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Steps/day and metabolic syndrome in African American adults: The Jackson Heart Study[☆]

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ABSTRACT

Objective. To examine the relationship between pedometer-measured step count data and the Metabolic Syndrome (MetS) in African American adults.

Method. 379 African American adults (mean age 60.1 years; 60% female) enrolled in the Jackson Heart Study (Jackson, MS) from 2000 to 2004 provided sufficient pedometer data for inclusion in this analysis. MetS was classified according to the International Diabetes Federation Task Force on Epidemiology and Prevention.

Results. Using steps/day categorized as tertiles (<3717 (referent), 3717–6238, >6238), participants taking 3717–6238 (Odds Ratio (OR)(95% Confidence Interval (CI)) = 0.34 (0.19, 0.61)) and >6238 steps/day (OR(95% CI) = 0.43 (0.23, 0.78)) had lower odds of having MetS compared to participants in the lowest tertile. Using previously suggested steps/day cut-points (<2500 (referent), 2500–4999, 5000–7499, ≥7500), the odds of having MetS were lower for participants taking 2500–4999 (OR(95% CI) = 0.32 (0.14, 0.72)), 5000–7499 (OR(95% CI) = 0.22 (0.09, 0.53)), and >7500 (OR(95% CI) = 0.26 (0.11, 0.65)) steps/day compared to those taking <2500 steps/day.

Conclusion. Compared to lower levels, higher levels of steps/day are associated with a lower prevalence of MetS in this older African American population.

Introduction

In the past decade, the prevalence of metabolic syndrome (MetS) has increased in African American men and women (Churilla et al., 2007; Mozumdar and Liguori, 2011). The impact of this increase could lead to an even greater cardiometabolic burden in this population that is already facing health disparities in chronic disease (Cowie et al., 2009; Lloyd-Jones et al., 2009). Physical activity (PA) is a modifiable behavioral risk factor for MetS. Although self-reported PA has been associated with MetS in African Americans (Irwin et al., 2002), some studies of objectively measured PA have not found relationships with most components of MetS (Crane and Wallace, 2007; Panton et al., 2007), have not measured MetS (Crane and Wallace, 2007; Hornbuckle et al., 2005; Panton et al., 2007), or have not controlled for the effect of ethnicity (Camhi et al., 2011; Churilla and Fitzhugh, 2009). Thus, the relationship between PA and MetS has not been clearly demonstrated in African Americans. Therefore, the purpose of this study is to assess the relationship between pedometer measured step count data and MetS in a large sample of African American adults.

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Methods

Participants

The participants in the study were enrolled in the Diet and Physical Activity Sub-study (DPASS) of the Jackson Heart Study (JHS). Specific details related to the JHS (Fuqua et al., 2005; Taylor et al., 2005) and the DPASS component of the JHS (Carithers et al., 2005; Dubbert et al., 2005) can be found elsewhere. Three academic institutions collaborated on the project: Jackson State University, the University of Mississippi Medical Center, and Tougaloo College. The research was approved by the Institutional Review Boards of all three institutions. All participants provided written informed consent.

Clinical procedures

All procedures were conducted after participants had undergone an 8-hour fast and abstention from caffeine, alcohol, heavy physical activity, and smoking. Participants were instructed to bring in all medications taken during the two weeks prior to their clinic exam. Height was measured without shoes and recorded to the nearest centimeter. Participants stood with their feet together and head held in the Frankfurt plane. Weight was measured on a balance scale, in light clothing, without shoes, and recorded to the nearest 0.5 kg. BMI was calculated as weight in kilograms divided by height in square meters. Waist circumference was measured at the level of the umbilicus using anthropometric tape. The measurement was recorded to the nearest centimeter upon the end of exhalation. A standard Littman stethoscope and a standard Hawksley random zero sphygmomanometer were used to measure blood pressure. Blood pressure was calculated as the average of two measurements taken 1 min apart, after the participant had rested for 5 min in a recumbent position in a quiet room. Approximately 97 mL of blood was drawn from each participant, from which serum high density cholesterol (HDL) and triglycerides, and plasma blood glucose levels were measured. All blood was collected within a 1-hour time frame.

Metabolic syndrome

MetS was defined according to the Joint International Diabetes Federation Task Force on Epidemiology and Prevention (Alberti et al., 2009). Thus, any three of the following five criteria were required to meet MetS definition: (1) large waist circumference (≥102 cm for men and ≥88 cm for women); (2) high triglyceride levels (≥150 mg/dL or on drug treatment); (3) low HDL cholesterol levels (≤40 mg/dL for men and ≤50 mg/dL in women or on drug treatment); (4) elevated blood pressure (≥130 mm Hg systolic or ≥ 85 mm Hg diastolic or on drug treatment); or, (5) elevated fasting glucose (≥100 mg/dL or on drug treatment).

Pedometer

The Yamax SW-200 pedometer (Yamax Corp., Tokyo, Japan) was utilized in the study. This pedometer has been shown to be a reliable and valid measurement of steps/day (Crouter et al., 2003; Schneider et al., 2003).

