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The Relationship Between Physical Activity and Mental Health Among University Students

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ABSTRACT

Purpose of the study: The transition to university life presents significant psychological challenges for students, including increased stress, anxiety, and depression. Physical activity has been recognized as a potential intervention for improving mental health outcomes, yet comprehensive understanding of this relationship among Indonesian university students remains limited. This study aimed to investigate the relationship between physical activity levels and mental health indicators among university students at Sekolah Tinggi Olahraga dan Kesehatan Bina Guna, examining the potential mediating factors and identifying optimal activity patterns for mental health benefits.

Materials and methods: A cross-sectional study was conducted with 420 students (aged 18-25 years) from Sekolah Tinggi Olahraga dan Kesehatan Bina Guna. Physical activity levels were assessed using the International Physical Activity Questionnaire (IPAQ-SF), while mental health was evaluated using the Depression Anxiety Stress Scale-21 (DASS-21) and the World Health Organization Well-Being Index (WHO-5). Data were analyzed using correlation analysis, multiple regression, and structural equation modeling.

Results: Students with high physical activity levels demonstrated significantly lower depression ($M = 8.2$, $SD = 4.1$) and anxiety scores ($M = 7.8$, $SD = 3.9$) compared to low-activity students (depression: $M = 14.6$, $SD = 6.2$; anxiety: $M = 13.4$, $SD = 5.8$; $p < 0.001$). A moderate positive correlation was found between physical activity and well-being scores ($r = 0.64$, $p < 0.001$). Students engaging in ≥150 minutes of moderate-vigorous physical activity weekly showed 40% better mental health outcomes.

Conclusions: Physical activity demonstrates a significant inverse relationship with negative mental health indicators and positive association with psychological well-being among university students. These findings support the implementation of structured physical activity programs as preventive mental health interventions in higher education settings.

Keywords
physical activity, mental health, university students, depression, anxiety, well-being, Indonesia.

INTRODUCTION

The university environment represents a critical transitional period in the life course of young adults, often characterized by rapid developmental changes, academic demands, and new social roles. For many students, entering higher education requires adaptation to an unfamiliar setting, coping with academic workloads, financial pressures, and managing independence from family. These changes are frequently associated with increased psychological distress, with prevalence rates of depression and anxiety among university students ranging between 30–50% globally (Auerbach et al., 2018). Mental health challenges during this stage are particularly concerning, as untreated conditions can negatively affect academic achievement, social functioning, and long-term psychological well-being (Harvey et al., 2018). In the Indonesian higher education context, additional stressors such as cultural adaptation pressures, socioeconomic inequalities, and high academic competition further intensify vulnerability to mental health problems (WHO, 2020).

Physical activity has been widely recognized as an effective non-pharmacological strategy to buffer against these stressors and promote positive mental health outcomes. Its psychological benefits are attributed to multiple neurobiological and psychosocial mechanisms, including the release of endorphins, regulation of stress hormones, enhancement of neuroplasticity, and improvement in sleep quality and social interaction (Kandola et al., 2019; Stubbs et al., 2017). The World Health Organization (2020) recommends at least 150 minutes of moderate-intensity physical activity per week for optimal health outcomes. However, evidence suggests that adherence rates to these guidelines among university students—particularly in developing countries—remain suboptimal (Warburton & Bredin, 2017). This imbalance highlights the urgency of exploring the role of physical activity as a preventive measure to address rising mental health concerns in the university student population.

A growing body of research has consistently documented the protective effects of physical activity on mental health across diverse populations. Meta-analyses reveal that regular engagement in physical activity can reduce depressive symptoms by 20–30% and anxiety symptoms by 15–25% compared to sedentary individuals (Rosenbaum et al., 2021; Schuch et al., 2018). Longitudinal studies among university students also demonstrate that structured exercise interventions improve stress management,

mood regulation, and resilience against academic pressures (Gordon et al., 2018). Furthermore, physical activity has been linked to enhanced cognitive functioning, improved sleep quality, and better overall life satisfaction, underscoring its role as a holistic well-being enhancer (Rebar et al., 2015).

