Response: The Differential Association between Muscle Strength and Diabetes Mellitus According to the Presence or Absence of Obesity (J Obes Metab Syndr 2019;28:46-52)

Bo Kyung Koo*

Department of Internal Medicine, SMG-SNU Boramae Medical Center, Seoul National University College of Medicine, Seoul, Korea

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*Corresponding author
Bo Kyung Koo

<https://orcid.org/0000-0002-6489-2656>

Department of Internal Medicine,
SMG-SNU Boramae Medical Center,
Seoul National University College of
Medicine, 20 Boramae-ro 5-gil,
Dongjak-gu, Seoul 07061, Korea
Tel: +82-2-870-2225
Fax: +82-2-831-2826
E-mail: bokyungkoomd@gmail.com

Currently, the Foundation for the National Institutes of Health Biomarkers Consortium Sarcopenia Project¹ and European Working Group on Sarcopenia in Older People² define muscle strength based on absolute muscle strength. Handgrip is relatively independent of weight-bearing movement, and no difference in absolute handgrip power between obese and non-obese subjects was reported.³ However, the relationship between body mass and muscle strength might be different between obese and non-obese individuals.³ In my previous study using Korea National Health and Nutrition Examination Survey (KNHANES) from 2014 to 2016, low muscle strength (LMS) defined using absolute handgrip strength, was independently associated with diabetes mellitus only in a non-obese population.⁴

Nutritional status, socioeconomic status, and occupation might be important confounders in the difference seen in the association between diabetes and LMS according to obesity status. An additional adjustment for daily protein intake per body weight (g/kg) confirmed that LMS was significantly associated with diabetes mellitus only in individuals without obesity (odds ratio [OR], 1.533; 95% confidence interval [CI], 1.224–1.920; model 2 in Table 1),

which was not different from the previously reported multivariable regression analysis results (model 1 in Table 1⁴). Furthermore, additional adjustments for socioeconomic status, occupation, and education level did not attenuate the statistical significance in the association between LMS and diabetes mellitus in non-obese individuals (OR, 1.487; 95% CI, 1.178–1.877; model 3 in Table 1). By contrast, there was no significant association between LMS and diabetes in an obese population in the same model (Table 1).

The significant association between diabetes and LMS in the non-obese population⁴ might be confounded by the muscle wasting and body weight loss frequently seen in subjects with long duration of diabetes or severe hyperglycemia. Comparing the diabetic subjects with and without obesity in the study population, non-obese diabetic subjects showed a significantly longer duration of diabetes compared to those with obesity: mean duration of diabetes was 6.7 years (standard error [SE], 0.3 years) and 4.2 years (SE, 0.2 years) in non-obese and obese diabetic subjects, respectively ($P < 0.001$). However, there was no difference in mean glycosylated hemoglobin level according to obesity status (7.2% [SE, 0.1%] and 7.2% [SE, 0.1%] in both groups; $P = 0.740$).

Table 1. The risk of diabetes mellitus according to low muscle strength in a stratified analysis according to the presence or absence of obesity

(Unweighted N)	Total (n = 14,642)		Non-obesity (n = 9,412)		Obesity* (n = 5,230)	
	OR (95% CI)	P	OR (95% CI)	P	OR (95% CI)	P
Unadjusted	1.248 (1.094–1.423)	0.001	1.444 (1.205–1.731)	<0.001	1.200 (0.982–1.468)	0.075
Model 1	1.317 (1.123–1.544)	0.001	1.513 (1.224–1.870)	<0.001	1.124 (0.879–1.437)	0.351
Model 2	1.325 (1.116–1.573)	0.001	1.533 (1.224–1.920)	<0.001	1.127 (0.870–1.461)	0.365
Model 3	1.308 (1.095–1.563)	0.003	1.487 (1.178–1.877)	0.001	1.144 (0.876–1.495)	0.323

*Defined as subjects with a body mass index ≥ 25 kg/m².

OR, odds ratio; CI, confidence interval; Model 1, adjusted for age, sex, muscle strength, family history of diabetes, abdominal obesity, hypertriglyceridemia, low high-density lipoprotein cholesterol, and hypertension; Model 2, adjusted for protein intake in addition to model 1; Model 3, adjusted for socioeconomic status, occupation, and education in addition to model 2.

Considering the difference in the duration of diabetes according to obesity status, subsequent analyses for recent-onset diabetes (duration less than 5 years) were performed. The prevalence of recent-onset diabetes was 6.3% (SE, 0.7%) and 5.5% (SE, 0.3%) in non-obese individuals with and without LMS; and 14.2% (SE, 0.7%) and 14.6% (SE, 1.4%) in obese subjects with and without LMS. There was no statistically significant association between LMS and recent-onset diabetes in either of the non-obese and obese groups (data not shown).

Information about body composition was not available in the KNHANES 2014–2016. Muscle mass itself has been reported to increase the risk of diabetes mellitus.⁵ Body mass index (BMI) cannot differentiate muscle mass from fat mass. Considering the limitation of BMI as an obesity marker,⁶ further studies to elucidate the independent association between LMS and diabetes according to body composition are needed.

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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