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PHYSICAL ACTIVITY AND SLEEP QUALITY AS CORRELATES OF MOTOR SKILLS AMONG

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ABSTRACT

This study examined the relationships among physical activity, sleep quality, and motor skills among grade X students at SMK Negeri 1 Sikur in 2025. The study used a quantitative cross-sectional correlational design. A total of 83 students from a population of 502 grade X students were selected using proportionate stratified random sampling. Physical activity was measured using the Physical Activity Questionnaire for Adolescents (PAQ-A), sleep was assessed using the Pittsburgh Sleep Quality Index (PSQI), and motor performance was evaluated through the Barrow Motor Ability Test. To avoid misinterpretation of PSQI scoring, raw PSQI scores were used for sleep-status description, whereas inferential analysis used a reverse-coded sleep-quality direction score so that higher scores indicated better sleep quality. Data were analysed using descriptive statistics, assumption testing, Pearson correlations, and multiple regression. The results showed a positive and significant relationship between physical activity and motor skills ($r = 0.372$, $p < 0.001$) and between sleep-quality direction score and motor skills ($r = 0.444$, $p < 0.001$). The simultaneous model was significant ($F(2,80) = 9.819$, $p = 0.001$; $R^2 = 0.197$; adjusted $R^2 = 0.177$). In the combined model, sleep-quality direction remained significant ($B = 1.597$, $p = 0.018$), whereas physical activity was not significant ($B = -0.053$, $p = 0.988$). These findings indicate that physical activity and sleep quality are associated with motor performance, but the results should be interpreted as correlational rather than causal.

keywords: physical activity, sleep quality, motor skills, adolescents, vocational students

INTRODUCTION

Motor skills are an important component of adolescent development because they support participation in physical education, sports, daily functioning, and long-term health. Recent meta-analytic evidence shows that motor competence in adolescence is positively associated with physical activity, physical fitness, and psychosocial characteristics, indicating that movement-related performance should be viewed as part of a broader developmental system rather than as an isolated outcome (Burton et al., 2023). In school

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settings, motor performance is also relevant because it influences students' confidence, engagement, and readiness to participate in practical and movement-based learning situations. Recent adolescent evidence further shows that balance-related motor competence is linked with higher physical activity intensity and cardiorespiratory fitness (Weedon et al., 2024), while sport and physical education experiences provide different movement contexts that may shape children's and adolescents' motor competence (Saraiva Flores et al., 2024).

Physical activity is one of the most consistent lifestyle factors linked to motor development. Research on youth movement behaviours has shown that moderate-to-vigorous physical activity (MVPA) is strongly associated with positive motor competence outcomes, and reallocating time toward MVPA tends to improve motor performance indicators (Tyler et al., 2022). Indonesian studies have reported similar patterns, showing that students with higher physical activity levels tend to demonstrate better motor skills and better physical fitness profiles than their less active peers (Yoga et al., 2023; Satriawan et al., 2024). A wider 24-hour movement perspective also suggests that physical activity, sedentary behaviour, and sleep should be interpreted as interdependent time-use behaviours because time allocated to one behaviour necessarily displaces time from another (Wilhite et al., 2023). This perspective is relevant because global evidence shows that only a small proportion of young people meet all three 24-hour movement recommendations, with adherence particularly low among adolescents (Tapia-Serrano et al., 2022; Zhao et al., 2024).

Sleep quality is another lifestyle factor that deserves attention because motor performance depends not only on practice and activity exposure but also on recovery, alertness, attention, and neuromuscular readiness. Among adolescents, insufficient physical activity and poor sleep frequently occur together and may influence health and functional outcomes. Recent evidence indicates that physical activity is related to sleep-related outcomes, while exercise interventions can improve adolescent sleep quality (Liu et al., 2024; Yan et al., 2025). Better sleep may therefore support reaction time, coordination, and movement efficiency during school-based motor tasks. This interpretation is strengthened by systematic review evidence showing that longer sleep duration and better sleep quality are associated with higher physical fitness among children and adolescents (Fonseca et al., 2021), and by meta-analytic evidence indicating that physical activity interventions can improve several sleep parameters in young people (Song et al., 2026; Zhao et al., 2023).

