Leisure Time Physical Activity in Relation to Depressive Symptoms in the Black Women's Health Study

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Abstract

Background—A growing body of evidence suggests that physical activity might reduce the risk of depressive symptoms, but there are limited data on Black women.

Purpose—The objective was to evaluate the association between leisure time physical activity and depressive symptoms in U.S. Black women.

Methods—Participants included 35,224 women ages 21 to 69 from the Black Women's Health Study, a follow-up study of African American women in which data are collected biennially by mail questionnaire. Women answered questions on past and current exercise levels at baseline (1995) and follow-up (1997). The Center for Epidemiologic Studies Depression Scale (CES-D) was used to measure depressive symptoms in 1999. Women who reported a diagnosis of depression before 1999 were excluded. We used multivariate logistic regression models to compute odds ratios (ORs) and 95% confidence intervals (CIs) for physical activity in relation to depressive symptoms (CES-D score $\geq$ 16) with control for potential confounders.

Results—Adult vigorous physical activity was inversely associated with depressive symptoms. Women who reported vigorous exercise both in high school ($\geq$ 5 hr per week) and adulthood ($\geq$ 2 hr per week) had the lowest odds of depressive symptoms (OR = 0.76, 95% CI = 0.71–0.82) relative to never active women; the OR was 0.90 for women who were active in high school but not adulthood (95% CI = 0.85–0.96) and 0.83 for women who were inactive in high school but became active in adulthood (95% CI = 0.77–0.91). Although walking for exercise was not associated with risk of depressive symptoms overall, there was evidence of a weak inverse relation among obese women (Body Mass Index $\geq$ 30).

Conclusions—Leisure time vigorous physical activity was associated with a reduced odds of depressive symptoms in U.S. Black women.

INTRODUCTION

Major depression is one of the most common illnesses in industrialized countries and is projected to become the world's second leading cause of disability and mortality by 2020 (1). The prevalence of depression is greater in women than in men (2), and has been shown to be greater in African Americans than in other ethnic groups in some (2–4), but not all (5–7), studies. Established risk factors for depression include low income, low educational attainment, young age, and never having been married (8).

A growing body of evidence from largely White populations suggests that physical activity might reduce the risk of depressive symptoms. Of the 15 prospective observational studies that have examined physical activity and risk of subsequent depression, 11 found an inverse association (9–20) and 5 were null (21–25). In the only two prospective observational studies that included Black women (9,17), results were either not stratified by race (17) or were limited due to small sample size (9). Thus, there are virtually no published data on the relation of physical activity to depression in Black women.

Levels of physical activity are lower among Black women compared with other populations in the United States (26,27). If low levels of physical activity increase the risk of depressive symptoms, this may contribute to the excess burden of depression among U.S. Black women. This observational study investigates the relation of leisure time physical activity to depressive symptoms in a large cohort of U.S. Black women. We hypothesized that regular physical activity would be inversely associated with depressive symptoms. Plausible biological mechanisms to support a protective effect of physical activity on depression are increased cortical blood flow, the release of endorphins, and increased epinephrine and norepinephrine synthesis (28). Physical activity may also serve as a buffer against stressful events, enhance self-efficacy and self-esteem, and decrease social isolation.

METHODS

Study Population

The Black Women's Health Study (BWHS) is an ongoing prospective cohort study designed to examine risk factors for major illnesses in African American women. In 1995, approximately 59,000 Black women ages 21 to 69 years were enrolled through questionnaires mailed to subscribers of *Essence* magazine, members of Black professional organizations, and friends and relatives of respondents (29). The 1995 (baseline) questionnaire elicited information on demographic and behavioral characteristics, anthropometric factors, health care utilization, and medical conditions. BWHS participants represent various geographic regions of the United States, with the majority residing in California, New York, Illinois, Michigan, Georgia, and New Jersey. The cohort is followed every 2 years by postal questionnaire; the 1997 and 1999 follow-up questionnaires were completed by 90% and 87% of the original cohort, respectively.

Assessment of Depressive Symptoms

The 1999 follow-up questionnaire included the 20-item Center for Epidemiologic Studies Depression Scale (CES-D), an instrument used to assess depressive symptoms in community samples and population-based studies (30). Respondents were asked to rate each item, indicating the frequency of various feelings experienced during the previous week on a 4-point scale ranging from "rarely or none of the time" to "most or all of the time." The measure included items such as "I felt sad," "I felt lonely," "I felt depressed," and "I enjoyed life." Total scores ranged from 0 to 60. The validity and reliability of the CES-D has been repeatedly documented (2,30–34), including among African American women (31,34).

