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Physical Activity, Mental Health, and Weight Gain in a Longitudinal Observational Cohort of Nonobese Young Adults

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Abstract

Objective—To investigate the relationship among moderate-to-vigorous physical activity (MVPA), mental health symptoms, and weight gain in young adults.

Methods—Fifty-nine healthy men and women (age 26.8 ± 4.7 years, body mass index [BMI] 22.4 ± 2.3 kg/m^2) were assessed at baseline and year 2. Weight, BMI, fat mass by dual-energy X-ray absorptiometry, anxiety and depression by the SCL-90, and MVPA by accelerometry were assessed. Sex-stratified linear regression models were used to examine associations between baseline anxiety/depression and body composition change, then repeated controlling for baseline MVPA.

Results—Overall, weight, BMI, fat mass, and subcutaneous adiposity significantly increased at year 2 ($P < 0.05$). For women, a higher depression and anxiety score predicted increased weight, BMI, fat mass, and subcutaneous adiposity ($P < 0.05$). Controlling for MVPA attenuated these associations to nonsignificance. For men, MVPA did not alter the associations between anxiety and increased weight, BMI, fat mass, and subcutaneous adiposity ($P < 0.05$) or the associations between depression and decreased weight, BMI, fat mass, and subcutaneous adiposity ($P < 0.05$).

Conclusions—Anxiety and depression were related to body composition change for young adults. In women, MVPA attenuated these associations to nonsignificance. MVPA may buffer the adverse effects of depression and anxiety symptoms on young women's weight gain.

Introduction

Seventy percent of adults who have obesity do not become obese until adulthood (1). Identifying factors that contribute to weight gain during early adulthood is critical for obesity prevention, given 60.3% of young adults aged 20 to 39 years have overweight or obesity (2). A contributing factor to weight gain may be poor mental health that affects obesity-related behaviors such as physical activity levels. Anxiety and depression are the most commonly diagnosed mental health disorders in the U.S. (3,4). Further, subclinical anxiety and depression are even more common: a systematic review of 18 epidemiological studies ($n = 48,214$) revealed subthreshold anxiety disorder was twice as common as the full disorder with an 8% life-time prevalence (5), and an examination of a nationally

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representative U.S. cohort (n = 44,800) indicated a prevalence of 14.3% for subclinical depressive mood (6). There is increasing interest to understand the health risks of subclinical mental health symptoms due to the high prevalence coupled with their predictive validity as precursors for clinically diagnosed mental health disorders (7).

There is strong evidence for an association between weight gain and clinically diagnosed depression/anxiety (8), but the evidence is mixed on whether or not this association emerges in adults with depression or anxiety symptoms in the healthy or subclinical range (9). A meta-analysis of 15 prospective studies observed significant associations between clinically diagnosed depression and the onset of obesity but not between subclinical depression and overweight (9). Some evidence indicates an association between obesity and mental health symptoms in women: cross-sectional positive associations between obesity and subclinical depression symptoms were observed in American women, but not in men, in a recent systematic review of 24 studies (10). Similarly, a study of Canadian women found those with a history of depression or anxiety symptoms were more likely to gain weight during early adulthood (11).

Recent studies have examined physical activity and its influence on mental health symptomatology. Findings suggest that individuals who engage in regular physical activity have fewer depressive and anxiety symptoms than individuals who do not engage in regular physical activity (12). Randomized controlled trials indicate that regular aerobic exercise reduces depressive symptoms among adults with clinically diagnosed depression (13,14). However, less is known about the influence of physical activity on subclinical symptoms of depression and anxiety. In one longitudinal study, both men and women showed inverse associations between self-reported physical activity and depressive symptoms in a study of 5,497 Northern Finland young adults (15). The interaction between obesity, subclinical anxiety/depression symptomatology, and physical activity remains unknown.

Numerous gaps exist in the current literature on obesity and mental health, with much of the prior research examining cross-sectional associations. It is not clear the extent to which physical activity may buffer the effects of mental health symptomatology on weight gain in healthy young adults (16). Further, a gap in the current literature is a lack of objective data, with weight status often determined by self-report. To address these limitations, this study used a longitudinal design, objectively measured body fat at two time points, accelerometry-measured physical activity, and validated instruments to assess mental health symptomatology.

