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Abstract

The association between physical activity (PA) and C-reactive protein (CRP) is inconsistent, with nearly all studies using self-report measures of PA. The purpose of this study was to examine the association between objectively-measured PA and CRP in U.S. adults and children. Adults (N=2912) and children (N=1643) with valid accelerometer data and CRP data were included in the analyses. Logistic regression analysis was used to assess the odds of meeting physical activity guidelines across CRP quartiles for children and among adults with low, average, and high CRP levels. For adults, after adjustments for age, gender, race, body mass index, smoking, diabetes, and high density lipoprotein cholesterol (HDL-C), compared to those with low CRP levels, odds ratios were 0.59 (CI = 0.45–0.77) and 0.46 (CI = 0.28–0.76) for participants with average and high CRP levels, respectively. For children, after adjustments for age, gender, race, weight status, and HDL-C, compared to those in CRP quartile 1, odds ratios were 0.96 (CI = 0.5–1.84), 1.23 (CI = 0.71–2.12), and 0.79 (CI = 0.33–1.88) for participants in quartiles 2, 3, and 4, respectively. Objectively-measured PA is inversely associated with CRP in adults, with PA not related to CRP in children.

Keywords

Accelerometry; population; inflammation

INTRODUCTION

Cardiovascular disease (CVD) remains one of the leading causes of mortality in the United States, accounting for 631,636 deaths in 2006 (Heron et al., 2009). With the recognition that atherosclerosis is an inflammatory process, C-reactive protein (CRP), a marker of inflammation, has been identified as a potential biomarker related to future CVD risk. Previous research shows that CRP concentration independently predicts cardiovascular events (e.g., myocardial infarction and ischemic stroke) in adults (Folsom et al., 2002; Koenig et al., 1999; Ridker et al., 1998) and is a better predictor of cardiovascular risk than

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other recognized markers such as low-density lipoprotein cholesterol (Ridker et al., 2002). Additionally, in children, elevated CRP has been linked with cardiovascular risk factors (Cook et al., 2000), as well as some vascular diseases, such as sickle cell disease (Krishnan et al., 2010).

The association between physical activity and reduced CVD risk may be mediated by the anti-inflammatory properties of physical activity (Albert et al., 2004; Pitsavos et al., 2003). Several studies examining the relationship between physical activity and CRP in adults report inverse associations (Albert et al., 2004; Anand et al., 2011; Atienza et al., 2011; Colbert et al., 2004; Ford, 2002; Geffken et al., 2001; Rothenbacher et al., 2003; Soares-Miranda et al., 2010; Uurtuya et al., 2010; Villegas et al., 2010; Wannamethee et al., 2002), with some showing no association (Lund et al., 2011; Rawson et al., 2003; Verdaet et al., 2004). In contrast to the findings obtained in adults, most (Kim et al., 2007; Martinez-Gomez et al., 2010; Moran et al., 2005; Platat et al., 2006; Ruiz et al., 2007; Thomas et al., 2008), but not all (Cook et al., 2000; Syrenicz et al., 2006) studies examining the association between physical activity and CRP in children have not found an association. However, nearly all of the previous studies examining the association between physical activity and CRP were limited by the use of self-report measures of physical activity. Although epidemiological studies use self-report measures to assess physical activity behavior, they are prone to considerable random measurement error, item-interpretation, recall bias, and social desirability effects, with recall limitations exacerbated in children (Shephard, 2003).

Accelerometry has recently come into use as a method for measuring physical activity in population-based studies of free-living individuals (Troiano et al., 2008). Accelerometry provides an objective, less invasive, minimally-reactive measure of physical activity, overcoming some of the major problems associated with self-report or sophisticated assessment methods (such as indirect calorimetry or doubly-labeled water). The use of accelerometry allows researchers to objectively measure the frequency, intensity, and duration of physical activity over multiple days. By providing valid and reliable estimates of physical activity (Hendelman et al., 2000), accelerometry may better reflect the true relationship between physical activity and CRP.

