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The Effect of Regular Physical Activity on Academic Achievement

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Abstract
This study investigates the relationship between regular physical activity and academic achievement among Physical Education, Health and Recreation (PJKR) students at the Faculty of Sports and Health Sciences (FIKK), Universitas Negeri Makassar (UNM). The research employs a quantitative correlational design with 120 students as participants, selected through purposive sampling technique. Data on physical activity levels were collected using the International Physical Activity Questionnaire (IPAQ), while academic achievement was measured through Grade Point Average (GPA) from the academic information system. The findings reveal a significant positive correlation ($r = 0.687$, $p < 0.01$) between regular physical activity and academic achievement. Students who engaged in moderate to vigorous physical activity for at least 150 minutes per week demonstrated higher GPAs compared to those with sedentary lifestyles. Multiple regression analysis indicates that physical activity contributes 47.2% to the variance in academic achievement, after controlling for other factors such as sleep quality, nutritional status, and study habits. These results suggest that maintaining regular physical activity patterns can serve as an effective strategy to enhance academic performance among PJKR students, supporting the integration of structured physical activity programs within the curriculum.

Keywords: physical activity, academic achievement, PJKR students, exercise, GPA

INTRODUCTION

The relationship between physical activity and academic performance has become an increasingly important topic in higher education research, particularly as universities seek comprehensive approaches to student success and well-being (Álvarez-Bueno et al., 2020). Physical activity, defined as any bodily movement produced by skeletal muscles that requires energy expenditure, encompasses a wide range of activities including sports, exercise, recreational activities, and daily functional movements (Singh et al., 2023). In the context of higher education, understanding how regular physical activity influences academic outcomes is crucial for developing holistic educational strategies that address both physical and cognitive development of students.

The theoretical foundation for examining the relationship between physical activity and academic achievement draws from multiple disciplines, including exercise physiology, cognitive neuroscience, and educational psychology. Neurobiological research has demonstrated that physical activity stimulates the production of brain-derived neurotrophic factor (BDNF), which plays a critical role in neuroplasticity, neurogenesis, and cognitive function enhancement (Mandolesi et al., 2018). Furthermore, regular exercise has been shown to improve cerebral blood flow, increase hippocampal volume, and enhance executive functions such as working memory, cognitive flexibility, and inhibitory control, all of which are essential for academic success (Hillman et al., 2008). These physiological mechanisms provide a biological basis for understanding how physical activity may translate into improved academic performance.

In Indonesia, the concern regarding student physical activity levels has grown significantly, particularly in light of increasing sedentary behaviors associated with technological advancement and urbanization (Rachman & Sutisyana, 2020). Studies have indicated that Indonesian university students, despite having access to sports facilities and programs, often fail to meet the World Health Organization's recommended guidelines of 150-300 minutes of moderate-intensity aerobic physical activity per week (WHO, 2020). This trend is particularly concerning for students in physical education programs, who are expected to model active lifestyles and eventually promote physical activity as future educators and health professionals (Nugraha et al., 2021).

The context of Physical Education, Health and Recreation (PJKR) students at FIKK UNM presents a unique and particularly relevant setting for investigating the physical activity-academic achievement relationship. These students are enrolled in a program specifically designed to develop their knowledge, skills, and competencies in sports science, physical education pedagogy, and health promotion (Kadir et al., 2022). Given the nature of their academic program, PJKR students are expected to maintain high levels of physical activity both as part of their coursework and as a professional disposition. However, the academic demands of university study, including theoretical coursework, assignments, examinations, and practical teaching requirements, may create competing time pressures that affect their ability to maintain regular physical activity patterns (Syahruddin et al., 2023).

Previous research has produced mixed findings regarding the relationship between physical activity and academic performance in various educational contexts. Some studies have reported strong positive correlations, suggesting that students who engage in regular physical activity achieve higher grades and demonstrate better cognitive performance (Marques et al., 2020). Other research has found weak or non-significant relationships, particularly when controlling for confounding variables such as socioeconomic status, prior academic achievement, and psychological factors (Owen et al., 2016). These inconsistencies highlight the complexity of the relationship and the need for context-specific research that considers the unique characteristics of different student populations.

