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Association of body mass index, physical activity, and quality of life among sport science students: A cross-sectional study

Gustiana Mega Anggita[1abcde,*], Neni Widiasmoro[2ad], Mohammad Arif Ali[1abc], Panita Khampoosa[3ad], & Dewi Marfu'ah Kurniawati[4abd]

Universitas Negeri Semarang, Indonesia[1]
Universiti Pendidikan Sultan Indris, Malaysia[2]
Srinakharinwirot University, Thailand[3]
Universitas Diponegoro, Indonesia[4]

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ABSTRACT

Background: Although physical activity is generally associated with better health and well-being, limited evidence has examined the relative associations of body mass index (BMI) and physical activity with quality of life among sport science students. **Objectives:** This study examined the relationships between BMI, physical activity, and quality of life and assessed sex differences among sport science students. **Methods:** A cross-sectional study involved 93 sport science students aged 18–25 years. BMI was measured directly, physical activity was assessed using the GPAQ, and quality of life was measured using the WHOQOL-BREF. Associations were examined using multiple linear regression after testing regression assumptions. **Results:** Most participants had normal BMI (68.89%) and high physical activity levels (47.31%). The mean quality of life score was 97.41 ± 11.87. Quality of life differed significantly across physical activity levels ($p = 0.024$), but not across BMI categories ($p = 0.914$) or by sex ($p = 0.473$). Physical activity was positively associated with quality of life ($\beta = 0.278$, $p = 0.007$), whereas BMI was not ($\beta = -0.045$, $p = 0.657$). The regression model explained 8.1% of the variance in quality of life ($R^2 = 0.081$, $p = 0.022$). **Conclusion:** Physical activity showed a stronger association with quality of life than BMI among sport science students, highlighting the importance of maintaining adequate physical activity to support student well-being.

Keywords: BMI; physical activity; quality of life; sex differences; sport science students

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Gustiana Mega Anggita, Department of Sport Science, Faculty of Sport Science, Universitas Negeri Semarang, Semarang, Indonesia
mega.anggita@mail.unnes.ac.id

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INTRODUCTION

Overweight and obesity have become major global public health concerns due to their increasing prevalence and adverse effects on physical, psychological, and social well-being (Martínez-Vizcaíno et al., 2024; Ward et al., 2024). According to the WHO international classification, overweight is defined as a BMI of ≥ 25 kg/m² and obesity as a BMI of ≥ 30 kg/m². In the present study, these standard WHO BMI classifications were used to categorise participants as underweight (< 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25.0-29.9 kg/m²), and obese (≥ 30.0 kg/m²) (WHO, 2025). Higher body mass index (BMI) has consistently been associated with poorer quality of life and increased risk of chronic disease (Blüher, 2019; Chooi et al., 2019; da Costa et al., 2023; Kolotkin & Andersen, 2017).

Physical activity is a key factor that can moderate the relationship between BMI and quality of life. Individuals with higher levels of physical activity tend to have a better quality of life, even within certain BMI categories (Kortt et al., 2026; Ma et al., 2025; Russo et al., 2021). Physical activity is consistently associated with a better quality of life across physical, psychological, and social domains. Individuals with higher levels of physical activity tend to report better mental health, physical functioning, and overall well-being, even within certain BMI categories (Chen et al., 2023; Mageit et al., 2025; Shi et al., 2023; Warburton & Bredin, 2019). Furthermore, low-to-moderate physical activity has been shown to significantly improve psychological health and overall quality of life among college students (Lalović et al., 2025).

However, the relationship between BMI, physical activity, and quality of life is complex and not always linear. A previous study showed that BMI can act as a mediator in the relationship between physical activity and quality of life, while sex acts as a moderating variable (Hoseini et al., 2022). This suggests that the relationship among BMI, physical activity, and quality of life cannot be understood simply by noting that each variable influences the others. Furthermore, several studies have shown that lifestyle factors, such as smartphone use, sedentary behavior, and physical activity habits, contribute to students' quality of life (Shi et al., 2023).