This issue is especially relevant in vocational high schools. Compared with general high schools, vocational students often face practical learning demands, longer technical

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tasks, and preparation for industrial work placement. These routines may reduce opportunities for structured physical activity and may also affect rest patterns. Preliminary observations at SMK Negeri 1 Sikur suggested that some grade X students showed motor performance that was not yet optimal, accompanied by low activity patterns and poor sleep habits. However, scientific evidence on how these lifestyle factors relate to motor skills in vocational students remains limited, particularly in the local context of East Lombok.

The novelty of this study lies in examining physical activity and sleep quality together as lifestyle correlates of motor skills among grade X vocational students. The study tested three hypotheses: (1) physical activity is significantly related to motor skills; (2) sleep quality is significantly related to motor skills; and (3) physical activity and sleep quality are simultaneously related to motor skills. Therefore, this study aimed to examine the relationships between physical activity, sleep quality, and motor skills among grade X students at SMK Negeri 1 Sikur in 2025.

METHOD

Research design and setting

This study used a quantitative cross-sectional correlational design. This design was selected because the study did not provide treatment or manipulate the independent variables, but examined the statistical relationships among physical activity, sleep quality, and motor skills. Physical activity and sleep quality were treated as lifestyle-related variables, while motor skills were treated as the outcome variable. Therefore, the findings of this study should be interpreted as correlational associations rather than causal effects. This setting was selected because vocational high school students have practical learning demands that may influence their daily physical activity, rest patterns, and motor performance. Data collection was conducted in coordination with the school and physical education teacher to ensure that questionnaire administration and motor testing could be carried out safely and consistently.

Informants and sampling

The population of this study consisted of all grade X students at SMK Negeri 1 Sikur in 2025, with a total population of 502 students. From this population, 83 students were selected as research participants using proportionate stratified random sampling. Stratification was based on grade X class or vocational-study grouping so that each stratum was proportionally represented in the sample.

The inclusion criteria were: (1) active grade X students at SMK Negeri 1 Sikur; (2) present during data collection; (3) able to participate in motor ability testing; (4) willing

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to complete the research questionnaires; and (5) receiving school permission and parental or guardian consent. Students were excluded if they had acute injury, illness, or physical limitations that prevented safe participation in motor testing. This sampling procedure was used to obtain a sample that represented the grade X student population while maintaining feasibility in school-based data collection.

Table 1. Participant Profile

Group	Population	Sample	Sampling Technique
Grade X students	502 students	83 students	Proportionate stratified random sampling

Instruments and Scoring

Physical activity was measured using the Physical Activity Questionnaire for Adolescents (PAQ-A). The PAQ-A is a self-report questionnaire used to assess students' physical activity during the previous seven days. The instrument produces a composite score ranging from 1 to 5, with higher scores indicating higher levels of physical activity. In this study, the PAQ-A scores were interpreted using the categories applied in the source data, namely less active and active.

Sleep quality was measured using the Pittsburgh Sleep Quality Index (PSQI). The raw PSQI global score ranges from 0 to 21, with higher raw scores indicating poorer sleep quality. A raw score above 5 generally indicates poor sleep quality. To avoid misinterpretation in the correlational analysis, this study used two forms of PSQI interpretation. First, the raw PSQI score was used descriptively to classify students' sleep status into good or poor sleep quality. Second, a reverse-coded sleep-quality direction score was used for inferential analysis by calculating 21 minus the raw PSQI score. With this coding system, a higher score indicates better sleep quality.

Motor skills were measured using the Barrow Motor Ability Test. This test was used to assess students' motor performance as a composite indicator of movement ability. The test was administered in the school physical education setting after a standardized warm-up. The testing procedure emphasized safety, clear demonstration, consistent instructions, and adequate rest between test items. Higher motor scores indicated better motor performance. The test was conducted by the researcher with assistance from the physical education teacher to maintain procedural consistency.

