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PHYSICAL ACTIVITY AND INCIDENT HYPERTENSION IN AFRICAN AMERICANS: THE JACKSON HEART STUDY

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Abstract

There is limited empirical evidence to support the protective effects of physical activity in the prevention of hypertension among African Americans. The purpose of this study was to examine the association of physical activity with incident hypertension among African Americans. We studied 1,311 participants without hypertension at baseline enrolled in the Jackson Heart Study, a community-based study of African Americans residing in Jackson, MS. Overall physical activity, moderate-vigorous physical activity (MVPA), and domain-specific physical activity (work, active living, household, and sport/exercise) were assessed by self-report during the baseline exam (2000–2004). Incident hypertension, assessed at exam 2 (2005–2008) and exam 3 (2009–2013), was defined as the first visit with systolic/diastolic blood pressure ≥140/90mmHg or self-reported antihypertensive medication use. Over a median follow-up of 8.0 years, there were 650 (49.6%) incident hypertension cases. The multivariable-adjusted hazard ratios (95% CI) for incident hypertension comparing participants with intermediate and ideal versus poor levels of MVPA were 0.84 (0.67–1.05) and 0.76 (0.58–0.99), respectively (P-trend=0.038). A graded, dose-response association was also present for sport/exercise-related physical activity (Quartiles 2, 3, and 4 vs. Quartile 1: 0.92 [0.68–1.25], 0.87 [0.67–1.13], 0.75 [0.58–0.97], respectively; P-trend=0.032). There were no statistically significant associations observed for overall physical activity, or work, active living, and household-related physical activities. In conclusion, the results of the current study suggest that regular MVPA or sport/exercise-related physical activity may reduce the risk of developing hypertension in African Americans.

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Keywords

Physical activity; exercise; hypertension; blood pressure; African Americans

INTRODUCTION

African Americans have the highest prevalence of hypertension across any racial/ethnic group in the United States, with prevalence rates of 40.8% and 41.5% for African American men and women, respectively.[1] Evidence shows that hypertension is associated with a disproportionate number of premature disabilities and deaths from myocardial infarction, stroke, and end-stage renal disease in African Americans than in other racial/ethnic groups in the United States and explains much of the racial disparity in mortality rates.[2, 3] Accordingly, there is a need to identify modifiable risk factors in African Americans amenable to behavioral intervention to mitigate their risk for the development of hypertension.

The protective effects of physical activity in the prevention of hypertension have been demonstrated across many populations.[4] As such, hypertension guidelines recommend the adoption of physical activity as a preventive lifestyle behavior.[5, 6] However, there is little published research on the association between physical activity and incident hypertension among African Americans. In a prior systematic review, only three studies were identified that examined the association between physical activity and incident hypertension among African Americans.[7] In all three studies, no statistically significant associations were observed.[8–10] These previous studies, however, were limited by the use of blood pressure (BP) thresholds for hypertension that differ from current guidelines, exclusion of young adults, and lack of consideration of the domain (e.g. occupational vs. leisure) or intensity (e.g. all activity vs. moderate-vigorous activity) of physical activity.

The purpose of this study was to examine the association of physical activity with incident hypertension among participants enrolled in the Jackson Heart Study (JHS), an exclusively African American population-based cohort. As evidence suggests that the protective effects of physical activity against the development of hypertension exist only for physical activity accrued during leisure-time and if levels are adequate to improve cardiorespiratory fitness (e.g. moderate-vigorous in intensity),[10, 11] (1) overall, (2) moderate-vigorous, and (3) domain-specific physical activity were all examined to characterize the physical activity-incident hypertension association.

METHODS

Study Population

The JHS is a population-based study designed to evaluate risk factors for cardiovascular disease (CVD) among African Americans. Details of the study design, recruitment, and data collection have been previously described.[12–14] Briefly, 5,301 African American adults aged ≥ 21 years who resided in the Jackson, Mississippi tri-county region were enrolled between 2000 and 2004. The baseline examination (Visit 1) included an in-home interview and a

clinical examination. Information on sociodemographic characteristics, health behaviors, and medical history were collected during the in-home interview. The clinical examination included blood collection and anthropometric and BP measurements.