Sport science students are often considered to be in better physical condition than non-sport science students due to their higher levels of physical activity. However, this does not always guarantee an optimal quality of life. Several studies have shown that students remain at risk of lifestyle imbalances, such as inconsistent physical activity, dietary changes, and variations in body mass index, which can impact their quality of life (Jaramillo Metrio et al., 2023). Furthermore, college is also synonymous with various changes, from academic demands and social adjustments to changes in daily routines. These situations can impact students' overall health and well-being (Vidal Bustamante et al., 2022; Lederer et al., 2025; Long, 2025; Olson et al., 2025). These unique characteristics suggest that the determinants of quality of life among sport science students may differ from those observed in the general population.

Although the association between physical activity and quality of life among university students has been relatively well documented, the existing evidence has primarily focused on general student populations rather than students enrolled in sport-related academic programmes. A systematic review and meta-analysis including 30 studies and 19,731 university students demonstrated a consistent body of evidence on the relationship between physical activity and quality of life in university populations (Abrantes et al., 2022). More recent systematic reviews have also continued to examine physical activity, mental health, and quality of life among higher-education students, indicating that the broader student population is no longer an understudied group (Donnelly et al., 2024).

However, it remains unclear whether these findings can be directly extended to sport science students. Unlike general university students, sport science students are typically exposed to regular physical activity and exercise as part of both their academic and extracurricular activities. Their higher habitual physical activity, physical fitness, and potentially greater skeletal muscle mass may produce a different relationship between anthropometric status and quality of life. In particular, BMI may have limited discriminatory value in this population because it does not distinguish between fat mass and lean body mass (Sweatt et al., 2024; Wu et al., 2024). Thus, a BMI value that may indicate increased weight in the general population may reflect substantially different body composition and functional status in physically active sport science students.

Furthermore, although both BMI and physical activity have been associated with quality of life, it remains unclear which of these factors has a stronger independent association with quality of life when considered simultaneously in a physically active student population. Previous research has largely examined physical activity and quality of life, or BMI and quality of life, separately, while evidence comparing their relative contributions within the same analytical model among sport science students remains limited (Keramat et al., 2022; Le & Delevry, 2021; Mejaddam et al., 2022). This distinction is important because identifying whether behavioural activity or anthropometric status is more closely associated with quality of life may help determine whether health promotion strategies for sport science students should prioritise maintaining physical activity, managing body weight, or addressing both factors.

Therefore, this study aims to examine the independent associations of BMI and physical activity with quality of life among sport science students and to assess sex differences in quality of life. By examining these factors simultaneously in the physically active population, this study contributes evidence on the relative relevance of behavioural and anthropometric indicators of quality of life in sport science students, a population that may differ from the general university population in terms of physical activity patterns and body mass index.

METHODS

Study Design

This study used a quantitative, cross-sectional study to examine the relationships among body mass index (BMI), physical activity, and quality of life among sports students, while also examining sex differences.

Participants and Sampling

The study participants were 93 active students of the Sports Study Programme of Semarang State University, graduating in the 2023-2025 intake, aged 18-25. An a priori sample size calculation was performed using G*power version 3.1 for a linear multiple regression (fixed model, R^2 deviation from zero). Assuming a medium effect size ($f^2 = 0.15$), an alpha level of 0.05, a statistical power of 0.80, and two predictors (BMI and physical activity), the required minimum sample size was 68 participants. The final sample of 93 participants, therefore, exceeded the minimum required sample size. Respondents were selected using purposive sampling because the study targeted sport science students who met predefined eligibility criteria, including active enrollment, willingness to participate, and completion of all study measures. Meanwhile, students with a history of chronic illness that could affect physical activity or who had experienced an injury in the last three months were excluded from the study. This approach was considered appropriate to ensure that the sample reflected the characteristics of the target population relevant to the study objectives.

