

RESEARCH ARTICLE

Association between exercise and mental health among emerging adults: Results from the 2023–2024 healthy minds study

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Abstract

Background: Emerging adulthood is a developmentally unstable period with a high burden of depression and anxiety, yet the association between exercise time and mental health in this population remains insufficiently understood.

Objective: The present study aims to investigate the association between exercise time and mental health (depression and anxiety) among emerging adults.

Methods: Data from 37,732 emerging adults aged 18 to 29 were drawn from the 2023–2024 Healthy Minds Study. Self-report exercise habits and mental health outcomes (depression and anxiety) were analyzed using multivariate logistic regression with adjustments for covariates.

Results: The results indicated significant associations between exercise, depression, and anxiety. Compared to participants who exercised less than 1 h per week, those who exercised ≥ 1 h per week had progressively lower odds of depressive and anxiety symptoms. The lowest odds were observed among those who exercised ≥ 5 h per week. These protective effects were evident in both males and females during emerging adulthood.

Conclusions: The findings of the present study suggest that incremental exercise is strongly associated with better mental health in emerging adults. Emerging adults who engaged in more exercise had significantly lower risks of depressive (odds ratio [OR] = 0.51, 95% confidence interval [CI] [0.46, 0.57]; $p < 0.001$) and anxious (OR = 0.64, 95% CI [0.58, 0.71]; $p < 0.001$) symptoms. These results highlight the necessity of supporting and promoting exercise as an important component of mental health programs in universities or communities. However, future research should include longitudinal and interventional studies to confirm causality and to determine the most effective approach to integrate physical activity into mental health promotion programs.

Keywords: Physical activity; Depression; Anxiety; Emerging adulthood

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1. Introduction

Emerging adulthood refers to a new and often stressful life stage spanning late adolescence to early adulthood, typically between 18 and 29 years of age.¹ During this highly unstable period, young people usually experience multiple developmental challenges, such as pursuing higher education, establishing romantic relationships, frequently changing jobs, and increasing financial stress.^{1,2} Without effective psychological adjustment strategies and social support resources, individuals may undertake developmental tasks far beyond their current cognitive abilities and emotional regulation levels in the short term, thereby triggering significant psychological stress responses and leading to a decline in subjective life satisfaction.^{2,3} Systematic reviews have consistently shown that the prevalence of mental health disorders among emerging adults is significantly higher than that of other age groups, with depression and anxiety being the most common diagnostic categories.^{4–6} A recent review reported that approximately 50% of emerging adults reported clinically significant depressive symptoms.⁷ Such mental health problems not only substantially impair their overall quality of life but also have a significant impact on academic performance, social relationships, and long-term career development. Given the considerable mental health burden faced by this group and its potential long-term adverse effects, identifying modifiable risk factors is of substantial clinical and practical importance.

Recent national evidence based on a nationally representative sample in the United States has shown that better overall lifestyle-related cardiovascular health is associated with lower odds of depression among young adults, underscoring the potential mental-health relevance of modifiable behaviors, including physical activity and sleep.⁸ Physical activity is defined as body movements produced by skeletal muscles with the expenditure of energy.⁹ There is encouraging evidence that regular physical activity effectively improves mental health outcomes (e.g., depression) across all age groups, offering a solution without the physiological side effects or financial burdens associated with prescription antidepressants.^{10–12} For example, the systematic review conducted by Wolf *et al.*¹³ has indicated that a higher cumulative time spent on moderate to vigorous physical activity per week was associated with a 12–32% lower risk of depressive symptoms and a 15–34% lower risk of anxiety symptoms among adults. A study including 1,143 college students from China found that vigorous exercise was associated with lower depression levels.¹⁴ Evidence from a meta-analysis of prospective observational studies involving 59,786 adolescents further demonstrated that higher levels

of physical activity were significantly associated with a decreased risk of depression.¹⁵ Moreover, a dose–response meta-analysis of 11 international cohorts reported an inverse association between physical activity volume and anxiety prevalence, with the strongest protective effect observed within the World Health Organization recommended range of 10–20 MET·h/week.¹⁶ Collectively, these research findings indicate that physical activity can serve as a feasible and scalable strategy for promoting the mental health of young people.