To build upon the extant knowledge base, the aim of this study was to examine the association between objectively-measured physical activity and CRP in adults and children using a representative sample of the U.S. population. Unlike the few studies employing an objective measure of physical activity (Atienza et al., 2011), this study sought to examine a potential dose-response relationship between physical activity and CRP by classifying CRP into clinically relevant categories (i.e., low, moderate, and high).

MATERIALS AND METHODS

Design and Participants

Data from the National Health and Nutrition Examination Survey (NHANES) 2003–2004 were used in the analyses. NHANES uses a representative sample of non-institutionalized U.S. civilians, selected by a complex, multistage probability design. Briefly, participants were interviewed in their homes and subsequently examined in mobile examination centers (MEC) across 15 U.S. geographic locations. The study was approved by the National Center for Health Statistics ethics review board, with informed consent obtained from all participants prior to data collection. For the present study, the final sample included 4,555 NHANES participants after the exclusion of participants who were without data for CRP, had insufficient accelerometry data, or who were pregnant.

Measurement of Physical Activity

At the MEC, participants ≥ 6 yr of age who were not prevented by impairments of walking or wearing an accelerometer wore an ActiGraph 7164 accelerometer (Shalimar, FL). Participants were asked to wear the accelerometer on the right hip for 7 days following their examination. Activity counts were summarized in 1-min epochs. For children 6–17 years of age, Freedson age-specific cut-points were used to classify moderate and vigorous physical activity intensity (Freedson et al., 1998). For individuals 18 yrs and older, a weighted average of 4 cut-points was used to classify moderate and vigorous physical activity intensity (Troiano et al., 2008). The threshold for moderate intensity was 2020 counts and the threshold for vigorous intensity was 5999 counts. Accelerometry data were reduced to mean activity counts per minute (cpm), mean duration (min) of moderate-to-vigorous physical activity (MVPA) bouts, and percentage of participants meeting physical activity guidelines. As recommended, accelerometry data is presented in 10-min bouts for adults and 1-min bouts for children (Haskell et al., 2007; Strong et al., 2005). For the analyses described here, only participants with valid accelerometry data (i.e., at least 4 days with 10 or more hours per day of monitoring data) were included in the analyses (Troiano et al., 2008). With the exception of CRP concentration in adults, there were no significant differences in demographic and selected biological variables between participants with or without valid accelerometry data. Among adults, CRP concentrations were higher in those with invalid accelerometry data than those with valid accelerometry data (mean ± SE of 0.51 ± 0.03 and 0.41 ± 0.02 mg/dL, respectively; $p < 0.05$).

Measurement of High Sensitivity CRP

During examination at the MEC, blood samples were obtained from participants 1 year of age and older. High sensitivity CRP concentration was quantified using latex-enhanced nephelometry, and reported in mg/dL to the nearest hundredth (0.01). The coefficients of variation (CV) by lot ranged from 3.1% to 9.9%. Further details about the laboratory procedures and quality control are available elsewhere (CDC, 2006).

Other Measurements

Information about age, gender, ethnicity, education, marital status and medical history (i.e., smoking and presence of diabetes and hypertension) was obtained from a questionnaire during a household interview. Trained household interviewers administered the questionnaire with interview data recorded using a Blaise format computer-assisted personal interview (CAPI) system. During examination at the MEC, body mass index (BMI) was calculated from measured weight and height (weight in kilograms divided by the square of height in meters). For individuals 6–19 years, overweight and obese was defined as ≥ 85^{th} and ≥ 95^{th} BMI percentiles for age and gender, respectively. For individuals 20–70+ years, overweight was defined as a BMI between 25.0 and 29.9 and obese was defined as a BMI greater than 30.0.

