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Depressive Symptoms Are Positively Associated with Time Spent Sedentary in Healthy Young US Adults

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ABSTRACT

Introduction: Sedentary time and depressive symptoms are positively associated in elderly adults and adults with chronic disease; however, little is known about this relationship in generally healthy young adults. The purpose of this study was to investigate the association between objectively measured sedentary time and depressive symptoms in a large sample of healthy young adults.

Methods: Time spent sedentary and in moderate-to-vigorous physical activity (MVPA) was measured in 430 participants (49% men; 28 ± 4 years; 25.5 ± 3.3 kg/m^2) using the SenseWear Mini Armband over a 10-day period. The Profile of Mood States depression scale was administered to assess depressive symptoms. Independent samples *t* tests investigated differences in MVPA, time spent sedentary, and Profile of Mood States scores between males and females. Linear regression analyses, adjusting for MVPA, sex, and body mass index, were employed to examine associations between sedentary time and depressive symptoms.

Results: Mean time spent sedentary while awake was 681 ± 94 min/d. Holding MVPA constant, depressive symptoms were positively associated with sedentary time ($\beta = 1.80$; $P < 0.01$; $R^2 = 0.54$). This association was statistically significant in males ($\beta = 2.06$; $P < 0.01$; $R^2 = 0.59$) but not females ($P = 0.10$).

Conclusions: Depressive symptoms are positively associated with time spent sedentary in healthy young US adults, independent of MVPA, particularly in men. A reduction in sedentary time may provide a valuable, low cost, option in the prevention of depressive symptoms.

Keywords: Sedentary time, Depressive symptoms, Young adults

Introduction

Sedentary behaviors are defined by the United States Department of Health and Human Services "2008 Physical Activity Guidelines for Americans" as daily activities requiring between 1.0 and 1.4 metabolic equivalents (METs) and can vary depending upon posture.[1] Sedentary behaviors include lying down, reclining, and sitting (eg, viewing television, driving, reading), and recent studies using objective measurement of adults' sedentary time (excluding sleep time) reported that over 9 hours per day are spent being sedentary while awake.[2,3] The large amounts of time that adults spend being sedentary is a growing cause of concern, with evidence suggesting that higher amounts of sedentary time increase the risk of diabetes, cardiovascular disease, and mortality, independent of physical activity.[4] The health benefits of physical activity on various health outcomes, including depression, have been well documented,[5] yet evidence exists showing that adults can display adequate levels of daily physical activity yet accumulate high amounts of sedentary time.[6] With growing evidence on the undesirable health outcomes associated with increased sedentary time independent of physical activity, establishing the correlates of sedentary time in adults is necessary.[7]

Current research reports that sedentary time is associated with increased caloric intake, decreased life satisfaction, and increased depressive symptoms.[7,8] However, a majority of these studies relied on subjective reports of sedentary time, investigated an older adult population, included sleep time in time spent sedentary, or limited sedentary time to a specific context (eg, viewing television, computer use).[8,9] Thus, the purpose of this study was to investigate the association between objectively measured sedentary time and depressive symptoms in a large sample of healthy young, active adults.

Methods

Overview

The present study uses baseline data of a prospective, observational study, collected between July 2011 and 2012. A detailed

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description of the Energy Balance Study, including recruitment strategies, participant characteristics, and procedures, has been reported elsewhere.[10] Briefly, the Energy Balance Study recruited 430 men and women between 21 and 35 years of age who have been weight stable for the previous 3 months and did not report any acute or chronic diseases. Inclusion criteria focused on selecting a broad group of healthy individuals with no major acute or chronic conditions that would impair normal engagement in physical activities. Individuals with a history of clinically diagnosed depression were excluded. The study protocol was approved by the University of South Carolina Institutional Review Board, and all participants provided written informed consent.

Anthropometry

All anthropomorphic measurements were performed with the participant dressed in surgical scrubs and in bare feet. Body mass index (BMI, kg/m^2) was calculated from the average of 3 height and weight measurements using a wall-mounted stadiometer (Model S100, Ayrton Corp., Prior Lake, Minn.) and electronic scale (Healthometer model 500KL, Health o meter, McCook, Ill.). Measurements were recorded to the nearest 0.1 cm and 0.1 kg, respectively.