Despite these promising findings, existing literature presents several methodological and contextual limitations. Much of the evidence has been generated from Western populations, with limited research focusing on Asian or Indonesian contexts. The cultural, social, and economic factors influencing both physical activity behavior and mental health outcomes may vary significantly across regions, limiting the generalizability of findings (Warburton & Bredin, 2017). Additionally, many studies have emphasized treatment effects in clinical populations rather than examining preventive impacts in general student cohorts. Inconsistencies in measurement tools for both physical activity and mental health further complicate the ability to establish precise dose-response relationships (Biddle & Batterham, 2015).

Despite the global recognition of the importance of physical activity for mental health, several research gaps remain unresolved. First, there is a scarcity of evidence examining the relationship between physical activity and mental health outcomes among Indonesian university students. Cultural norms, socioeconomic status, and academic structures may influence patterns of physical activity engagement differently compared to Western contexts. Second, little is known about the optimal frequency, intensity, and type of physical activity that yield the greatest psychological benefits for this population. While WHO guidelines provide general recommendations, specific activity patterns tailored to student populations remain underexplored (WHO, 2020). Third, the mediating mechanisms through which physical activity exerts its psychological benefits—such as improved sleep quality, enhanced self-efficacy, and social support—are not yet fully understood in the Indonesian context (Rebar et al., 2015; Stubbs et al., 2017).

Given the increasing prevalence of mental health issues among university students in Indonesia and the strong theoretical and empirical evidence supporting physical activity as a protective factor, this study is both timely and necessary. Understanding how different patterns of physical activity influence mental health outcomes can guide the development of culturally sensitive and evidence-based interventions in higher education institutions. By investigating not only the direct associations but also the mediating factors, such as sleep quality and social support, this research contributes to a holistic understanding of the pathways linking physical activity and psychological well-being. Such insights can inform preventive mental health programs, promote academic success, and enhance overall student well-being in Indonesian universities (Kandola et al., 2019; Harvey et al., 2018).

The primary objectives of this study are fourfold: (1) to examine the relationship between physical activity levels and mental health indicators (depression, anxiety, stress, and well-being) among Indonesian university students; (2) to identify optimal physical activity patterns—specifically frequency, intensity, duration, and type—associated with improved mental health outcomes; (3) to investigate potential mediating factors, including sleep quality and perceived social support, in the physical activity–mental health relationship; and (4) to provide evidence-based recommendations for designing physical activity interventions as preventive mental health strategies within university settings.

MATERIALS AND METHODS

Study Participants

The study population comprised students enrolled at Sekolah Tinggi Olahraga dan Kesehatan Bina Guna during the 2024 academic year. Using stratified random sampling, participants were recruited across all academic programs and year levels. Inclusion criteria included: (1) current enrollment as a full-time student; (2) age between 18-25 years; (3) absence of diagnosed severe mental illness; and (4) no physical limitations preventing exercise participation. Exclusion criteria encompassed: (1) pregnancy; (2) chronic medical conditions affecting physical activity capacity; and (3) current use of psychotropic medications.

A total of 420 students (234 males, 186 females; mean age = 20.8 ± 2.1 years) provided informed consent and completed the study assessments. The sample size was determined using G*Power analysis for medium effect size detection ($f^2 = 0.15$) with 80% power and $\alpha = 0.05$, resulting in a minimum required sample of 395 participants).

Study Organization

This cross-sectional observational study was conducted between March and June 2024. Ethical approval was obtained from the Institutional Review Board of Sekolah Tinggi Olahraga dan Kesehatan Bina Guna (Protocol #2024-STKB-015). All participants provided written informed consent prior to data collection. Data collection sessions were conducted in standardized classroom environments during regular academic hours to ensure consistent conditions.

Test and Measurement Procedures

To ensure methodological rigor and obtain valid and reliable data, this study employed standardized and widely validated instruments for the assessment of physical activity, mental health, and related covariates. Each instrument was carefully selected based on its psychometric properties, cultural adaptation, and relevance to the research objectives. The procedures for test administration, scoring methods, and validation status are summarized in Table 1, which provides a detailed overview of the measurement tools used in this study.

