Original Research

Participation in Higher Intensity Physical Activity Predicts Lower Depressive Symptom Incidence in College Students

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ABSTRACT

International Journal of Exercise Science 15(7): 667-675, 2022. The prevalence of depression and insufficient physical activity (PA) continue to rise in the United States, particularly among college students. PA is typically associated with decreased levels of depressive symptoms; however, the association between different intensities of PA and depressive symptoms is unclear among college students. The aim of this study was to examine how well weekly moderate PA (MPA), vigorous PA (VPA) and strength training (ST) volumes predicted depressive symptoms in college students. Students self-reported weekly MPA, VPA, ST, depressive symptoms (CESD-7), restful nights of sleep, grade point average (GPA) and socio-demographic characteristics. Four individual linear regression models were performed to examine how MPA, VPA, and ST predicted depressive symptoms. Covariates controlled for socio-demographic characteristics (gender, race/ethnicity, and sexual orientation) and other variables (GPA and sleep) that could influence depressive symptoms. Data suggested that higher volumes of VPA (β = -0.11; R^2 = 0.157) and higher days of ST (β = -0.11; R^2 = 0.157) significantly predicted ($p < 0.001$) lower depressive symptoms. While MPA volume (β = -0.01; R^2 = 0.147) did not significantly predict depressive symptoms. Higher volumes of VPA and more days of ST participation predicts lower depressive symptoms in college students. High intensity exercise programs should be promoted at universities and throughout the young adult population. Exercise prescription may be useful and successful for students at risk of depression. Emphasis placed on these intensities will attempt to decrease depressive symptoms in students.

KEY WORDS: Young adults, exercise, intensities, depression, mental health

INTRODUCTION

Depression, in the field of mental health, has become an increasingly worrisome condition. Clinically defined as a mental health condition 'more than sadness', depression includes symptoms such as insomnia, loss of energy, and a lack of interest in activities that the individual once found enjoyable (6). Depressive symptoms not only affect individuals on a daily basis but can also affect their careers and families. Over the past decade, the prevalence of depression continues to increase (29).

Prevalence of depression has been shown to significantly vary based on sociodemographic characteristics, such as economic status, race/ethnicity, and job status (2, 11); although, one of the most at-risk populations are college students (17). There has been a substantial increase in prevalence of depressive symptoms among college students in the US over the past decade. In a nationally representative report from 2011, 10.9% of college undergraduates stated that they had been diagnosed with depression in the past year compared with 19.2% from a similar report in 2019, representing a roughly 75% increase (3, 5). Two major factors associated with these increased levels of depression in this population include low sleep quality/quantity (12) and having a lower grade point average (GPA) (16).

There are many factors which play a role in the risk of being diagnosed with depression, but it can be prevented and treated through many different behavioral changes. Physical activity (PA) has been shown to be a modifiable risk factor in college students that decreases the prevalence and risk of depression (10, 28). For long term depression prevention and treatment, PA has shown stronger effects when compared to medication (8, 20). A combination of both moderate intensity PA (MPA) and vigorous intensity aerobic PA (VPA), along with strength training (ST), are currently recommended for all able adults, including college-aged individuals, to obtain substantial health benefits (1). Recent studies have suggested that only 67.4% of college students meet these recommended aerobic PA guidelines, and only 40.7% meet both aerobic and ST recommendations (5). This statistic is discouraging because of the known benefits of regular PA participation and its positive effects in decreasing the risk of depression.

Studies focused on college students suggest that participation in PA provides benefits to mental health and is associated with lower incidence of depressive symptoms (10, 14). High intensity PA has been shown to be the most effective to lower depressive symptom incidence in adults, however this has not been documented in young adults (15). The current study was conducted to examine how well weekly MPA, vigorous VPA and ST volumes predicted depressive symptoms in college students.

METHODS

Participants and Protocol
In the academic years of 2018/2019 and 2019/2020, a cross-sectional study was conducted using a web-based survey (Qualtrics, Provo, UT) that was distributed at a large northeastern university. Participants were students enrolled in general health and wellness courses and were recruited via direct email. The response rate was 14.29%, resulting in 1,937 participants. Volunteers who completed the survey had an opportunity to enter a drawing to win a $50 gift card as incentive. Contact information for the drawing was collected separately from the survey data to ensure anonymity. Prior to starting the survey, a link presented information about the study and participants provided informed consent. Incomplete survey data was discarded (n = 199). The Pennsylvania State University Institutional Review Board approved this study, and all methods follow ethical consideration for exercise psychology (22).

