

The relationship between Sleep and Exercise: An analysis of current research and personal data reflection

Sleep and exercise are key components of physical and psychological well-being, particularly among university students who often face high levels of academic stress and irregular schedules (Miao, 2025). Recent studies have increasingly examined not only whether exercise predicts better sleep but how psychological and lifestyle mediators such as rumination, stress, depression, health literacy, and life satisfaction might explain this association. This review critically evaluates three recent peer-reviewed studies exploring the relationship between sleep and exercise in adult and student populations. The review compares their findings, assesses the strength of the proposed relationships, examines mediating variables, and evaluates the methodologies used, drawing on additional sources to contextualise the critique.

A recent study examining university students investigated whether physical activity predicted sleep quality and whether this relationship was mediated by rumination and depression (Xu, 2025). The authors found a significant negative association between physical activity and sleep problems: students who engaged in more frequent or intense exercise reported better overall sleep. Importantly, the relationship appeared to operate largely through psychological mechanisms. The study proposed a chain mediation model in which physical activity reduced rumination, which subsequently reduced depressive symptoms, leading to improved sleep outcomes (Xu, 2025). The strength of the direct association was modest, but the indirect pathways accounted for a meaningful proportion of the variance in sleep quality. The use of validated measures such as the Pittsburgh Sleep Quality Index (PSQI) (Buysse, 1989) and established depression and rumination scales enhances the reliability of the findings. The sample size was enough for mediation analysis, and statistical techniques such as bootstrapping improved the validity of indirect-effect estimates. However, several limitations reduce the power of the findings. While the model assumes that exercise reduces rumination and depression, which in turn improve sleep, the opposite pattern is also possible, poor sleep may contribute to low physical activity and increased rumination (Xu, 2025). The heavy reliance on self-report measures introduces recall bias and social desirability effects, students may overestimate their physical activity or underestimate problematic sleep behaviours. Despite these limitations, the study offers valuable insight into the psychological mechanisms through which physical activity may support sleep quality in student populations.

A second recent study explored whether perceived stress and ruminative thinking in the relationship between physical exercise and sleep quality among college students (Liu, 2025). The authors reported that greater physical activity was associated with fewer sleep problems, but again the direct relationship was weaker than the mediated pathways. Exercise was found to reduce perceived stress, which in turn reduced rumination, ultimately leading to better sleep. This hierarchical chain mediation model (Zhang, 2023) is consistent with theoretical frameworks such as the stress-buffering hypothesis, which proposes that regular physical activity improves stress resilience and emotional processing.

The study's strengths include its large sample size and its use of multiple validated scales, including the PARS-3 for physical activity, the Perceived Stress Scale (Harris 2023), the Ruminative Responses Scale (Treynor, 2003), and the PSQI (Buysse, 1989). By incorporating several psychosocial variables, the study provides more of an understanding of how exercise may influence sleep indirectly by altering cognitive and emotional states. The methodology is like Study 1 with the use of self-reported physical activity (Healey, 2020), particularly as it does not capture intensity, duration, or objective exertion which limits the precision of conclusions. Like many cross-sectional survey designs, mediation models are statistically permissible but theoretically fragile. Additionally, the study does not consider lifestyle factors (screen time, diet, alcohol, or chronotype) that may also influence sleep quality. Despite these weaknesses, the study reinforces the central role of stress and cognitive patterns in explaining how physical activity contributes to better sleep.