The current analysis was restricted to 2,051 participants with systolic blood pressure (SBP) <140 mmHg, diastolic blood pressure (DBP) <90 mmHg, and who were not taking antihypertensive medication at baseline. Participants who did not attend Exam 2 in 2005–2008 and/or Exam 3 in 2009–2012 were excluded (n=275) as were participants with missing information on BP or antihypertensive medication use at both visits (n=106). We further excluded participants with missing physical activity data (n=85) or who did not report work-related physical activity (e.g. unemployed or retired; n=274) during the baseline visit. After these exclusions, the current analyses included 1,311 participants (Figure S1 in the online-only Data Supplement). The JHS was approved by institutional review boards of participating institutions. All participants provided informed consent.

Assessment of Physical Activity

Physical activity at the baseline examination was assessed using the JHS Physical Activity Survey, a 30-item questionnaire that assesses physical activity in four domains: active living habits, work, home life, and sport/exercise activities.[15] Scores for each domain range from 0 to 4 with lower scores representing lower physical activity. A total physical activity score is calculated by summing scores from the four domains (ranges 0 to 16).

To quantify the number of minutes/week spent in moderate or vigorous physical activity (MVPA), the Sport/Exercise items that queried the frequency and duration of participation in the three most sport/exercise activities performed in the past year were converted to “minutes/week” as previously described.[16] Consistent with the American Heart Association’s “Life’s Simple 7” metric, participants were stratified as having poor (0 minutes of MVPA/week), moderate (>0 and <150 minutes of moderate physical activity/week and >0 and <75 minutes of vigorous physical activity/week), or ideal (≥150 minutes of moderate physical activity/week or ≥75 minutes of vigorous physical activity/week) levels of MVPA.[17] A detailed summary of methodology for deriving the physical activity variables are reported in the Supplemental Methods.

BP measurement

At each visit, participants rested for 5 minutes in an upright position with their back and arms supported, feet flat on the floor and legs uncrossed prior to having their BP measured. Trained staff conducted two BP measurements in the right arm using a random-zero sphygmomanometer (Hawksley and Sons Ltd., Lancing, UK) at Visits 1 and 2, and semi-automatic oscillometric device (Omron HEM-907XL, Omron Healthcare Inc., Lake Forest, Il.) at Visit 3. The random-zero BP measurements were calibrated to the semi-automated device using robust regression (see Supplemental Methods for details). One minute elapsed between measurements. An appropriate cuff size, determined from arm circumference measurement, was used. The two BP measurements were averaged for analysis.

Incident hypertension was defined as the first follow-up study visit (Visits 2 or 3) with SBP ≥ 140 mmHg, DBP ≥ 90 mmHg, or self-reported antihypertensive medication use.

Covariates

Sociodemographic characteristics (age, sex, education, income, marital status, employment status), CVD risk factors (diabetes, total, LDL, and HDL cholesterol, and body mass index [BMI]), lifestyle behaviors (cigarette smoking, alcohol consumption, diet), estimated glomerular filtration rate (eGFR), and parental history of hypertension were included as covariates. A detailed summary of methodology for the measurement and calculation of these variables are reported in the Supplemental Methods.

Statistical Analyses

Participants were stratified by level of MVPA (poor, intermediate, or ideal) and, separately, into quartiles according to the Total Physical Activity Index. Interval-censored Cox regression[18] was used to calculate hazard ratios (HRs) for incident hypertension associated with higher MVPA categories (intermediate and ideal) versus the lowest MVPA category (poor) and, separately, higher Total Physical Activity Index quartiles (quartiles 2, 3, and 4) versus the lowest quartile (quartile 1). Models were adjusted for age and sex (Model 1). Subsequent models included adjustment for having less than a high school education, annual family income <$50,000, being married, and fulltime employment (Model 2), and further adjustment for heavy alcohol drinking, current smoking, healthy diet score, diabetes, total cholesterol, HDL cholesterol, LDL cholesterol, eGFR <60 ml/min/1.73 m^2, and parental history of hypertension (Model 3). Models were additionally adjusted for SBP and DBP (Model 4) and BMI (Model 5). P-trend tests were conducted by including the MVPA categories and Total Physical Activity Index quartiles as ordinal variables in regression models. The above analyses were then repeated in a fully adjusted model (Model 5) testing for effect modification across age group (<60 and ≥60 years), sex (male and female), and BP level (normotension [SBP <120 and DBP <80 mmHg] vs. prehypertension [SBP 120–139 mm Hg or DBP 80–89 mmHg]) by including multiplicative interaction terms in the regression model.