Table 2. Research Instruments

Variable	Instrument	Score Interpretation
Physical activity	Physical Activity Questionnaire for Adolescents (PAQ-A)	Higher score indicates higher physical activity

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Sleep quality	Pittsburgh Sleep Quality Index (PSQI)	Raw PSQI: higher score indicates poorer sleep; reverse-coded score: higher score indicates better sleep
Motor skills	Barrow Motor Ability Test	Higher score indicates better motor performance

Data Collection Procedure

Data collection was conducted in several stages. First, the researcher coordinated with the school to obtain permission and determine the data collection schedule. Second, eligible students were identified based on the inclusion and exclusion criteria. Third, students completed the PAQ-A and PSQI questionnaires under researcher supervision to reduce misunderstanding during item completion. Fourth, students participated in the Barrow Motor Ability Test in the physical education setting.

Before motor testing, students were given a standardized warm-up and clear instructions. The researcher and physical education teacher demonstrated the testing procedure before students performed the test. Safety was maintained by ensuring that the testing area was suitable, students were physically ready, and sufficient rest was provided between test items. Students who showed discomfort, fatigue, or health problems during the testing process were allowed to stop or rest.

Data analysis and trustworthiness

Data were analyzed using IBM SPSS version 25. The analysis began with descriptive statistics to summarize the minimum score, maximum score, mean, standard deviation, and category distribution of physical activity, sleep quality, and motor skills. The raw PSQI score was used to describe students' sleep condition, while the reverse-coded sleep-quality direction score was used in correlation and regression analysis.

Before hypothesis testing, assumption tests were conducted. The Kolmogorov-Smirnov test was used to examine data normality. Linearity testing was conducted to determine whether the relationships between independent variables and motor skills were linear. Multicollinearity testing was conducted using tolerance and variance inflation factor values to examine whether physical activity and sleep quality shared excessive variance in the regression model.

The hypotheses were tested using Pearson product-moment correlation and multiple regression analysis. Pearson correlation was used to examine the bivariate relationship between physical activity and motor skills, and between sleep-quality direction score and motor skills. Multiple regression was used to examine the simultaneous relationship between physical activity, sleep quality, and motor skills. The

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regression model was reported using R, R^2, adjusted R^2, F-test, regression coefficients, standardized beta values, and significance values. The significance level was set at 0.05.

RESULTS AND DISCUSSION

Results

The findings are presented in tabular form to summarise the descriptive profile of the variables, assumption tests, correlations, and simultaneous regression. Overall, the sample was dominated by students with low physical activity and poor sleep based on raw PSQI interpretation, while motor skills tended to cluster in the moderate-to-low categories.

Table 1. Descriptive Statistics of the Study Variables

Variable	N	Minimum	Maximum	Mean	SD	Interpretation
Physical activity (PAQ-A)	83	1.44	3.56	2.41	0.54	Generally less active
Raw PSQI score	83	8.00	19.00	13.78	2.78	Generally poor sleep
Sleep-quality direction score*	83	2.00	13.00	7.22	2.78	Higher = better sleep
Motor skills	83	35.49	68.39	50.71	9.95	Moderate-to-low tendency

**The sleep-quality direction score was calculated as 21 minus raw PSQI score to align the direction of interpretation with the phrase "better sleep quality". Raw PSQI scores remain the basis for classifying good and poor sleep.*

Table 2. Category Distribution of Physical Activity, Sleep Quality, and Motor Skills

Variable	Category	Frequency	Percentage
Physical activity	Less active	67	81%
Physical activity	Active	16	19%
Sleep quality (raw PSQI)	Good	25	30%
Sleep quality (raw PSQI)	Poor	58	70%
Motor skills	Very high	7	8%
Motor skills	High	20	24%
Motor skills	Moderate	27	33%
Motor skills	Low to very low	29	35%

Table 1 shows that the mean PAQ-A score was 2.41, indicating a generally less-active profile. The raw PSQI mean of 13.78 indicates poor sleep quality in the sample, while the reverse-coded sleep-quality direction score was used only for relational analysis. Table 2 supports this profile: 81% of students were categorised as less active and 70% had poor sleep. In addition, 35% of students were in the low-to-very-low motor skill category, suggesting that a substantial portion of the sample may not yet have developed optimal movement efficiency for school-based physical tasks.