The importance of conducting this research within the Indonesian context, specifically at UNM, is underscored by several factors. First, there is limited empirical evidence regarding the physical activity patterns and academic outcomes of Indonesian PJKR students, despite the growing recognition of physical activity's importance in higher education (Pratama & Argantos, 2021). Second, understanding this relationship can inform curriculum development and student support services, enabling the university to create evidence-based interventions that optimize both physical and academic outcomes. Third, given that PJKR students will become future physical education teachers and sports professionals, their own experiences with physical activity and academic success may influence their future professional practices and ability to promote active lifestyles among their students (Maksum, 2020).

The theoretical framework guiding this study integrates several models and perspectives. The cognitive enhancement hypothesis suggests that physical activity improves academic performance through direct effects on brain structure and function, including increased neurogenesis, enhanced synaptic plasticity, and improved neurotransmitter regulation (Donnelly et al., 2016). The stress reduction model proposes that physical activity serves as a buffer against academic stress, reducing cortisol levels and improving mood states, which in turn facilitates better concentration and learning (Hogan et al., 2020). Additionally, the self-regulation perspective suggests that the discipline and goal-setting behaviors developed through regular physical activity may transfer to academic contexts, enhancing study habits and time management skills (Budde et al., 2008).

Several potential mediating and moderating factors must be considered when examining the physical activity-academic achievement relationship. Sleep quality represents one important mediating variable, as physical activity can improve sleep patterns, which subsequently affects cognitive function and academic performance (Xiang et al., 2022). Nutritional status may also mediate this relationship, as students who engage in regular physical activity often demonstrate greater awareness of nutritional needs and healthier eating patterns (Sari & Hidayat, 2021). Furthermore, psychological factors such as

self-efficacy, motivation, and stress management may serve as both mediators and moderators, influencing how physical activity translates into academic outcomes (Lubans et al., 2016).

The present study aims to address several research gaps in the existing literature. While international research has examined physical activity and academic achievement in various student populations, limited attention has been given to specialized programs such as physical education students in Indonesian universities. Additionally, most previous studies have focused on children and adolescents, with less research examining university students who face distinct developmental and contextual challenges (Putri & Wijayanti, 2023). By focusing specifically on PJKR students at FIKK UNM, this research contributes to understanding how physical activity influences academic achievement in a population where such activity is integral to both personal development and professional preparation.

METHODS

This research employed a quantitative correlational research design to investigate the relationship between regular physical activity and academic achievement among PJKR students at FIKK UNM. The correlational approach was selected as appropriate for examining the strength and direction of the relationship between these two variables without manipulating either variable experimentally (Creswell & Creswell, 2018). The study was conducted during the academic year 2023/2024, with data collection taking place over a period of three months from August to October 2023. The research location was FIKK UNM, situated in Makassar, South Sulawesi, Indonesia, which houses the PJKR study program and provides comprehensive sports facilities including indoor and outdoor training areas, fitness centers, and specialized sports laboratories (Saleh & Anwar, 2022).

The population of this study consisted of all active PJKR students enrolled at FIKK UNM during the 2023/2024 academic year, totaling approximately 450 students across all academic years from first to fourth year. From this population, a sample of 120 students was selected using purposive sampling technique based on specific inclusion criteria. The inclusion criteria required participants to be actively enrolled full-time students, have completed at least two semesters of study to ensure sufficient academic performance data, have no serious medical conditions that would restrict physical activity participation, and provide voluntary informed consent to participate in the research. The sample size was determined using the Slovin formula with a margin of error of 5%, which indicated that a minimum of 110 participants would be adequate, and an additional 10 participants were included to account for potential data attrition or incomplete responses (Sugiyono, 2019).

The independent variable in this study was regular physical activity, operationally defined as structured or unstructured bodily movement performed consistently over time, measured in terms of frequency, intensity, duration, and type of activities. Physical activity levels were assessed using the Indonesian version of the International Physical Activity Questionnaire-Long Form (IPAQ-LF), which has been validated for use in Indonesian populations and demonstrates good reliability with Cronbach's alpha coefficient of 0.89 (Adiputra et al., 2020). The IPAQ-LF collects detailed information about physical activity participation across multiple domains including work-related activities, transportation, household chores, recreational activities, and sports participation. Participants reported their physical activity over the previous seven days, and responses were scored according to the IPAQ protocol to categorize students into low, moderate, or high physical activity levels based on metabolic equivalent task (MET) minutes per week.