All of the above analyses were repeated examining each individual activity domain (Active Living, Work, Home Life, and Sport/Exercise Index) modeled as quartiles. In sensitivity analyses, we calculated the percentage of participants developing each component of incident hypertension, separately (SBP ≥ 140 mmHg or DBP ≥ 90 mmHg, and alternatively, antihypertensive medication use), and the HRs for these outcomes. Analyses were performed using SAS Version 9.4 (SAS Institute, Cary NC).

RESULTS

Participant Characteristics

Among the 1,311 participants included in the current analysis, 514 (39.2%), 487 (37.1%), and 310 (23.7%) participants had poor, intermediate, and ideal levels of MVPA, respectively. Participants with higher levels of MVPA were, on average, younger, more likely to be male, less likely to have diabetes, less than a high school education, an annual family income < $50,000, and smoke, had a higher healthy diet score, and had lower BMI and SBP (Table 1). Participant characteristics stratified by Total Physical Activity Index score quartiles are shown in Table S1.

MVPA or Total Physical Activity Index and Incident Hypertension

The median time between Visit 1 and Visit 2 was 4.8 years and between Visit 1 and Visit 3 was 8.0 years. During follow-up there were 650 cases (49.6%) of incident hypertension; 414 cases at Exam 2 and 236 cases at Exam 3. A description of how incident hypertension cases were defined (BP level, antihypertensive medication use, or both) is described in the Supplemental Results.

In models adjusted for age, sex, and sociodemographic factors, higher levels of MVPA and higher quartiles of the Total Physical Activity Index were associated with a lower risk for incident hypertension (Models 1 and 2, Table 2). The association between MVPA and incident hypertension, but not the Total Physical Activity Index, remained statistically significant after further multivariable adjustment including BMI (Models 3–5, Table 2). The associations between MVPA and the Total Physical Activity Index with incident hypertension did not vary by age, sex, or BP level (all interaction p-values >0.05; data not shown). The pattern of results were similar when incident hypertension was defined by BP level only and, separately, initiation of antihypertensive medication only (Table S2), although the relatively smaller number of outcomes may have limited statistical power to detect statistical significance.

Individual Activity Domains and Incident Hypertension

In models adjusted for age and sex, higher quartiles of the Active Living and, separately, the Sport/Exercise Index were associated with a lower risk for incident hypertension (Model 1, Table 3). The association between the Sport/Exercise Index and incident hypertension, but not the Active Living Index, remained statistically significant after further multivariable adjustment (Models 2–5, Table 3). The association of the Sport/Exercise Index with incident hypertension did not vary by age, sex, or BP level (all interaction p-values >0.05; data not shown). Higher quartiles of the Work Index were associated with an increased risk for hypertension after adjustment for age, sex, and sociodemographics (Models 1 and 2) but not after further multivariable adjustment. There were no associations between the Home/Life Index and incident hypertension in unadjusted or adjusted analyses. The pattern of results were similar when incident hypertension was defined by blood pressure level only, and separately, initiation of antihypertensive medication only (Tables S2 and S3).

DISCUSSION

In this population-based sample of African Americans, higher levels of MVPA were associated with a lower risk of incident hypertension. Graded dose-response associations were also observed for the Sport/Exercise index, a measure of voluntary and purposeful participation in sport/exercise activities. In a fully adjusted model, there were no significant associations observed for the overall Total Physical Activity Index, or the individual indexes for Active Living, Home Life, and Work, with incident hypertension.

In the current study, approximately 50% of JHS participants developed hypertension over a median follow-up of 8 years. A similar percentage of African Americans developed hypertension over 8 to 10 years in other population-based studies.[19, 20] These findings

highlight the high burden of hypertension among African Americans and the need to identify modifiable risk factors to lower this risk. Aerobic exercise training reduces BP, with meta-analyses reporting reductions in SBP and DBP of 3.5 and 2.5 mmHg, respectively, pooling all race/ethnicities.[21] Although protective effects of aerobic exercise-based physical activity in the prevention of hypertension have been well documented in white populations,[8–10] scare data exist for African Americans.