Total cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides were obtained from blood samples at the MEC. Total cholesterol, HDL-C and LDL-C were measured enzymatically using the Cholesterol High Performance reagent (Roche Diagnostics, Indianapolis, IN). Triglycerides were analyzed enzymatically simultaneously with total cholesterol, HDL-C and LDL-C using reagents from the same manufacturer. For total cholesterol by lot, coefficient of variation (CV) ranged from 1.2% to 1.4%. For HDL-C by lot, CV ranged from 1.7% to 2.3%. For triglycerides by lot, CV ranged from 1.5% to 2.1%. Further details about the laboratory procedures and quality control are available elsewhere (CDC, 2006).

Data Analysis

All statistical analyses were performed using SAS (version 9.2, SAS Institute; Cary, NC) and SUDAAN (version 10.0.0, RTI International; Research Triangle Park, NC) to account for the complex survey design used in NHANES. Sample weights were used to produce weighted estimates for all analyses. SUDAAN PROC SURVEYMEANS procedure was used to analyze the weighted mean and standard error of continuous variables such as height, weight, total cholesterol and accelerometer counts. SUDAAN PROC SURVEYFREQ procedure was used to tabulate the frequencies of categorical variables such as smoking and race.

For adults, the following three CRP cut-offs were used to categorize risk of developing cardiovascular disease: 1) < 0.1 mg/dL (low risk), 2) 0.1–0.3 mg/dL (average risk), and 3) > 0.3 mg/dL (high risk) (Pearson et al., 2003). Given the lower CRP values in children and the lack of defined CRP reference values for children, CRP levels were categorized into quartiles based on the distribution of CRP levels in all children (≤ 19 y). Because CRP concentrations are elevated in numerous acute infections and chronic inflammatory diseases, we examined whether elevated CRP concentrations indicative of acute infection (≥ 1 mg/dL) (Pearson et al., 2003) might possibly confound the relationship between objectively-measured physical activity and CRP. CRP categories for both children and adults were compared with and without CRP concentrations greater than 1 mg/dL. Students *t*-test revealed no significant differences; therefore, CRP concentrations greater than 1 mg/dL were included in all analyses. Participants with coronary artery disease were not excluded from the analyses. SUDAAN PROC SURVEYMEANS was used to analyze the weighted mean and standard error of counts per minute (cpm), mean duration of MVPA bouts, and activity status (i.e., meeting or not meeting physical activity guidelines) stratified by children and adults.

Multiple linear regression analysis, using SUDAAN PROC REGRESS, was used to compare mean cpm, mean duration of MVPA bouts, and activity status across categories of CRP. Variables that were substantively related to both CRP and physical activity level were initially included in the regression models. These variables included age, gender, race, smoking, HDL-cholesterol, LDL-cholesterol, BMI, hypertension, diabetes, and education. Subsequently, variables that were not associated with cpm, mean duration of MVPA bouts, and activity status were removed from the models ($p > 0.10$). For children, the resulting model was adjusted for age, gender, race, weight status (overweight/not overweight), and HDL-C. For adults, the resulting model was adjusted for age, gender, race, BMI, smoking, diabetes, and HDL-C. P-values for linear trends (evaluated by the Wald test) were calculated by assigning the median values to each level of the category of CRP and treating it as a continuous variable. Further adjustments for medications that can effect CRP levels (e.g., aspirin and statins) did not significantly (or appreciably) change the results; therefore, medication use was not included as a covariate in the final models. Adjusted multivariate logistic regression models were performed using SUDAAN PROC RLOGIST to provide odds ratios and 95% confidence intervals. The dependent variable was dichotomized into meeting physical activity guidelines and not meeting physical activity guidelines.

RESULTS

Descriptive characteristics of the study population are presented for children (≤ 19 y) and adults (≥ 20 y) and are displayed in Table 1.

In adults, CRP concentrations ranged from 0.01 mg/dL to 18.5 mg/dL. Approximately, 37% of adults had an elevated CRP level (≥ 0.3 mg/dL) (Pearson et al., 2003). In children, CRP concentrations ranged from 0.01 mg/dL to 11.2 mg/dL. Although there is no reference value

specific to children, approximately 13% of children had a CRP level ≥ 0.3 mg/dL. Descriptive statistics for the physical activity variables are presented for children and adults in Table 2.