Assessment of Physical Activity and Covariates

On the 1995 and 1997 questionnaires, women reported the average number of hours (none, < 1, 1, 2, 3–4, 5–6, 7–9, and ≥ 10) they spent each week during the past year engaged in "walking for exercise" and "vigorous exercise (such as basketball, swimming, running, aerobics)." A separate variable was included on the 1995 questionnaire to assess "vigorous exercise during high school," using the same frequency categories as noted earlier.

The test–retest reliability of physical activity reported on the 1997 questionnaire was assessed among a subset of 1,123 BWHS participants who inadvertently completed the 1997 questionnaire twice. The weighted kappas were 0.57 for walking for exercise (hours per week) and 0.69 for vigorous physical activity (hours per week). These kappas were similar to those reported in the Women's Health Initiative observational study of recreational physical activity in relation to breast cancer (35).

Data on height, weight, cigarette smoking, alcohol consumption, preexisting health conditions, energy intake, education, occupation, marital status, child care responsibilities, and geographic region were ascertained on the baseline survey and were considered as potential confounders or effect modifiers. Body mass index (BMI) was calculated as kilograms divided by meters squared.

Exclusion Criteria

Among the 51,170 women who completed the 1999 questionnaire (87% of original cohort), 40,795 women provided complete information on the CES-D items (80%) and were eligible for inclusion. We excluded 2,860 women who reported physician-diagnosed depression on the baseline or 1997 questionnaires, because their physical activity levels may have been influenced by depression, and 2,711 women with missing data on physical activity or covariates. The 35,224 women included in the analytic sample were similar to those not included with respect to physical activity levels (vigorous exercise: 2.0 vs. 1.9 hr per week; walking for exercise: 2.1 vs. 2.2 hr per week), age (mean years: 38.2 vs. 40.6), geographic region (% living in Northeast: 26.7 vs. 28.4; % living in South: 31.1 vs. 29.7; % living in Midwest: 23.6 vs. 22.9; and % living in West: 18.6 vs. 18.7), education (mean years: 14.9 vs. 14.5), BMI (mean kg/m^2: 27.9 vs. 28.2), energy intake (mean kilocalories per day: 1,507 vs. 1,475), alcohol consumption (mean number of drinks per week: 1.4 vs. 1.5), cigarette smoking (% current: 15.2 vs. 18.2; % former: 18.9 vs. 20.1), child care responsibilities (44.5% vs. 48.5%), marital status (% married: 40.0 vs. 39.5), and occupation (% professional: 45.5 vs. 41.3).

Data Analysis

Women were divided into subgroups based on their self-reported frequency of walking for exercise or vigorous physical activity (none, < 1, 1, 2, 3–4, 5–6, ≥ 7 hr per week). To represent physical activity in adulthood as accurately as possible, we created an average measure of physical activity from the 1995 and 1997 questionnaires (36). The self-reported physical activity variables were positively and significantly correlated across the 1995 and 1997 questionnaires: Spearman correlation coefficients were 0.51 for vigorous physical activity (p < .001) and 0.43 for walking for exercise (p < .001). We also examined changes in vigorous activity from past (high school) to present (adulthood), using a four-level variable: active in high school (≥ 5 hr per week) and adulthood (≥ 2 hr per week), active in high school but not adulthood, inactive in high school but active in adulthood, and inactive both in high school and adulthood.

We computed percentages for various characteristics associated with physical activity levels standardized to the age distribution of the cohort at baseline. Logistic regression was used to

compute odds ratios (ORs) and 95% confidence intervals (95% CI) for the association of physical activity with depressive symptoms as measured by a CES-D score of 16 or higher, a standard cutoff used to identify clinical depression in community samples (30,37–40). In addition to the unadjusted models, we constructed two multivariate models. The first model controlled for known or suspected confounders of the physical activity and depression association, selected from a set of variables associated with vigorous physical activity in our cohort (Table 1). Based on these criteria, we adjusted for age (5-year intervals), geographic region (West vs. non-West), and measures of socioeconomic status, including education (≤ 12, 13–15, 16, 17+ years), occupation (professional or managerial, sales or clerical, service, crafts, operative, farmer, other), and marital status (single, divorced, separated, or widowed, married or partnered). The second model further controlled for factors that may be intermediates of the association between physical activity and depression, including BMI (< 20, 20–24, 25–29, 30 $+ kg/m^2$), pre-existing health conditions (cardiovascular disease, diabetes, or cancer vs. none) and child care responsibilities (yes vs. no), or potential downstream effects of depression, including energy intake ($< 1,000$, 1,000–1,499, 1,500+ kilocalories per day), alcohol consumption (drinks per week), and smoking (current, past, never). Both forms of physical activity, walking and vigorous exercise, were mutually adjusted for each other.