The dependent variable was academic achievement, operationally defined as the cumulative academic performance of students measured through their Grade Point Average (GPA). GPA data were obtained from the official academic information system of UNM with proper authorization and ethical clearance, ensuring data confidentiality and privacy protection. The GPA represents the weighted average of grades earned across all completed courses, calculated on a 4.00 scale according to the Indonesian higher education grading system, where scores are distributed as follows: A equals 4.00, A minus equals 3.70, B plus equals 3.30, B equals 3.00, B minus equals 2.70, C plus equals 2.30, C equals 2.00, D equals 1.00, and E equals 0.00 (Direktorat Jenderal Pendidikan Tinggi, 2020).

Several control variables were included in the analysis to account for potential confounding factors that might influence the relationship between physical activity and academic achievement. These variables included demographic characteristics such as gender and academic year level, sleep quality measured using the Pittsburgh Sleep Quality Index (PSQI) adapted for Indonesian populations, nutritional status assessed through Body Mass Index (BMI) calculations and a brief dietary assessment questionnaire, and study habits evaluated using a standardized study skills inventory. The inclusion of these control variables allowed for more precise estimation of the unique contribution of physical activity to academic achievement while accounting for other factors known to influence academic performance (Fajar et al., 2021).

Data collection procedures followed a systematic protocol to ensure consistency and reliability. Initial contact with potential participants was made through course coordinators and class representatives, who provided information about the research and invited voluntary participation. Students who expressed interest in participating attended an information session where the research purpose, procedures, confidentiality measures, and their rights as research participants were explained in detail. Written informed consent was obtained from all participants before any data collection commenced. Participants then completed the IPAQ-LF questionnaire and supplementary questionnaires regarding control variables during designated sessions in classroom settings, with researchers available to answer questions and ensure proper completion. Questionnaire administration typically required thirty to forty-five minutes per participant, and completed questionnaires were immediately checked for completeness before participants departed (Hidayat & Mustafa, 2020).

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 26.0 software. Descriptive statistics including means, standard deviations, frequencies, and percentages were calculated to characterize the sample and summarize the distribution of variables. Before conducting inferential analyses, data were screened for accuracy, missing values, and outliers, and assumptions of statistical tests including normality, linearity, and homoscedasticity were examined. Normality was assessed using the Kolmogorov-Smirnov test and visual inspection of histograms and Q-Q plots, while linearity was evaluated through scatterplots and residual plots (Santoso, 2021). The primary analysis employed Pearson product-moment correlation to examine the bivariate relationship between physical activity levels and GPA, with correlation coefficients interpreted according to conventional guidelines where values between 0.00 and 0.30 indicate weak correlation, 0.30 to 0.70 indicate moderate correlation, and above 0.70 indicate strong correlation. Multiple linear regression analysis was subsequently conducted to examine the contribution of physical activity to academic achievement while controlling for other variables, with the model including physical activity as the predictor variable of interest and control variables as covariates. Statistical significance was determined using an alpha level of 0.05 for all inferential tests, and effect sizes were reported alongside p-values to provide comprehensive information about the practical significance of findings (Ghozali, 2018).

Ethical considerations were carefully addressed throughout the research process. Ethical approval was obtained from the Research Ethics Committee of FIKK UNM prior to data collection, ensuring that the research protocol met institutional standards for human subjects research. Participants were informed that their participation was voluntary and that they could withdraw from the study at any time without penalty or negative consequences. Confidentiality was maintained by assigning unique identification codes to participants and storing data in password-protected electronic files accessible only to the research team. Personal identifying information was kept separate from research data and will be destroyed after the completion of the study. Furthermore, academic performance data obtained from university records were handled with strict confidentiality protocols and used only for research purposes as specified in the ethical approval and informed consent documents (Kementerian Riset dan Teknologi, 2020).

RESULT AND DISCUSSION

The descriptive analysis of participant characteristics revealed that the sample consisted of 120 PJKR students with a gender distribution of 78 males (65%) and 42 females (35%), which reflects the typical gender composition in physical education programs in Indonesia where male students traditionally outnumber female students (Rahman & Hasyim, 2022). The distribution across academic years showed 32 students (26.7%) from first year, 35 students (29.2%) from second year, 31 students (25.8%) from third year, and 22 students (18.3%) from fourth year. The mean age of participants was 20.4 years with a standard deviation of 1.6 years, ranging from 18 to 24 years, which is consistent with the typical age range for undergraduate students in Indonesian universities (Statistik, 2021).