Measurements and Instruments

Variable measurements were conducted using widely used, internationally validated instruments. BMI was obtained by direct measurement of height and weight using a Serenity height-measuring instrument and a digital scale HWD-01, a combined device designed to measure both height and body weight (Ayala San Pedro et al., 2025). Body height was recorded in centimeters (cm) with participants standing upright without footwear, and body weight in kilograms (kg) with participants wearing light clothing and without footwear. Measurements were performed once for each participant. BMI was calculated as body weight in kilograms divided by the square of height in meters (kg/m^2) and then classified according to the WHO international classification into underweight, normal, overweight, and obese (WHO, 2025). Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ), developed by the WHO. The GPAQ assesses physical activity across different domains, including work-related, transport-related, and recreational activity, as well as sedentary behavior. Because these domains represent distinct aspects of physical activity rather than items measuring a single underlying construct, internal consistency is not considered the primary indicator of the instrument's measurement quality. Therefore, established evidence of the GPAQ's validity and test-retest reliability was used to support its application in the present study. GPAQ data were converted into MET-minute/week and classified into low, moderate, and high physical activity categories according to GPAQ

scoring protocol (Hamidi et al., 2024; Keating et al., 2019; Lubis et al., 2023; Rahman et al., 2025; Rudolf et al., 2020). In the present sample, Cronbach's alpha was 0.622, however, this value was not used as primary evidence of GPAQ reliability because the questionnaire assesses distinct physical activity domains. Instead, established evidence of criterion validity and test-retest reliability was considered more appropriate for assessing the GPAQ's measurement quality. Quality of life was assessed using the Indonesian version of the WHOQOL-BREF, a 26-item instrument covering four domains: physical health, psychological health, social relationships, and environment. The instrument also includes two general items assessing overall quality of life and general health. In the present study, the WHOQOL-BREF items were scored according to the established scoring procedures, including reverse scoring of negatively phrased items (items 3, 4, and 26). A composite quality of life score was then calculated for each participant by summing the scores of all 26 items. Thus, the resulting score represented a raw composite score rather than a standardised 0-100 domain score. Higher composite scores indicated better perceived quality of life. The composite score was selected as the primary outcome because the objective of this study was to examine the overall association of BMI and physical activity with quality of life, rather than domain-specific associations. In the Indonesian population, the WHOQOL-BREF has good internal consistency and reliability, with a Cronbach's alpha value of 0.90 and an ICC of 0.70-0.79 (Çiçek, 2018; Kotarska et al., 2021).

Data Collection

Data collection was conducted directly at Universitas Negeri Semarang. First, the researcher explained the purpose, benefits, and stages of the study to all respondents. Students who agreed to participate were asked to sign an informed consent form to indicate their voluntary participation. Next, anthropometric measurements of height and weight were taken, and respondents completed a physical activity and quality of life questionnaire under the researcher's guidance and supervision to minimise errors and ensure completeness.

Statistical Analysis

The collected data were analysed using IBM SPSS Statistics version 26. Descriptive statistics were first performed to summarise participants' characteristics. Data normality was assessed using the Shapiro-Wilk test. Differences in quality of life across BMI categories and physical activity levels were examined using one-way ANOVA, whereas differences according to sex were analysed using the independent-samples t-test. The assumption of homogeneity of variance for the ANOVA was assessed using Levene's test. When the omnibus ANOVA was statistically significant, Tukey's honestly significant difference (HSD) test was performed for post-hoc pairwise comparison. The relationship between continuous variables was assessed using Pearson's correlation analysis. Multiple linear regression analysis was subsequently performed to examine the independent associations of BMI and physical activity with quality of life. Regression assumptions, including linearity, normality of residuals, homoscedasticity, and multicollinearity, were assessed before interpreting the regression model. Statistical significance was set at $p < 0.05$.

Ethical Considerations

This research has obtained ethical approval from the Research Ethics Committee of Universitas Negeri Semarang under number 277/KEPK/FK/KLE/2026. Throughout the research process, respondent data confidentiality was maintained, and all participation was voluntary.

RESULTS AND DISCUSSION

Results

A total of 93 sports science students participated in this study, with an average age of 19.01 ± 1.12 years. Most participants were male (77.42%), while 22.58% were female. Based on BMI categories, the majority of participants were in the normal weight category (69.89%), followed by underweight (15.05%), overweight (12.90%), and obesity (2.15%). Regarding physical activity, 47.31% of participants had high levels, 40.86% had moderate levels, and 11.83% had low levels. The mean composite score quality of life score was 97.41 ± 11.87 (**Table 1**).