Some hypertension treatment guidelines recommend different initial drug classes in African American and white populations.[22] Whether race-specific guidelines for hypertension prevention are also warranted is unclear. Findings from the National Health and Nutrition Examination Survey (NHANES), the Atherosclerosis Risk in Communities (ARIC) Study, and an initial report from the Findings from the Coronary Artery Risk Development in Young Adults (CARDIA) study showed no association of leisure or non-leisure physical activity with incident hypertension in subsample analyses of African American participants.[8–10] More recent analyses of the CARDIA study reported that more leisure-time physical activity was associated with a lower risk of incident hypertension in African American men, but not women.[11] Current public health guidelines recommend MVPA 3–4 days/week for at least 40 min/session to reduce the risk of hypertension.[23] The results of the current study provide evidence which reinforce these recommendations that regular physical activity, particularly sport and/or exercise-related physical activity, is important for the prevention of hypertension among African American men and women.

The lack of an association between physical activity and incident hypertension reported in previous studies have been attributed to inaccuracies of the instruments used to assess physical activity, use of questionnaires not validated in African Americans, and the lack of range in physical activity levels.[8–10] The JHS study used a physical activity questionnaire that (1) queries the frequency and duration of physical activity participation, (2) has been validated for use in African Americans, and (3) had good distribution across the analytical sample.[15, 24] These strengths overcome the limitations of prior studies to help address an important evidence gap regarding the role of physical activity in the prevention of hypertension among African Americans.

A meta-analysis by Huai et al. examined the association between different domains of physical activity and incidence of hypertension and reported an inverse association between leisure-time physical activity, but not occupational physical activity, with incident hypertension among 136,846 persons of whom ~5% were black.[25] In the current study, higher levels of MVPA and the Sport/Exercise Index were associated with a lower risk of incident hypertension, while no association was observed for work, active living, or household-related physical activities after adjustment for confounders. Generally, occupational or household activity are often not done in bouts long enough to elicit beneficial cardiorespiratory or metabolic adaptations (e.g. 10 min or more) and typically consist of non-dynamic movements that do not increase cardiac output or whole-body metabolism. Thus, the lack of an association between the Work and Home Life indexes and incident hypertension in the current study may, in part, be attributed to the nature and/or intensity of occupational and household activities. Although active lifestyle activities (e.g., walking or biking to work/school or for errands) are of the dynamic type and may occur in

bouts long enough to elicit health benefit, because the JHS Physical Activity Survey did not assess the intensity of walking/biking during lifestyle activities, it's unclear whether the null findings for the Active Living Index can be attributed to such activities being predominately light in intensity. Although the more common, everyday physical activities (occupational, household, and lifestyle) were not associated with incident hypertension; the health benefits of such activities have been previously demonstrated and they should not be ruled out as important lifestyle behaviors.[26–28] Future studies are still needed to determine the type and optimal dose of physical activity (frequency, duration, intensity) to reduce the risk of hypertension in African Americans.

Our finding that the Total Physical Activity Index was not associated with incident hypertension highlights the importance of assessing specific domains of physical activity. The distinction between leisure and non-leisure physical activity may be particularly important among African Americans as previous studies have shown that African Americans engage in high amounts of occupational physical activity, but little leisure-time MVPA.[29, 30] Thus, composite scores or assessment of general physical activity levels without consideration of occupational vs. leisure-time domains may obscure associations in this population.

The mechanisms by which physical activity may prevent the development of hypertension are unclear. One mechanism by which physical activity is associated with a lower rate of developing hypertension is BMI reduction. We observed only minimal changes in the associations of MVPA and the Sport/Exercise Index with incident hypertension after adjustment for BMI; suggestive that BMI does not mediate these associations. Similar findings have been reported in predominantly white populations.[31, 32] Other suggested mechanisms include improved endothelial function, sodium handling, or baroreflex sensitivity, as well as decreased sympathetic or renin-angiotensin system activity.[33]

