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Brief research report

Metabolic syndrome and discrepancy between actual and self-identified good weight: Aerobics Center Longitudinal Study

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ABSTRACT

This study examined whether the discrepancy between measured and self-identified good weight (weight discrepancy) predicts metabolic syndrome (MetSyn). This study included 6,413 participants enrolled in the Aerobics Center Longitudinal Study (mean follow-up: 4.8 ± 3.8 years). Weight discrepancy was defined as measured weight minus self-identified good weight. MetSyn was defined using standard definitions. Hazard ratios (HRs) and 95% confidence intervals (95% CIs) for incident MetSyn, by weight discrepancy category, were estimated using Cox proportional hazards regression. The multivariable-adjusted HR for MetSyn was 3.48 (95% CI = 2.48–4.86) for those who maintained higher weight discrepancy over time compared to individuals with lower weight discrepancy. Additional adjustment for body mass index did not change this interpretation (HR = 3.44; 95% CI = 2.46–4.82). Weight discrepancy may be a useful screening characteristic and target for future interventions to further reduce the risk of chronic weight-related disorders, included MetSyn.

Introduction

Previous cross-sectional research has indicated that larger discrepancies between measured and self-identified good weight (i.e., weight discrepancy) have been associated with greater dieting frequency, increased snacking, yo-yo dieting, physical inactivity, tobacco use, and alcohol consumption (Blake et al., 2013). Individuals with chronically larger weight discrepancies had three times greater risk of developing type 2 diabetes compared to individuals with smaller weight discrepancies (Wirth, Blake, Hebert, Sui, & Blair, 2014). Although this concept of weight discrepancy has not been validated against measures of weight dissatisfaction, similarities do exist. For example, weight dissatisfaction also has been associated with poor eating habits (e.g., vomiting, binging), increased tobacco and alcohol consumption, diagnosed mental illness, poorer self-perceived health, and stress (Forrester-Knauss & Zemp Stutz, 2012; Garber, Boyer, Pollack, Chang, & Shafer, 2008; Keel, Baxter, Heatherton, & Joiner, 2007; Wade, Zhu, & Martin, 2011).

Although there is little research focusing on weight discrepancy and health outcomes, it is possible that the mechanisms of disease progression among those with high weight discrepancy may be similar to those proposed for high weight dissatisfaction. Those with chronically high weight discrepancies over time may experience excessive stress or negative affect, which can potentially induce numerous physiological changes (e.g., immune, metabolic, inflammatory, and behavioral changes) potentially increasing the risk of chronic disease. A similar mechanism has been proposed for weight dissatisfaction (Cernelic-Bizjak & Jenko-Praznikar, 2014; Muennig, 2008; Steptoe & Brydon, 2009) and may be applicable for weight discrepancy as well.

Although related to diabetes, metabolic syndrome (MetSyn) includes multiple factors associated with poor health characteristics (i.e., abdominal obesity, hypertension, glucose intolerance, elevated triglycerides, and high-density lipoprotein cholesterol [HDL-C]) (Grundy, Brewer, Cleeman, Smith, & Lenfant, 2004). The estimated prevalence of MetSyn typically falls between 20% and 30% for most countries, with an elevated prevalence mirroring

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a high rate of obesity in the United States, where about 69% of the population is overweight (34%) or obese (35%) (Grundy, 2008; Ogden, Carroll, Kit, & Flegal, 2014). Interventions targeting poor health behaviors, such as those associated with factors linked to the weight discrepancy, have been found to reduce the risk of MetSyn (Yamaoka & Tango, 2012). Therefore, we hypothesized that larger weight discrepancies at baseline would be associated with increased MetSyn among a population of adults from the Aerobics Center Longitudinal Study (ACLS). Additionally, we hypothesized that those with chronically higher weight discrepancies over a period ≥2 years will have increased risk of MetSyn compared to those who maintained lower weight discrepancies.

Method

Participants

The ACLS enrolled volunteer patients who were referred by doctors or healthcare providers for preventive medical examinations from the Cooper Clinic (Dallas, TX). The Cooper Institute Institutional Review Board provided annual protocol review (Blair, Kohl, et al., 1989). For these analyses, males or females needed to be ≥20 years old; have undergone ≥2 clinical examinations between 1986 and 2006; have complete data on all MetSyn components; had objectively measured weight; provided self-identified good weight and data on selected covariates; and have no baseline MetSyn, diabetes, cardiovascular disease (CVD), cancer, ulcers, gallbladder disease, jaundice, hepatitis, cirrhosis, or colon polyps. We further excluded those whose body mass index [BMI = weight (kg)/height $(m)^2$] did not fall between 18.5 and 50 kg/m^2, as values outside this range may represent subclinical disease.