Although research on the relationship between physical activity and mental health is increasing, significant gaps still exist. Firstly, there is relatively little research specifically targeting emerging adults, and much of the evidence comes from broader adult populations or adolescents, which may overlook the unique developmental factors of emerging adults. Secondly, the dose–response relationship between physical activity and mental health remains unclear, particularly regarding whether a gradual increase in exercise time leads to a proportional improvement in mental health symptoms. Additionally, although preliminary evidence suggests that the mental health benefits derived from exercise may differ between men and women,^{17,18} research on gender differences in the associations between physical activity and mental health remains insufficient.

Therefore, filling these gaps is important for improving the physical activity recommendations specifically targeted at emerging adults. This study aims to address these research gaps by examining the associations between different durations of exercise and depression and anxiety among emerging adults. The study further explores the potential dose-response relationship and investigates gender differences in these associations. By clarifying these key issues, the study may provide effective strategies for promoting mental health and ultimately contribute to improving the mental health status and quality of life of this population.

2. Methods

2.1. Sample

This cross-sectional study utilized the data from the Healthy Minds Study (HMS), an annual web-based survey of college student health. This dataset includes respondents from higher education institutions across the United States who were surveyed during the period from 2023 to 2024. Participants were students aged 18 years or above, including both undergraduate and graduate students. At each participating institution, a random sample of up to 4,000 enrolled students (aged ≥18) was invited to participate (all students were invited at smaller

institutions with < 4,000 total enrollment).¹⁹ The overall survey response rate was 9%, which is comparable to the response rates of other non-probability online surveys.^{20,21} All study procedures were approved by the Health Sciences and Behavioral Sciences Institutional Review Board at the University of Michigan.

2.2. Exercise

Exercise behavior as an independent variable was assessed with a single self-report item asking respondents: “In the past 30 days, how many hours weekly on average did you spend exercising? (involving any moderate or vigorous exercise, where “moderate exercise” was roughly equivalent to brisk walking or biking).” Response options were: < 1 h, 1–2 h, 2–3 h, 3–4 h, or ≥ 5 h per week. For analysis, these categories were treated as a categorical variable, with the < 1 h per week group considered as the reference category.²²

2.3. Mental health

Depression and anxiety were the primary outcome variables, assessed using standard validated scales. Depressive symptoms were measured using the 9-item Patient Health Questionnaire (PHQ-9), and anxiety symptoms were measured using the 7-item Generalized Anxiety Disorder scale (GAD-7). Each scale is designed to ask the participants about the frequency of their symptoms over the past two weeks, and then a total severity score is calculated (ranging from 0–27 for the PHQ-9 and 0–21 for the GAD-7). The cut-off value for a positive screen of depression and anxiety (indicating a possible diagnosis of depression or anxiety) is a score of ≥ 10 points.²³

2.4. Control variables

Based on prior literature, several sociodemographic factors were considered as potential confounding factors in the analyses.^{24,25} Age (in years) was considered as a continuous variable. Gender was categorized as male, female, and transgender/other, according to the survey response options. Race/Ethnicity was self-identified and classified into the following categories: African American/Black, American Indian or Alaskan Native, Asian American/Asian, Hispanic/Latino, Native Hawaiian or Pacific Islander, Middle Eastern, Arab, or Arab American, White, and other. Additionally, international student status was included as a binary variable (yes or no). Educational attainment has been shown to relate systematically to the allocation of movement behaviors in emerging adults, supporting its consideration as an important sociodemographic correlate/confounder in movement–mental health analyses.²⁴ In this study, education/academic level was recorded as the student’s program level (categorized as undergraduate, master’s, doctoral, or other). All covariates were based on