Socio-demographic characteristics - Participants self-reported their age, race/ethnicity, gender identity (male, female), sexual orientation, and year standing in college.

Physical Activity Behaviors - Weekly self-reported recreational/leisure time MPA and VPA (7) were assessed using the reliable and validated Global PA Questionnaire (GPAQ) (9). Muscle-strengthening (strength-training [ST]) activity was measured similarly to the GPAQ (30), asking questions regarding the frequency (days/week) throughout the week of participation in muscle strengthening activities for at least 10 minutes. This ST measurement was asked separately from the other VPA and MPA measurements.

Depressive Symptoms - Depressive symptoms were assessed using the Center for Epidemiology Studies-Depression Scale 7 (CESD-7), a seven-item version created from the original version (25, 26) that measures depressive symptoms. Respondents rated how often they experienced different symptoms on a four-point scale ranging from (0) rarely or none of the time (less than one day a week) to (3) most or all of the time (5-7 days a week). The CESD-7 includes items pertaining the following depressive symptoms: poor appetite, trouble keeping one's mind on task, feeling depressed, restless sleep, feeling sad, and inability to 'get going.' It has demonstrated acceptable psychometric properties in past studies with this population (21). A CESD-7 summary score was created by adding all of the items' answers together. In the current study, reliability was good ($a = 0.81$).

Well-rested Sleep - Sleep was assessed using an item from the NCHA (4), where participants indicated how many days they got enough sleep to feel well rested in the morning during the past week (0 through 7 nights). The average of responses for this measure was treated as a continuous variable for statistical analyses.

Grade Point Average (GPA) - Participants self-reported their cumulative collegiate GPA on a 0 to 4.0 scale.

Statistical Analysis
Frequencies and descriptive statistics were computed to summarize the data. All data were analyzed using the SPSS Version 26.0 (IBM, Armonk, NY). Four individual linear regression models were run to examine the variance in depression within the volumes of each PA type (MPA, VPA, ST, and all intensities combined) with the depressive symptoms scale (CESD-7). Gender (man or woman), race/ethnicity, well-rested sleep, GPA, and sexual orientation were all used as covariates in these models. Preliminary analyses of covariates (gender, race/ethnicity, sleep, GPA, and sexual orientation) found significant differences in depression symptoms ($p < 0.05$). Based on these analyses, significance was set at $a = 0.005$ to conservatively accommodate for multiple comparisons.

RESULTS

The sample (n = 1,738) consisted of college-aged adults (20.5 ± 1.6 years), with the majority identifying as women (n = 1083, 63.5%) and Non-Hispanic White (n = 1,255, 72.8%). Table 1 shows a complete description of participant socio-demographic frequencies and average PA volume per intensity across gender and race/ethnicity.

Table 1. Participant demographics (n = 1,738)

	n	%	MPA min/week	VPA min/week	ST days/week
				Mean (SD)	
Total Sample	1738	100	199.3 (216.8)	159.8 (176.8)	1.8 (1.9)
Gender					
Women	1083	62.3	201.2 (222.0)	139.7 (158.0)	1.4 (1.7)
Men	622	35.8	196.7 (210.0)	195.2 (201.0)	2.3 (2.1)
Race					
NH Caucasian	1255	72.8	211.4 (220.2)	168.1 (179.5)	1.8 (1.9)
NH African American	46	2.7	169.6 (200.2)	134.1 (127.1)	1.4 (1.6)
Hispanic or Latinx	83	4.8	202.8 (202.6)	155.0 (181.2)	1.8 (1.8)
NH Asian American	150	8.7	144.0 (185.0)	138.8 (178.3)	1.7 (2.0)
NH Other	106	6.1	129.5 (188.1)	115.5 (156.7)	1.2 (1.8)
NH Multiracial	84	4.9	218.1 (248.1)	144.6 (173.1)	1.5 (1.7)

Note: NH- Non-Hispanic; missing values not used in descriptive statistics; VPA- Vigorous Physical Activity; MPA- Moderate Physical Activity; ST- Strength Training

Outcome measures are outlined in table 2. Based on the overall sample, the average CESD-7 score was 6.0397 (SD = 4.18), the average days participants stated getting enough sleep to feel well-rested was 3.53 days (SD = 1.69) and the average GPA (on a 0.0-4.0 scale) was 3.339 (SD = 0.51).