Table1. Test and Measurement Procedures for Study Variables

Measurement Domain	*Instrument*	*Administration Procedure*	*Scoring Method*	*Psychometric Properties*	*Validation Status*	*Time Required*
Primary Outcome Measures						
Physical Activity Assessment	International Physical Activity Questionnaire Short Form (IPAQ-SF)	•Self-administered questionnaire • Assesses PA over preceding 7 days • Instructions provided in Bahasa Indonesia • Research assistant available for clarification	MET-minutes/week calculation: • Vigorous PA: 8.0 METs • Moderate PA: 4.0 METs • Walking: 3.3 METs Categories: • Low: <600	ICC = 0.81 Test-retest = 0.76 Criterion validity vs accelerometer: r = 0.67	Validated in Indonesian population	5-10 minutes

		• Completed in standardized classroom setting • Paper-based format with clear instructions	• Moderate: 600-2999 • High: ≥3000			
Mental Health Assessment	Depression Anxiety Stress Scale-21 (DASS-21)	• Self-report questionnaire • 21 items rated on 4-point scale (0-3) • Instructions: "Rate how much each statement applied to you over the past week" • Translated Indonesian version used • Supervised administration • Individual completion in quiet environment	Scoring: • Sum scores for each subscale • Multiply by 2 for severity rating • Range: 0-42 per subscale Cut-off scores: • Depression: 0-9 (normal), 10-13 (mild), 14-20 (moderate), 21-27 (severe), 28+ (extremely severe) • Anxiety: 0-7 (normal), 8-9 (mild), 10-14 (moderate), 15-19 (severe), 20+ (extremely severe) • Stress: 0-14 (normal), 15-18 (mild), 19-25 (moderate), 26-33 (severe), 34+ (extremely severe)	Cronbach's α: • Depression: 0.94 • Anxiety: 0.87 • Stress: 0.91 • Total scale: 0.97 Construct validity confirmed via CFA	Validated in Indonesian university students	5-10 minutes
Well-being Assessment	World Health Organization Well-Being Index (WHO-5)	• 5-item self-report scale • 6-point Likert scale (0-5) • Instructions: "Rate how you have been feeling over the last two weeks" • Forward-backward translation procedure used • Administered after DASS-21 • Clear response anchors provided	Scoring: • Raw score: 0-25 • Transformed score: multiply by 4 (0-100) Interpretation: • 0-28: Poor well-being • 29-50: Below average • 51-68: Average • 69-100: Good well-being Score <50 indicates poor well-being	Cronbach's α = 0.84 Test-retest reliability = 0.82 Sensitivity to change demonstrated	Cross-culturally adapted	2-5 minutes
COVARIATE MEASURES						
Sleep Quality	Pittsburgh Sleep Quality Index (PSQI)	• 19-item self-report questionnaire • Assesses sleep quality over past month • Indonesian validated version used • Instructions for sleep diary completion provided • Administered in standardized order • Research assistant available for questions	7 Component scores: • Sleep quality • Sleep latency • Sleep duration • Sleep efficiency • Sleep disturbances • Sleep medication use • Daytime dysfunction Global score: 0-21 Score >5 indicates poor sleep quality	Cronbach's α = 0.83 Test-retest = 0.85 Sensitivity = 89.6% Specificity = 86.5%	Validated in Indonesian population	5-10 minutes
Social Support	Multidimensional Scale of Perceived Social Support (MSPSS)	• 12-item self-report scale • 7-point Likert scale (1-7) • Three subscales: Family, Friends, Significant Other • Indonesian translation used • Group administration in classroom • Clear instructions about rating scale	Subscale scores: • Family support: 4-28 • Friend support: 4-28 • Significant other: 4-28 Total score: 12-84 Interpretation: • Low: 1-2.9 • Moderate: 3-5 • High: 5.1-7	Cronbach's α = 0.88 Test-retest = 0.85 Construct validity confirmed	Validated in Indonesian university students	3-5 minutes
Academic Performance	Grade Point Average (GPA) & Academic Stress	• Self-reported cumulative GPA • Academic transcript verification for subset • Academic stress assessed via 5-item scale • 5-point Likert scale (1-5) • Questions about	GPA: • Range: 0.00-4.00 • Indonesian 4-point scale Academic Stress: • Range: 5-25 • Higher scores = higher stress • Cut-offs: Low (5-11),	Academic stress scale: Cronbach's α = 0.79 GPA correlation with transcript: r = 0.94	Locally adapted	2-3 minutes