Pedometer monitoring

Participants were scheduled for six clinic visits as part of the DPASS. The pedometer-determined PA assessments were conducted on a maximum of three of these clinic visits. A week before their third, fourth, and fifth scheduled DPASS clinic visits participants were mailed the pedometer and a step log to record their daily steps at the end of each day. They were instructed to wear the pedometer at their waist for a 3-day monitoring period, which consisted of three consecutive days. Participants were asked to reset the pedometer at the beginning of each day and to remove it only at night for sleeping or for water activities, such as bathing or swimming. Participants were also instructed to record times when the device was not worn. Participants returned the log and the pedometer at the subsequently scheduled clinic visit. This procedure was repeated for a maximum of three separate pedometer assessment occasions. The DPASS clinic visits (and thus the pedometer assessments) were separated by approximately one month.

Data treatment and statistical analysis

Participants were included in this analysis if they had logged all three required days of pedometer data for at least one of the required three assessment periods. Step counts <500 on any single day were considered outliers (Julius et al., 2011; Tudor-Locke et al., 2011a) and therefore were excluded. Data from any given assessment period with less than three days were excluded because they did not adhere to study protocol and because three days of measurement demonstrates the greatest reliability (Newton et al., 2012). Initially, there were 481 DPASS participants with at least 1 day of logged pedometer data; 91 participants were excluded because their pedometer data did not meet the inclusion criteria, leaving 390 DPASS participants (aged 37–81 years) with valid pedometer data. An additional 11 were excluded because of missing demographic or MetS risk factor information. Therefore, this analysis was based on data from 379 participants (78.8% of initial DPASS sample); 130 of these participants had data from three pedometer assessments, 136 had data from two assessments, and 113 had data from one assessment. Because there were single and multiple assessments, mean steps/day was calculated by averaging step counts over the total number of days (3, 6, or 9) of pedometer assessment (1, 2, or 3). Both single three-day assessments and multiple three-day assessments have been shown to be reliable (Kang et al., 2009; Newton et al., 2012).

Categorical steps/day

Steps/day was categorized using two different criteria: tertiles and previously suggested cut-points. Tertile 1 was <3717 steps/day (n = 127), Tertile 2 was 3717–6238 steps/day (n = 126), and Tertile 3 was >6238 steps/day (n = 126). Four distinct categories were utilized when steps/day was classified based on previously suggested cut-points: 'basal activity' (<2500 steps/day, n = 58), 'limited activity' (2500–4999 steps/day, n = 139), 'low active' (5000–7499 steps/day, n = 96), and 'somewhat active' to 'highly active' (≥ 7500 steps/day, n = 86) (Tudor-Locke et al., 2009, 2011b).

Chi-square analysis (for categorical variables) and ANOVA (for continuous variables) were used to assess significant differences in demographic characteristics between participants across tertiles. Logistic regression was used to assess the relationship between categorical steps/day and the presence or absence of (1) MetS and (2) each of the five criteria components of MetS. The results were expressed as Odds Ratios (OR) with accompanying 95% confidence intervals. Two models were tested: Model 1, results were adjusted for age and sex; Model 2, results were further adjusted for education, alcohol consumption, smoking, and BMI.

Continuous steps/day

Logistic regression was also used to assess the relationship between steps/day as a continuous variable and the presence or absence of MetS. These analyses mirrored the analyses for categorically determined steps. The results were expressed as ORs per 1000 steps/day increments.

Results

Demographic characteristics

The demographic characteristics of the sample can be seen in Table 1. There are statistical differences across various tertiles for the components of MetS. There was no difference in the prevalence of MetS ($\chi^2 = 0.27$; $p = .61$) between those with and without complete pedometer data.

Categorical steps/day: Tertiles

In Model 1, controlling for demographic factors, participants who took 3717–6238 (Tertile 2) and >6238 (Tertile 3) steps/day, respectively, had 70% lower odds of having MetS (p values < 0.001) compared to participants in the lowest tertile (<3717 steps/day), respectively (Table 2). The odds were 66% and 57% lower (p values < 0.001) in Model 2.

There were 54% and 52% (p values < 0.05) lower odds of having elevated blood glucose for participants in the Tertiles 2 and 3, respectively, compared to participants in the lowest tertile in Model 1. These values were 53% and 48% (p values < 0.05) in Model 2. There were 70% and 54% (p values < 0.05) lower odds of having high blood pressure for participants in the two highest tertiles compared to participants in the lowest tertile in Model 1. Only those taking 3717–6238 steps/day retained their lower odds (66%, p value < 0.01) in Model 2. Compared to participants in the lowest tertile in Model 1, the odds were 65% and 60% lower (p values < 0.001) for those taking 3717–6238 and >6238 steps/day, respectively, for large waist circumference, and were lower by 54% (p < 0.01) for those taking >6238 steps/day for