A third large-scale study examined the relationship between physical exercise and sleep quality using a sample of more than 12,000 university students. Interestingly, unlike the previous studies, this research found no significant direct effect of exercise on sleep quality. Instead, the effects were entirely indirect and mediated through health literacy and life satisfaction. Students who exercised more tended to demonstrate higher health literacy, which was associated with greater life satisfaction, which in turn predicted better sleep patterns. This highlights psychosocial pathways that are broader in scope than stress or rumination alone. The exceptionally large sample is a key strength, providing strong statistical power and allowing for precise estimation of indirect paths. The use of structural equation modelling (SEM) (Stein, 2017) is appropriate for testing complex, multi-layered mediation and helps illustrate the importance of behavioural and psychological constructs. The inclusion of health literacy a variable examined in sleep and exercise research also extends existing theoretical frameworks by suggesting that exercise may contribute to better sleep indirectly through enhanced well-being and knowledge that promote healthy behaviours. However, several limitations temper the strength of the conclusions. As with the previous two studies, the reliance on self-reported sleep and physical activity (Healey, 2020) may limit accuracy. SEM (Stein, 2017) is sensitive to model specification and assumes no unmeasured confounders which is an assumption unlikely to hold in real-world behavioural research. The generalisability of findings may also be limited if the sample was drawn from a single country, as cultural factors heavily influence sleep habits and exercise norms. Despite these setbacks, the study contributes unique insights by identifying broader lifestyle and satisfaction pathways through which exercise may indirectly influence sleep.

Together, the three studies suggest a consistent, though modest, association between physical activity and improved sleep among university students. Importantly, all three studies suggest that the relationship is primarily indirect: exercise influences psychological or lifestyle variables, which in turn impact sleep. Rumination, depression, perceived stress, health literacy, and life satisfaction emerge as key mediators. These findings imply that exercise does not operate solely through physiological mechanisms such as thermoregulation or circadian alignment; instead, psychological and behavioural pathways are central.

There are also notable differences across studies. While Studies 1 and 2 found both direct and indirect links between exercise and sleep, Study 3 reported only indirect effects. This discrepancy may be due to variations in statistical methods, sample characteristics, or the types of mediators included. Studies examining stress and rumination may be detecting more immediate psychological pathways, whereas those incorporating health literacy or life satisfaction capture broader lifestyle effects.

Across the studies, the strength of associations remains minimal, suggesting that exercise is part of a more complex system. The findings align with the evidence showing that exercise improves subjective sleep quality but with small-to-moderate effect sizes. Collectively, these studies underscore the need for integrative models that account for multiple interacting variables rather than assuming a straightforward relationship between physical activity and sleep.

Overall, recent research suggests that physical activity is associated with better sleep among university students, but primarily through psychological and lifestyle mediators such as stress, rumination, depression, health literacy, and life satisfaction (He,2025). Direct effects of exercise on sleep appear modest, while indirect pathways play a more substantial role. However, the reliance on self-report measures and cross-sectional designs limits the strength of current conclusions. Future studies should incorporate objective measurement, longitudinal or experimental designs, and more diverse samples to more clearly establish causality. Together, the findings highlight the importance of integrating exercise with broader well-being and mental health strategies to improve sleep outcomes.

7-day sleep record. (Carney,2013)

Da y	Bedtim e	Tried to Slee p	Sleep Onset Latenc y	Wak e Time	Sleep Duration *	Night Waking ?	Number of Awakenings	Total Time Awake at Night
1	9:00 pm	10:30 pm	30 min	8:30 am	~9 hrs 30 min	Yes	1	30 min
2	9:35 pm	11:00 pm	15 min	10:00 am	~10 hrs 45 min	Yes	3	5 min
3	10:00 pm	10:35 pm	10 min	7:00 am	~8 hrs 15 min	No	0	0
4	9:45 pm	10:00 pm	45 min	11:00 am	~12 hrs 15 min	No	0	0

5	11:00 pm	12:05 am	35 min	9:00 am	~8 hrs 20 min	Yes	1	15 min
6	10:30 pm	10:45 pm	15 min	8:30 am	~9 hrs 30 min	No	0	0
7	11:35 pm	11:45 pm	45 min	11:00 am	~11 hrs 15 min	Yes	2	10 min

7-day exercise record. (Sallis, 1993)

Day	Exercise Type	Duration	Intensity
1	Run	45 min	Moderate
2	Arm weight training	1 hr	Low
3	Walk	1 hr	Low
4	Leg weight training	45 min	High
5	HIIT workout	1 hr	High
6	Cycle	30 min	Moderate
7	Walk	1 hr	Low

Over a seven-day period, I monitored my sleep behaviours—including sleep duration, sleep onset latency (Iskander,2023), and night awakenings alongside daily exercise type, duration, and intensity. Across the week, my sleep duration ranged from 8 hours 15 minutes to 12 hours 15 minutes, with an average of approximately 9 hours 55 minutes. Sleep onset latency varied between 10 and 45 minutes, and I experienced night awakenings on four of the seven nights. My exercise routine was consistent throughout the week, with a combination of running, walking, cycling, high-intensity interval training, and resistance training performed daily at varying intensities.