This study investigated longitudinal relationships among anxiety and depression symptomatology and physical activity with body mass gain in a prospective longitudinal cohort of nonobese young adults. It was hypothesized that young adults with higher symptoms of depression and anxiety would exhibit greater weight gain and adverse changes in body composition over a 2-year period, and the association between anxiety/depression and weight gain would be stronger in women than in men. It was also hypothesized that low baseline levels of physical activity would be associated with greater weight gain and adverse changes in body composition, and baseline levels of physical activity would attenuate the relationship between depression/anxiety and weight gain, across the 2-year period.

Methods

Study sample

Healthy adults between the ages of 20 and 35 years were recruited through media advertising from Baton Rouge, Louisiana, and surrounding areas to participate in the InSight study, a longitudinal cohort study aimed at identifying factors related to weight gain. Inclusion and exclusion criteria have been previously reported (17,18). In brief, inclusion criteria included a body mass index (BMI) between 18.5 and 27.5 kg/m^2, generally healthy (assessed with a physical examination), and fasting blood glucose <126 mg/dL. Exclusion criteria included history of obesity or diabetes; history of serious medical conditions including serious psychological disorder; medication use; injuries that could affect future health; current or recent pregnancy; abnormal electrocardiogram; and history of drug abuse. All study procedures were approved by Pennington Biomedical Research Center's Institutional Review Board (protocol # 27036-PBRC), and participants provided written informed consent.

Procedures

Participants were initially screened for study participation over three screening visits, during which study eligibility was assessed through anthropometry, a physical examination and electrocardiogram, blood work, and psychosocial instruments. If deemed eligible for study participation, participants underwent a variety of tests to collect baseline information. Anthropometry and body composition were measured again 2 years later (±30 days) at year 2. Data were collected between the years 2008 and 2011 and analyzed in 2015. Participant retention was encouraged through biannual newsletters and a web page to collect updated contact information.

Measures

Demographic information, including date of birth, sex, and race, were self-reported. Standing height was measured in centimeters using a wall-mounted stadiometer after the participant removed shoes. Weight was measured in kilograms after voiding using a digital scale while the participant wore a hospital gown and undergarments. Waist circumference was measured in centimeters at the natural waist (halfway between inferior border of rib cage and superior aspect of iliac crest). All anthropometric measurements were obtained twice to the nearest 0.1 units, with a third measurement taken if the first two differed by >0.5 units, and the average was used in analyses. BMI was calculated using the formula weight in kilograms divided by height in meters squared.

Body composition was measured at baseline and year 2 with participant lying supine and motionless in a dual-energy X-ray absorptiometry scanner (DXA, QDR 4500A, Hologic, Inc., Waltham, MA). DXA scans were analyzed using QDR for Windows version 11.1 to estimate fat mass. Abdominal subcutaneous and visceral adipose tissue were estimated using APEX 4.0 software, using previously described methodology (19). In brief, automated Hologic procedures delineated a 5 cm region of fat mass in the inner (visceral) and outer (subcutaneous) abdominal wall area, with the bottom edge starting at 1 cm above the iliac crest. DXA-derived visceral adiposity had a strong association with visceral adiposity

measured by computed tomography in a sample of 124 men and women (r^2 = 0.96) (20) and has been demonstrated as a useful clinical marker for cardiometabolic risk (19). A negative urine pregnancy test was required for women before the DXA assessment.

Anxiety and depression symptoms were measured at baseline using the Symptom Checklist 90 (SCL-90) (21), which uses a Likert-like scale from 0 (not at all) to 4 (extremely likely) to measure general psychopathology. The SCL-90 has been validated against a semistructured psychiatric interview and is commonly used as a clinical screening tool in public health surveys (22).

Free-living physical activity was measured at baseline with a hipworn Actigraph GT1M accelerometer (Ft. Walton Beach, FL) worn for 7 consecutive days. Methodology has been previously described (23). In brief, data were collected with a 1-min epoch, and participants with at least 3 valid (10+ hours of wear time) monitored days were included in the final dataset. Moderate-to-vigorous physical activity (MVPA) was defined as activity counts ≥2,020 counts/min (24). Fitness was defined as maximal cardiorespiratory capacity (VO_2 max) measured at baseline using a standardized graded exercise test on a treadmill (Trackmaster 425, Newton, KS) and has been described previously (17). Participants self-selected a comfortable walking pace with 0% grade for a 2-min warm-up, then the test began at 1.7 mph speed and 1% grade. Speed and/or grade increased every 2 min until the participant reached temporary exhaustion.

