



Association of Regular Resistance Training and Obesity with Type 2 Diabetes Prevalence among Korean Adults: Analysis of the 2023 Korea National Health and Nutrition Examination Survey (KNHANES) Data

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Dear Editor-in-Chief

A decline in physical activity and an increase in sedentary behavior are recognized as significant determinants of obesity, which, in turn, contribute to an elevated risk of developing a range of chronic diseases, including type 2 diabetes. Particularly in South Korea, aerobic activities such as walking and running are the predominant forms of physical activity, whereas participation in resistance training remains comparatively limited. Muscle hypertrophy resulting from resistance training has a positive effect on blood glucose control, thereby offering significant benefits to individuals with type 2 diabetes (1).

Therefore, this study aimed to investigate the associations among regular participation in resistance training, obesity levels, and the risk of developing type 2 diabetes among Korean adults, based on the 2023 Korea National Health and Nutrition Examination Survey (KNHANES) data.

The data utilized in this study were obtained from the 2023 KNHANES, comprising a sample of 4,881 Korean adults aged 19 years or older. The dataset included responses to a physical activity

questionnaire (specifically regarding resistance training) and measures of fasting blood glucose levels. In this study, "regular participation in resistance training" was defined as performing in resistance exercises such as push-ups, sit-ups, dumbbell exercises, weightlifting, and pull-ups, for at least 60 minutes on three or more days in the past week. Body mass index (BMI) was calculated using the following formula: $BMI = \text{weight (kg)} / \text{height (m)}^2$. Additionally, the diagnostic criteria for diabetes were defined according to the guidelines set forth by the American Diabetes Association, where diabetes was defined as having a fasting blood glucose level of 126 mg/dL or higher (2). Statistical analysis was conducted using SPSS/Windows version 26.0 (IBM Corp., Armonk, NY, USA). The participants were categorized based on their regular participation in resistance training and obesity levels, dividing them into high and low BMI groups. Subsequently, the participants were further stratified into four groups: ① Regular participation in resistance training (RRT) & Low BMI, ② RRT & High



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BMI, ③ Non-participation in resistance training (NRT) & Low BMI, and ④ NRT & High BMI. After adjusting for potential confounders, including age, gender, and smoking, logistic regression analysis was performed to calculate the odds ratio

(OR) and 95% confidence interval (CI). Participants were classified based on regular participation in resistance training and BMI, with BMI being categorized as high ($\text{BMI} \geq 25 \text{ kg/m}^2$) and low ($\text{BMI} < 25 \text{ kg/m}^2$). The analysis of the risk of type 2 diabetes across the four groups is provided in Table 1.

Table 1: Combined association of regular participation in resistance training and BMI levels on Type 2 diabetes

Total (n=4,881)	RRT		NRT	
	BMI < 25kg/m ² (n=614)	25kg/m ² ≤ BMI (n=311)	BMI < 25kg/m ² (n=2,522)	25kg/m ² ≤ BMI (n=1,434)
OR (95% CI) Crude				
	1	2.36(1.29-4.31)	1.82(1.14-2.90)	3.27(2.05-5.22)
Adjusted for age, sex, and smoking				
	1	2.58(1.40-4.76)	2.18(1.35-3.50)	3.79(2.35-6.11)
Abbreviations, RRT: Regular participation in resistance training, NRT: Non-participation in resistance training, OR: Odds Ratio, CI: confidence interval.				

After adjusting for age, gender, and smoking, the analysis showed a significantly higher risk of developing type 2 diabetes in the 'RRT & High BMI' group, 'NRT & Low BMI' group, and 'NRT & High BMI' group compared to the 'RRT & Low BMI' group [Reference, Odds ratio (OR): 1]. Specifically, the odds ratios for these groups were 2.58 [OR: 2.58 (95% CI: 1.40-4.76)], 2.18 [OR: 2.18 (95% CI: 1.35-3.50)], and 3.79 [OR: 3.79 (95% CI: 2.35-6.11)], respectively, with all differences reaching statistical significance.

This study established that regular participation in resistance training and obesity levels are significantly associated with the risk of developing type 2 diabetes among Korean adults. A reduction in physical activity and exercise, coupled with an increase in sedentary behavior, has been shown to elevate obesity levels and decrease lean body mass, both of which contribute to an increased risk of developing type 2 diabetes (3). In light of the present findings and previous research, regular engagement in resistance training and effective weight management emerge as key strategies for promoting healthier lifestyles among Korean adults.

In conclusion, regular resistance training that promotes muscle hypertrophy, together with appropriate weight management, is one of the most effective approaches to reducing the risk of diabetes in Korean adults.

Conflict of interest

The authors declare that there is no conflict of interest.

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