Table 1. Characteristics of the Study Participants

Variable	n (%)/ Mean ± SD
Total Sample	93
Age (year)	19.01 ± 1.12
Sex	
Male	72 (77.42%)
Female	21 (22.58%)
BMI Categories	
Underweight	14 (15.05%)
Normal	65 (69.89%)
Overweight	12 (12.90%)
Obese	2 (2.15%)
Physical Activity (GPAQ)	
Low	11 (11.83%)
Moderate	38 (40.86%)
High	44 (47.31%)
Quality of Life (QoL), composite score	97.41 ± 11.87

Note. QoL was calculated as a composite raw score based on the 26 WHOQOL-BREF items after applying the required reverse scoring. Higher scores indicate a better perceived quality of life

Bivariate analysis showed no significant differences in quality of life scores across BMI categories (F(3.89) = 0.173, p = 0.914). Although the mean QoL score was lowest among students in the obese category (92.50 ± 3.54), this group comprised only two participants and should therefore be interpreted with caution. The assumption of homogeneity of variance was satisfied for BMI categories (Levene's test, F(3.89) = 2.279, p = 0.085).

In contrast, quality of life scores differed significantly across physical activity levels (F(2.90) = 3.870, p = 0.024). Students with high physical activity had the highest mean QoL score (100.61 ± 11.46), followed by those with moderate (95.53 ± 11.66) and low physical activity (91.09 ± 11.19). Tukey's HSD post-hoc analysis showed that QoL was significantly higher in the high physical activity group than in the low physical activity group (mean difference = 9.523, p = 0.042). No significant differences were observed between the low and moderate physical activity groups (p = 0.501) or between the moderate and high physical activity groups (p = 0.119). Quality of life scores also did not differ significantly between male and female students (97.89 ± 12.16 vs. 95.76 ± 10.90; t(91) = 0.721, p = 0.473). The assumption of equal variances wa met based on Levene's test (F = 0.357, p = 0.552) (**Table 2**).

Table 2. Quality of Life According to BMI Categories, Physical Activity Level, and Sex

Variable	QoL composite score (Mean ± SD)	Test statistics	p-value
BMI Categories		F(3.89) = 0.173	
Underweight	97.07 ± 13.24		
Normal	97.83 ± 12.52		
Overweight	96.33 ± 7.11		
Obese	92.50 ± 3.54		0.914
Physical Activity (GPAQ)		F(2.90) = 3.870	
Low	91.09 ± 11.19		
Moderate	95.53 ± 11.66		
High	100.61 ± 11.46		0.024
Sex		t(91) = 0.721	
Male	97.89 ± 12.16		
Female	95.76 ± 10.90		0.473

Note. Values are presented as mean ± SD. P-values were obtained using one-way ANOVA for BMI categories and physical activity level, and the independent sample t-test for sex. Homogeneity of variance was assessed using Levene's test. Tukey's HSD test was used for post-hoc comparisons following the significant ANOVA for physical activity.

The multiple linear regression model was statistically significant, F(2.90) = 3.965, p = 0.022, and explained 8.1% of the variance in the composite quality of life score (R^2 = 0.081; adjusted R^2 = 0.061). Physical activity was positively associated with quality of life (β = 0.278, p = 0.007), whereas BMI was not significantly

associated with quality of life (β = -0.045, p = 0.657). These findings indicate that physical activity showed a stronger independent association with the composite quality of life score than BMI in the present sample.

Table 3. Association of BMI, and Physical Activity with Quality of Life

Variable	B	SE	β	t	p-value	VIF
(Constant)	89.976	6.988	–	12.875	< 0.001	-
BMI	-0.883	1.981	-0.045	-0.446	0.657	1.000
Physical Activity (PA)	4.811	1.757	0.278	2.738	0.007	1.000

Model statistics: R = 0.258; R^2 = 0.081; Adjusted R^2 = 0.061; F(2.90) = 3.965; p = 0.022.
PA = Physical Activity; BMI = Body Mass Index; B = unstandardized regression coefficient; SE = standard error; β = standardized regression coefficient; t = partial test value; Sig. = significance value (p-value); VIF = Variance Inflation Factor.

