Digital Sleep Diary Self-Monitoring and Perceived Sleep Quality in Civil Engineering Students: A Pilot Pretest–Posttest Controlled Study

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Abstract

Sleep curtailment and poor subjective sleep quality are frequently observed among university students, particularly in high-demand programs. This study evaluated whether short-term self-monitoring via a digital sleep diary is associated with changes in perceived sleep quality among civil engineering students. A pilot pretest–posttest controlled design was conducted among 20 second-year Bachelor of Science in Civil Engineering students. Participants were allocated to an experimental group completing a structured digital sleep diary each morning for seven days or to a control group that continued usual routines without monitoring. Perceived sleep quality was assessed pre- and post-intervention using the Pittsburgh Sleep Quality Index (PSQI). Diary data yielded 70 daily observations describing sleep duration and related behavioral/context indicators. At baseline, all participants were classified as poor sleepers (PSQI > 5) and reported short sleep duration (mean hours in bed = 5.28). The experimental group showed a larger numerical reduction in PSQI (9.45 to 8.10; change −1.35) than the control group (9.50 to 8.90; change −0.60), but the group × time interaction was not statistically significant (p = .115). Diary summaries indicated mean sleep duration of 5.60 hours, caffeine use in 45% of entries, and no within-week variation in the academic stressor indicator. A 7-day digital sleep diary produced a directional improvement in perceived sleep quality but did not yield statistically significant superiority over control in this pilot sample. Findings support diary-based self-monitoring as a feasible awareness tool while highlighting workload- and stimulant-related constraints that may limit short-term behavioral change in high-demand curricula.

Keywords: *sleep self-monitoring; digital sleep diary; perceived sleep quality; PSQI; engineering students; academic stress; caffeine use*

1. Introduction

Sleep is a foundational biological requirement that underpins attention, executive functioning, memory consolidation, mood regulation, and physiological recovery. In university settings, however, sleep is frequently treated as a flexible resource that can be traded for deadlines, examinations, commuting demands, and extensive screen exposure. This pattern is particularly salient in academically intensive programs where the perceived costs of "lost study time" are high and where performance culture is shaped by endurance norms. In such contexts, sleep is not merely an individual health behavior but also a behavioral outcome influenced by institutional workload structure, peer expectations, and the daily rhythm of coursework.

Engineering students constitute a salient subgroup for examining sleep-related behavioral risks because the curriculum commonly involves sequential technical courses, high-stakes assessments, prolonged cognitive load, and project-based deliverables that cluster within the same weeks. In the present study context, second-year civil engineering students occupy a transitional stage where foundational courses shift into more specialized and demanding content. This transition can intensify time pressure and encourage routine sleep restriction as a compensatory strategy, even when students recognize that degraded sleep impairs concentration and productivity.

From a behavioral science perspective, one of the most accessible approaches to improving health-related routines is self-monitoring. Sleep diaries—particularly digital formats—are low-cost tools that can increase self-awareness by externalizing bedtime routines, wake times, and subjective perceptions of rest. Diary-based self-monitoring also offers a practical advantage for student populations: it requires minimal time per day, can be administered via widely accessible platforms, and does not depend on specialized equipment. Nonetheless, the evidence base suggests that awareness alone may be insufficient when individuals face persistent structural constraints, such as continuous workload and compensatory caffeine reliance. In such cases, self-monitoring can expose the problem clearly without providing

sufficient degrees of freedom to change the behavior in the short term.

The present study evaluates a pragmatic question relevant to student wellbeing and behavioral self-regulation: whether the simple act of completing a structured digital sleep diary for one week is associated with improvements in perceived sleep quality among civil engineering students. Baseline data in this cohort indicate that poor sleep quality is widespread: all participants were categorized as poor sleepers using the PSQI threshold and reported short sleep duration (mean hours in bed = 5.28).

This starting point makes the cohort a meaningful test case for diary-based self-monitoring, because the intervention is being applied to a group with demonstrably suboptimal perceived sleep quality, rather than to a generally well-rested sample.