self-report at the time of the survey.²²

2.5. Statistical analysis

To correct for non-response bias, this study constructed sample probability weights based on data covering all students from each participating university (including key covariates such as gender, race/ethnicity, and academic year). These sample weights equalized the overall weight of each school in the national estimates rather than weighting them by the size of their student enrollment. Standard errors were clustered at the college level.^{26,27} Descriptive statistics were used to characterize the sample’s sociodemographic profile, exercise-time distribution, and prevalence of depressive and anxiety symptoms. To ensure population-level generalizability, all estimates were appropriately weighted using design-based weights. Multivariable logistic regression models were then used to examine the association between exercise time (independent variable) and each mental health outcome (depression and anxiety) while adjusting for all covariates. Two separate logistic regression models were constructed: one with depression (PHQ-9 ≥ 10 vs. < 10) and another with anxiety (GAD-7 ≥ 10 vs. < 10) as the dependent variables. In both models, the <1 h/week exercise group was used as the reference category. All aforementioned sociodemographic variables were included as covariates in each model. We report adjusted odds ratios (ORs) with 95% confidence intervals (CIs) for each exercise category (relative to the reference group) in association with the depression and anxiety outcomes. All statistical analyses were performed using Stata 18.5 (Stata Corp, USA) and weighted using the sample weights described. Statistical significance was defined as a two-tailed p -value < 0.05.

3. Results

The present study included 37,732 college students. The descriptive characteristics of the study sample are presented in Table 1. The weighted mean age of participants was 21.19 ± 2.83 years, with minimal differences between individuals with depression (21.20 ± 2.86 years) and those without (21.17 ± 2.79 years). Values for categorical variables are presented as unweighted counts (n) with weighted percentages (%). Over half (52.97%) of respondents identified as female. The majority of participants were White (67.93%), followed by American/Black (11.03%), Hispanic/Latino (10.09%), and Asian American (7.40%). Minor racial groups such as American Indian (0.78%) and Native Hawaiian or Pacific Islander (0.33%) also represented smaller proportions of the sample. International students accounted for 5.52%. Regarding academic status, 84.40% of participants were undergraduates, with significantly lower proportions in higher degree categories: master’s students (7.99%),

doctoral students (4.61%), and other (3.00%). Among participants screening positive for depression and anxiety, females accounted for a larger proportion (depression: 55.41%; anxiety: 59.54%) than males (depression: 31.75%; anxiety: 28.18%). Exercise time exhibited considerable variation, with the largest group (25.08%) reporting less than 1 h of exercise per week, followed by 1–2 h (26.47%) and 2–3 h (21.10%). Participants who exercised for ≥ 5 h represented 24.70% of the sample. Additional descriptive results are presented in Table 1.

Table 2 presents the associations of exercise time with depression and anxiety in multivariable logistic regression analyses. Compared with participants who exercised <1 h per week, those who exercised 1–2 (OR = 0.71, 95% CI [0.64, 0.79]; $p < 0.001$), 2–3 (OR = 0.71, 95% CI [0.63, 0.80]; $p < 0.001$), 3–4 h (OR = 0.56, 95% CI [0.52, 0.66]; $p < 0.001$), and ≥ 5 h (OR = 0.51, 95% CI [0.46, 0.57]; $p < 0.001$) per week had lower odds of depression. Similar inverse associations were observed for anxiety. Participants who exercised ≥ 5 h per week had the lowest odds of anxiety symptoms compared with those who exercised less than 1 h per week (OR = 0.64, 95% CI [0.58, 0.71]; $p < 0.001$). Participants engaging in 1–2 h (OR = 0.77, 95% CI [0.69, 0.85]; $p < 0.001$), 2–3 h (OR = 0.78, 95% CI [0.69, 0.88]; $p < 0.001$), or 3–4 h (OR = 0.66, 95% CI [0.58, 0.74]; $p < 0.001$) of exercise per week also had lower odds of anxiety symptoms compared with the reference group.