Sex-stratified regression analyses were conducted to explore whether the associations of BMI and physical activity with quality of life differed descriptively between male and female students. Among male students, physical activity was significantly associated with quality of life (β = 0.299, p = 0.011), whereas BMI was not (β = -0.038, p = 0.739). Among female students, neither physical activity (β = 0.188, p = 0.425) nor BMI (β = -0.073, p = 0.757) was significantly associated with quality of life. These sex-stratified findings should be interpreted with caution because the female subgroup comprised only 21 participants, and no formal interaction analysis was performed.

Table 4. Association of BMI and Physical Activity with Quality of Life by Sex

Variable	B	SE	β	t	p-value	VIF
Male						
(Constant)	87.119	6.773	-	12.863	< 0.001	-
BMI	-0.774	2.310	-0.038	-0.335	0.739	1.000
PA	5.196	1.992	0.299	2.608	0.011	1.000
Female						
(Constant)	90.971	12.213	-	7.448	< 0.001	
BMI	-1.250	3.978	-0.073	-0.314	0.757	1.000
PA	3.190	3.909	0.188	0.816	0.425	1.000

Discussion

In interpreting these findings, it is important to note that quality of life was represented by a composite score derived from all 26 WHOQOL-BREF items. The WHOQOL-BREF is structured into four domains: physical health, psychological health, social relationships, and environment, together with two general items. In the present study, a composite score was used to provide a single summary measure of perceived quality of life consistent with the primary objective of examining the overall associations of BMI and physical activity with quality of life. Therefore, the present findings should be interpreted as associations with overall composite quality of life rather than with any specific WHOQOL-BREF domain.

This study examined the associations of BMI and physical activity with quality of life among sport science students. The main finding was that physical activity was positively associated with quality of life, whereas BMI was not significantly associated with quality of life. The regression model explained 8.1% of the variance in quality of life. Although the sex-stratified analyses showed a significant association between physical activity and quality of life among male participants, but not female participants, these findings should be interpreted with caution because the analyses were sex-stratified and did not formally test whether the association differed between sexes. Overall, the findings indicate that physical activity was more consistently associated with quality of life than BMI in this population.

The positive associations between physical activity and quality of life observed in this study are consistent with previous evidence showing that physically active individuals generally experience better physical, psychological, and social functioning than less active individuals (Akksilp et al., 2023; García-Hermoso et al., 2022). Regular physical activity has also been associated with lower risk of depression and anxiety, improved emotional regulation, and greater life satisfaction, all of which may contribute to a better quality of life (Priyono & Kim, 2024). Likewise, epidemiological studies have demonstrated that moderate-to-vigorous

physical activity is positively associated with health-related quality of life across populations (Chen et al., 2023; García-Hermoso et al., 2022). Even relatively small but sustained increases in physical activity have been associated with improvements in physical and psychological well-being (Kandola et al., 2019). These findings provide a potential explanation for the positive association between physical activity and quality of life observed among the sport science students in the present study.

A plausible explanation for the stronger association observed with physical activity is that it reflects functional capacity and physiological adaptation rather than body size alone. Regular exercise is associated with adaptations in the cardiovascular, musculoskeletal, and metabolic systems, including improvements in cardiorespiratory fitness, skeletal muscle function, mitochondrial function, insulin sensitivity, and inflammatory regulation. These adaptations can support physical functioning, metabolic health, and psychological well-being, which are important components of quality of life (Bull et al., 2020; Gallo-Villegas & Calderón, 2023; Pinto et al., 2023). Thus, physical activity may capture aspects of functional health that are not represented by BMI alone.