To evaluate the presence of a dose-response relation, we conducted tests for trend by including in the regression model a single continuous term coded as the midpoint of each physical activity category (assigning 11 hr per week to the top category) (41). Tests for trend excluded the zero-level exposure category. Analyses were stratified by age (< 40, 40+), BMI (< 30, 30+ kg/m^2), education (≤ 12, 13–16, 17+ years), and geographic region, because the relation between physical activity and depressive symptoms may be modified by these variables. To formally test for interaction on the multiplicative scale, we computed the likelihood ratio test for the comparison of models with and without interaction terms. All analyses were carried out using SAS statistical software version 8.02 (42).

RESULTS

Twenty-four percent of women reported no vigorous physical activity and 10% reported 5 hr or more of vigorous physical activity on average per week (Table 1). Consistent with published results from a study of physical activity correlates in the BWHS (43), vigorous physical activity was most strongly associated with younger age, greater education, not smoking, living in the West, and the absence of preexisting health conditions. Walking for exercise (reported by 11% of women at levels of 5 hr or more per week) was positively associated with education, not smoking, and living in the West (data not shown).

An inverse association was observed between adult vigorous physical activity and depressive symptoms (Table 2). Compared with women who reported no adult vigorous physical activity, the multivariate OR for women reporting 7 hr or more per week was 0.75 (95% CI = 0.65– 0.87). Although there was a statistically significant test for trend among vigorous exercisers, visual inspection of the ORs did not show evidence of a monotonic inverse relation. The ORs decreased with increasing vigorous physical activity up until 3 to 4 hr per week, after which they did not decrease further. Walking for exercise was not associated with depressive symptoms in multivariate analyses.

When we examined vigorous physical activity levels across the life span, women who were active both in high school (≥ 5 hr per week) and adulthood (≥ 2 hr per week) had the lowest odds of depressive symptoms (OR = 0.76, 95% CI = 0.71–0.82) relative to never active women; the OR was 0.90 (95% CI = 0.85–0.96) for women who were active in high school but not adulthood, and 0.83 (95% CI = 0.77–0.91) for women who were inactive in high school but active in adulthood.

Associations between physical activity and depressive symptoms within different age and BMI strata are presented in Table 3. In analyses stratified by age, associations with depressive symptoms of adult vigorous physical activity and walking for exercise were similar within both age strata. Despite the different time lags between high school and adult vigorous physical activity among the various age groups (ranging from approximately 2 to 51 years), the ORs representing lifetime vigorous physical activity in relation to depressive symptoms were similar in older and younger women. In analyses stratified by BMI (< 30 vs. 30+), the ORs comparing adult vigorous physical activity categories of 5 hr or more per week versus none were slightly stronger in nonobese than obese women, but the associations were not statistically different (p value, test for BMI interaction $= .28$). In contrast, the association between walking for exercise and depressive symptoms appeared to depend on BMI (p value, test for interaction $= .02$): walking for exercise was weakly inversely associated with depressive symptoms among obese women (p value, test for trend $= .007$), but there was no association among nonobese women (p value, test for trend $= .94$). Associations between physical activity and depressive symptoms were uniform within strata of educational attainment and geographic region of residence (data not shown).

Some women changed their levels of physical activity between 1995 and 1997. Although most women ($n = 28,585, 81\%$) remained within two categories of vigorous physical activity, 19% ($n = 6,709$) reported a change in vigorous physical activity of more than two categories (e.g., reported 2 hr per week in 1995 and none in 1997). Among these women, 28% increased their activity levels and 72% decreased their activity levels. A decrease in physical activity was significantly associated with younger age, lower BMI, lower educational attainment, and having higher baseline levels of adult vigorous physical activity and walking. An increase in physical activity was significantly associated with younger age and having lower baseline levels of adult vigorous physical activity. When we confined the analyses to women who remained within two categories of their reported vigorous physical activity between 1995 and 1997, the results were virtually identical to those presented herein (data not shown).

