

Cardiovascular Health Metrics and Accelerometer-Measured Physical Activity Levels: National Health and Nutrition Examination Survey, 2003-2006

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Abstract

Objective: To determine whether relationships exist between accelerometer-measured moderate-to-vigorous physical activity (MVPA) and other cardiovascular (CV) health metrics in a large sample.

Patients and Methods: Data from the 2003-2006 National Health and Nutrition Examination Survey (NHANES) collected from January 1, 2003, through December 31, 2006, were used. Overall, 3454 nonpregnant adults 20 years or older who fasted for 6 hours or longer, with valid accelerometer data and with CV health metrics, were included in the study. Blood pressure (BP), body mass index (BMI), smoking status, diet, fasting plasma glucose level, and total cholesterol level were defined as ideal, intermediate, and poor on the basis of American Heart Association criteria. Results were weighted to account for sampling design, oversampling, and nonresponse.

Results: Significant increasing linear trends in mean daily MVPA were observed across CV health levels for BMI, BP, and fasting plasma glucose ($P < .001$). Those with a poor BMI and BP had significantly lower mean daily MVPA than those with intermediate and ideal BMIs and BPs (all $P < .001$). In addition, individuals with an intermediate fasting plasma glucose level had significantly lower mean daily MVPA than individuals at the ideal levels ($P < .001$). No significant linear trends were observed for cholesterol, smoking, and diet. A significant linear trend was observed for mean daily MVPA and the overall number of other CV health metrics ($P < .001$).

Conclusion: Objectively measured MVPA was related to other CV health metrics in this large sample. These results support the inclusion of physical activity in the overall definition of ideal CV health.

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In 2010, the American Heart Association (AHA) set its 2020 Strategic Impact Goal to improve the cardiovascular (CV) health of all Americans.¹ Using evidence on 7 modifiable CV disease risk factors (blood pressure [BP], body mass index [BMI], current smoking status, diet, fasting plasma glucose level, total cholesterol level, and physical activity), ideal, intermediate, and poor levels were defined for each factor.¹ Although being physically active is known to be important to maintain and improve health,² physical activity has not been included in previous CV risk profile assessments, such as the Framingham risk score.³ Because high levels of leisure time physical activity have been associated with fewer coronary heart disease events, independent of the Framingham risk score,⁴ the addition of physical activity to composite

risk scores is timely and warrants further exploration.

Previous studies have reported large variability in the prevalence estimates among the 7 CV health metrics in US adults and adolescents,^{5,6} using the National Health and Nutrition Examination Survey (NHANES) data. The association between CV health metrics and mortality has also been investigated.⁷ However, these previous studies have relied on self-reported physical activity data. Self-reported physical activity questionnaires are known to have some limitations, such as low reliability and incorrect reporting of duration and intensity of activity.⁸ A previous study using NHANES data found significant associations between both self-reported and accelerometer-measured physical activity and several individual CV biomarkers.⁹ However, it is not known how physical activity levels

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differ across levels of each of the AHA CV health metrics or how the number of CV health metrics is related to physical activity.

Because of the inclusion of physical activity as one of the AHA CV health metrics, it is important to determine that physical activity brings a unique contribution to overall CV health. Thus, research is required to understand the relationships among physical activity and the other CV health criteria. The purpose of this study was to determine whether differences in daily accelerometer-measured moderate-to-vigorous activity (MVPA) exist among the 3 levels of the other 6 CV health metrics and whether a linear association exists between daily MVPA and the number of CV health metrics classified at the ideal levels.

METHODS

Sample

Data from the 2003-2004 and 2005-2006 NHANES cycles collected from January 1, 2003, through December 31, 2006, were used in this analysis. Detailed information about the overall procedures is available elsewhere.⁵ Briefly, NHANES uses a sampling method to ensure that the sample is nationally representative of the civilian, noninstitutionalized US population. For these 2 cycles of NHANES, a total of 10,020 respondents 20 years and older were interviewed and examined. Accelerometer data were obtained from 8077 individuals.⁹ Demographic characteristics (age, sex, race/ethnicity, educational attainment, and annual household income) were self-reported during the home interview.

Assessment of CV Health Metrics

The procedures for data collection of CV health metrics are described in detail in the NHANES online manuals at www.cdc.gov/nchs/nhanes/nhanes_questionnaires.htm and have been summarized elsewhere.^{5,10} Briefly, BP was measured up to 4 times after the participants were seated quietly for at least 5 minutes; the mean measured BP (excluding the first measure) was used for this analysis. Current smoking status was assessed by self-report questionnaire. Height and weight were measured using standard procedures, and BMI was calculated as weight in kilograms divided by the square of height in meters. Diet was assessed by two 24-hour recalls and

a food frequency questionnaire. Blood was drawn in the morning after an overnight fast for measurement of blood lipids and plasma glucose. Participants also self-reported their medications.

Definition of Ideal CV Health Metrics Levels

The definition of CV health metrics levels closely followed the definitions given by Lloyd-Jones et al.¹ Below are brief descriptions of the definitions used in this study.

Blood Pressure

Participants with a systolic blood pressure (SBP) of 140 mm Hg or higher or a diastolic blood pressure (DBP) of 90 mm Hg or higher were classified as having poor CV health for this metric. Participants with a SBP between 120 and 139 mm Hg, with a DBP between 80 and 89 mm Hg, or who were treated to goal were classified as having intermediate CV health, and participants with a SBP less than 120 mm Hg, with a DBP less than 80 mm Hg, and who were not taking medication were classified as having ideal CV health for this metric.

Body Mass Index

Participants were classified as having poor, intermediate, and ideal CV health for this metric, according to BMI levels of 30 or higher, 25 to less than 30, and less than 25, respectively.

Current Smoking

Participants who had smoked 100 cigarettes during their lifetime and were still currently smoking were classified as having poor CV health for this metric. Former smokers who had quit for less than 12 months were classified as having intermediate CV health. Former smokers who had quit for at least 12 months or participants who had never smoked were classified as having ideal CV health for this metric.

Fasting Plasma Glucose

Participants with a fasting plasma glucose level of 126 mg/dL or higher, 100 to 125 mg/dL or treated to goal, and less than 100 mg/dL (to convert to mmol/L, multiply by 0.0555) and who were not taking medication had poor, intermediate, and ideal CV health for this metric, respectively.

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