Several limitations should be noted when interpreting findings from the current study. First, physical activity was assessed by self-report. Second, minutes of MVPA/week were only able to be derived from items of the Sport/Exercise domain. Thus, MVPA may be underestimated as it does not account for occupational, household, or lifestyle-related physical activity. Third, the JHS was conducted in a single metropolitan area in the Southeastern US, possibly limiting its generalizability to other African American populations. Finally, as in all observational studies, there may be residual confounding from unmeasured factors. Notwithstanding these limitations, the JHS is one of the largest population-based studies conducted among African Americans. This landmark study provided a unique opportunity to characterize physical activity levels in four separate domains and evaluate their association with incident hypertension to elucidate the type of physical activity that mitigates risk for the development of hypertension in African Americans.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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PERSPECTIVES

In a population-based sample of African Americans, higher levels of MVPA and participation in higher levels of sport and/or exercise were associated with a lower risk of incident hypertension. In contrast, total physical activity, as well as occupational, household, and lifestyle physical activities, were not associated with incident hypertension after adjustment for potential confounders. The results of the current study provide evidence that increasing sport and/or exercise-related physical activity may reduce the incidence of hypertension among African Americans.

NOVELTY AND SIGNIFICANCE

What Is New?

This is one of the first studies to examine whether different domains (e.g. occupational vs. leisure) or intensity (e.g. all activity vs. moderate-vigorous activity) of physical activity are differentially associated with incident hypertension among African Americans.

What Is Relevant?

In a population-based sample of African Americans, higher levels of moderate-vigorous and sport/exercise-related physical activity were associated with a lower risk of incident hypertension. There were no significant associations observed for overall physical activity, or work, active living, and household-related physical activities.

Summary

Regular physical activity, particularly sport and/or exercise-related physical activity, may reduce the incidence of hypertension among African Americans.

Table 1

Characteristics of participants (n=1,311) by level of moderate-vigorous physical activity.

Variable	Level of MVPA			P-Trend
	Poor *(n=514)*	Intermediate *(n=487)*	Ideal *(n=310)*	
Age (years)	49.5 ± 10.8	47.2 ± 10.2	45.7 ± 10.6	<0.001
Male (%)	35.8	33.5	46.5	0.008
Body Mass Index (kg/m^2)	31.6 ± 7.8	30.8 ± 7.5	29.9 ± 5.9	0.004
Education <High School (%)	11.9	5.5	5.2	<0.001
Income <$50,000 (%)	42.8	45.1	34.1	0.044
Married (%)	60.2	59.3	62.9	0.518
Fulltime Employment (%)	77.8	81.1	79.0	0.539
Heavy alcohol drinking (%) *	3.5	3.5	4.2	0.641
Current Smoking (%)	17.7	11.0	8.2	<0.001
Healthy Diet Score †	1.1 ± 0.9	1.3 ± 0.9	1.4 ± 1.0	<0.001
Diabetes (%) ‡	9.7	7.7	3.9	0.003
Total Cholesterol (mg/dL)	196.8 ± 40.1	194.7 ± 36.9	195.4 ± 41.0	0.701
LDL Cholesterol (mg/dL)	127.2 ± 35.9	124.6 ± 34.2	126.0 ± 39.6	0.549
HDL Cholesterol (mg/dL)	50.3 ± 13.2	52.1 ± 14.2	51.1 ± 13.8	0.150
eGFR <60 ml/min/1.73 m^2 (%)	1.2	0.2	1.0	0.545
Parental Hx of Hypertension (%)	66.0	71.9	70.5	0.119
Systolic BP (mmHg)	119.8 ± 10.3	117.4 ± 10.7	116.7 ± 10.4	<0.001
Diastolic BP (mmHg)	75.0 ± 7.2	73.9 ± 7.1	74.2 ± 7.3	0.056

Data presented as mean ± standard deviation or percentage.

BP, blood pressure; eGFR, estimated glomerular filtration rate; HDL, high density lipoprotein; Hx, history; LDL, low density lipoprotein; MVPA, moderate-vigorous physical activity.

* Defined as 14 drinks/week for men; >7 drinks/week for women.

† Defined as number of the following dietary components: ≥4.5 cups/day of fruits and vegetables, ≥3 servings/day of whole grains, <1,500 mg/day of sodium, ≤450 kcal/week of sugary beverages, and ≥3.5 ounces of fish twice per week.

‡ Defined as fasting glucose ≥126 mg/dL, HbA1c ≥6.5%, or use of antidiabetes medication.