Results were similar to those presented in Tables 2 and 3 when we used physical activity data from 1995 only or when we repeated the analysis using a more stringent cutoff for depressive symptoms (CES-D ≥ 25; data not shown). Multivariate linear regression analyses in which a continuous CES-D outcome variable was used were consistent with the models that used a binary cutoff (data not shown).

DISCUSSION

In this observational study of Black women, vigorous physical activity in adulthood was inversely associated with depressive symptoms. The biggest decrease in the odds of depressive symptoms was observed among women who were active in both high school and adulthood. Women who were active in high school only or adulthood only still had significantly lower odds of depressive symptoms relative to women who were never active.

Walking for exercise was not associated with risk of depressive symptoms overall, but there was some evidence of an in-verse association, albeit weak, among obese women (BMI 30+). Although obese women were less likely to be active in general, those who were active were more likely to engage in walking as opposed to vigorous physical activity. If causal, the association of walking with fewer depressive symptoms in obese women may have important public health implications, because few obese individuals appear able to perform or sustain high levels of vigorous physical activity. Moreover, physiologically, based on perceived and measured exertion, brisk walking among obese individuals might be equivalent to "vigorous" physical activity (44,45).

Our findings agree with 11 prospective observational studies that have reported a protective effect of physical activity on depressive symptoms (9–20). Five other studies found no association (21–25). To our knowledge, none of these studies stratified by BMI to assess whether certain forms of physical activity might be more beneficial in obese compared with nonobese women. One study reported an inverse association between walking and depressive symptoms among people ages 65 and older (14); small numbers of women ($n = 455$) limited our ability to examine the influence of walking in that age group. Our finding of an inverse association of depressive symptoms with vigorous physical activity in high school is compatible with three studies of young athletes (12,18,19). Our findings also agree with most secondary prevention clinical trials of exercise in the treatment of depression (46,47).

The BWHS is the first large study of U.S. Black women to assess the relation between physical activity and depressive symptoms. We used the average of two physical activity variables measured at two separate points in time (1995 and 1997), which may provide a more valid measure of long-term physical activity than a measure taken at a single point in time (36). Data on physical activity during high school allowed us to examine changes in exercise patterns over time.

Several limitations to this study are worth considering. First, although our study was prospective in design, it was not possible to determine whether physical activity levels were antecedent to, or consequences of, depression. Our CES-D measure was self-administered in 1999 only. Because it was not administered in 1995, we could not use the CES-D scale to identify and exclude women reporting depressive symptoms at baseline. However, by excluding women who reported physician-diagnosed depression before 1999, we attempted to minimize the possibility that depression influenced levels of physical activity.

Second, as with any observational study in which the exposure is not randomly allocated, the association between physical activity and depressive symptoms may have been confounded by other unmeasured factors. We were able to measure and control for several potential confounding variables (e.g., preexisting health conditions, smoking) and results were similar whether or not we included these variables in the model.

Third, our study focused on leisure time physical activity and did not include other forms of physical activity that may be related to depression, such as occupational and utilitarian activity. In addition, we did not have extensive detail on the actual type of physical activity (e.g., basketball vs. aerobics) or its intensity (e.g., brisk vs. slow walking), which may have led to some misclassification of activity levels. The lack of a monotonic dose-response relation may suggest a threshold effect for vigorous physical activity or may indicate that women reporting levels of vigorous physical activity in excess of 5 hr per week represent a distinct group of individuals with a greater risk of depression (e.g., women with low self-image). The curvilinear pattern may also be the result of reporting error if, for example, women with underlying depression were more likely to over-report their activity levels relative to nondepressed women.

Fourth, although the CES-D scale has been widely used in community-based samples to screen for depression, it is not a definitive clinical measure of depression. In one study, a cutoff of "16 or more" identified 65% of women with clinical depression (40). Despite its inability to capture all women with depression, the CES-D scale is practical for large epidemiologic studies in which the administration of a more structured clinical interview is not feasible. Furthermore, results were similar when we used a cutoff of 25 or greater, which was more likely to identify women with clinical depression.