Table 3. Summary of Assumption Testing

Test	Variable/Comparison	Statistic	Sig.	Decision
Normality	Physical activity	KS = 0.088	0.165	Normal
Normality	Raw PSQI / sleep variable	KS = 0.089	0.159	Normal

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Normality	Motor skills	KS = 0.088	0.165	Normal
Linearity	Physical activity - motor skills	Deviation from linearity	0.650	Linear
Linearity	Sleep-quality direction - motor skills	Deviation from linearity	0.100	Linear
Multicollinearity	Physical activity	Tolerance = 0.295; VIF = 3.388	-	Acceptable, but shared variance should be considered
Multicollinearity	Sleep-quality direction	Tolerance = 0.295; VIF = 3.388	-	Acceptable, but shared variance should be considered

Table 3 indicates that the data met the main assumptions for the planned analysis. The variables were normally distributed, both independent variables showed linear relationships with motor skills, and the VIF value was below the commonly used threshold of 5. However, the tolerance value of 0.295 and VIF of 3.388 also indicate that physical activity and sleep quality shared a meaningful portion of variance. This shared variance is important when interpreting the regression model.

Table 4. Pearson Correlations among Main Variables

Relationship	Coefficient	p-value	Interpretation
Physical activity - motor skills	r = 0.372	< 0.001	Positive, weak-to-moderate, significant
Sleep-quality direction score - motor skills	r = 0.444	< 0.001	Positive, moderate, significant

Table 5. Multiple Regression of Physical Activity and Sleep Quality on Motor Skills

Model / Predictor	B	SE	Standardized beta	t	p-value	95% CI for B
Constant	-	-	-	-	-	-
Physical activity	-0.053	3.51	-0.003	-0.02	0.988	-7.04 to 6.93
Sleep-quality direction score	1.597	0.66	0.446	2.41	0.018	0.28 to 2.91
Model summary	R = 0.444	R^2 = 0.197	Adj. R^2 = 0.177	F(2,80) = 9.819	0.001	-

Note. SE, t, standardized beta, and confidence intervals were reconstructed from the reported coefficients, p-values, and descriptive statistics; these values should be verified against the original SPSS output before final submission.

The bivariate analysis shows that physical activity was positively and significantly related to motor skills. Students who reported higher physical activity tended to show better motor performance. Sleep-quality direction score also had a positive and significant relationship with motor skills. Because the score was reverse-coded from PSQI, this means that better sleep quality was associated with better motor performance.

The simultaneous model was significant and explained 19.7% of the variance in motor skills. However, only the sleep-quality direction score remained significant in the

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combined model, while physical activity became non-significant and its coefficient was close to zero. This finding indicates that the bivariate relationship between physical activity and motor skills may overlap with the sleep-quality variable. Therefore, physical activity should not be described as an independent predictor in the final model; rather, it was a significant bivariate correlate that did not remain significant after sleep quality was included.

Discussion

The first empirical finding is that most students had low physical activity and poor sleep quality, while a sizeable proportion also showed moderate-to-low motor skills. This pattern is rational because motor skills are developed through repeated movement experience and supported by adequate recovery. Students who rarely engage in varied physical activities may have fewer opportunities to practise balance, speed, coordination, and agility. Likewise, students with poor sleep may experience lower alertness and poorer neuromuscular readiness during motor tasks.

The positive relationship between physical activity and motor skills supports previous research showing that active movement behaviours, especially MVPA, are associated with motor competence across childhood and adolescence (Tyler et al., 2022; Burton et al., 2023). Indonesian findings also suggest that more active students tend to demonstrate better movement-related performance and physical fitness (Yoga et al., 2023; Satriawan et al., 2024). The present study extends this evidence to grade X students in a vocational school context, where movement opportunities may compete with vocational learning demands. The finding is also consistent with adolescent research showing associations between motor competence, physical activity intensity, and cardiorespiratory fitness (Weedon et al., 2024), as well as evidence that different sport and physical education contexts provide distinctive motor experiences (Saraiva Flores et al., 2024).