In contrast, BMI is simple anthropometric index that reflects body size but does not distinguish fat mass from lean body mass.This limitation is particularly relevant among sport science students, who may engage in regular exercise and have relatively greater skeletal muscle mass than less physically active populations. Consequently, individuals with similar BMI values may have substantially different body composition and functional characteristics. For example, a student classified as overweight according to BMI may have a relatively high proportion of lean mass rather than excess adiposity. Therefore, BMI may be less sensitive for characterizing differences in health and quality of life within physically active student populations (Sweatt et al., 2024; Wu et al., 2024).

The absence of a significant association between BMI and quality of life in the present study may also be related to the characteristics of the study population. Most participants had normal BMI and moderate to high levels of physical activity, while only a small proportion were classified as obese. This relatively homogeneous distribution may have limited the variability in BMI and reduced the ability to detect an association with quality of life. Previous studies have similarly suggested that the relationship between BMI and quality of life may be influenced by physical activity, health status, and other lifestyle-related factors (Keramat et al., 2022; Le & Delevry, 2021; Mejaddam et al., 2022). Therefore, the absence of a significant association in the present study should not be interpreted as evidence that BMI is unrelated to quality of life, but rather as a finding that BMI was not a significant correlate of quality of life within this particular population.

This study found no significant difference in quality of life scores between male and female students, and sex was not included as a predictor in the primary regression model. The sex-stratified analyses showed that physical activity was significantly associated with quality of life among male participants but not among female participants. However, these findings should be interpreted with caution because the difference in regression coefficients between males and females was not formally tested with an interaction term. Therefore, the present findings do not establish that the association between physical activity and quality of life is stronger in males. Instead, they suggest that the association observed in the overall sample may warrant further investigation by sex. Future studies with larger, more balanced samples should use formal interaction analyses to determine whether sex moderates the association between physical activity and quality of life.

This study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design precludes causal inferences regarding the relationship among BMI, physical activity, and quality of life. Second, physical activity and quality of life were assessed using self-report instruments, which may be subject to recall and social desirability bias. Third, quality of life was analysed using a composite score derived from all 26 WHOQOL-BREF items rather than separate standardised scores for the four WHOQOL-BREF domains (physical health, psychological health, social relationships, and environment). Although the composite score was selected to provide a single overall measure consistent with the primary objective of this study, this approach may have obscured domain-specific associations between BMI, physical activity, and quality of life. Future studies should consider examining the four domains separately to determine whether the observed associations differ across dimensions of quality of life. Fourth, body composition was not directly measured. Because BMI cannot distinguish fat mass from lean body mass, it may not accurately reflect

adiposity in physically active individuals with greater skeletal muscle mass. Finally, the study included only sport science students from a single university, most of whom had normal BMI and moderate to high levels of physical activity. Consequently, the findings should be interpreted with caution and may not be generalisable to broader university student populations or the general population. Nevertheless, this study provides an initial insight into the relationships among BMI, physical activity, and composite quality of life among sport science students. Future research should involve larger and more diverse samples, longitudinal designs, objective measures of physical activity and body composition, and separate analyses of the four WHOQOL-BREF domains to provide a more comprehensive understanding of these relationships.

CONCLUSION

Among sport science students, higher levels of physical activity were positively associated with better composite quality of life, whereas BMI was not significantly associated with quality of life. Physical activity showed a stronger independent association with quality of life than BMI in the present sample, suggesting that functional and behavioral factors may be more relevant to quality of life than body size alone in this physically active student population. Although the associations between physical activity and quality of life appeared stronger among male students, this difference was not formally tested for statistical significance as an interaction effect and should therefore be interpreted with caution. Given the cross-sectional design, these findings should not be interpreted as evidence of a causal relationship. Future studies should involve larger, more diverse populations and incorporate longitudinal designs, objective measures of physical activity, and direct measures of body composition to further clarify these associations.

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CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest in this research, either financial or non-financial, that could influence the results or interpretation of the research reported.

AI DISCLOSURE STATEMENT

The authors used and Grammarly solely for language editing, grammar checking, and improving the clarity of the manuscript. These tools were not used to generate, analyse, interpret, or develop the scientific content, research methods, results, or conclusions of the study.

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