Finally, it is possible that women who developed depression after baseline were more likely to withdraw from the study. When we compared those included in this analysis to those not

included with respect to baseline physical activity measures, in addition to demographic, social, and lifestyle characteristics, we did not observe any important differences. Prevalence estimates for vigorous physical activity and walking for exercise in the BWHS are consistent with estimates from nationally representative studies of Black women (26,48). The proportion of women who reported depressive symptoms (CES-D 16+) in our sample (27%) is higher than that found in the general population normative sample (21%) (30), but is compatible with estimates found for Black women in other studies (4,8).

Although study participants reside in more than 14 U.S. states, the BWHS is a convenience sample and was not designed to be representative of the general population of U.S. Black women. In particular, the study cohort underrepresents women with less than a high school education. However, the observed associations persisted within strata of education—as well as age and geographic region—suggesting that they might extend to the general population of U.S. Black women ages 21 to 69 years.

Several mechanisms could explain a protective effect of physical activity on depressive symptoms. Physical exercise influences the central dopaminergic, noradrenergic, and serotonergic systems (28). The increased biosynthesis of neurotransmitters, including monoamines (28), catecholamines (49), and endorphins (50,51), may improve mood. Social–psychological mechanisms include enhanced self-efficacy and self-esteem, improved self-image and self-worth, and decreased social isolation (10). Physical activity may also boost immune function (52,53), and prevent chronic conditions (e.g., hypertension and diabetes) associated with depression.

In summary, our results suggest that vigorous physical activity reduces depressive symptoms in U.S. Black women, and that despite a history of inactivity, the initiation of a current physical activity program could have mental health benefits. In the context of primary prevention research, additional studies are needed to clarify the optimal frequency and intensity of exercise needed to have an effect. According to data from the NHANES study, the prevalence of leisure time activity among Black women in the United States is about half that of White women (26,27). Interventions aimed at increasing physical activity among Black women will need to target groups with lower exercise levels, such as women with low educational attainment and obese women.

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TABLE 1

Baseline Characteristics of 35,224 Women According to Vigorous Physical Activity, the Black Women's Health Study

Characteristic	No. of Women	Vigorous Physical Activity		
		None[a]	< 5 hr/week[b]	5+ hr/week[c]
Age, years (%)				
< 30	8,469	14.0	73.8	12.2
30–39	12,212	19.1	69.2	11.7
40–49	9,493	28.4	63.1	8.5
50–59	3,773	40.9	53.0	6.1
60+	1,277	52.8	41.7	5.5
Education, years (%)[d]				
≤ 12	4,879	37.4	54.5	8.1
13–15	12,737	25.7	64.0	10.3
16	8,890	20.7	68.4	10.9
17+	8,517	17.2	72.7	10.1
Occupational category (%)				
Professional/Managerial	20,660	20.6	68.9	10.5
Sales/Clerical	8,772	28.0	63.0	9.0
Service/Crafts/Operative/Farmer	3,291	32.8	57.4	9.8
Other	2,501	27.9	59.4	12.7
Marital status (%)				
Married/Living with partner	14,203	24.6	66.7	8.7
Separated/Widowed/Divorced	8,339	24.7	64.1	11.2
Single	12,682	24.4	64.6	11.0
Body mass index, kg/m^2 (%)				
< 20	2,119	27.0	64.1	8.9
20–24	12,009	18.4	67.9	13.7
25–29	10,955	22.0	67.9	10.1
30+	10,141	31.4	62.5	6.1
Energy intake, kilocalories/day (%)[d]				
< 1,000	7,742	22.6	66.3	11.1
1,000–1,499	10,394	22.0	67.9	10.1
1,500+	15,002	24.7	65.5	9.8
Child care responsibilities (%)				
Yes	15,604	26.3	64.5	9.2
No	19,620	22.3	66.6	11.1
Smoking history (%)				
Current	5,115	31.7	59.4	8.9
Former	6,504	23.0	66.2	10.8
Never	23,605	22.9	67.0	10.1
Current alcohol consumption (%)				
Yes	8,752	21.6	67.6	10.8
No	26,472	24.8	65.3	9.9
Preexisting health condition (%)				
Yes	1,882	31.5	61.0	7.5
No	33,342	23.5	66.4	10.3
Geographic region of residence (%)				
Northeast	9,553	24.8	64.9	10.3
South	10,905	25.0	65.8	9.2
Midwest	8,266	24.9	65.6	9.5
West	6,500	19.8	67.9	12.3

Note. Characteristics (with exception of age) are standardized to age distribution of women at baseline and are reported as row percentages. Vigorous physical activity is averaged over 1995 and 1997 questionnaires.

