

# Association of Muscular Strength with Incidence of Metabolic Syndrome in Men

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## Abstract

**Purpose:** To examine the association between muscular strength and incidence of metabolic syndrome.

**Methods:** Participants were 3233 men (20-80 yr) initially free of metabolic syndrome who had two or more clinical examinations between 1980 and 2003, including baseline muscular strength and cardiorespiratory fitness assessment. Metabolic syndrome was defined according to NCEP-ATP III criteria. Muscular strength was quantified by combining body weight-adjusted one-repetition maximal measures for leg and bench presses. Cardiorespiratory fitness was assessed by maximal treadmill test.

**Results:** A total of 480 men developed metabolic syndrome during a mean follow-up period of  $6.7 \pm 5.2$  yr. In a Cox regression analysis adjusted for age, the hazard ratios (95% confidence intervals) of metabolic syndrome associated with the incremental categories of muscular strength were 1.00 (referent), 0.88 (0.69-1.12), 0.77 (0.60-0.98), and 0.54 (0.42-0.71), respectively (linear trend  $P < 0.0001$ ). The inverse trend persisted after adjustment for smoking, alcohol intake, number of baseline metabolic syndrome risk factors, family history of diabetes, hypertension, and premature coronary disease ( $P = 0.004$ ), but was attenuated ( $P = 0.06$ ) when further adjusted for cardiorespiratory fitness. Compared with the lowest strength category, the highest strength category was associated with 44 and 39% lower risk ( $P < 0.05$  each) of incident metabolic syndrome among normal weight body mass index (BMI  $< 25$ ) and overweight or obese (BMI  $\geq 25$ ) men, respectively. An inverse association of incident rates was also seen within stratum of age (20-39 yr,  $P < 0.001$ ; 40-49 yr,  $P < 0.01$ ; and 50+ yr,  $P < 0.05$ ).

**Conclusions:** Muscular strength was inversely associated with metabolic syndrome incidence, independent of age and body size. Potential benefits of greater muscular strength presumably through resistance exercise training should be considered in primary prevention of metabolic syndrome.