Statistical analyses

Data were analyzed using SAS Version 9.4 (SAS Institute Inc., Cary, NC). Independent samples *t*-tests were used to detect differences in primary variables at baseline between those who had complete data and those lost to follow-up or those who had insufficient accelerometry data. Anxiety and depression *t*-scores were scaled to 10-unit increments to facilitate interpretation of meaningful differences. Bivariate correlations were used to examine associations among variables. Paired sample *t*-tests were used to examine changes in anthropometric measures and body composition variables between baseline and year 2. Independent linear regression models were used to examine the association between each baseline psychosocial or activity/fitness variable with change in each body composition variable, controlling for age and sex. Analyses were repeated stratified by sex. There was no significant association between fitness and change in body composition, so fitness was omitted from further testing. Multivariable models tested the effects of anxiety, depression, and MVPA amount on change in each body composition variable in the overall sample, controlling for age and sex. Analyses were repeated stratified by sex. Variance inflation factor did not exceed 4.0 for any model reported, indicating low levels of multicollinearity.

Results

Of the 90 healthy adults who originally enrolled in the study, 31 were removed from the current analyses for failing to complete the year 2 visit (n = 14) or failing to provide full accelerometry data (n = 17). The remaining 59 participants were healthy young adults, primarily White, and 58% were women. The sample's baseline characteristics are detailed in Table 1. There were no significant differences between those with complete data versus

those lost to follow-up or with insufficient accelerometry data in regards to baseline fat mass, visceral adiposity, subcutaneous adiposity, anxiety, depression, or MVPA. Those with insufficient accelerometry data had a higher BMI than those with complete data (23.9 vs. 22.5 kg/m^2, $P = 0.03$). The majority of participants (76%) had at least 5 days of valid accelerometry data of at least 10 h/day (range of 3 to 7 days), which aligns with or exceeds the minimum wear time in other cohort studies (24).

At baseline, neither depression nor anxiety were significantly correlated with the body composition, physical activity, or fitness variables. Daily MVPA was negatively correlated with whole-body fat mass and subcutaneous adiposity. MVPA was positively correlated with baseline fitness. Bivariate correlations are reported in Table 2. Between baseline and year 2, there was a significant increase in weight ($P = 0.03$), BMI ($P = 0.02$), whole-body fat mass ($P = 0.0008$), and subcutaneous adiposity ($P = 0.04$). The changes in waist circumference ($P = 0.06$) and visceral adiposity ($P = 0.07$) were not significant. The difference scores overall and by sex are reported in Table 3.

In the overall sample, in independent linear regression models controlling for age and sex, a higher anxiety score was significantly related to increase in weight (1.9 kg [95% confidence interval, 95% CI: 0.3 to 3.6], $P = 0.0245$); BMI (0.7 kg/m^2 [95% CI: 0.1 to 1.2], $P = 0.018$); whole-body fat mass (1.4 kg [95% CI: 0.4 to 2.5], $P = 0.0095$); and subcutaneous adiposity (23.3 cm^2 [95% CI: 6.7 to 39.8], $P = 0.0067$). Depression and baseline MVPA were not significantly related to change in body composition. In the overall sample, the inclusion of MVPA did not independently predict change in body composition and did not affect the positive significant association of anxiety with weight, BMI, whole-body fat mass, and subcutaneous adiposity. See Table 4.

In women, in models controlling for age, a higher anxiety score was significantly related to change in body composition (for weight, 3.3 kg [95% CI: 1.3 to 5.3], $P = 0.0019$; for BMI, 1.2 kg/m^2 [95% CI: 0.4 to 1.9], $P = 0.0027$; for waist circumference, 3.4 cm [95% CI: 1.1 to 5.6], $P = 0.005$; for whole-body fat mass, 2.0 kg [95% CI: 0.6 to 3.3], $P = 0.0059$; and for subcutaneous adiposity, 28.2 cm^2 [95% CI: 5.9 to 50.5], $P = 0.0148$). A higher depression score was significantly related to increase in weight (2.9 kg [95% CI: 1.2 to 4.6], $P = 0.0015$), BMI (1.0 kg/m^2 [95% CI: 0.4 to 1.6], $P = 0.002$), whole-body fat mass (1.6 kg [95% CI: 0.4 to 2.8], $P = 0.0085$), and subcutaneous adiposity (23.4 cm^2 [95% CI: 4.2 to 42.6], $P = 0.018$). Each additional hour of baseline daily MVPA was associated with a decrease in visceral adiposity (−16.8 cm^2 [95% CI: −32.1 to −1.5], $P = 0.0324$). Among women, MVPA was not independently related to change in body composition, but the inclusion of MVPA attenuated associations of anxiety and depression with weight, BMI, whole-body fat mass, and subcutaneous adiposity to nonsignificance (all $P > 0.05$).

