Low Muscle Strength as a Risk Factor for Non-Alcoholic Fatty Liver Disease in Different Metabolic Subgroups

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Background

Recently, Non-alcoholic fatty liver disease (NAFLD) has become one of the leading liver diseases that threatens our health worldwide. Low muscle strength, obesity, insulin resistance, and metabolic syndrome are recognized as key factors for NAFLD. However, the impact of low muscle strength itself in different metabolic conditions has not been widely studied.

Methods

A cross-sectional analysis was performed on a sample of 5,427 participants from the 2019 Korea National Health and Nutrition Examination Survey (KNHANES). Relative handgrip strength [rHGS=handgrip strength/body mass index (BMI)] was used to assess muscle strength. The cut-off values for low rHGS were 1.405 for men and 0.850 for women. NAFLD was diagnosed if the Hepatic Steatosis Index (HSI) was over 36. Participants were stratified according to insulin resistance, metabolic syndrome and obesity for subgroup analyses.

Results

Complex samples multivariate logistic regression analysis revealed a significant association between low muscle strength and NAFLD after adjustment for other confounders (odds ratio [OR] = 2.41, $p<0.001$). In subgroups stratified by insulin resistance, metabolic syndrome, and obesity, a significant association between low muscle strength and NAFLD still remained (OR = 2.05-4.19 depending on the subgroup, all $p<0.05$), except in the non-obese group.

Table 1. Adjusted ORs with 95% CIs for NAFLD of the lowest sex-specific rHGS quartile, assessed by two different predictive models

	By HSI (n=1194, 24.0%)		
Variables	Odds ratios	95% CI	P value
Crude model	3.49	2.93-4.15	<0.001
Multivariable	2.41	1.62-3.57	<0.001

P values were obtained by complex samples multivariate logistic regression analyses

Multivariable: adjustment for age, gender, waist circumference, weight, HOMA-IR, fasting blood glucose, total cholesterol, triglyceride, AST, ALT, diabetes, hypertension status, aerobic exercise, resistant exercise, smoking, drinking status and residence.

Table 2. Adjusted ORs with 95% CIs for NAFLD of the lowest sex-specific rHGS quartile assessed by HSI according to insulin resistance, metabolic syndrome and obesity

	Variables	Model 1	Model 2	Model 3
Subgroup 1	Insulin resistance (+)	2.94 (2.26-3.83)	2.41 (1.38-4.18)	2.18 (1.21-3.90)
	P value	<0.001	0.002	0.009
	Insulin resistance (-)	3.04 (2.29-4.06)	2.47 (1.35-4.50)	2.38 (1.28-4.43)
	P value	<0.001	0.003	0.006
Subgroup 2	Metabolic syndrome (+)	2.98 (2.31-3.84)	2.22 (1.31-3.76)	2.03 (1.21-3.42)
	P value	<0.001	0.003	0.008
	Metabolic syndrome (-)	4.19 (3.12-5.63)	3.21 (1.71-6.02)	3.55 (1.77-7.11)
	P value	<0.001	<0.001	<0.001
Subgroup 3	Obese	2.05 (1.58-2.65)	2.35 (1.37-4.04)	2.24 (1.29-.89)
	P value	<0.001	<0.001	0.01
	Non-obese	1.08 (0.67-1.73)	0.81 (0.32-2.08)	0.55 (0.22-1.38)
	P value	0.77	0.67	0.20

P values were obtained by complex samples multivariate logistic regression analyses

Model 1 = age and sex. Model 2 = model 1 + waist circumference, weight, HOMA-IR, fasting blood glucose, total cholesterol, triglyceride, AST, ALT, diabetes status, and hypertension. Model 3 = model 2 + aerobic exercise, resistant exercise, smoking, drinking status and residence

Conclusion

This research presented that low muscle strength correlates with a risk of NAFLD. This relationship was independent of insulin resistance and metabolic syndrome, but was dependent on the presence of obesity.