Analysis of physical activity levels using IPAQ-LF scores revealed considerable variation among participants. The classification based on MET-minutes per week indicated that 23 students (19.2%) fell into the low physical activity category with less than 600 MET-minutes per week, 51 students (42.5%) were classified as having moderate physical activity levels with 600 to 3000 MET-minutes per week, and 46 students (38.3%) demonstrated high physical activity levels exceeding 3000 MET-minutes per week. The mean physical activity level was 2847.5 MET-minutes per week with a standard deviation of 1523.8, suggesting substantial individual differences in activity patterns. Interestingly, approximately one-fifth of students engaged in low levels of physical activity despite being enrolled in a physical education program, which raises concerns about the gap between expected and actual activity behaviors among these students who are preparing to become physical education professionals (Kusuma & Wardani, 2023).

The academic achievement data showed that the sample's mean GPA was 3.24 with a standard deviation of 0.42, ranging from 2.35 to 3.95 on the 4.00 scale. The distribution of GPA categories revealed that 8 students (6.7%) had GPAs below 2.75, which is considered satisfactory level, 52 students (43.3%) had GPAs between 2.75 and 3.25 representing good performance, 45 students (37.5%) achieved GPAs between 3.26 and 3.75 indicating very good performance, and 15 students (12.5%) attained GPAs above 3.75 representing outstanding achievement. This distribution suggests that the majority of PJKR students at FIKK UNM maintain good to very good academic standing, which may partly reflect the selective admission process for the program and the motivational characteristics of students who choose to pursue physical education as their field of study (Purnomo & Setiawan, 2022).

The control variables demonstrated interesting patterns that warranted consideration in subsequent analyses. Sleep quality assessment using the PSQI revealed a mean global score of 6.8 with a standard deviation of 2.4, with 47 students (39.2%) reporting poor sleep quality indicated by PSQI scores above 5, suggesting that a substantial proportion of students experience sleep difficulties that could affect both physical activity participation and academic performance. The nutritional status assessment showed a mean BMI of 22.7 kg/m² with most students (71.7%) falling within the normal weight category, though 18.3% were classified as overweight or obese and 10.0% as underweight, indicating some nutritional concerns that might interact with physical activity patterns and academic outcomes (Safitri & Ramadhan, 2021). Study habits inventory scores ranged from 42 to 87 out of a possible 100, with a mean of 68.5 and standard deviation of 12.3, suggesting moderate to good study skills across the sample with room for improvement in many students.

The primary research question concerning the relationship between physical activity and academic achievement was addressed through correlation analysis. The Pearson product-moment correlation revealed a statistically significant positive correlation between physical activity levels and GPA, with a correlation coefficient of r equals 0.687 and p-value less than 0.01, indicating a moderate to strong relationship. This correlation coefficient suggests that approximately 47.2% of the variance in academic achievement can be explained by physical activity levels, though this should be interpreted cautiously as correlation does not imply causation and other factors may contribute to both variables (Wibowo et al., 2023). When examining the relationship separately by physical activity category, students in the high physical activity group demonstrated significantly higher mean GPA of 3.48 compared to the moderate activity group mean GPA of 3.21 and the low activity group mean GPA of 2.89, with analysis of variance (ANOVA) confirming statistically significant differences between groups with F equals 28.64 and p-value less than 0.001.

Further analysis through multiple linear regression was conducted to examine the unique contribution of physical activity to academic achievement while controlling for potential confounding variables. The regression model included physical activity as the primary predictor variable along with control variables including gender, academic year, sleep quality, BMI, and study habits. The overall model was statistically significant with F equals 42.35 and p-value less than 0.001, and explained 68.4% of the variance in GPA indicated by an adjusted R-squared value of 0.684. Within this model, physical activity remained a significant predictor of academic achievement with a standardized beta coefficient of 0.512 and p-value less than 0.001, indicating that for every one standard deviation increase in physical activity level, GPA increased by approximately 0.512 standard deviations when holding other variables constant. This finding provides robust evidence that physical activity makes a substantial unique contribution to academic achievement beyond the effects of other important factors (Andriani & Susanto, 2022).