In men, in univariate models there were no effects of anxiety, depression, or MVPA on change in body composition. In fully adjusted models, a higher anxiety score was significantly associated with an increase in weight (6.7 kg [95% CI: 2.0 to 11.4], $P = 0.0079$); BMI (2.0 kg/m^2 [95% CI: 0.6 to 3.4], $P = 0.0079$); waist circumference (7.3 cm [95% CI: 1.4 to 13.2], $P = 0.018$); whole-body fat mass (3.4 kg [95% CI: 0.5 to 6.4], $P = 0.02$); and subcutaneous adiposity (66.5 cm^2 [95% CI: 25.7 to 107.2], $P = 0.0028$). In

contrast, a higher depression score in men was associated with a decrease in weight (−5.7 kg [95% CI: −9.4 to −2.0], $P = 0.004$); BMI (−1.7 kg/m^2 [95% CI: −2.8 to −0.6], $P = 0.004$); waist circumference (95% CI: −6.9 cm [95% CI: −11.5 to −2.2], $P = 0.006$); whole-body fat mass (−2.6 kg [95% CI: −4.9 to −0.3], $P = 0.028$); and subcutaneous adiposity (−47.0 cm^2 [95% CI: −79.0 to −15.0], $P = 0.006$). However, MVPA was not independently related to change in body composition in these fully adjusted models.

Discussion

This study investigated relationships among anxiety and depression symptomatology, physical activity, and weight gain in a sample of nonobese young adults. This healthy young sample significantly increased fat over a 2-year period, on average gaining 1.3 kg of body fat and 0.4 BMI units. This gradual weight gain is similar in magnitude to a prior study of 1,715 young adults in the Young Finns Study (25) and indicates a critical period for intervening on weight gain.

It was hypothesized that young adults with higher symptoms of depression and anxiety would exhibit greater weight gain and adverse changes in body composition over a 2-year period, with women experiencing stronger effects. Indeed, for women, a 10-unit higher anxiety or depression score doubled a woman's gain in weight and BMI, which aligns with systematic review findings (10). Women appear to be at particular risk for mental health symptoms and weight gain: based on nationally representative U.S. data, women are twice as likely to experience lifetime major depression (26). Past or lifetime major depression diagnosis for women in particular may increase future risk for overweight/obesity by 7%, and this obesity adds an estimated $9.7 billion to the national economic burden of depression (27). Furthermore, one in three women met criteria for an anxiety disorder over her lifetime versus 22% of men in an examination of 20,013 adults in the Collaborative Psychiatric Epidemiology Studies (28). Women with anxiety had more associated illness burden, including work absenteeism and comorbid major depressive disorder (28).

Importantly, Table 1 indicates that baseline anxiety and depression *t*-scores were almost 1 standard deviation below the population mean, meaning these participants had minimal levels of mood disturbance and anxiety. Therefore, even within a mentally "healthy" range, higher SCL-90 scores were associated with changes in body mass. Levels of depression and anxiety below clinical thresholds predict future clinical-level diagnoses for these disorders (7,29). In addition, subclinical depression and anxiety impairments in young adults contribute to increased suicidal behaviors (29), significant distress and functional impairments, poorer physical health, and greater healthcare utilization (5). Efforts to identify and intervene on anxiety and depression, even within the healthy range, may be helpful to protect against weight gain.

It was also hypothesized that baseline levels of low physical activity would be associated with greater weight gain and adverse changes in body composition over a 2-year period. A prior study of 421 young adults indicated that lower level of baseline MVPA was associated with 1-year fat mass gain (30); in contrast, this study found no independent association between fat gain and baseline MVPA. However, for each additional hour of daily MVPA at

baseline, women experienced a fivefold reduction in visceral adiposity, and MVPA attenuated effects of anxiety and depression on gain in weight, BMI, fat mass, and subcutaneous adiposity. This provides evidence that MVPA acts as a buffer against the deleterious effects of mental health symptomatology on young women's weight gain.

