative strength and not absolute strength. Handgrip strength must be normalized by BMI or BW before being associated with insulin resistance. This study also found that relative handgrip strength normalized by BW had a slightly stronger correlation ($r = -0.230$) with insulin resistance compared to that normalized by BMI ($r = -0.163$). The limitation of this research is that the cross-sectional design used cannot explain the cause-and-effect relationship between the variables studied.

6. Conclusion

Relative handgrip strength was associated with insulin resistance while absolute handgrip strength was not correlated with insulin resistance. In assessing insulin resistance, it is best to use relative handgrip strength measurements rather than absolute handgrip strength.

Conflict of Interest: Authors declare no conflicts of interest

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