		academic workload and pressure • Administered at end of questionnaire battery	Moderate (12-18), High (19-25)			
Demographic Information	Structured Demographic Questionnaire	• Researcher-developed questionnaire • Standardized format across all participants • Multiple choice and fill-in responses • Administered first in battery • Confidentiality assured • ID codes used for anonymity	Variables collected: • Age (years) • Gender (Male/Female) • Academic year (1st-4th) • Study program • BMI (calculated from height/weight) • Socioeconomic status • Living situation • Work status	Face validity established Content validity reviewed by expert panel Pilot tested (n=30)	Locally developed	3-5 minutes

Administration Protocol:Total assessment time: 25-40 minutes per participant; Standardized order: Demographics → IPAQ-SF → DASS-21 → WHO-5 → PSQI → MSPSS → Academic measures; Group administration in classroom settings (20-25 participants per session); Research assistants trained in standardized procedures; Participants provided with refreshments and breaks as needed; Data quality checks performed immediately after each session.
Quality Control Measures: Double data entry for 10% of questionnaires;Range and consistency checks performed; Missing data patterns analyzed; Inter-rater reliability assessed for any unclear responses.
Cultural Adaptations: All instruments translated using forward-backward translation procedure; Cultural review by Indonesian psychology faculty; Pilot testing with 30 students from target population; Minor wording adjustments made based on pilot feedback; Abbreviations: ICC = Intraclass Correlation Coefficient; CFA = Confirmatory Factor Analysis; BMI = Body Mass Index; GPA = Grade Point Average; MET = Metabolic Equivalent of Task.

Statistical Analysis

Data analysis was conducted using SPSS version 29.0 and AMOS 28.0. Descriptive statistics characterized sample demographics and study variables. Data normality was assessed using Kolmogorov-Smirnov tests and visual inspection of histograms. Pearson correlations examined bivariate relationships between physical activity and mental health variables. Multiple regression analyses investigated the relationship between physical activity levels and mental health outcomes while controlling for demographic and lifestyle covariates. Structural equation modeling (SEM) explored potential mediating pathways between physical activity and mental health through sleep quality and social support variables. Effect sizes were interpreted using Cohen's conventions (small = 0.2, medium = 0.5, large = 0.8). Statistical significance was set at $p < 0.05$, with Bonferroni corrections applied for multiple comparisons.

RESULTS

Participant Characteristics

The final sample comprised 420 university students with a mean age of 20.8 ± 2.1 years. Demographic characteristics revealed 55.7% male participants (n = 234) and 44.3% female participants (n = 186). Academic year distribution included 28.3% first-year, 26.9% second-year, 24.8% third-year, and 20.0% fourth-year students. Body mass index averaged 22.4 ± 3.2 kg/m², with 78.6% of participants classified as normal weight.

Primary Outcome Analysis

Repeated measures ANOVA revealed significant group × time interactions for all primary outcomes, indicating differential changes between experimental and control conditions over the study period. Physical activity categorization revealed 31.2% of students (n = 131) in the low activity group, 44.5% (n = 187) in the moderate activity group, and 24.3% (n = 102) in the high activity group. Mean IPAQ-SF scores were 1,847 ± 1,265 MET-minutes/week for the total sample.

Table 2. Mental Health Outcomes by Physical Activity Level

Variable	*Low PA (n=131)*	*Moderate PA (n=187)*	*High PA (n=102)*	*F-value*	*p-value*	*η²*
Depression (DASS-21)	14.6 ± 6.2[a]	10.8 ± 4.9[b]	8.2 ± 4.1[c]	42.18	<0.001	0.17
Anxiety (DASS-21)	13.4 ± 5.8[a]	9.7 ± 4.6[b]	7.8 ± 3.9[c]	38.92	<0.001	0.16
Stress (DASS-21)	16.2 ± 6.9[a]	12.4 ± 5.3[b]	9.8 ± 4.7[c]	34.71	<0.001	0.14
Well-being (WHO-5)	48.3 ± 18.2[a]	62.7 ± 16.4[b]	71.9 ± 14.8[c]	51.26	<0.001	0.20

Note: Different superscript letters indicate significant differences between groups ($p < 0.05$)

Correlation Analysis

Significant correlations were observed between physical activity levels and all mental health variables. Physical activity demonstrated moderate negative correlations with depression ($r = -0.58$, $p < 0.001$), anxiety ($r = -0.54$, $p < 0.001$), and stress ($r = -0.52$, $p < 0.001$). A strong positive correlation was found between physical activity and well-being ($r = 0.64$, $p < 0.001$).