Procedure

The protocol, including all clinical and physical activity measures, has previously been described in detail and followed a standard manual of operations (Blair, Kannel, Kohl, Goodyear, & Wilson, 1989). Participants provided informed consent and arrived for the clinical examination after ≥12-h fast. Information collected included personal and family health histories, fasting blood chemistry analyses, anthropometry, resting blood pressure, electrocardiogram, and a maximal graded exercise test. BMI was computed from measured weight and height.

Measures

Weight discrepancy. Weight discrepancy was defined as measured weight minus self-identified good weight, which was obtained by asking participants "What do you consider a good weight for yourself?" High weight discrepancy was defined as having a difference in measured and self-identified good weight that was above the median (males: 2.72 kg; females: 3.52 kg) and low weight discrepancy was defined as a difference at or below the median. Only 5% of the study population had a negative weight discrepancy that was below −2.3 kg (−5 pounds). Considering that these individuals with a weight discrepancy indicating they may want to weigh more (i.e., negative values) were low in frequency and may be different than those who want to weigh less, they were removed from the analyses. Secondary analyses examined the difference in weight discrepancy using the baseline visit and the visit at which ≥2 years of follow-up occurred (referred to as time point two) and required that participants had at least a third follow-up visit. For secondary analyses, a four-level weight discrepancy variable was created. A participant having low or high discrepancy at both baseline and time point two was classified as 'stayed low' or 'stayed high', respectively. If a participant changed from high to low or low to high, he/she was classified as 'became low' or 'became high', respectively.

Metabolic syndrome. MetSyn criteria were based on the National Cholesterol Education Program Adult Treatment Panel guidelines with modifications from the American Heart Association and the National Heart, Lung, and Blood Institute (Grundy et al., 2004). MetSyn was defined as exceeding the cut-point values for ≥3 of the following components: waist circumference (males: ≥102 cm; females: ≥88 cm), blood pressure (systolic: ≥130 mmHg; diastolic: ≥85 mmHg), fasting HDL-C (males: <40 mg/dL; females: <50 mg/dL), fasting triglycerides (≥150 mg/dL), or fasting glucose intolerance (≥100 mg/dL).

Covariate data. A standardized medical history questionnaire was used to obtain information on smoking habits, alcohol intake, personal history of chronic disease (e.g., myocardial infarction, stroke, cancer, hypertension, diabetes, hypercholesterolemia, colon polyps), and eating habits. Physical activity was self-assessed by answering questions on current moderate and vigorous physical activity and intention regarding future activity (Blair, Kohl, et al., 1989; Lee et al., 2012), as well as objectively measured through a maximal treadmill test, which provided estimates of cardiorespiratory fitness, using a modified Balke protocol (Balke & Ware, 1959; Blair, Kohl, et al., 1989; Lee et al., 2012). Resting blood pressure was recorded as the first and fifth Korotkof sounds by auscultatory methods. Serum samples were analyzed for lipids and glucose by a laboratory that participates in the CDC Lipid Standardization Program and meets its quality control standards.

Statistical Analyses

All analyses were performed using SAS® (version 9.3, Cary, NC). Frequencies or means and standard deviations were calculated for demographic and health-related characteristics; chi-square or *t*-tests were used to examine differences between low and high weight discrepancy at baseline. Cox proportional hazards regression was used to estimate hazard ratios (HRs) and 95% confidence intervals (95% CI) which represent the hazard (i.e., chance) of MetSyn incidence among those with high weight discrepancy, compared to those with low discrepancy. Follow-up time was the time between the baseline visit and censorship (i.e., last examination or first MetSyn ascertainment). The first model was an a priori model and adjusted for age, sex, physical inactivity (inactive vs. active as defined by no leisure-time activity during the three months prior to baseline), smoking status (current vs. non-smoker), alcohol intake (heavy vs. non-heavy drinker defined as >14 drinks for men or >7 drinks for women per week), and family history of diabetes at baseline (Wirth et al., 2014). The variable selection model was based on a backward elimination procedure. Variable selections began with a series of bi-variable analyses (i.e., weight discrepancy + covariate). If a covariate had a $p \leq .20$, it was added to the full model. Backward elimination procedures were then used to develop the final models, which included all covariates that when removed led to a 10% change in the hazard ratio (HR) of weight discrepancy or were statistically significant. The last model was developed by adding BMI to the variable selection models. All models were stratified by sex. For secondary analyses, follow-up began at time point two until censorship, which had to be at least two years. Cox proportional hazards models were applied in the same manner for the secondary analyses as described above.

Results

Average participant (n = 6,168) follow-up time was 4.8 ± 3.8 years with 1,055 (17%) newly reported MetSyn cases. At