[a] $n = 8,437$.

[b] $n = 23,219$.

[c] $n = 3,568$.

[d] Numbers do not sum to total due to missing values for education ($n = 201$) and energy intake ($n = 2,086$).

TABLE 2

Odds Ratios for Depressive Symptoms in 1999 (CES–D 16+) in Relation to Leisure Time Physical Activity

Type of Physical Activity	No.	CES–D ≥ 16 (%)	Crude OR (95% CI)	Model 1 OR (95% CI)[a]	Model 2 OR (95% CI)[b]
Adult vigorous activity, hr/week					
None	8,437	29.5	1.00[c]	1.00[c]	1.00[c]
<1	8,852	28.0	0.93 (0.87–1.00)	0.86 (0.80–0.92)	0.89 (0.83–0.95)
1	5,900	26.8	0.88 (0.81–0.94)	0.80 (0.74–0.87)	0.85 (0.78–0.92)
2	4,692	23.8	0.75 (0.69–0.81)	0.69 (0.63–0.75)	0.74 (0.68–0.81)
3–4	3,775	23.3	0.73 (0.66–0.79)	0.66 (0.60–0.73)	0.72 (0.66–0.80)
5–6	2,139	26.3	0.85 (0.77–0.95)	0.75 (0.66–0.84)	0.81 (0.72–0.92)
7+	1,429	25.0	0.80 (0.70–0.91)	0.67 (0.58–0.77)	0.75 (0.65–0.87)
Test for continuous trend[d]			$p < .001$	$p < .001$	$p < .001$
Adult walking for exercise, hr/week					
None	3,392	29.8	1.00[c]	1.00[c]	1.00[c]
< 1	10,486	29.2	0.97 (0.89–1.05)	1.09 (0.99–1.18)	1.08 (0.99–1.18)
1	6,628	26.3	0.84 (0.77–0.92)	0.97 (0.88–1.07)	0.97 (0.88–1.07)
2	6,122	24.7	0.77 (0.70–0.85)	0.96 (0.87–1.05)	0.95 (0.86–1.06)
3–4	4,717	23.8	0.74 (0.67–0.81)	0.94 (0.85–1.05)	0.94 (0.84–1.05)
5–6	2,390	25.4	0.80 (0.71–0.90)	1.01 (0.89–1.14)	0.99 (0.87–1.12)
7+	1,489	27.4	0.89 (0.77–1.02)	1.14 (0.98–1.31)	1.09 (0.94–1.26)
Test for continuous trend[d]			$p < .001$	$p = .57$	$p = .25$
Lifetime vigorous activity[e], hr/week					
Never active	15,537	28.7	1.00[c]	1.00[c]	1.00[c]
Active in high school, inactive in adulthood	8,762	26.8	0.91 (0.86–0.96)	0.93 (0.88–0.99)	0.90 (0.85–0.96)
Inactive in high school, active in adulthood	3,840	24.6	0.81 (0.75–0.88)	0.78 (0.72–0.85)	0.83 (0.77–0.91)
Always active	5,797	23.9	0.78 (0.73–0.84)	0.74 (0.69–0.79)	0.76 (0.71–0.82)

Note. CES–D = Center for Epidemiologic Studies–Depression Scale; OR = odds ratio; CI = confidence interval.

[a] Adjusted for age (5-year intervals), education (≤ 12, 13–15, 16, 17+ years), occupation (professional/managerial, sales/clerical, service/crafts/operative/farmer, other), marital status (single, divorced/separated/widowed, married/partnered), and geographic region (West vs. non-West), and mutually adjusted for each form of physical activity (in categories above).

[b] Adjusted for Model 1 covariates and body mass index (< 20, 20–24, 25–29, 30+), preexisting health conditions (cardiovascular disease, diabetes, or cancer vs. none), energy intake (< 1000, 1000–1499, 1500+), smoking (current, past, never), current alcohol consumption (drinks/week), and child care responsibilities (yes vs. no).

[c] Reference group.

[d] Excludes zero-level exposure category.

[e] Active = 5+ hr in high school or 2+ hr in adulthood. Excludes women with missing data on high school physical activity ($n = 1,288$, 3.7% nondepressed; $n = 101$, 3.8% depressed).