Table 3 presents the association between exercise time and depression and anxiety stratified by gender. Among male participants, engaging in 1–2 h of exercise per week was associated with a 31% lower odds of depression (OR = 0.69, 95% CI [0.56, 0.86]; $p = 0.001$) relative to less than 1 h. The protective effects strengthened progressively with increasing exercise time: 2–3 h (OR = 0.65, 95% CI [0.52, 0.81]; $p < 0.001$), 3–4 h (OR = 0.61, 95% CI [0.49, 0.77]; $p < 0.001$), and ≥ 5 h (OR = 0.48, 95% CI [0.40, 0.59]; $p < 0.001$). Similar inverse associations were observed in females. For example, females exercising ≥ 5 h/week exhibited 48% lower odds of depression (OR = 0.52, 95% CI [0.46, 0.59]; $p < 0.001$).

For anxiety, males demonstrated stronger risk reductions with increasing exercise time. Engaging in 1–2 h (OR = 0.70, 95% CI [0.56, 0.86]; $p = 0.003$), 2–3 h (OR = 0.64, 95% CI [0.51, 0.81]; $p < 0.001$), 3–4 h (OR = 0.61, 95% CI [0.48, 0.80]; $p < 0.001$), and ≥ 5 h (OR = 0.53, 95% CI [0.43, 0.64]; $p < 0.001$) exercise per week was linked to 30–47% lower odds of anxiety. A similar result of reduced risk was also observed in females, for example, 1–2 h (OR = 0.78, 95% CI [0.70, 0.88]; $p < 0.001$), 2–3 h (OR = 0.83, 95% CI [0.71, 0.96]; $p < 0.001$), 3–4 h (OR = 0.65, 95% CI [0.56, 0.75]; $p < 0.001$), and ≥ 5 h (OR = 0.69,

95% CI [0.61, 0.78]; $p < 0.001$).

4. Discussion

Using data from HMS, the present study examined the association between exercise time and mental health outcomes, particularly depression and anxiety symptoms, among a large sample of emerging adults. The findings indicated a robust inverse relationship between exercise time and the odds of experiencing depressive and anxiety symptoms. Emerging adults who engaged in high levels of exercise (≥ 5 h per week) had significantly lower odds of depression and anxiety symptoms compared to those who engaged in less exercise (<1 h per week). After adjusting for sociodemographic and academic covariates, participants who engaged in ≥ 5 h of exercise per week had a 49% lower odds of depressive symptoms and 36% lower odds of anxiety symptoms than those who exercised <1 h/week. These protective effects were evident in both males and females during emerging adulthood. Taken together, these findings support the promotion of regular exercise as a potentially relevant component of mental health promotion in this population.^{28,29}

The present findings are broadly consistent with prior literature suggesting that greater exercise time is associated with better mental health outcomes. Regarding depression, a previous study reported lower odds of mental health problems among university students who participated in more exercise.³⁰ Moreover, in a recent population-based study investigating the mental health of undergraduate students, Rodríguez-Romo *et al.*³¹ reported that undergraduate students who engaged in more exercise had a lower risk of depression. Regarding anxiety, a cross-sectional study of college students reported that those with higher levels of physical activity had lower odds of anxiety than less active students.¹⁷ This association was consistently confirmed in subsequent prospective cohort studies and multiple systematic meta-analyses. The existing evidence collectively indicates that young individuals who regularly engage in more physical activity tend to have a significantly lower risk of developing clinical anxiety disorders compared to their sedentary peers.^{32,33} These associations may be explained by multiple psychosocial and physiological mechanisms. At the psychosocial level, regular exercise consistently strengthens self-efficacy beliefs, fosters more adaptive and flexible coping strategies under stress, and facilitates access to reciprocal, emotionally supportive social networks.^{12,34} At the physiological level, regular exercise elicits robust adaptive responses, including enhanced neuroendocrine regulation, attenuation of systemic inflammation, and stabilization of neurotransmitter signaling, each of which has been empirically linked to improved mental and