Depressive symptoms measurement

The depressive symptoms scale of the Profile of Mood States (POMS) questionnaire[11] was used to assess depressive symptoms. The POMS questionnaire has been used in previous research examining exercise and mood.[12] The 15 items ask participants to identify their present state by responding to a list of adjectives (eg, gloomy, sad, lonely, and so on), choosing from 1 of the following 5 responses: *Not at all (0), A little (1), Moderately (2), Quite a bit (3), and Extremely (4)*. Individual responses are summed for a total score for depressive symptoms that could range from 0 to 60 (eg, 15 items all scored as "*Extremely*" would equal 60), with a higher score signaling greater depressive symptoms.[11] Past research on the concurrent validity between the adjectives used to assess depressive symptoms within the POMS (15 items of a total of 65 items) and the Beck Depression Scale has shown a moderate correlation between the 2 instruments (r = 0.61).[11] The POMS demonstrates adequate internal consistency for a multidimensional instrument with stable factor structure that accounts for a high percentage of total variance.[11,13]

Sedentary time and physical activity

Sedentary time during waking hours was objectively measured using the SenseWear Mini Armband (BodyMedia, Inc., Pittsburgh, Pa.) over a 10-day period. This portable, multisensor device is worn on the upper arm and incorporates measurements of triaxial accelerometry, galvanic skin response, skin temperature, near body temperature, and heat flux. The armband has been shown to be a valid device to measure sedentary time and physical activity in adults.[14] Participants were deemed compliant if they completed 7 days of wear (including 2 weekend days) with at least 21 hours of verifiable time on each of these days.[10] During periods of non-wear time, participants reported their activities, which were subsequently imputed based on the Compendium of Physical Activities.[15] Subsequently, time spent sleeping, in sedentary pursuits (<1.5 METs), in light physical activity (1.5–3 METs), and in moderate-to-vigorous physical activity (MVPA; >6 METs), was determined using SenseWear's proprietary algorithm (version 7.0 professional). Consistent with other studies objectively measuring sedentary time using the SenseWear Mini Armband, sleep time was subtracted from the time spent sedentary, leaving the sum of awake minutes per day for which energy expenditure was <1.5 METs.[16,17]

Statistical analysis

Independent samples *t* tests were used to investigate differences in MVPA, time spent sedentary, and POMS scores between males and females. Linear regression models tested the association between sedentary time (dependent variable) and depressive symptoms (independent variable), adjusting for MVPA, age, sex, and BMI. Interactive terms were explored where statistically significant associations were seen or to investigate theoretical reasoning. A secondary, separate model was run for sex. Although previous research has found BMI to be a significant predictor of depression, the young and relatively healthy-weight population herein did not warrant an additional separate analysis.[8,18] Statistical significance was set at $P < 0.05$, and all analyses were performed using Stata (v.13.1, StataCorp, College Station, Tex.).

Results

A total of 418 participants (49% men) completed measures on depressive symptoms and sedentary time. Characteristics of the study sample are presented in Table 1. The mean age and BMI was 28 years and 25.4 kg/m^2, respectively. The majority of the sample was caucasian (67%), and 84% of the sample obtained a college degree or higher. For the study sample, mean time spent sedentary while awake was 681 min/d. No statistical difference existed between men and women. This sample spent an average of 135.7 min/d in MVPA. There was a significant effect for sex (t = 6.63; $P < 0.001$), with men being more active than women. There were no statistical differences in POMS depressive symptoms scores for sex.

As seen in Table 2, there was a positive association between depressive symptoms and sedentary time for the total sample, independent of BMI and MVPA. Age was initially included in the model but did not affect the results, so it was removed from the final model reported. In the sex-specific analyses, a positive association between depressive symptoms and sedentary time was observed in males ($\beta = 2.06$; $P < 0.01$; $R^2 = 0.59$). Although a positive trend was seen in females, this finding was not statistically significant ($P = 0.10$). When interactive terms were included in the model (depressive symptoms and MVPA, age, sex, or BMI), there was no statistically significant interactions.