Mean cpm, mean duration of MVPA bouts and activity status across CRP quartiles in children are shown in Table 3. Additionally, the logistic regression results for the association between percent meeting physical activity guidelines across CRP quartiles among children are displayed in Table 3. For children, after adjustment for age, gender, race, weight status, and HDL-cholesterol, mean cpm, mean duration of MVPA bouts and activity status did not differ across CRP quartiles. There was no association between percent meeting physical activity guidelines and CRP, after adjustment for age, gender, race, weight status, and HDL-cholesterol. Compared to those in CRP quartile 1 (i.e., lowest CRP levels), odds ratios were 0.96 (CI = 0.5–1.84) for participants in quartile 2, 1.23 (CI = 0.71–2.12) for participants in quartile 3, and 0.79 (CI = 0.33–1.88) for participants in quartile 4.

Mean cpm, mean duration of MVPA bouts and activity status across three CRP cut-offs (low = < 0.1 mg/dL; average = 0.10–0.3 mg/dL; high = > 0.3 mg/dL) in adults are shown in Table 4. Among adults, mean cpm, mean duration of MVPA bouts and activity status decreased with increasing CRP levels. After adjustments for age, gender, race, BMI, smoking, diabetes, and HDL-cholesterol, participants with low, average, and high CRP levels had mean (SE) accelerometer cpm per day of 340.4 (6.9), 320.1 (3.3), and 302.0 (3.8), respectively. Participants with low, average, and high CRP levels had mean adjusted duration (min) of MVPA bouts per day of 8.7 (0.7), 6.5 (0.6), and 6.1 (0.5), respectively. Adjusted percent (SE) meeting physical activity guidelines for participants with low, average, and high CRP levels were 13.6% (1.2), 7.8% (1.2), and 6.7% (0.9), respectively. In contrast to the results obtained in children, the tests for trend were statistically significant for mean cpm ($p < 0.01$), mean duration of MVPA bouts ($p = 0.02$), and activity status ($p = 0.01$).

The results of the logistic regression association between percent meeting physical activity guidelines across CRP cut-offs among adults are displayed in Table 4. The results show an inverse association between percent meeting physical activity guidelines and CRP, after adjustments for age, gender, race, BMI, smoking, diabetes, and HDL-cholesterol. Compared to those with low CRP levels, participants with average CRP levels were 0.59 (CI = 0.45–0.77) times less likely to meet PA guidelines and participants with high CRP levels were 0.46 (CI = 0.28–0.76) times less likely to meet PA guidelines.

DISCUSSION

This study examined the association between objectively-measured physical activity and CRP in children and adults using a nationally representative sample. Our key finding was that objectively-measured physical activity was significantly inversely associated with CRP in adults, but not in children.

These results are in accordance with other studies that have examined the association between self-reported physical activity and CRP. Koenig and colleagues (1999) showed that among 936 men aged 45–64 years, leisure-time physical activity was inversely associated with CRP concentrations. Similarly, Wannamethee and colleagues (2002) reported leisure time physical activity to be inversely associated with CRP concentration among 4,252 adults from the U.K. Specifically, physically active adults had 33% lower CRP levels than inactive adults. Collectively, this supports the findings of Plaisance and Grandjean (2006) who reviewed 12 cross-sectional studies and found that physically active adults have CRP concentrations 19–35% lower than less active adults. Additionally, these results are also

supported by a systematic review by Kasapis and Thompson (2005), which concluded that both cross-sectional comparisons and longitudinal exercise training studies demonstrate a long-term “anti-inflammatory” effect of physical activity.

