

## Handgrip strength is associated with metabolic syndrome among middle-aged and elderly community-dwelling persons

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### Abstract

The association of low muscle strength with cardio-metabolic risks remains controversial. The present study included 742 men aged 70 ± 9 years and 937 women aged 70 ± 8 years from a rural village. We examined the cross-sectional relationship between relative muscle strength defined by handgrip strength (HGS)/body weight (BW) ratio, and metabolic syndrome (MetS) based on the modified criteria of the National Cholesterol Education Program's Adult Treatment Panel (NCEP-ATP) III report and its components. Of these, 203 men (27.4%) and 448 women (47.8%) had MetS. In men, increasing quartile of HGS/BW ratio was significantly and independently associated with high waist circumference (odds ratio, 0.31; 95% confidence interval (CI), 0.24–0.41) and elevated triglyceridemia (0.71, 0.59–0.86). In women, it was also significantly and independently associated with high waist circumference (0.41; 0.36–0.48), high blood pressure (0.78; 0.66–0.92), Low HDL-cholesterolemia (0.84; 0.73–0.98) and elevated triglyceridemia (0.65; 0.53–0.79). In both genders, the prevalence of MetS significantly decreased in relation to increasing HGS/BW ratio. After adjustment for age, smoking status, drinking status, LDL-C, estimated glomerular filtration ratio (eGFR), and medication, the respective odds ratio (95% CI) for the quartile of HGS/BW ratio for MetS was 1.00, 0.54 (0.34–0.85), 0.32 (0.19–0.53), and 0.16 (0.09–0.29) in men, and 1.00, 0.76 (0.50–1.16), 0.33 (0.22–0.51), and 0.16 (0.10–0.25) in women. These results suggest that HGS/BW ratio was significantly and negatively associated with an increased risk of cardio-metabolic disorders in Japanese-community dwelling persons.

### Introduction

Handgrip strength (HGS) is an easily obtainable measure of physical health and muscle function. It is a commonly used test to estimate overall nutrition (1), future disability (2), functional capacity (3–5), adverse outcomes (mortality, functional decline, institutionalization) (6,7), cardiovascular disease (CVD) (8), as well as cause-specific and total mortalities (9,10). Moreover, HGS was strongly correlated with total muscle strength, and correlation coefficients between 0.736 and 0.890. Moreover, the correlation remained strong even when controlled for body weight (BW) (0.485–0.564). This indicates that in clinical practice, HGS can be used as a tool to provide rapid indication of someone's general muscle strength (11).

Metabolic syndrome (MetS) is a cluster of cardio-metabolic risk factors, such as central obesity, systemic hypertension, elevated fasting glucose, elevated triglyceridemia, and

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low high-density lipoprotein cholesterol (HDL-C) levels. It is known as a pre-disease state that leads to an increased risk of CVD (12,13), type 2 diabetes (12), and all-cause mortality (12,14). The prevalence of MetS is increasing worldwide with the global increase in obesity. MetS is more prevalent in women and the elderly (15), and is related to several modifiable lifestyle-related factors, such as physical activity level (16) and muscle strength (17,18). Insulin resistance plays an important role in the pathophysiology of MetS and has even been postulated as its underlying cause. Moreover, it has also been ~~been~~ suggested as a pathogenetic mechanism of muscle loss because skeletal muscle plays an important role in whole-body glucose metabolism and insulin sensitivity (19,20). In addition, increased intramyocellular fat content and fatty acid metabolites have also been shown to play a pivotal role in the development of insulin resistance in skeletal muscle (21–23). Many studies investigating the relationship between muscle loss and MetS have yielded conflicting results (24–27). However, the effects of declining muscle strength on insulin resistance have not been investigated in the general population.

To address this hypothesis, we examined the cross-sectional relationship between HGS as total muscle strength, and MetS based on the modified criteria of the National

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