Table 1. Descriptive characteristics of the study sample

Variables	Total (<i>N</i> = 37,732)	Non-depression (<i>n</i> = 22,445)	Depression (<i>n</i> = 15,287)	Non-anxiety (<i>n</i> = 23,997)	Anxiety (<i>n</i> = 13,735)
Age	21.19 ± 2.83	21.20 ± 2.86	21.17 ± 2.79	21.15 ± 2.84	21.25 ± 2.81
Gender					
Male	10,036 (39.62)	6,929 (44.71)	3,107 (31.75)	7,646 (45.81)	2,390 (28.18)
Female	24,683 (52.97)	14,560 (51.40)	10,123 (55.41)	15,085 (49.42)	9,598 (59.54)
Transgender/other	3,013 (7.41)	956 (3.89)	2,057 (12.84)	1,266 (4.77)	1,747 (12.28)
Race					
African American/Black	2,687 (11.03)	1,629 (11.32)	1,058 (10.5)	1,814 (11.62)	873 (9.94)
American Indian or Alaskan Native	266 (0.78)	136 (0.70)	130 (0.92)	158 (0.73)	108 (0.88)
Asian American	3,529 (7.40)	2,247 (7.77)	1,282 (6.82)	2,505 (8.13)	1,024 (6.04)
Hispanic/Latino	3,597 (10.09)	1,959 (9.66)	1,638 (10.74)	2,230 (10.04)	1,367 (10.17)
Native Hawaiian or Pacific Islander	123 (0.33)	67 (0.33)	56 (0.32)	73 (0.30)	50 (0.39)
Middle Eastern, Arab, or Arab American	469 (1.20)	267 (1.29)	202 (1.07)	279 (1.17)	190 (1.25)
White	26,616 (67.93)	15,885 (67.65)	10,731 (68.37)	16,653 (66.77)	9,963 (70.08)
Other	445 (1.24)	255 (1.28)	190 (1.18)	285 (1.24)	160 (1.25)
International student					
No	35,298 (94.48)	20,890 (94.23)	14,408 (94.87)	22,254 (93.85)	13,044 (95.66)
Yes	2,434 (5.52)	1,555 (5.77)	879 (5.13)	1,743 (6.15)	691 (4.34)
Academic information					
Undergraduate	30,700 (84.40)	17,758 (82.74)	12,942 (86.97)	19,176 (83.45)	11,524 (86.16)
Master	3,919 (7.99)	2,595 (8.75)	1,324 (6.80)	2,673 (8.46)	1,246 (7.10)
Doctoral	2,218 (4.61)	1,552 (5.41)	666 (3.39)	1,576 (5.05)	642 (3.80)
Other	895 (3.00)	540 (3.10)	355 (2.84)	572 (3.04)	323 (2.94)
Exercise time					
Less than 1 h	9,463 (26.47)	4,106 (22.30)	4,840 (32.95)	5,357 (23.55)	4,380 (31.89)
1–2 h	8,121 (21.10)	3,049 (20.81)	3,408 (21.56)	5,072 (20.95)	2,938 (21.39)
2–3 h	6,012 (15.20)	2,245 (15.05)	2,438 (15.42)	3,767 (15.03)	2,130 (15.51)
3–4 h	5,118 (12.53)	1,659 (13.51)	1,821 (10.99)	3,459 (13.30)	1,523 (11.09)
≥5 h	9,018 (24.70)	2,676 (28.33)	2,780 (19.08)	6,342 (27.17)	2,764 (20.12)

Notes: Values for continuous variables are presented as weighted mean ± standard deviation, whereas categorical variables are presented as unweighted counts (*n*) with weighted percentages (%). All sample sizes reported in the column headers are unweighted.