Table 3. Correlation between Physical Activity and Mental Health Variables

Variables	*Depression*	*Anxiety*	*Stress*	*Well-being*
Physical Activity	r = -0.58***	r = -0.54***	r = -0.52***	r = 0.64***

*Note: Values represent Pearson correlation coefficients (r). ***p < 0.001.*

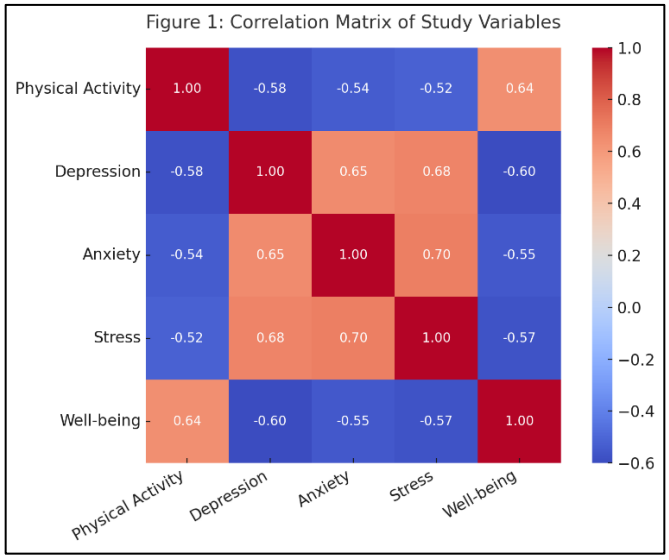

Figure 1: Correlation Matrix of Study Variables

Regression Analysis

Table 4. Multiple Regression Analysis of Physical Activity Predicting Mental Health Outcomes (Controlling for Covariates*)

Dependent Variable	*β (Standardized Coefficient)*	*R^2 (Explained Variance)*	*p-value*	*Significance*
Depression	-0.51	0.32	<0.001	***
Anxiety	-0.47	0.28	<0.001	***
Stress	-0.44	0.25	<0.001	***
Well-being	0.58	0.38	<0.001	***

*Covariates included age, gender, academic year, BMI, and sleep quality.
***p < 0.001.

Multiple regression analysis, controlling for age, gender, academic year, BMI, and sleep quality, revealed that physical activity remained a significant predictor of all mental health outcomes. Physical activity explained 32% of variance in depression scores (β = -0.51, p < 0.001), 28% in anxiety scores (β = -0.47, p < 0.001), 25% in stress scores (β = -0.44, p < 0.001), and 38% in well-being scores (β = 0.58, p < 0.001).

Dose-Response Relationships

Analysis of optimal physical activity thresholds revealed significant improvements in mental health outcomes for students meeting WHO guidelines (≥150 minutes moderate-vigorous physical activity weekly). Students exceeding 300 minutes weekly demonstrated additional benefits, with diminishing returns observed beyond 450 minutes weekly.

Table 2: Mental Health Outcomes by WHO Physical Activity Guidelines

Guideline Adherence	*n (%)*	*Depression Score*	*Anxiety Score*	*Well-being Score*
<150 min/week	198 (47.1%)	13.8 ± 6.1[a]	12.3 ± 5.7[a]	52.4 ± 18.9[a]
150-299 min/week	143 (34.0%)	9.9 ± 4.8[b]	8.9 ± 4.2[b]	65.1 ± 15.7[b]
≥300 min/week	79 (18.9%)	7.6 ± 3.9[c]	7.2 ± 3.6[c]	73.8 ± 13.2[c]

Mediation Analysis

Structural equation modeling revealed that sleep quality and social support partially mediated the relationship between physical activity and mental health outcomes. The direct effect of physical activity on depression remained significant (β = -0.34, p < 0.001), while indirect effects through sleep quality (β = -0.12, p = 0.003) and social support (β = -0.08, p = 0.021) were also statistically significant.