The intervention itself is intentionally minimal: a seven-day digital diary completed each morning by the experimental group, while the control group maintains usual routines without monitoring. Perceived sleep quality is assessed using the PSQI at baseline and after one week. Within the diary group, daily observations (N = 70) also provide descriptive indicators of sleep duration and contextual factors. Preliminary summaries depict an average sleep duration of 5.60 hours and signal potential constraints on behavioral change, including caffeine use in nearly half of entries and stable, uniformly high academic stress reports across the week.

Two contributions follow from this framing. First, the study provides a pilot test of a feasible self-monitoring approach that is easily replicable in similar academic environments. Second, it clarifies whether a short self-monitoring period yields measurable changes in perceived sleep quality, or whether structural barriers dominate in the short run.

1.1 General Objective

To evaluate whether a 7-day digital sleep diary self-monitoring intervention is associated with changes in perceived sleep quality (PSQI) among second-year civil engineering students, relative to a no-diary control condition.

1.2 Specific Objectives

To describe baseline sleep health in the sample using PSQI classification and reported sleep duration (hours in bed).

To compare pretest versus post-test PSQI scores within each group (diary vs control) after one week.

To test whether the change in PSQI over time differs between groups using a mixed (group × time) analytic framework.

To summarize diary-derived sleep pattern indicators (e.g., sleep duration, latency coding, restfulness rating, morning status) and contextual markers (academic stressor level; caffeine use frequency) within the diary group.

To profile the reported "influencing factors" (e.g., caffeine use, morning status, academic stressor indicator) alongside diary-derived sleep indicators to contextualize barriers to short-term change.

2. Review of Related Literature

2.1 Sleep deprivation as an academic and cognitive risk in engineering education

Sleep is consistently positioned in the literature as a foundational physiological requirement with direct implications for learning effectiveness, particularly through its role in memory consolidation and cognitive processing. Within academically demanding environments, the erosion of sleep time becomes a plausible pathway to weakened academic functioning and reduced psychological readiness for complex tasks. Ampofo et al. (2025) explicitly linked adequate sleep with memory consolidation, emphasizing the counterproductive logic of late-night studying when sustained sleep loss ultimately impairs the retention of technical material. This concern becomes especially salient in engineering programs, where mastery is cumulative and strongly dependent on sustained attention and accurate recall of formulas, procedures, and problem-solving schemas.

The global framing presented in the reviewed studies highlights engineering education as a context where workload intensity, prolonged study hours, and elevated performance stakes become structural antecedents of disrupted sleep. Ahmed et al. (2021) described engineering programs as persistently high-stress learning environments characterized by extensive study demands and heavy mental burden, producing continuous sleep disruption. This aligns with the view that sleep loss in such settings is not a sporadic inconvenience but a patterned, curriculum-linked condition. Complementing this framing, Ajeigbe (2025) underscored that poor sleep extends beyond fatigue and can compromise both academic functioning and mental health, reinforcing the

relevance of sleep quality as a dual academic and wellbeing concern in engineering student populations.

2.2 From "sleep hours" to perceived sleep quality: why subjective evaluation matters

A central methodological implication of the reviewed literature is that sleep problems cannot be reduced to total hours slept. Perceived sleep quality, restfulness, and the felt experience of recovery appear consequential for daily functioning—particularly in high-pressure academic environments where confidence, emotion regulation, and sustained concentration are required. Windmill et al. (2024) reported that perceptions of sleep tend to correlate more strongly with mood than with actual hours slept, signaling that how individuals appraise their sleep may be a proximal determinant of cognitive-emotional readiness.

This position is strengthened by work emphasizing mismatches between objective indicators and subjective experience. The review by Cudney et al. (2020) highlighted that device-based metrics may not be equivalent to what individuals feel and report about their own sleep, supporting the methodological defensibility of prioritizing perceived sleep quality when the outcome of interest is subjective functioning, daily wellbeing, and self-regulatory capacity. In this sense, perceived sleep quality is not treated as a secondary proxy but as a substantively meaningful target aligned with how students interpret their readiness to perform.