Although the majority of studies examining the association between physical activity and CRP were cross-sectional, several longitudinal investigations have been published. These studies examined the independent effects of exercise training on CRP levels in individuals with or at risk for CVD. Smith and colleagues (1999) showed that 6-months of exercise training that consisted of an average of two supervised exercise sessions per week lasting an average of 70 minutes per session resulted in 35% reductions in CRP in 43 middle-aged male and female participants at risk for CVD. In 235 adults with CVD, Milani and colleagues (2004) showed that a formalized cardiac rehabilitation exercise program consisting of 3 structured exercise sessions per week for 3-months reduced median CRP levels by 41% compared with no CRP changes in the control group. Notably, the reduction in CRP for patients on statins was 42% and was similar to the 38% reduction observed in patients not on statins, suggesting that the effects of the exercise program was independent of statin therapy. In addition to the protective effect that physical activity may have on preventing CVD in healthy adults through reductions in CRP, the results of these studies suggest that long-term exercise may also be protective against CVD among individuals at risk of developing CVD as well as reduce inflammation in individuals with CVD.

The mechanism(s) through which physical activity positively influences specific inflammatory activity (e.g., CRP) associated with CVD remains unclear. One plausible explanation is the indirect effect of physical activity on CRP reduction through changes in body weight.

Adipocytes have been shown to synthesize cytokines (IL-1, TNF-alpha) which are involved in the production of CRP (Yudkin et al., 2000). By reducing adipose mass, physical activity could decrease cytokine production, which, in turn, could decrease CRP concentration. However, in the present study, CRP was inversely associated with physical activity after adjusting for body mass index, suggesting that physical activity influences the inflammatory process through other mechanisms. Physical activity has also been suggested to mitigate inflammation by improving insulin resistance, as inflammatory markers are typically raised in insulin-resistant individuals (Geffken et al., 2001). However, after adjusting for the participants’ diabetes status, an indication of their fasting insulin concentration, the association between physical activity and CRP remained statistically significant. Another possible mechanism through which physical activity may decrease inflammation is by improving endothelial function. Activated endothelial cells can increase the production of IL-1, IL-6 and adhesion molecules, thereby inducing inflammation (Romano et al., 1997). Regular physical activity has been shown to improve endothelial function by preserving nitric oxide availability (Taddei et al., 2000) and by reducing peripheral inflammatory markers (e.g., adhesion molecules) associated with endothelial dysfunction (Adamopoulos et al., 2001).

The present study did not reveal an association between CRP and objectively-measured physical activity in children. Our findings are consistent with those reported by Kim and colleagues (2007) who found that 6-weeks of exercise training did not change CRP concentrations in obese Korean children. Similarly, Thomas and colleagues (2008) found no association between physical activity and CRP in 164 schoolchildren aged 12–13 years. It is plausible that during childhood, it may be too early in development for physical activity to have an effect on CRP levels. In addition, our results may be explained by the relatively low CRP levels (i.e., floor effect) and by a lack of variability in CRP in children. For children, mean (SE) CRP concentrations were 0.15 (0.01) mg/dL. Furthermore, only 13% of children

had elevated CRP concentration (> 0.3 mg/dL). It is possible that when CRP is not elevated, physical activity may have little influence. However, given that there is no defined reference value for children, future research efforts should identify a reference value through which this conclusion can be reconsidered.

The major strength of this investigation was the examination of the association between physical activity and CRP in children and adults using objectively-measured physical activity and a nationally representative sample. Limitations of this study include the cross-sectional study design, which precludes the ability to make causal inferences regarding the temporal relationship between physical activity and CRP. Additionally, we were unable to examine the association between objectively-measured physical activity and other key biomarkers of inflammation, such as IL-6 and TNF-alpha, as these variables were not measured in the 2003–2004 NHANES cycle.