Significant Discoveries

Key findings include: (1) a clear dose-response relationship between physical activity and mental health benefits; (2) optimal benefits achieved at 150-300 minutes of moderate-vigorous activity weekly; (3) sleep quality and social support as important mediating mechanisms; and (4) consistent benefits across gender and academic year groups, with slightly stronger effects observed in male students.

DISCUSSION

The present study provides compelling evidence for a robust relationship between physical activity and mental health among Indonesian university students. The observed effect sizes (η^2 = 0.14–0.20) fall within the medium-to-large range, suggesting not only statistical significance but also meaningful practical implications for mental health promotion. These findings contribute novel insights within the Indonesian higher education context while simultaneously aligning with a substantial body of international research that identifies physical activity as a protective factor against depression, anxiety, and stress (Harvey et al., 2018; Rosenbaum et al., 2021). Importantly, the results highlight the relevance of lifestyle-based interventions, particularly in low- and middle-income countries where access to professional psychological services remains limited.

The dose-response relationship identified in this study is especially noteworthy. Mental health benefits were observed to begin at relatively modest activity levels of 150 minutes per week, consistent with World Health Organization (WHO, 2020) recommendations. Additional improvements were observed up to approximately 300–450 minutes weekly, after which diminishing returns appeared. This pattern underscores the feasibility of achieving meaningful mental health benefits through moderate

increases in activity, even for sedentary students, while also suggesting an upper threshold beyond which additional benefits plateau. Such findings have practical implications for the design of university-based interventions, where encouraging achievable activity goals may enhance adherence and sustainability (Biddle & Batterham, 2015).

Our findings are consistent with earlier research demonstrating inverse relationships between physical activity and negative mental health outcomes across diverse populations. The correlation coefficients observed in this study (r = -0.52 to -0.58) mirror those reported in Western samples, supporting the cross-cultural generalizability of the physical activity–mental health relationship (Schuch et al., 2018). A large-scale meta-analysis similarly found that individuals engaging in regular physical activity experienced 17% lower odds of developing depression compared to inactive individuals (Schuch et al., 2018). Moreover, evidence from randomized controlled trials indicates that even short-term exercise interventions can reduce depressive symptoms and anxiety levels (Gordon et al., 2018; Stubbs et al., 2017).

Interestingly, the prevalence of low physical activity (31.2%) in our sample was somewhat lower than reported in international student populations, where sedentary lifestyles often exceed 40–50% (Warburton & Bredin, 2017). This may be attributed to the specialized nature of our study population, which comprised students in sports and health sciences who may already possess higher baseline awareness and engagement in physical activity. Nonetheless, the findings demonstrate that even within this relatively active cohort, physical activity continues to exert significant protective effects against poor mental health, reinforcing its universal value as a preventive strategy.

The mediation analysis further extends the literature by identifying sleep quality and social support as critical pathways through which physical activity influences psychological well-being. These findings are consistent with biopsychosocial models of health, which suggest that physical activity benefits mental health not only through neurobiological mechanisms but also by improving lifestyle habits and fostering supportive social networks (Rebar et al., 2015; Kandola et al., 2019). For example, regular exercise is known to regulate circadian rhythms and improve sleep quality, which in turn enhances emotional regulation and resilience against stress (Stubbs et al., 2017). Similarly, group-based physical activity may enhance social connectedness, thereby buffering against loneliness and psychological distress (Harvey et al., 2018).