Table 2. Multivariate logistic regression analysis of factors associated with depressive and anxiety symptoms

Variables	Depression				Anxiety			
	p	OR	95% CI		p	OR	95% CI	
Age	0.070	1.01	1.00	1.03	<0.001	1.03	1.01	1.05
Gender								
Male		Reference				Reference		
Female	<0.001	1.41	1.30	1.53	<0.001	1.86	1.71	2.03
Transgender/other	<0.001	4.21	3.67	4.83	<0.001	3.83	3.35	4.39
International students								
No		Reference				Reference		
Yes	0.259	1.10	0.93	1.29	0.153	0.88	0.74	1.05
Race								
African American/Black		Reference				Reference		
American Indian or Alaskan Native	0.023	1.55	1.06	2.26	0.054	1.48	0.99	2.21
Asian American	0.434	1.08	0.89	1.32	0.808	1.03	0.83	1.27
Hispanic/Latino	0.033	1.21	1.02	1.45	0.053	1.19	1.00	1.43
Native Hawaiian or Pacific Islander	0.386	1.27	0.74	2.20	0.102	1.86	0.88	3.91
Middle Eastern, Arab, or Arab American	0.928	1.02	0.61	1.73	0.117	1.50	0.90	2.47
White	0.083	1.14	0.98	1.32	0.002	1.27	1.09	1.47
Other	0.895	1.02	0.72	1.45	0.254	1.28	0.84	1.97
Academic information								
Undergraduate		Reference				Reference		
Master	<0.001	0.71	0.63	0.80	<0.001	0.77	0.69	0.87
Doctoral	<0.001	0.59	0.51	0.70	<0.001	0.69	0.58	0.81
Other	0.085	0.83	0.66	1.03	0.209	0.87	0.70	1.08
Exercise time								
<1 h		Reference				Reference		
1–2 h	<0.001	0.71	0.64	0.79	<0.001	0.77	0.69	0.85
2–3 h	<0.001	0.71	0.63	0.80	<0.001	0.78	0.69	0.88
3–4 h	<0.001	0.56	0.52	0.66	<0.001	0.66	0.58	0.74
≥5 h	<0.001	0.51	0.46	0.57	<0.001	0.64	0.58	0.71

Abbreviations: CI: Confidence interval; OR: Odds ratio.

Table 3. Association between exercise time and depression and anxiety stratified by gender

Exercise time	Male				Female				Transgender/other				
	<i>p</i>	OR	95%CI		<i>p</i>	OR	95%CI		<i>p</i>	OR	95%CI		
Depression													
<1 h		Reference					Reference				Reference		
1–2 h	0.001	0.69	0.56	0.86	<0.001	0.71	0.63	0.80	0.026	0.68	0.49	0.96	
2–3 h	<0.001	0.65	0.52	0.81	<0.001	0.74	0.64	0.86	0.034	0.69	0.48	0.97	
3–4 h	<0.001	0.61	0.49	0.77	<0.001	0.54	0.47	0.63	0.153	0.75	0.50	1.11	
≥5 h	<0.001	0.48	0.40	0.59	<0.001	0.52	0.46	0.59	0.031	0.64	0.43	0.96	
Anxiety													
<1 h		Reference					Reference				Reference		
1–2 h	0.003	0.70	0.56	0.86	<0.001	0.78	0.70	0.88	0.096	0.77	0.56	1.05	
2–3 h	<0.001	0.64	0.51	0.81	0.011	0.83	0.71	0.96	0.515	0.90	0.65	1.24	
3–4 h	<0.001	0.61	0.48	0.80	<0.001	0.65	0.56	0.75	0.350	0.84	0.58	1.21	
≥5 h	<0.001	0.53	0.43	0.64	<0.001	0.69	0.61	0.78	0.522	0.89	0.62	1.27	

Abbreviations: CI: Confidence interval; OR: Odds ratio.

physical health outcomes.^{35,36} Moreover, recent evidence among emerging adults suggests that dietary intake of live microbes may serve as a potential mediating variable, partially explaining the negative association between leisure-time physical activity and depressive symptoms.³⁷ Future studies should examine potential interactions between dietary patterns and physical activity. Together, the proposed mechanisms suggest that physical activity may represent a useful component of broader mental health promotion strategies. For most emerging adults, engaging in more physical activity may be beneficial in reducing the risk of depression and anxiety.^{31,38}