Table 2

Hazard ratio for incident hypertension by level of moderate-vigorous physical activity and quartile of Total Physical Activity Index.

Index	N cases of incident hypertension/N at risk (%)	Hazard ratio (95% CI) for Incident Hypertension				
		Model 1*	Model 2†	Model 3‡	Model 4//	Model 5¶
Level of MVPA						
Poor	292/514 (56.8%)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Intermediate	231/487 (47.4%)	0.79 (0.66–0.94)	0.76 (0.63–0.92)	0.75 (0.61–0.93)	0.82 (0.66–1.03)	0.84 (0.67–1.05)
Ideal	127/310 (41.0%)	0.68 (0.55–0.84)	0.65 (0.52–0.82)	0.67 (0.52–0.87)	0.74 (0.57–0.97)	0.76 (0.58–0.99)
		P-trend <0.001	P-trend <0.001	P-trend=0.001	P-trend=0.020	P-trend=0.038
Total Physical Activity Index						
Q1	170/327 (52.0%)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Q2	191/329 (58.1%)	1.25 (1.01–1.54)	1.21 (0.96–1.52)	1.19 (0.92–1.54)	1.12 (0.86–1.46)	1.15 (0.88–1.51)
Q3	149/327 (45.6%)	0.97 (0.77–1.22)	0.92 (0.72–1.18)	0.96 (0.73–1.25)	1.02 (0.77–1.34)	1.04 (0.79–1.36)
Q4	140/328 (42.7%)	0.84 (0.67–1.05)	0.81 (0.63–1.04)	0.85 (0.64–1.12)	0.89 (0.67–1.20)	0.93 (0.70–1.25)
		P-trend=0.037	P-trend=0.030	P-trend=0.129	P-trend=0.386	P-trend=0.545

CI, confidence interval; MVPA, moderate/vigorous physical activity.

Total Physical Activity Index Quartile levels: Q1: ≤7.94, Q2: 7.95–9.50, Q3: 9.51–11.04; Q4: ≥11.05.

*Model 1: Adjusted for age and sex.

†Model 2: Adjusted for covariates in model 1 plus education <high school, income <$50,000, married, and fulltime employment.

‡Model 3: Adjusted for covariates in model 2 plus alcohol drinking, current smoking, healthy diet score, diabetes, total cholesterol, HDL cholesterol, LDL cholesterol, and eGFR <60.

//Model 4: Adjusted for covariates in model 3 plus systolic BP and diastolic BP.

¶Model 5: Adjusted for covariates in model 4 plus BMI.

Pseudo R^2 for overall model with level of MVPA: Model 1=3.1; Model 2=17.5; Model 3=33.6; Model 4=40.2; Model 5=40.4

Pseudo R^2 for overall model with Total Physical Activity Index: Model 1=3.0; Model 2=17.3; Model 3=33.4; Model 4=40.0; Model 5=40.3

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Table 3

Hazard ratio for incident hypertension by quartiles of Active Living, Work, Home/Life, and Sport/Exercise domains.