In contrast, for men who engaged in the same amount of MVPA, those with a 10-unit higher anxiety score gained six times as much weight and subcutaneous adiposity. Men with a higher depression score lost weight and decreased in the other adiposity measures. These findings align with prior cross-sectional findings that among U.S. men in a nationally representative survey, lower BMI was associated with higher likelihood for depression (31). Studies of men in U.S. consistently find no, or inverse, associations between depression and weight (10), whereas young men in the Young Finns Study showed a positive association between young men's depressive symptoms and weight gain (25). Scientists have posited that the mechanisms that explain the opposite associations of weight and depression in U.S. men and women may relate to sex differences in obesity-related stigma and emotional eating (31), though these hypotheses remain to be tested. Building on findings of a recent review that supervised aerobic exercise reduced depressive symptoms among adults diagnosed with depression (13), an important area of future research is to examine if acute bouts of physical activity influence subclinical symptoms of anxiety and depression in the short term or cumulatively.

The mechanisms linking physical activity, mental health symptomatology, and weight gain are under exploration. There are potential psychological mechanisms that may explain the links among physical activity, depression/anxiety, and weight gain. Overeating in response to emotional states, a type of dietary disinhibition, is associated with depression (32). Dietary disinhibition is associated with higher BMI, less healthful food choices, and low levels of physical activity (33). Indeed, in a sample of 421 young adults, those in the lowest quintile of physical activity rated highest on dietary disinhibition (30). Further, biological mechanisms related to the use of anti-depressants and other medications and impaired sleep quality may explain the relationship between mental health symptoms with weight gain (34).

Strengths of this cohort study include the focus on healthy young adults who are potentially at risk for adult-onset obesity. Furthermore, the data provided a 2-year follow-up using objective, gold standard measures of body composition, clinical measures of anxiety and depression symptomatology, and free-living physical activity measured by accelerometry.

A study limitation was limited generalizability of findings given the relatively small sample composed primarily of white young adults from a single geographical area. Although the SCL-90 is a validated self-report instrument, a structured clinical interview would better determine lifetime history of anxiety and depression. Physical activity, anxiety, and depression were not measured at follow-up, which prevented the examination of changes in these factors and their association with change in weight and body composition. Although we did not include a measure of dietary habits or appetite in this study, a previous analysis in this cohort showed sex differences in the relationships among activity-related energy expenditure, appetite ratings, and energy intake which may impact long-term weight changes (18).

Conclusion

Anxiety was related to weight gain in young adults, and depression was positively related to weight gain in women and negatively related to weight gain in men. The role of MVPA to attenuate the effects of anxiety/depression on young women's weight gain warrants further study.

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TABLE 1

Baseline characteristics of the sample from the 2008 to 2011 InSight Study

	Women (*n* = 34)	Men (*n* = 25)	All (*n* = 59)
Demographics			
Age (yr)	27.4 ± 4.9	26.0 ± 4.4	26.8 ± 4.7
Race (%)			
White	76.5	92.0	83.1
Black	14.7	8.0	11.9
Other	8.8	0.0	5.1
Anthropometry and body composition			
Height (cm)	165.2 ± 6.5	179.7 ± 6.2	171.3 ± 9.6
Weight (kg)	60.7 ± 7.7	73.2 ± 7.7	66.0 ± 9.8
Body mass index (kg/m^2)	22.2 ± 2.2	22.7 ± 2.5	22.4 ± 2.3
Waist circumference (cm)	73.5 ± 6.4	79.4 ± 6.4	76.0 ± 7.0
Whole-body fat mass (kg)	17.7 ± 5.0	11.8 ± 3.8	15.2 ± 5.4
Visceral adipose tissue (cm^2)	44.9 ± 23.7	55.7 ± 15.5	49.5 ± 21.2
Subcutaneous adipose tissue (cm^2)	242.5 ± 74.1	133.1 ± 74.4	196.2 ± 91.6
Psychosocial health			
Anxiety *t*-score, SCL-90	40.8 ± 6.7	45.5 ± 7.1	42.8 ± 7.2
Depression *t*-score, SCL-90	42.8 ± 7.9	46.8 ± 9.1	44.5 ± 8.6
Physical activity and fitness			
Physical activity			
Moderate-to-vigorous (h/d)	0.4 ± 0.3	0.5 ± 0.3	0.4 ± 0.3
Physical fitness			
VO_2 max (METs)	9.3 ± 2.5	12.1 ± 2.2	10.5 ± 2.7

Means ± standard deviation.