In summary, the objectively-measured physical activity was inversely associated with CRP in adults, but not in children. Future prospective studies are needed to determine whether regular participation in physical activity during childhood can help attenuate increased inflammation later in life. Further research is needed to determine the frequency, intensity and duration of physical activity necessary to lower CRP and if gender or ethnicity moderates the relationship between objectively-measured physical activity and CRP. Additional studies are also needed to delineate the mechanism by which physical activity affects the inflammatory process in adults, and in particular, if lowering CRP results in lower rates of CVD morbidity and mortality. Lastly, as was done in the present study, future researchers are encouraged to measure high sensitivity CRP whenever feasible, as this test can detect lower levels of CRP. Standard CRP measurement has limited sensitivity below levels of approximately 4–5 mg/dL and may, therefore, not be able to detect low degree inflammation or provide as accurate of a prediction of cardiovascular disease. Consequently, the true association between CRP and various behaviors and health outcomes is likely to be attenuated when standard CRP measurement approaches are taken.

PERSPECTIVES

Unlike the few studies employing an objective-measure of physical activity, this study sought to examine the association between objectively-measured physical activity and CRP in adults and children using a representative sample of the U.S. population. In adults, the association between CRP and physical activity appears to have an inverse dose response relationship. To mitigate inflammation, adults should engage in at least 150-minutes a week of moderate-intensity physical activity or at least 75-minutes a week of vigorous-intensity physical activity. Given that physical activity is associated with immediate health outcomes in children, such as adiposity (Janz et al., 2009), skeletal health (Bailey et al., 1999), and psychological health (Schwartz & Puhl, 2003), all children should be encouraged to engage in physical activity on a regular basis, with a sensible goal of 60-minutes or more of MVPA on a daily basis (Strong et al., 2005).

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Table 1

Weighted Means and Percentages (Standard Error) for Selected Characteristics of the Analyzed Sample of Children (≤ 19 y) and adults (≥ 20 y), NHANES, 2003–2004.

Variable	Children	Adults
N	1643	2912
Age (yr)	12.16 (0.21)	48.29 (0.47)
% Male	52.81 (1.20)	49.01 (1.26)
Height (cm)	151.90 (0.89)	169.25 (0.27)
Weight (kg)	51.16 (0.95)	80.75 (0.48)
BMI (kg/m^2)	21.17 (0.22)	28.09 (0.16)
% Overweight or Obese [a]	36.90 (2.29)	67.16 (1.63)
Ethnicity		
% Non-Hispanic White	61.93 (5.04)	76.09 (3.35)
% Non-Hispanic Black	15.82 (2.48)	8.92 (1.56)
% Hispanic	19.09 (3.77)	10.63 (2.23)
% Other	3.16 (0.93)	4.36 (0.77)
Education		
% < High School	92.96 (1.06)	15.88 (1.39)
% High School	3.40 (0.72)	26.24 (1.28)
% > High School	3.64 (0.81)	57.88 (1.56)
% Hypertensive	2.37 (0.91)	30.86 (1.43)
% Diabetic	0.36 (0.20)	7.43 (0.79)
Smoking Status		
% Never smoked	N/A	51.28 (0.89)
% Former smoker	N/A	26.75 (0.99)
% Currently smoke	N/A	21.97 (1.01)
Marital Status		
% Married	0.98 (0.46)	62.11 (1.80)
% Separated	0.06 (0.06)	2.14 (0.40)
% Never Married	97.66 (0.68)	14.01 (1.53)
% Living with Partner	1.30 (0.48)	5.57 (0.55)
Total Cholesterol (mmol/L)	4.24 (0.02)	5.24 (0.02)
HDL Cholesterol (mmol/L)	1.41 (0.01)	1.41 (0.01)
LDL Cholesterol (mmol/L)	2.35 (0.04)	3.02 (0.03)
Triglycerides (mmol/L)	1.01 (0.03)	1.68 (0.07)
C-Reactive Protein (mg/dL)	0.15 (0.01)	0.41 (0.02)

[a] For individuals 6–19 years, overweight and obese defined as ≥ 85th and ≥ 95 th BMI percentiles for age and gender, respectively. For individuals 20–70+ years, overweight defined as a BMI between 25.0 and 29.9 and obese defined as a BMI greater than or equal to 30.0.

N/A, not applicable - not measured in this age group.