Among the control variables in the regression model, study habits emerged as the strongest predictor with a standardized beta of 0.398 and p-value less than 0.001, confirming the well-established relationship between effective study strategies and academic success. Sleep quality also showed a significant positive association with GPA with beta equals 0.187 and p-value equals 0.015, consistent with research demonstrating that adequate sleep supports cognitive processes essential for learning and memory consolidation (Hartanto & Budiman, 2023). Interestingly, gender, academic year, and BMI did not show statistically significant relationships with GPA in this model when other variables were controlled, with p-values of 0.234, 0.478, and 0.651 respectively, suggesting that these demographic and anthropometric characteristics may be less directly related to academic achievement in this particular population compared to behavioral factors like physical activity, study habits, and sleep.

Supplementary analyses explored potential non-linear relationships and interaction effects to provide a more nuanced understanding of how physical activity influences academic achievement. Scatterplots with fitted regression lines suggested that the relationship between physical activity and GPA was primarily linear across the observed range of values, with no strong evidence of curvilinear patterns that would indicate diminishing returns or threshold effects. However, when examining potential moderating effects, an interesting interaction emerged between physical activity and study habits, where the positive relationship between physical activity and GPA was stronger among students with better study habits compared to those with poorer study skills, though this interaction approached but did not reach conventional statistical significance with p-value equals 0.067, suggesting this finding should be interpreted cautiously and warrants further investigation in future research (Nugroho & Prasetyo, 2021).

The discussion of these findings must be situated within both theoretical frameworks and practical implications for PJKR students and the broader higher education context. The strong positive correlation between physical activity and academic achievement found in this study aligns with the cognitive enhancement hypothesis, which posits that regular physical activity improves brain function through multiple neurobiological mechanisms including increased cerebral blood flow, enhanced neuroplasticity, elevated production of brain-derived neurotrophic factor, and improved neurotransmitter regulation (Mandolesi et al., 2018). These neurophysiological changes translate into enhanced cognitive functions particularly relevant for academic success, including improved attention, working memory, executive function, processing speed, and information integration (Singh et al., 2023). For PJKR students specifically, who engage in both structured sports training and academic coursework, the cognitive benefits of physical activity may be especially pronounced as they regularly experience the acute cognitive enhancement effects following exercise sessions.

The finding that physical activity accounts for approximately 47% of the variance in academic achievement represents a substantial effect that has important practical implications. This effect size is larger than many reported in previous studies with general student populations, which typically find correlations in the range of 0.20 to 0.45 (Marques et al., 2020). Several factors may explain why the relationship appears particularly strong in this sample of PJKR students. First, these students possess greater knowledge about exercise science and its benefits, which may enhance their motivation to

maintain regular physical activity and their awareness of how such activity affects their cognitive functioning. Second, the physical education curriculum at FIKK UNM includes substantial practical components requiring regular physical activity participation, creating a supportive environment and built-in opportunities for activity that may not exist for students in other academic programs (Syahruddin et al., 2023). Third, students who choose to pursue physical education as their field of study may possess certain dispositional characteristics such as higher physical self-efficacy, greater intrinsic motivation for movement, and better stress management skills that facilitate both regular physical activity and academic success.

The concern that approximately 19% of PJKR students demonstrated low physical activity levels despite being enrolled in a physical education program deserves careful consideration. This finding suggests that academic pressures, personal circumstances, or other barriers may prevent some students from maintaining the active lifestyles expected in their chosen profession. Qualitative research exploring the barriers and facilitators of physical activity among PJKR students would provide valuable insights for developing targeted interventions (Pratama & Argantos, 2021). Universities might consider implementing structured physical activity programs, providing flexible scheduling for sports participation, creating peer support systems for active living, and explicitly integrating physical activity tracking and reflection into the curriculum to help all students, especially those at risk of inactivity, maintain regular physical activity patterns throughout their studies.

The significant relationships between sleep quality, study habits, and academic achievement observed in this study highlight the interconnected nature of health behaviors and academic outcomes. Previous research has demonstrated that physical activity, sleep, nutrition, and study behaviors form an integrated system where changes in one component often affect others (Lubans et al., 2016). For example, regular physical activity can improve sleep quality through multiple mechanisms including increased sleep pressure, reduced sleep latency, enhanced slow-wave sleep, and better circadian rhythm regulation, and improved sleep subsequently supports cognitive functions essential for learning (Xiang et al., 2022). Similarly, the discipline and goal-setting skills developed through maintaining regular physical activity routines may transfer to academic contexts, enhancing time management, persistence, and strategic approach to studying (Budde et al., 2008). These interconnections suggest that interventions aimed at improving academic achievement should adopt holistic approaches addressing multiple health behaviors rather than focusing narrowly on single factors.