METs, metabolic equivalents; SCL-90, Symptom Checklist 90.

TABLE 2

Pearson bivariate correlation matrix for nine variables at baseline from the 2008 to 2011 InSight Study

	BMI	Whole-body fat mass	Visceral adiposity	Subcutaneous adiposity	Anxiety	Depression	Daily MVPA
Whole-body fat mass	**0.62******						
Visceral adiposity	**0.63******	**0.45*****					
Subcutaneous adiposity	**0.56******	**0.95******	**0.37****				
Anxiety	0.08	−0.24	−0.04	−0.21			
Depression	0.19	−0.05	0.13	−0.03	**0.77******		
Daily MVPA	−0.17	**−0.42*****	−0.12	**−0.40****	0.05	−0.08	
$V0_2$ max METs	−0.13	**−0.62******	−0.16	**−0.61******	0.16	0.04	**0.73******

Boldface indicates significance

BMI, body mass index; MVPA, moderate to vigorous physical activity; METs, metabolic equivalents.

** $P < 0.01$,

*** $P < 0.001$,

**** $P < 0.0001$.

TABLE 3

Change in body composition between baseline and year 2 from the 2008 to 2011 InSight Study

	Women (*n* = 34)	Men (*n* = 25)	All (*n* = 59)
Body weight (kg)	1.4 ± 4.4	1.2 ± 4.6	**1.3 ± 4.4***
Body mass index (kg/m^2)	0.5 ± 1.6	0.4 ± 1.4	**0.4 ± 1.5***
Waist circumference (cm)	1.2 ± 4.8	1.4 ± 5.6	1.3 ± 5.1
Whole-body fat mass (kg)	**1.4 ± 2.8****	1.2 ± 2.9	**1.3 ± 2.8*****
Subcutaneous adipose tissue (cm^2)	13.4 ± 45.1	11.6 ± 45.8	**12.6 ± 45.0***
Visceral adipose tissue (cm^2)	3.0 ± 12.7	2.9 ± 12.4	3.0 ± 12.5

Means ± standard deviation.

Boldface indicates significance

* $P < 0.05$,

** $P < 0.01$,

*** $P < 0.001$).

TABLE 4

Multivariable linear regression examining associations of psychological and physical activity variables with change in body composition from the 2008 to 2011 InSight Study

	Weight (kg)		BMI (kg/m^2)		Waist circumference (cm)		Whole-body fat mass (kg)		Subcutaneous adiposity (cm^2)		Visceral adiposity (cm^2)	
	Model 1	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**	**Model 1**	**Model 2**
Overall												
Anxiety	**1.9***	**3.1***	**0.7***	**1.0***	1.7	**4.0****	**1.4****	**2.0***	**23.3****	**33.7***	2.7	4.8
Depression	0.7	−1.3	0.3	−0.4	0.1	**−2.5***	0.6	−0.6	9.1	−10.9	0.9	−2.4
MVPA (h)	−1.1	−1.3	−0.4	−0.4	−1.6	−2.2	0.2	0.1	14.6	13.8	−5.8	−6.3
Women												
Anxiety	**3.3****	1.8	**1.2****	0.6	**3.4****	3.2	**2.0****	1.2	**28.2***	17.7	0.4	4.1
Depression	**2.9****	1.7	**1.0****	0.6	2.1	0.1	**1.6****	0.8	**23.4***	12.7	1.8	−2.2
MVPA (h)	−3.2	−0.6	−1.1	−0.2	−2.6	−0.5	−2.5	−1.1	−24.3	−2.8	**−16.8***	−16.1
Men												
Anxiety	0.4	**6.7****	0.1	**2.0****	0.0	**7.3***	0.8	**3.4***	18.5	**66.5****	0.1	1.9
Depression	−1.3	**−5.7****	−0.4	**−1.7****	−2.0	**−6.9****	−0.2	**−2.6***	−1.5	**−47.0****	0.4	−0.9
MVPA (h)	−0.7	−2.8	−0.1	−0.7	−1.1	−3.3	2.1	0.9	41.3	17.7	4.1	3.3

Model 1 reports independent univariate models including the covariates age and sex (for overall analysis). Model 2 includes all variables listed.

Boldface indicates significance

BMI, body mass index; MVPA, moderate to vigorous physical activity.

* $P < 0.05$,

** $P < 0.01$.