Significant gender differences have been observed in multiple fields such as cardiovascular health, subjective happiness, and physical activity.^{39,40} Regarding mental health, epidemiological studies have shown that females have approximately twice the lifetime risk of developing depression compared to males.⁴¹ This pattern appears broadly consistent with our sample. In terms of the association between physical activity and mental health, Portela-Pino *et al.*⁴² explored the role of gender-specific motivations and preferences for physical activity, which may help to consider gender as an important factor

in mental health. For example, previous research has suggested that males are more inclined to participate in team sports.⁴³ Such activities not only help improve social interaction skills but also positively promote the development of emotional regulation and psychological resilience,^{3,43} thus potentially playing a protective role in the primary prevention of depression and anxiety disorders. However, our findings did not show clear evidence of a sex difference in the associations examined. This may reflect limited statistical power in subgroup analyses. Further, stratified analysis by gender reduced the effective sample size of each subgroup. In particular, the sample size of the male subgroup was significantly smaller than that of the female subgroup, leading to a prominent insufficiency in the statistical power to test gender-specific associations. Future research should include larger, more sex-balanced samples to better evaluate potential sex differences in the association between physical activity in emerging adulthood and mental health problems.

This study has several limitations, which should be acknowledged. First, the cross-sectional design used self-reported variables in exercise and mental health data, which may introduce recall bias and social desirability

bias. Participants may underreport symptoms of anxiety and depression or exaggerate how much they exercise. These factors may have affected measurement validity, and consequently, the observed associations. Future research could strengthen confidence in the results by incorporating objective activity measures (e.g., accelerometer, wearable device) and clinical evaluations of depression and anxiety. Second, conclusions regarding causality are impossible due to the cross-sectional design. Exercise has been linked to better mental health outcomes, but it is unclear if more exercise improves mental health or if those who are in better mental health are more willing to exercise. To elucidate directionality and causal mechanisms, longitudinal or experimental designs are required. Third, the generalizability of our findings may be limited to emerging adults aged 18–29 years. Thus, the results may not generalize to other populations. Finally, the study focused on overall exercise time but did not account for exercise type, intensity, social setting, or motivation, all of which may affect mental health differently. Future studies might examine how different forms of physical activity (e.g., team sports vs. solitary exercise, moderate vs. vigorous activity) and psychosocial factors contribute to mental health outcomes to provide more actionable suggestions.

Based on the research results on the relationship between exercise and mental health, this study can provide certain practical guidance for emerging adults. Universities and community mental health services may consider implementing supportive exercise-promotion initiatives during emerging adulthood as part of broader mental health promotion efforts. During emerging adulthood, encouraging greater participation in exercise may be helpful as part of broader efforts to prevent depression, anxiety, and other psychological problems, thereby improving their overall quality of life. Given that this study did not specifically explore the type of exercise, it is recommended to promote emerging adults to participate in various forms of physical activities, which not only help to improve mental health but also bring additional health benefits.

5. Conclusion

The findings of the present study suggest that greater exercise time was significantly associated with better mental health among emerging adults. Emerging adults who engaged in more exercise had significantly lower risks of depressive and anxious symptoms. These results support the promotion of exercise as a potential component of mental health promotion in universities and communities. Longitudinal and interventional studies are needed to clarify causality and determine the most effective implementation strategies.

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Conflict of interest

The authors declare they have no competing interests.

Author contributions

Conceptualization: Yanjie Zhang

Formal analysis: All authors

Methodology: Yanjie Zhang

Writing–original draft: All authors

Writing–review & editing: All authors

Ethics approval and consent to participate

The Healthy Minds Study was approved by the Health Sciences and Behavioral Sciences Institutional Review Board at the University of Michigan. The secondary data we used in our study has been anonymized.

Consent for publication

The secondary data we used in our study has been anonymized.

Availability of data

Data from the Healthy Minds Study can be obtained at <https://healthymindsnetwork.org/hms>. The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

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