From a theoretical perspective, the findings of this study support an integrative model combining cognitive enhancement, stress reduction, and self-regulation mechanisms to explain how physical activity influences academic achievement. The cognitive enhancement pathway operates through direct neurobiological effects improving brain structure and function as previously discussed. The stress reduction pathway suggests that physical activity serves as an effective coping strategy for managing academic stress, with regular exercise reducing cortisol and inflammatory markers, increasing endorphin and serotonin levels, and providing psychological benefits such as improved mood, reduced anxiety, and enhanced self-esteem (Hogan et al., 2020). For university students who frequently experience high academic pressure, deadlines, examinations, and performance expectations, these stress-buffering effects of physical activity may be particularly important for maintaining cognitive function and academic performance. The self-regulation pathway proposes that the behavioral patterns developed through regular physical activity training, such as goal setting, planning, self-monitoring, and persistence in the face of challenges, represent transferable skills that enhance academic behaviors and outcomes (Donnelly et al., 2016).

The practical implications of these findings for PJKR program management and student support services are substantial. First, the results provide empirical justification for maintaining and potentially expanding the practical physical activity components within the PJKR curriculum, as these activities appear to support rather than detract from academic achievement despite competing for students' time and energy (Maksum, 2020). Second, the findings suggest that promoting regular physical activity should be viewed as an academic support strategy rather than merely a recreational or health promotion activity, which might encourage greater institutional investment in sports facilities, programs, and initiatives specifically designed to enhance student physical activity participation. Third, the identification of students with low physical activity levels as an at-risk group suggests the

need for early screening and targeted interventions, perhaps including physical activity counseling, personalized exercise prescriptions, or structured activity programs designed to help less active students increase their participation in ways that fit their schedules, preferences, and capabilities (Adiputra et al., 2020).

The contextual factors unique to Indonesian higher education and specifically to UNM must be considered when interpreting these findings. Indonesian universities increasingly recognize the importance of student wellbeing and holistic development alongside academic achievement, reflected in various campus health and sports promotion initiatives (Rachman & Sutisyana, 2020). However, challenges remain including limited sports facilities at some institutions, competing academic demands, cultural factors that may discourage physical activity participation particularly among female students, and insufficient integration of physical activity promotion into student support services. For FIKK UNM specifically, the institution possesses considerable advantages including extensive sports facilities, faculty expertise in exercise science and physical education, and a programmatic focus that naturally emphasizes physical activity, yet the finding that a substantial minority of students remain insufficiently active suggests that simply providing resources and expertise may be insufficient without systematic efforts to engage all students and address individual barriers to participation (Kadir et al., 2022).

Several limitations of this study must be acknowledged when interpreting the findings and considering their generalizability. First, the cross-sectional correlational design precludes causal inferences, as the directionality of the relationship between physical activity and academic achievement cannot be definitively established from these data. While the theoretical framework and previous experimental research suggest that physical activity influences academic achievement, alternative explanations such as reverse causation where higher achieving students have better time management allowing for more physical activity, or third variable explanations where unmeasured factors such as motivation or socioeconomic status influence both variables, cannot be ruled out (Nugroho & Prasetyo, 2021). Second, the reliance on self-report measures for physical activity assessment introduces potential measurement error due to recall bias, social desirability responding, or difficulties estimating activity intensity and duration, though the use of the validated IPAQ instrument partially mitigates this concern. Third, the sample was drawn from a single institution and specific academic program, which may limit generalizability to other universities, other academic disciplines, or different student populations, particularly those in programs without an inherent emphasis on physical activity. Fourth, while several important control variables were included, other potentially relevant factors such as socioeconomic status, family support, psychological characteristics, and previous academic achievement were not measured, leaving open the possibility of omitted variable bias in the regression analyses.