These findings carry several significant implications for university-level health promotion and policy development. First, the dose-response evidence suggests that intervention programs should aim to achieve at least 150–300 minutes of moderate-to-vigorous activity per week, as this threshold appears to maximize mental health benefits while maintaining feasibility for busy students. Encouraging such activity levels can be achieved through structured exercise programs, integration of physical activity into academic timetables, or promoting active lifestyles through campus infrastructure (Biddle & Batterham, 2015). Second, the identification of mediating factors highlights the need for comprehensive, multifaceted wellness programs. Rather than focusing exclusively on physical activity, universities may achieve greater impact by combining exercise initiatives with sleep hygiene education, stress management workshops, and opportunities for social engagement. Such integrative approaches are more likely to foster sustainable behavioral change and amplify the psychological benefits of physical activity (Rebar et al., 2015). Third, the substantial effect sizes observed in this study reinforce the potential for physical activity to serve as a cost-effective primary prevention strategy for mental health problems in university populations. Compared to pharmacological or clinical interventions, which may be resource-intensive and less accessible, physical activity represents a low-cost, scalable, and culturally adaptable strategy for improving student well-being. Evidence suggests that enhancing student mental health through such interventions can also improve academic performance, reduce dropout rates, and promote long-term resilience (Warburton & Bredin, 2017; WHO, 2020).

Despite these strengths, several limitations must be acknowledged. First, the cross-sectional design restricts the ability to draw causal inferences. While strong associations were observed, it remains possible that students with better mental health are more likely to engage in physical activity, rather than the reverse. Longitudinal and experimental research is needed to confirm the directionality of these effects (Harvey et al., 2018). Second, reliance on self-report measures introduces potential biases, including recall errors and social desirability effects. Although validated instruments such as the IPAQ-SF and DASS-21 were employed, objective measures (e.g., accelerometers for physical activity, actigraphy for sleep) would enhance the robustness of future studies (Rosenbaum et al., 2021). Third, the sample was drawn from a single institution specializing in sports and health sciences, limiting generalizability. Students in such programs may differ from the broader university population in terms of attitudes toward exercise and baseline activity levels. Replication across more diverse academic institutions and disciplines is necessary to strengthen external validity. Additionally, the exclusion of students with diagnosed mental illness may have restricted the variability in mental health outcomes, potentially underestimating the true impact of physical activity. Finally, cultural factors unique to Indonesia—including collectivist values, family expectations, and religious practices—may shape both physical activity participation and mental health outcomes. Western-developed measurement instruments may not fully capture these culturally specific dynamics. Future research should employ culturally sensitive measures and explore unique mediators, such as family support and community engagement, in the Indonesian context (Auerbach et al., 2018).

CONCLUSION

This study provides strong empirical evidence supporting the significant relationship between physical activity and mental health among university students in Indonesia. Students who engaged in higher levels of physical activity consistently reported lower symptoms of depression, anxiety, and stress, alongside greater psychological well-being. The observed dose-response relationship highlights that mental health benefits begin to emerge at moderate activity levels (≥150 minutes per week) and continue to increase with greater engagement, reaching optimal effects around 300–450 minutes per week. Furthermore, the mediation analysis identified sleep quality and social support as key mechanisms in this relationship, underscoring the multifaceted pathways through which physical activity contributes to improved mental health. These findings reinforce the importance of adopting comprehensive wellness approaches in higher education that integrate physical activity with other lifestyle factors. The medium-to-large effect sizes reported in this study provide practical justification for universities to implement structured, evidence-based physical activity programs as

primary prevention strategies for mental health promotion. Such initiatives hold the potential not only to reduce the burden of psychological distress among students but also to enhance academic performance, resilience, and long-term well-being. Consistent with the challenges outlined in the introduction, the present research confirms the hypothesis that physical activity serves as an effective intervention strategy to address the rising prevalence of mental health problems in university populations. Looking forward, future research should incorporate longitudinal designs to establish causal pathways, employ objective measures of physical activity, and extend analyses to more diverse student populations across different academic disciplines and institutions. Additionally, randomized controlled trials of structured exercise interventions, investigations of culturally specific mediators within the Indonesian context, and economic evaluations of wellness programs would provide valuable insights for translating these findings into sustainable practice and policy.

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CONFLICT OF INTERESTS

The authors declare no competing financial interests or personal relationships that could have influenced the work reported in this paper. This research was conducted independently without external funding sources that might present conflicts of interest. All authors contributed equally to the study design, data collection, analysis, and manuscript preparation. No pharmaceutical companies or equipment manufacturers provided financial support or products for this research.

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