Physical Activity Regression Models - Four independent linear regression models for each type of PA were conducted to show the individual significance and effect on depressive symptom variance. Covariates (gender, race/ethnicity, sleep, GPA, and sexual orientation) were used throughout all regression models.

Moderate Physical Activity (MPA) Model - MPA did not significantly predict (p = 0.836) the variance of depressive symptoms, although a number of covariates (sleep, GPA, sexual orientation) explained a significant portion of the variance in depressive symptoms (p < 0.001). The MPA model explained 14.7% of the variance in depressive symptoms.

Vigorous Physical Activity (VPA) Model - VPA significantly predicted (p < 0.001) the variance of depressive symptoms. For every minute of VPA added per week, depressive symptoms were shown to decrease by β = 0.11. The variance was also significantly (p < 0.001) explained by a number of covariates (sleep, GPA, sexual orientation). The VPA model explained 15.7% of the variance in depressive symptoms.

Strength Training (ST) Model - ST also significantly predicted the variance of depressive symptoms ($p < 0.001$). For every day of ST added per week, depressive symptoms were shown to decrease by $\beta = 0.11$. The variance was also significantly ($p < 0.001$) explained by a number of covariates (sleep, GPA, sexual orientation). The ST model explained 15.7% of the variance in depressive symptoms.

VPA, MPA, and ST Combined Model - Under our adjusted p-value of ($p < 0.005$); MPA ($p = 0.349$), VPA ($p = 0.005$) and ST ($p = 0.006$) as individual variables did not significantly predict the variance of depressive symptoms in the model. Although, a number of covariates (sleep, GPA, sexual orientation) significantly ($p < 0.001$) predicted the variance of depressive symptoms. The combined model explained 16.1% of the total variance in depressive symptoms.

Table 2. Predictions of variance in depressive symptoms based on PA intensities and covariates

Model		B	SE	β	t	CI 95%	p
MPA	($R^2 = 0.147$)						
	MPA (min/week)	0.00	0.00	-0.01	-0.21	(-0.001, 0.001)	0.836
	Gender	-0.52	0.20	-0.06	-2.63	(-0.91, -0.132)	0.009
	Race/Ethnicity	-0.55	0.22	-0.06	-2.56	(-0.974, -0.128)	0.011
	Sleep	-0.75	0.06	-0.31	-13.16	(-0.859, -0.636)	< 0.001
	GPA	-0.79	0.19	-0.1	-4.2	(-1.157, -0.421)	< 0.001
	Sexual Orientation	-1.85	0.33	-0.13	-5.59	(-2.494, -1.198)	< 0.001
VPA	($R^2 = 0.157$)						
	VPA (min/week)	0.00	0.00	-0.11	-4.54	(-0.003, -0.001)	< 0.001
	Gender	-0.39	0.2	-0.05	-1.93	(-0.776, 0.005)	0.053
	Race/Ethnicity	-0.48	0.21	-0.05	-2.23	(-0.898, -0.057)	0.026
	Sleep	-0.74	0.06	-0.31	-13.14	(-0.852, -0.631)	< 0.001
	GPA	-0.78	0.19	-0.1	-4.18	(-1.146, -0.414)	< 0.001
	Sexual Orientation	-1.77	0.33	-0.13	-5.4	(-2.419, -1.129)	< 0.001
ST	($R^2 = 0.157$)						
	ST (days/week)	-0.24	0.05	-0.11	-4.51	(-0.339, -0.133)	< 0.001
	Gender	-0.32	0.20	-0.04	-1.57	(-0.714, 0.078)	0.116
	Race/Ethnicity	-0.49	0.21	-0.05	-2.28	(-0.909, -0.069)	0.023
	Sleep	-0.73	0.06	-0.3	-12.9	(-0.84, -0.619)	< 0.001
	GPA	-0.78	0.19	-0.1	-4.19	(-1.148, -0.417)	< 0.001
	Sexual Orientation	-1.75	0.33	-0.12	-5.31	(-2.393, -1.102)	< 0.001
VPA/MPA/ST	($R^2 = 0.161$)						
	VPA (min/week)	0.00	0.00	-0.08	-2.83	(-0.003, -0.001)	0.01
	MPA (min/week)	0.00	0.00	0.02	0.94	(0.0, 0.001)	0.35
	ST (days/week)	-0.16	0.06	-0.08	-2.76	(-0.281, -0.047)	0.01
	Gender	-0.28	0.20	-0.03	-1.39	(-0.677, 0.116)	0.17
	Race/Ethnicity	-0.47	0.22	-0.05	-2.19	(-0.891, -0.049)	0.03
	Sleep	-0.73	0.06	-0.30	-12.89	(-0.839, -0.618)	< 0.001
	GPA	-0.78	0.19	-0.10	-4.18	(-1.143, -0.413)	< 0.001
	Sexual Orientation	-1.73	0.33	-0.12	-5.25	(-2.37, -1.081)	< 0.001