Despite these limitations, this study makes several important contributions to the literature on physical activity and academic achievement in higher education. The research provides empirical evidence specifically from Indonesian PJKR students, a population that has received limited attention in previous research despite being particularly relevant given their dual roles as students and future physical activity professionals. The findings demonstrate a robust relationship between physical activity and academic achievement that persists even after controlling for other important variables, strengthening confidence in the practical significance of this relationship (Andriani & Susanto, 2022). The study employs validated measurement instruments and appropriate statistical analyses, providing methodologically rigorous evidence to inform both theory and practice. Furthermore, by identifying physical activity as a modifiable factor associated with academic achievement, this research points toward practical interventions that could benefit student success while simultaneously promoting health and wellbeing.

Future research should address the limitations of this study and extend the findings in several directions. Longitudinal research designs tracking students across multiple semesters or years would allow examination of temporal patterns and provide stronger evidence regarding causality by determining whether changes in physical activity precede changes in academic achievement (Wibowo et al., 2023). Experimental or quasi-experimental studies implementing structured physical activity

interventions and examining effects on academic outcomes would provide more definitive causal evidence while also evaluating the effectiveness of specific intervention approaches. Mixed methods research incorporating qualitative components such as interviews or focus groups could provide deeper understanding of students' experiences with physical activity and academics, the mechanisms linking these domains, and the barriers and facilitators affecting physical activity participation among PJKR students. Comparative studies examining these relationships across different academic disciplines, different types of institutions, or different countries would help establish the generalizability of findings and identify contextual factors that moderate the physical activity-academic achievement relationship. Finally, research examining additional mediating and moderating variables such as motivation, stress management, social support, and time management would provide more comprehensive theoretical models of how physical activity influences academic outcomes and would identify subgroups who might benefit most from physical activity interventions (Kusuma & Wardani, 2023).

CONCLUSSION

This study investigated the relationship between regular physical activity and academic achievement among PJKR students at FIKK UNM, revealing a significant positive correlation that persists even when controlling for other relevant factors. The findings demonstrate that students who engage in higher levels of physical activity tend to achieve higher academic performance as measured by GPA, with physical activity accounting for a substantial proportion of variance in academic achievement. These results support theoretical frameworks suggesting that physical activity enhances cognitive function through neurobiological mechanisms, reduces academic stress, and promotes self-regulation skills that transfer to academic contexts. For PJKR students specifically, maintaining regular physical activity appears to be not only consistent with their professional preparation but also supportive of their academic success. The study identifies approximately one-fifth of students as having low physical activity levels despite being enrolled in a physical education program, highlighting the need for targeted interventions to support these at-risk students and ensure that all PJKR students maintain the active lifestyles central to their chosen profession and beneficial for their academic achievement.

Based on these findings, several recommendations are proposed for different stakeholders. For PJKR students, the results suggest that prioritizing regular physical activity throughout their university studies is likely to support rather than compromise their academic goals, and students should strive to maintain at least moderate intensity physical activity for 150 minutes per week as recommended by the World Health Organization while also developing effective study habits and ensuring adequate sleep to maximize academic performance (WHO, 2020). For faculty and program administrators at FIKK UNM, the findings support maintaining substantial practical physical activity components within the curriculum and considering the development of early warning systems to identify students with low physical activity levels who may benefit from additional support or counseling to increase their participation. University student services should consider physical activity promotion as an academic support strategy rather than merely a health initiative, potentially developing programs that help students integrate physical activity into their busy schedules and creating campus environments that facilitate active living through accessible facilities, organized activities, and supportive policies (Saleh & Anwar, 2022).

For policymakers and higher education administrators more broadly, these findings contribute to the evidence base supporting investments in campus sports facilities, physical activity programs, and initiatives promoting active student lifestyles, as such investments may yield returns not only in health outcomes but also in academic success and student retention. Future research should employ longitudinal and experimental designs to strengthen causal inferences, explore the mechanisms linking physical activity to academic achievement through investigation of potential mediators such as cognitive function, stress levels, and sleep quality, examine these relationships in diverse student populations across different academic disciplines and institutional contexts, and develop and evaluate targeted interventions designed to increase physical activity among university students while measuring effects on both health and academic outcomes. By continuing to build the evidence base

regarding physical activity and academic achievement, researchers can contribute to developing comprehensive approaches to student success that recognize the fundamental interconnections between physical health, mental wellbeing, and academic performance in higher education contexts.

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