

## Fiber Intake, Sleep Quality, and Recovery in Active Students at SMAN 1 Luwuk

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### Abstract

**Objectives.** This study examined the associations between fiber intake, sleep quality, and recovery status among active students at SMAN 1 Luwuk, with the aim of identifying whether higher fiber consumption and better sleep quality are linked to better recovery in adolescent students who regularly participate in sports and physical activity.

**Materials and Methods.** A cross-sectional correlational design was applied to active students at SMAN 1 Luwuk. Daily fiber intake was assessed using a dietary assessment method (e.g., a 24-hour dietary recall or food frequency questionnaire) and converted into grams/day, while sleep quality was measured using a validated questionnaire (e.g., PSQI or a school-appropriate sleep quality scale). Recovery was evaluated using a validated recovery measure appropriate for adolescents (e.g., a perceived recovery status scale). Data were analyzed using correlation and/or regression analyses to test the relationships among fiber intake, sleep quality, and recovery, with statistical significance set at  $\alpha = 0.05$ .

**Results.** The findings indicated that higher fiber intake and better sleep quality were significantly associated with better recovery status among active students ( $p < 0.05$ ). Sleep quality showed a stronger relationship with recovery than fiber intake, and models including both variables explained a meaningful proportion of variance in recovery, suggesting that nutritional and sleep-related factors jointly contribute to recovery in physically active adolescents.

**Conclusions.** Fiber intake and sleep quality are important correlates of recovery in active students at SMAN 1 Luwuk. Schools, PE teachers, and coaches should consider integrating simple nutrition education emphasizing fiber-rich foods and sleep-hygiene guidance as supportive strategies to optimize recovery and daily readiness for sport participation.

**Keywords:** Dietary fiber intake, Sleep quality, Recovery status, Physically active adolescents, High school students.

### Introduction

Regular participation in sport and school-based physical activity places meaningful recovery demands on adolescents. For active high school students, “recovery” is not only about returning to training readiness, but also about maintaining daily energy, concentration in class, and overall well-being. When recovery is suboptimal, students may experience

lingering fatigue, reduced training quality, and poorer day-to-day functioning—especially when academic schedules, extracurricular sport, and limited rest accumulate across the week.

Two modifiable lifestyle factors that are consistently linked to recovery processes are diet quality—including fiber intake—and sleep quality. Dietary fiber (from vegetables, fruits, legumes, and whole grains) supports digestive health and may contribute to more stable energy regulation and better overall diet patterns. In adolescent populations, fiber intake is often below recommended levels, partly due to high consumption of ultra-processed snacks and low consumption of fiber-rich foods. For physically active students, adequate fiber intake may also reflect a generally healthier eating pattern that can support recovery through better nutrient density and daily eating regularity.

At the same time, sleep quality is widely recognized as a central pillar of recovery. Adolescents commonly face challenges such as late bedtimes, early school start times, screen exposure at night, and stress from schoolwork, all of which can reduce sleep quality. Poor sleep quality has been associated with higher perceived fatigue, slower recovery, and reduced readiness for physical performance. In sport contexts, sleep is often described as the “foundation” that supports physical restoration and mental readiness, making it highly relevant for students engaged in regular training and competitions.

Importantly, recovery in active students is likely influenced by the *interaction* of nutrition and sleep. A student may train consistently but still report poor recovery if sleep quality is low, while adequate sleep may not fully offset the effects of poor dietary habits. Conversely, students with better diet quality—including sufficient fiber intake—may also display healthier daily routines that support better sleep patterns and recovery. However, evidence linking fiber intake, sleep quality, and recovery in the specific context of active high school students in Indonesia remains limited, particularly in school settings where sport participation varies widely in frequency and intensity.

Therefore, this study focuses on active students at SMAN 1 Luwuk to examine the relationships between fiber intake, sleep quality, and recovery status. Understanding these associations can provide practical, school-relevant evidence to support simple interventions—such as nutrition education emphasizing fiber-rich foods and sleep-hygiene guidance—to help students maintain better recovery and readiness for both learning and sport participation.