These observations partially align with findings from published research. Gebhart (2013) indicates that exercise can improve subjective sleep quality, but the effects are typically small to moderate, and exercise has little reliable impact on sleep duration. My mixed results fit within this wider literature, as the associations I observed were subtle and inconsistent. While some studies suggest that vigorous exercise performed close to bedtime may impair sleep for certain individuals (Stutz,2019), this did not seem

to be the case in my data. Instead, the variability in my sleep appeared more closely related to differences in bedtime and daily routine than to exercise intensity or type.

Several factors may help explain why my results differ from findings in the published literature. My bedtimes varied considerably across the week, which likely disrupted my sleep pattern and may have reduced any potential influence of exercise. In addition, other factors such as daily stress, screen use before bed, and general lifestyle routines were not controlled and may have affected my sleep independently of physical activity. Some of the longer sleep periods may also reflect accumulated sleep pressure rather than exercise-related improvements.

When examining the relationship between my exercise behaviour and sleep outcomes, no strong or consistent patterns emerged. High-intensity exercise (e.g., leg weight training and HIIT) did not appear to disrupt my sleep, as I slept more than 12 hours on one of these days and more than 8 hours on another. Likewise, low-intensity activities such as walking were followed by both relatively short and relatively long sleep durations, with no consistent effect on night awakenings. Moderate-intensity exercise, such as running or cycling, seemed to be followed by broadly stable sleep durations, but this pattern was not strong enough to suggest a causal link. Overall, my data suggest that my daily exercise did not clearly or consistently influence either sleep quality or sleep duration within this short time frame.

In summary, although exercise is widely acknowledged to contribute to improved sleep quality (Zhang,2025), my one-week self-monitoring records revealed no clear or consistent association between my exercise behaviour and my sleep outcomes. The variability in my sleep appeared to be driven more by external factors and irregular routines than by differences in exercise type or intensity. This reflection highlights the complexity of sleep and exercise interactions and underscores the importance of using more rigorous and longer-term measurement approaches when attempting to understand these relationships.

Self-monitoring and self-report measures of sleep and exercise have several limitations. Sleep diaries rely on estimates of sleep onset and awakenings, which are often inaccurate due to recall bias and limited awareness during the night (Short,2017). Sleep duration is approximated rather than objectively measured, and perceived sleep quality can be influenced by mood, expectations, or daily stress. Similarly, self-reported exercise intensity and duration can be affected by misjudgement or motivation to present behaviour positively. Because these measures are subjective, short-term, and uncontrolled for confounding variables such as caffeine intake, stress, and screen exposure, the relationship observed between exercise and sleep may not reflect true physiological patterns. As such, self-report data can provide useful insights but should be interpreted with caution.

Reference list

Buysse, D. J., Reynolds, C. F., 3rd, Monk, T. H., Berman, S. R., & Kupfer, D. J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry research*, 28(2), 193–213.

Carney, C. E., Buysse, D. J., Ancoli-Israel, S., Edinger, J. D., Krystal, A. D., Lichstein, K. L., & Morin, C. M. (2012). The consensus sleep diary: standardizing prospective sleep self-monitoring. *SLEEP*, 35(2), 287–302.