Note: VPA- Vigorous Physical Activity; MPA- Moderate Physical Activity; ST- Strength Training; GPA- Grade point average (0.0-4.0)

DISCUSSION

The findings from this study demonstrate that higher volumes of higher intensity PA, such as ST and VPA, predicted lower depressive symptoms in college students, while MPA did not. Participation in higher intensity workouts and exercise suggest lower prevalence of depressive symptoms. This study fills the gaps of literature for physical activity intensities and depressive symptoms in this population; although, consistent with other findings on adults. These findings suggest that participation in higher intensity PA can be potentially beneficial for better mental health in this population. In addition to the model's significance for VPA and ST for depressive symptoms, lower weekly amounts of restful sleep, lower GPAs, and non-heterosexual orientation significantly predicted more depressive symptoms among college students, which aligns with previous studies (2, 11, 12, 16).

Especially in the college-aged population, there is evidence to support the importance of prevention with mental health problems (5, 10, 11, 16, 28). Developing healthy habits during this transitional life stage may have the potential to help with establishing behaviors that carry forward into subsequent life stages. College is an important time to create healthy habits. Previous research has shown that habits created in college are more likely to last post-graduation (27). Healthy habits, such as obtaining the recommended weekly PA, may also have the potential to decrease the risk of developing depressive symptoms (18). Studies have shown that PA, in any form, has also been shown to help prevent negative outcomes on depression (10); however, this study suggests that higher intensity PA types (VPA and ST) may be correlated to lower depressive symptoms in the college student population.

Current literature has suggested that any type PA has an effect of combatting negative mental health in many populations (13); however, our study has suggested evidence regarding the importance of VPA and ST in college populations. Our results regarding participation in high intensity PA are consistent with literature that show high intensity interval training (HIIT) programs play a role decreasing depressive symptoms (24). Whereas the literature has focused on other populations, there is a lack of literature testing the differences between college students' participation in different PA intensities compared to their depressive symptoms. These results fill the gaps in the college student PA and depressive symptoms literature.

Although universities and community leaders should advocate for all types of PA, this study suggests that an emphasis should be placed on creating opportunities for VPA and ST. Concurrently, universities and community leaders should emphasize the promotion of resources and programs which support more sleep, increased academic success (GPA), and a focus on resources accessible to non-heterosexual students. Providing increased access to facilities and class opportunities has been shown to increase PA levels in adults (19). Therefore, university health clinic and campus recreation groups should consider increasing the number of exercise classes, gym space, equipment, and capacity size in intramural and recreation buildings to encourage more VPA and ST participation.

There were limitations to the current study. The similarity between predictive values of the VPA and ST models could be biased by volunteer sampling and subjective self-measurement techniques and participant confusion. There were limitations to the current study. The PA and depression measures, although reliable and validated, are self-reported and participants may have inaccurate recall of different types of PA or intensities of PA. Furthermore, a student population from a large north-eastern university does not allow for generalizability to all college-aged individuals in the US. Future research should focus on objective/device-based measures of PA while continuing to focus on PA intensity and mental health (23).

This study demonstrates that participation in higher volumes of weekly VPA and ST predicts lower depressive symptoms in college students, whereas increased volumes of weekly MPA did not. These results should encourage universities and college administrators to advocate for higher intensity PA for better mental health. Wellness of a population, especially in college students, can be encouraged through the act of PA.

ACKNOWLEDGEMENTS

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