Table 2

Weighted Mean (Standard Error) Accelerometer Counts Per Minute, Mean (Standard Error) Duration of Moderate-to-Vigorous Physical Activity per Day and Percent (Standard Error) Meeting Physical Activity Guidelines for Children (≤ 19 y) and Adults (≥ 20 y), NHANES, 2003–2004.

Variable	Children	Adults
Mean accelerometer counts per min	504.9 (10.1)	319.4 (5.2)
Mean duration (min) of MVPA activity bouts per day [a]	55.9 (2.2)	7.0 (0.5)
% Meeting PA guidelines [b]	31.7 (2.1)	9.1 (0.9)

[a] For children aged 6–19 years, 1-minute bouts were used. For adults 20 and older, 10-min bouts (with a 2-minute interruption interval) were used.

[b] For children aged 6–19 years, 60 minutes or more of at least moderate intensity physical activity, daily (1-min bouts). For adults 20 and older, 150 minutes or more of moderate intensity physical activity per week or 75 minutes or more of vigorous intensity physical activity per week (10-min bouts).

PA, physical activity

MVPA, moderate-to-vigorous physical activity

Table 3

Weighted Mean (Standard Error) Accelerometry Counts, MVPA Bouts, and Percent Meeting Physical Activity Guidelines Across CRP Quartiles in Children (≤ 19 y; N = 1,615), NHANES, 2003–2004.

	CRP				
	Q1 (≤ 0.01)	**Q2 (0.02–0.04)**	**Q3 (0.05–0.12)**	**Q4 (≥ 0.13)**	**F-test for Linear Trend**
Mean accelerometer counts per min †	503.1 (12.8)	505.3 (11.3)	518.1 (11.1)	495.0 (15.1)	p = 0.46
Mean MVPA bouts per day (1 min bouts) †	54.8 (2.7)	55.3 (2.1)	58.8 (2.2)	55.2 (3.0)	p = 0.88
% Meeting PA guidelines a †	31.2 (3.8)	31.4 (2.1)	34.1 (2.3)	30.9 (3.6)	p = 0.83
Logistic Regression OR (95% CI)					
% Meeting PA guidelines a †	1.0	0.96 (0.5–1.84)	1.23 (0.71–2.12)	0.79 (0.33–1.88)	

a 60 minutes or more of at least moderate intensity physical activity, daily (1-min bouts).

† adjusted for age (continuous), gender (male/female), race (non-Hispanic white; non-Hispanic black; Hispanic; other), weight status (overweight/not-overweight), and HDL-cholesterol (mg/dL).

PA, physical activity

MVPA, moderate-to-vigorous physical activity

Table 4

Weighted Mean (Standard Error) Accelerometry Counts, MVPA Bouts, and Percent Meeting Physical Activity Guidelines Across Levels of CRP in Adults (≥ 20 y; N = 2,874), NHANES, 2003–2004.

	CRP			
	Low (< 0.1)	**Average (0.10–0.3)**	**High (> 0.3)**	**F-test for Linear Trend**
Mean accelerometer counts per min [†]	340.4 (6.9)	320.1 (3.3)	302.0 (3.8)	p < 0.01
Mean MVPA bouts per day (10 min bouts) [†]	8.7 (0.7)	6.5 (0.6)	6.1 (0.5)	p = 0.02
% Meeting PA guidelines [a †]	13.6 (1.2)	7.8 (1.2)	6.7 (0.9)	p = 0.01
Logistic Regression OR (95% CI)				
% Meeting PA guidelines [a †]	1.0	0.59 (0.45–0.77)	0.46 (0.28–0.76)	

[a] 150 minutes or more of moderate intensity physical activity per week or 75 minutes or more of vigorous intensity physical activity per week (10-min bouts).

[†] adjusted for age (continuous), gender (male/female), race (non-Hispanic white; non-Hispanic black; Hispanic; other), BMI (continuous), smoking (never smoked; former smoker; current smoker), diabetes (has diabetes; does not have diabetes), and HDL-cholesterol (mg/dL).

PA, physical activity

MVPA, moderate-to-vigorous physical activity