Index	N cases of incident hypertension/N at risk (%)	Hazard ratio (95% CI) for Incident Hypertension				
		Model 1*	Model 2†	Model 3‡	Model 4//	Model 5¶
Active Living Index						
Q1	197/365 (54.0%)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Q2	137/263 (52.1%)	1.03 (0.83–1.29)	1.03 (0.81–1.32)	0.96 (0.73–1.26)	1.01 (0.76–1.34)	1.02 (0.77–1.35)
Q3	192/404 (47.5%)	0.88 (0.72–1.07)	0.89 (0.72–1.11)	0.90 (0.71–1.15)	0.88 (0.69–1.13)	0.89 (0.69–1.14)
Q4	124/279 (44.4%)	0.82 (0.65–1.03)	0.85 (0.66–1.09)	0.83 (0.62–1.10)	0.87 (0.65–1.17)	0.89 (0.67–1.19)
		P-trend=0.041	P-trend=0.113	P-trend=0.174	P-trend=0.228	P-trend=0.291
Work Index						
Q1	145/312 (46.5%)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Q2	145/335 (43.3%)	0.92 (0.73–1.16)	0.91 (0.71–1.17)	0.88 (0.67–1.15)	0.83 (0.63–1.09)	1.48 (1.15–1.92)
Q3	165/306 (53.9%)	1.22 (0.97–1.53)	1.19 (0.93–1.52)	1.14 (0.88–1.49)	1.10 (0.84–1.44)	1.14 (0.86–1.52)
Q4	195/358 (54.5%)	1.31 (1.05–1.63)	1.32 (1.03–1.68)	1.16 (0.88–1.53)	1.12 (0.85–1.48)	1.11 (0.82–1.50)
		P-trend=0.002	P-trend=0.005	P-trend=0.109	P-trend=0.178	P-trend=0.135
Home/Life Index						
Q1	162/343(47.2%)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Q2	215/376(57.2%)	1.35 (1.09–1.65)	1.49 (1.19–1.87)	1.55 (1.21–1.99)	1.49 (1.15–1.92)	0.84 (0.64–1.11)
Q3	140/289(48.4%)	1.11 (0.88–1.40)	1.19 (0.92–1.53)	1.22 (0.92–1.61)	1.13 (0.85–1.50)	1.13 (0.86–1.48)
Q4	133/303(43.9%)	1.01 (0.80–1.28)	1.02 (0.79–1.33)	1.05 (0.78–1.41)	1.07 (0.80–1.45)	1.14 (0.86–1.51)
		P-trend=0.735	P-trend=0.756	P-trend=0.926	P-trend=0.943	P-trend=0.863
Sport/Exercise Index						
Q1	287/506(56.7%)	1.00 (ref)	1.00 (ref)	1.00(ref)	1.00(ref)	1.00(ref)
Q2	83/162(51.2%)	0.91 (0.71–1.17)	0.92 (0.70–1.20)	0.85 (0.63–1.14)	0.89 (0.66–1.21)	0.92 (0.68–1.25)
Q3	138/300(46.0%)	0.79 (0.65–0.98)	0.76 (0.61–0.95)	0.78 (0.60–1.00)	0.85 (0.66–1.10)	0.87 (0.67–1.13)
Q4	142/343(41.4%)	0.66 (0.54–0.81)	0.62 (0.50–0.78)	0.65 (0.51–0.84)	0.73 (0.56–0.94)	0.75 (0.58–0.97)
		P-trend <0.001	P-trend <0.001	P-trend=0.001	P-trend=0.017	P-trend=0.032

CI, confidence interval.

Active Living Index quartile cutoffs: Q1: ≤1.50, Q2: 1.75–2.00, Q3: 2.25–2.75; Q4: ≥3.00; Work Index quartile cutoffs: Q1: ≤2.00, Q2: 2.13–2.50, Q3: 2.63–3.00; Q4: ≥3.12; Home/Life Index quartile cutoffs: Q1: ≤1.85, Q2: 2.00–2.29, Q3: 2.43–2.71; Q4: ≥2.85; Sport/Exercise Index quartile cutoffs: Q1: <1.25, Q2: 1.25–2.50, Q3: 2.75–3.25; Q4: ≥3.5.

[*] Model 1: Adjusted for age and sex.

[†] Model 2: Adjusted for covariates in model 1 plus education <high school, income <$50,000, married, and fulltime employment.

[‡] Model 3: Adjusted for covariates in model 2 plus alcohol drinking, current smoking, healthy diet score, diabetes, total cholesterol, HDL cholesterol, LDL cholesterol, and eGFR <60.

[//] Model 4: Adjusted for covariates in model 3 plus systolic BP and diastolic BP.

[¶] Model 5: Adjusted for covariates in model 4 plus BMI.

Pseudo R^2 for overall model with Active Living Index: Model 1=2.6; Model 2=16.9; Model 3=33.2; Model 4=40.0; Model 5=40.3

Pseudo R^2 for overall model with Work Index: Model 1=3.0; Model 2=17.4; Model 3=33.3; Model 4=40.2; Model 5=40.4

Pseudo R^2 for overall model with Home/Life Index: Model 1=2.8; Model 2=17.3; Model 3=33.7; Model 4=40.4; Model 5=40.6

Pseudo R^2 for overall model with Sport/Exercise Index: Model 1=3.1; Model 2=17.6; Model 3=33.6; Model 4=40.2; Model 5=40.4