Discussion

To our knowledge, this is the first study to examine the association between objectively measured sedentary time and depressive symptoms in a large, generally healthy, and young adult population. The findings from this study align with previous research identifying a positive association between depressive symptoms and sedentary time in adults[8,19]; however, this is one of the first studies to recognize this association in healthy young adult males, independent of MVPA. Although Sanchez et al.[18] found a positive association between sedentary time and depressive symptoms in females, the sample characteristics largely differed from this study (ie, overweight/obese; mean age = 41 years). The present sample was highly active, surpassing the national daily recommendations for daily adult physical activity (approximately >30 min/d MVPA).[1] Similarly, this young active group of adults spent almost 2 more hours per day compared to other studies employing objective measures of sedentary time in adult populations.[3,17–19] It could be that this group is spending long periods of time sitting during the

TABLE 1.
Characteristics and Descriptive Statistics of the Study Sample

Characteristics	Total Sample		Males		Females	
N	418		205		213	
% White	67		68		65	
% College degree	84		77		90	
Average annual income (%)						
$20,000 or less	17		17		16	
$20,000–$39,999	35		30		40	
$40,000–$59,999	20		20		20	
$60,000–$79,999	12		14		11	
$80,000 or more	16		19		13	
	Mean	SD (±)	Mean	SD (±)	Mean	SD (±)
Age (y)	28.0	4.0	27.5	3.9	27.8	3.7
BMI (kg/m^2)	25.4	3.8	25.5	3.3	25.3	4.3
MVPA (min/d)	135.7	77.3	159.6	81.4*	112.4	65.2
Sedentary (min/d)	681.0	93.8	684.6	98.1	677.5	89.5
POMS Depressive Symptoms Score	3.3	5.4	3.5	5.6	3.1	5.2

*Statistical significance between males and females ($P < 0.05$).

TABLE 2.
Associations of Sedentary Time With Depressive Symptoms: Results From Linear Regression Models With Selected Covariates

Analysis	Model	Covariate(s)*	β	SE	*P*	95% Confidence Interval	Adjusted R-squared
Total sample	Full	Depressive symptoms	1.80	0.58	<0.01	0.66 to 2.94	0.54
		MVPA	-0.95	0.05	<0.01	-1.05 to -0.85	
		BMI	-1.39	0.97	0.15	-3.30 to 0.51	
		Sex	-51.12	6.68	<0.01	-64.26 to -37.90	
Sex	Males	Depressive symptoms	2.06	0.78	<0.01	0.52 to 3.61	0.59
		MVPA	-0.90	0.05	<0.01	-1.00 to -0.79	
		BMI	-2.44	1.51	0.10	-5.42 to 0.53	
	Females	Depressive symptoms	1.42	0.86	0.10	-0.29 to 3.12	0.46
		MVPA	-0.92	0.07	<0.01	1.06 to -0.78	
		BMI	-0.80	1.33	0.55	-3.43 to 1.83	

*Statistically insignificant interactions between depressive symptoms and MVPA, age, BMI, or sex are not presented.
SE, standard error.

day (eg, 84% of study sample had completed or was in the process of completing a college degree), occupying high-paying jobs (~50% of study sample earn >$40,000 per annum; Table 1) and time-demanding desk jobs, and, therefore, they counteract this sedentary time with purposive exercise sessions at moderate and vigorous intensities. With reports showing that young adults are 60% more likely to experience depressive symptoms than adults aged 50 years or older, and as antidepressants are the third most prescribed drug in the United States,[20] the findings herein support the role of possible lifestyle modifications (eg, breaking up long periods of sedentary time)[21] as a worthwhile consideration with the potential to prevent detrimental health outcomes.

The discrepancies that exist between the current findings and past research may be due to methodological differences[8] and the present studies' unique sample characteristics (ie, healthy, young, well-educated, highly active), which potentially set this study apart from other studies investigating older or more clinical adult populations.[19,22] Nonetheless, the findings herein extend previous research by identifying a positive association between depressive symptoms and sedentary time in healthy young adult males. The findings herein add to a growing body of evidence on the association between depressive symtpoms and sedentary time in young, active adults, independent of MVPA. Strengths of this study include the use of an understudied population (eg, young healthy adults, highly active) for assessing depressive symptoms and using objective methods to capture sedentary time. The findings are limited by the cross-sectional nature of the study design, which impairs determination of causality and direction. Additionally, the highly active sample may have limited the influence of depressive symtpoms on sedentary time, represented by the collective low scores (sample mean = 3.3). Nonetheless, a significant assoication was still found that emphasizes the need to address sedentary behavior as a risk factor for public health. Finally, future research through longitudinal/experimental investigation is warranted to explore whether depressive symptoms are a behavioral antecedent and/or an outcome of sedentary time.

Disclosure

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