Gebhart, C., Erlacher, D., & Schredl, M. (2011). Moderate exercise plus sleep education improves self-reported sleep quality, daytime mood, and vitality in adults with chronic sleep complaints: a waiting list-controlled trial. *Sleep disorders*, 2011, 809312. <https://doi.org/10.1155/2011/809312>

Harris, K. M., Gaffey, A. E., Schwartz, J. E., Krantz, D. S., & Burg, M. M. (2023). The Perceived Stress Scale as a Measure of Stress: Decomposing Score Variance in Longitudinal Behavioral Medicine Studies. *Annals of behavioral medicine : a publication of the Society of Behavioral Medicine*, 57(10), 846–854. <https://doi.org/10.1093/abm/kaad015>

He, M. H., Zhao, T. Y., Zhu, W. D., Lou, H., Zhang, D. Y., Mu, F. Z., Zhang, X. Y., Li, Y. H., Zhang, W. H., Liu, Q., Wang, J. Q., Li, C. X., Li, H. Y., Zhou, N., Zhang, Y., Zuo, H. J., Wang, W., Wang, X. Y., Lu, B. C., Zhao, L. L., ... Gu, F. (2025). The effect of physical exercise on sleep quality in university students: chain mediation of health literacy and life satisfaction. *Frontiers in psychology*, 16, 1604916. <https://doi.org/10.3389/fpsyg.2025.1604916>

Healey, E. L., Allen, K. D., Bennell, K., Bowden, J. L., Quicke, J. G., & Smith, R. (2020). Self-Report Measures of Physical Activity. *Arthritis care & research*, 72 Suppl 10(Suppl 10), 717–730. <https://doi.org/10.1002/acr.24211>

Iskander, A., Jairam, T., Wang, C., Murray, B. J., & Boulos, M. I. (2023). Normal multiple sleep latency test values in adults: A systematic review and meta-analysis. *Sleep medicine*, 109, 143–148. <https://doi.org/10.1016/j.sleep.2023.06.019>

Liu D, Tian Y, Liu M, Yang S. (2025) The Impact of Physical Exercise on Sleep Quality Among College Students: The Chain Mediating Effects of Perceived Stress and Ruminative Thinking. *Psychol Res Behav Manag*;18:361-373
<https://doi.org/10.2147/PRBM.S510207>

Miao Li, Xiao-Ying Jin, Han Li, Meng-Dan Chu, Zeng-Feng Su,(2025)Sleep quality and its correlates among medical undergraduates in Anhui Province: A cross-sectional study on academic stress, mental health, and lifestyle factors,*Sleep Epidemiology*,Volume 5,

Sallis, J.F., Buono, M.J., Roby, J.J., Micale, F.G.,and Nelson, J.A. (1993). Seven-day recall and other physical activity self-reports in children and adolescents. *Medicine and Science in Sports and Exercise*; 25, 99-108.

Short, M. A., Arora, T., Gradisar, M., Taheri, S., & Carskadon, M. A. (2017). How Many Sleep Diary Entries Are Needed to Reliably Estimate Adolescent Sleep?. *Sleep*, 40(3), zsx006. <https://doi.org/10.1093/sleep/zsx006>

Stein, C. M., Morris, N. J., Hall, N. B., & Nock, N. L. (2017). Structural Equation Modeling. *Methods in molecular biology* (Clifton, N.J.), 1666, 557–580. https://doi.org/10.1007/978-1-4939-7274-6_28

Stutz, J., Eiholzer, R., & Spengler, C. M. (2019). Effects of Evening Exercise on Sleep in Healthy Participants: A Systematic Review and Meta-Analysis. *Sports medicine* (Auckland, N.Z.), 49(2), 269–287. <https://doi.org/10.1007/s40279-018-1015-0>

W. Treynor, R. Gonzalez, S. Nolen-Hoeksema (2003). Rumination Reconsidered: A Psychometric Analysis // *Cognitive Therapy and Research*, . 27(3)

Xu, L., Yan, W., Hua, G. et al. (2025). Effects of physical activity on sleep quality among university students: chain mediation between rumination and depression levels. *BMC Psychiatry* 25, 7 . <https://doi.org/10.1186/s12888-024-06450->

Zhang, J., Hu, Z., Zheng, S. et al.(2023) A chain mediation model reveals the association between mindfulness and depression of college students. *Sci Rep* 13, 16830

Zhang, Z., Liu, X. A chain mediating model of the impact of physical exercise on sleep quality. *BMC Public Health* 25, 1493 (2025). <https://doi.org/10.1186/s12889-025-22728-x>