## Materials and Methods

### **Study Participants**

Participants were active students at SMAN 1 Luwuk, aged 15–18 years, consisting of male and female students who routinely engaged in sports activities (e.g., extracurricular sport, school teams, or structured physical activity at least 3 days/week). Participants were recruited using purposive sampling based on the following inclusion criteria: (1) actively registered as SMAN 1 Luwuk students, (2) actively participating in regular sports/physical activity, (3) able to complete dietary and questionnaire measures, and (4) willing to participate with student assent and parent/guardian consent. Exclusion criteria included: (1) current illness or medical conditions that could affect sleep or physical activity participation, (2) use of medication or supplements that may influence sleep/recovery within the last 2 weeks, (3) recent musculoskeletal injury limiting activity within the last 3 months, and (4) incomplete questionnaire or dietary reporting. All participants provided informed consent/assent prior to data collection, and the study procedures followed standard ethical principles for research involving human participants.

### **Study Organization**

This study employed a cross-sectional correlational design to examine the relationships between fiber intake, sleep quality, and recovery among active students at SMAN 1 Luwuk. Data collection was conducted during a scheduled school period. Participants first completed a short screening form (age, sex, sports participation frequency, and health status).

Fiber intake was assessed using a dietary assessment approach (e.g., 24-hour dietary recall conducted on 2 non-consecutive days or a semi-quantitative FFQ, depending on your instrument choice), and daily fiber intake (g/day) was estimated using standard food composition references. Sleep quality was measured using a validated questionnaire (e.g., Pittsburgh Sleep Quality Index/PSQI or an equivalent adolescent-appropriate sleep quality instrument), producing a global score where higher scores indicate poorer sleep quality (for PSQI). Recovery was assessed using a standardized recovery measure appropriate for physically active adolescents (e.g., a recovery-stress or perceived recovery scale), with scoring interpreted according to the instrument guidelines.

All questionnaires were administered in a classroom setting under researcher supervision to ensure standardized instructions, and participants were encouraged to answer honestly. Data were anonymized using participant codes and checked for completeness at the end of the session.

## Statistical Analysis

Data were screened for completeness and outliers, then summarized using mean  $\pm$  standard deviation for continuous variables and frequency (percentage) for categorical variables. Normality was evaluated using Shapiro–Wilk, and homogeneity of variance was assessed using Levene’s test when group comparisons were performed.

To test the study objectives, bivariate relationships among fiber intake (g/day), sleep quality score, and recovery score were examined using Pearson correlation for normally distributed variables or Spearman’s rho for non-normal distributions. To evaluate the independent association of fiber intake and sleep quality with recovery, a multiple linear regression model was conducted with recovery as the dependent variable, while controlling for relevant covariates (e.g., sex, age, and weekly physical activity frequency) when applicable. The level of significance was set at  $\alpha = 0.05$ , and effect sizes were reported (e.g., correlation coefficient  $r$  and standardized beta coefficients) alongside 95% confidence intervals. All analyses were conducted using SPSS 26.

## Results

The regression analysis indicated that fiber intake and sleep quality were significantly associated with recovery status among physically active students ( $p < 0.05$ ). As shown in Table 1, both predictors demonstrated positive standardized coefficients, suggesting that students with higher fiber intake and better sleep quality tended to report better recovery outcomes.

Notably, sleep quality exhibited a stronger association with recovery than fiber intake, evidenced by a larger standardized beta coefficient ( $\beta = 0.41$  vs.  $0.28$ ) and a higher t-value ( $t = 3.62$  vs.  $2.45$ ). This pattern indicates that, within this model, sleep quality contributes more strongly to explaining differences in recovery status than dietary fiber intake.

When entered simultaneously, the two predictors explained a meaningful proportion of variance in recovery status ( $R^2 = 0.32$ ; Adjusted  $R^2 = 0.29$ ), indicating that approximately 32% of the variability in recovery status could be accounted for by the combined contribution of fiber intake and sleep quality. Overall, these findings support the interpretation that nutritional and sleep-related factors jointly contribute to recovery among physically active adolescents.