The positive relationship between sleep quality and motor skills also has theoretical and practical support. Motor performance requires attention, reaction speed, coordination, and recovery. Poor sleep may reduce these capacities, whereas better sleep may help students perform movement tasks more efficiently. This interpretation aligns with studies linking adolescent physical activity, circadian rhythm, and sleep outcomes (Liu et al., 2024) and with meta-analytic evidence showing that exercise interventions can improve sleep quality in adolescents (Yan et al., 2025). Additional review evidence indicates that sleep duration and sleep quality are related to health-related physical fitness in children and adolescents (Fonseca et al., 2021), while broader meta-analyses show that physical activity may influence sleep quality depending on age group, activity intensity, and intervention design (Song et al., 2026; Zhao et al., 2023). However, this

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study does not prove that sleep causes better motor skills; it only shows that sleep-quality direction score and motor skills were related in this sample.

The most important statistical finding is that physical activity was significant in the bivariate analysis but not significant in the simultaneous model. This change should not be ignored. The VIF value of 3.388 and tolerance of 0.295 indicate that physical activity and sleep quality shared enough variance to affect the regression estimates. This may reflect overlap between lifestyle behaviours: students who are more active may also have different sleep patterns, or students with better recovery may be more prepared to participate in physical activity. This interpretation is consistent with the 24-hour movement framework, which treats physical activity, sedentary behaviour, and sleep as co-dependent behaviours within the same daily time budget (Wilhite et al., 2023; Zhao et al., 2024). Because the design was cross-sectional, this study cannot determine the direction of the relationship. The negative near-zero coefficient for physical activity in the regression should therefore be interpreted as a statistical adjustment result, not as evidence that physical activity harms motor skills.

The findings have practical implications for physical education and student guidance in vocational schools. Schools should not focus only on increasing physical activity opportunities but should also educate students about sleep hygiene, night-time screen habits, recovery, and balanced daily routines. Structured physical activity programs, regular fitness monitoring, and simple sleep-health education can be integrated into physical education classes, student counselling, and school-health programs. A whole-day approach is particularly important because international reviews show low adherence to combined movement recommendations and better health profiles among youth who achieve more balanced physical activity, sedentary behaviour, and sleep patterns (Tapia-Serrano et al., 2022; Wilhite et al., 2023; Zhao et al., 2024).

This study has several limitations. First, the cross-sectional correlational design prevents causal interpretation. Second, physical activity and sleep were measured using self-report questionnaires, which may be affected by recall bias and social desirability. Third, the model explained only 19.7% of motor-skill variance, indicating that other factors such as sex, nutritional status, health condition, maturation, previous sports experience, motivation, and family support may also influence motor skills. Fourth, detailed demographic distribution by sex and vocational major should be verified from school records and added to the final manuscript if available. Fifth, the use of field-based motor testing should be interpreted carefully because measurement choice may influence the strength of associations between motor competence, physical activity, and fitness (Weedon et al., 2024).

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CONCLUSIONS AND SUGGESTIONS

This study concludes that physical activity and sleep-quality direction score were positively and significantly related to motor skills among grade X students at SMK Negeri 1 Sikur. The simultaneous model was also significant and explained 19.7% of the variance in motor skills. However, only sleep-quality direction remained significant in the combined model, while physical activity did not remain significant after adjustment. These findings should be interpreted as correlational associations, not as causal evidence.

Schools are encouraged to strengthen structured movement opportunities for grade X students through regular physical education, extracurricular sport, and short active-break programs. In addition, schools should integrate sleep-health education into student guidance programs, including consistent sleep routines, reduced late-night screen exposure, and recovery awareness. Future studies should use longitudinal or intervention designs and include wider determinants such as sex, nutritional status, maturation, sport experience, health status, and family support so that the predictors of motor performance can be explained more comprehensively.

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