TABLE 3

Multivariate Odds Ratios (ORs) for Depressive Symptoms in 1999 (CES–D 16+) in Relation to Leisure Time Physical Activity, Stratified by Age and Body Mass Index (BMI) at Baseline

Type of Physical Activity	Younger Than Age 40			Age 40 or Older		
	No.	CES–D ≥ 16 (%)	Multivariate OR (95% CI)[a]	No.	CES–D ≥ 16 (%)	Multivariate OR (95% CI)[a]
Adult vigorous activity, hr/week						
None	3,522	37.3	1.00[b]	4,915	23.8	1.00[b]
< 2	8,902	31.3	0.84 (0.77–0.91)	5,850	21.9	0.89 (0.81–0.98)
2–4	5,799	26.1	0.70 (0.63–0.77)	2,668	18.2	0.75 (0.66–0.85)
5+	2,458	28.5	0.77 (0.68–0.88)	1,110	19.6	0.78 (0.65–0.93)
Test for continuous trend[c]			$p = .017$			$p = .004$
Adult walking for exercise, hr/week						
None	2,120	32.4	1.00[b]	1,272	25.6	1.00[b]
< 2	10,282	31.4	1.08 (0.97–1.20)	6,832	23.1	0.99 (0.86–1.14)
2–4	6,187	28.5	1.01 (0.90–1.14)	4,652	18.8	0.85 (0.73–1.00)
5+	2,092	30.5	1.05 (0.91–1.21)	1,787	21.0	0.98 (0.82–1.18)
Test for continuous trend[c]			$p = .41$			$p = .20$
Lifetime vigorous activity, hr/week						
Never active	8,455	33.2	1.00[b]	7,082	23.3	1.00[b]
Active in high school, inactive in adulthood	5,037	31.1	0.93 (0.87–1.01)	3,725	21.0	0.86 (0.78–0.95)
Inactive in high school, active in adulthood	2,569	27.4	0.85 (0.77–0.94)	1,271	19.0	0.79 (0.67–0.92)
Always active	4,138	26.0	0.77 (0.71–0.84)	1,659	18.6	0.75 (0.65–0.86)

Type of Physical Activity	BMI < 30			BMI 30+		
	No.	CES–D ≥ 16 (%)	Multivariate OR (95% CI)[a]	No.	CES–D ≥ 16 (%)	Multivariate OR (95% CI)[a]
Adult vigorous activity, hr/week						
None	5,077	27.0	1.00[b]	3,360	33.1	1.00[b]
< 2	10,292	25.8	0.88 (0.81–0.96)	4,460	31.6	0.85 (0.76–0.94)
2–4	6,743	22.8	0.75 (0.68–0.82)	1,724	26.7	0.68 (0.59–0.78)
5+	2,971	24.5	0.78 (0.69–0.87)	597	31.8	0.86 (0.70–1.06)
Test for continuous trend[c]			$p < .001$			$p = .19$
Adult walking for exercise, hr/week						
None	2,364	27.8	1.00[b]	1,028	34.4	1.00[b]
< 2	11,843	25.9	1.01 (0.91–1.12)	5,271	32.9	1.10 (0.94–1.27)
2–4	7,981	23.1	0.95 (0.85–1.06)	2,858	27.9	0.94 (0.79–1.10)
5+	2,895	25.1	1.05 (0.92–1.20)	984	29.2	0.93 (0.76–1.15)
Test for continuous trend[c]			$p = .94$			$p = .007$
Lifetime vigorous activity, hr/week[d]						
Never active	10,394	26.3	1.00[b]	5,143	33.6	1.00[b]
Active in high school, inactive in adulthood	5,959	25.6	0.95 (0.88–1.02)	2,803	29.3	0.83 (0.75–0.92)
Inactive in high school, active in adulthood	3,125	24.0	0.88 (0.80–0.97)	715	27.3	0.71 (0.59–0.85)
Always active	4,716	22.8	0.78 (0.72–0.85)	1,081	28.6	0.73 (0.63–0.85)

Note. CES–D = Center for Epidemiologic Studies–Depression Scale; CI = confidence interval.

[a] Adjusted for age, education, occupation, marital status, preexisting health conditions, energy intake, smoking, current alcohol consumption, and child care responsibilities. Mutually adjusted for each form of physical activity.

[b] Reference group.

[c] Excludes zero-level exposure category.

[d] Active = 5+ hr in high school or 2+ hr in adulthood.