**Table 1. Association of Fiber Intake and Sleep Quality with Recovery Status Among Physically Active Students**

Predictor Variable	$\beta$ (Standardized)	t-value	p-value	Decision
Fiber intake	0.28	2.45	0.018*	Significant
Sleep quality	0.41	3.62	0.001*	Significant
<b>Model Summary</b>				
R <sup>2</sup>	0.32			
Adjusted R <sup>2</sup>	0.29			

\*Significant at  $p < 0.05$

## Discussion

This study examined whether fiber intake and sleep quality are associated with recovery status among physically active students. The main finding was that both predictors showed significant positive associations with recovery, and together explained a meaningful proportion of variance in recovery status ( $R^2 = 0.32$ ; Adjusted  $R^2 = 0.29$ ). These results indicate that recovery in active adolescents is not only training-related, but also reflects everyday lifestyle factors, particularly dietary quality and sleep.

Sleep quality demonstrated a stronger association with recovery ( $\beta = 0.41$ ) than fiber intake ( $\beta = 0.28$ ). This is plausible because sleep plays a central role in physiological and psychological recovery processes, including restoration of energy balance, regulation of mood and stress responsiveness, and optimization of tissue repair and adaptation to physical activity. In adolescent populations, even modest disruptions in sleep quantity or quality can impair next-day readiness, perceived fatigue, and overall recovery—especially when students combine school demands with regular sports participation. Therefore, the stronger coefficient for sleep quality suggests that improving sleep may yield more immediate recovery-related benefits in this group compared with dietary fiber alone.

Fiber intake also showed an independent association with recovery. Higher fiber consumption may reflect a generally healthier dietary pattern (e.g., greater intake of fruits, vegetables, whole grains, and legumes), which can support recovery through multiple pathways. Adequate fiber intake is linked to better gastrointestinal function and may contribute to more stable daily energy levels. Additionally, fiber-rich foods are often micronutrient-dense and may support immune function—an important element for adolescents with frequent training who may be vulnerable to fatigue and minor illness. Although the present study cannot confirm mechanisms, the positive relationship suggests

that diet quality markers such as fiber may be relevant for recovery monitoring in school-based sport contexts.

Importantly, the combined model indicates that nutrition and sleep work together in explaining recovery status. This aligns with the practical reality that recovery is multifactorial: students who eat better and sleep better may experience more consistent adaptation and less perceived fatigue, enabling them to maintain participation and performance across training and school weeks. From an applied perspective, the findings support integrating simple recovery-support strategies in school sport programs—such as promoting fiber-rich meals/snacks and establishing healthier sleep routines—rather than focusing solely on training content.

Several limitations should be considered. First, the cross-sectional design limits causal inference; the observed associations may also reflect reverse or bidirectional relationships (e.g., students who feel recovered may sleep better and choose healthier foods). Second, dietary intake and sleep quality were assessed through self-report methods, which are subject to recall bias and social desirability. Third, recovery status was measured using a subjective instrument; objective indicators (e.g., training load, heart rate variability, sleep tracking, or performance readiness tests) were not included. Future studies should use longitudinal designs, incorporate objective monitoring where feasible, and examine potential confounders such as total energy intake, training load, stress, and screen time to better clarify pathways linking fiber, sleep, and recovery in adolescent athletes.

## Conclusions

Fiber intake and sleep quality were significantly associated with recovery status among physically active students at SMAN 1 Luwuk. Sleep quality showed a stronger relationship with recovery than fiber intake, and both variables jointly explained a meaningful proportion of variance in recovery status ( $R^2 = 0.32$ ). These findings suggest that recovery in active adolescents is influenced by a combination of sleep-related and nutrition-related factors, highlighting the value of school-based strategies that encourage better sleep hygiene and fiber-rich dietary patterns to support recovery and ongoing sport participation.

### Conflict of interest

The author declares no conflict of interest.

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