Population-oriented evidence further connects sleep quality with broader quality-of-life indicators. Lee, Kim, and Chung (2021) associated sleep quality with quality of life, framing sleep as a contributor to psychological strength and everyday functioning. Similarly, Carpi et al. (2022) reported associations between sleep quality and health-related quality of life in university students, with an implication—also reflected in the document—that engineering majors may exhibit particularly low sleep scores. Together, these studies position sleep quality as a meaningful indicator not only of rest but of functional capacity in academic and non-academic domains.

2.3 Stress, coping resources, and post-pandemic dynamics affecting sleep

The reviewed literature frames student sleep as a product of both external academic demands and internal coping mechanisms. Stress is repeatedly treated as a high-impact driver of sleep disturbance, while protective personal resources may buffer this effect. Tafoya et al. (2023) identified self-control and resilience as strengths that can safeguard sleep quality even under stress, highlighting a mediation-oriented understanding of how perceived stress translates into sleep outcomes. Jaroszewicz et al. (2023) reinforced sleep disturbance as a broad, post-pandemic issue among university students, suggesting that contemporary sleep problems may be partially shaped by residual disruptions in routines, coping patterns, and stress exposure established during the pandemic period.

Longer-horizon stress–sleep relationships are also recognized. Brown and Papp (2024) examined trajectories of stress, coping, and sleep quality across multiple years during and after the COVID-19 pandemic, supporting the view that sleep quality patterns may be embedded in evolving adaptation processes rather than isolated daily choices. Within this framing, sleep interventions that focus purely on individual intention may encounter structural constraints unless they also acknowledge sustained academic pressures and contextual instability.

The stressors impacting sleep are not unique to engineering but are prevalent across high-stakes, licensure-driven academic programs. A thematic review of health professions education in the Philippines—a context analogous to engineering in its intensity—identifies "role overload and burnout" and "moral distress" as systemic challenges exacerbated by generational shifts and digital environments (Bermido, Quinto, & Atento, 2025). This mirrors the engineering student's environment, where workload and performance anxiety are endemic. Furthermore, a study on dormitory-based medical students found strong correlations between lifestyle factors (screen time, sleep hours) and burnout dimensions like emotional exhaustion (Quinto et al., 2025). This evidence underscores that in demanding academic tracks, poor sleep hygiene and high stress are interlinked, creating a cycle that degrades both wellbeing and academic capacity.

The Philippine "New Normal" context aligns with this broader international evidence, emphasizing schedule disorientation and the blending of study time with rest time in hybrid learning arrangements. Estrada-Araoz et al. (2023) reported mental health challenges as students returned to face-to-face learning, including abnormal sleep behaviors exacerbated by commuting demands and hectic schedules, contributing to reduced intellectual focus and increased irritability. Gumasing et al. (2022) further described a sleep crisis among Metro Manila college students in high-stakes programs such as engineering, driven by excessive workload and academic anxiety, with a substantial proportion identifying as poor sleepers. These studies position sleep deprivation as a localized and contemporary concern rather than a purely global phenomenon.

2.4 Sleep self-monitoring and the sleep diary as a behavioral tool

Against the backdrop of high workload and stress, the reviewed literature introduces self-monitoring as a pragmatic, low-barrier approach to increasing awareness and potentially shifting behavior. The sleep diary is presented as a structured self-monitoring instrument that records bedtime, wake time, awakenings, and subjective sleep ratings, enabling individuals to visualize patterns that may otherwise remain unrecognized. This mechanism is framed as especially relevant to individuals with sleeping problems rather than uniformly beneficial for healthy sleepers. Tollånes et al. (2025) examined sleep monitoring tools and suggested that while healthy sleepers may observe minimal change, individuals experiencing disturbed sleep in high-stress contexts may experience a "reality-check" effect—an awareness shift that can catalyze reconsideration of routines and priorities.

Methodologically, daily diary approaches are supported as a means to capture day-to-day coupling between stress exposure and nighttime sleep, producing a granular account of how academic demands translate into sleep outcomes. Slavish et al. (2021) argued that daily diary methods provide a "play-by-play" representation of how daily projects and stressors affect sleep, strengthening the logic of diary-based designs when the aim is to detect short-window changes in perceived sleep experience.

The literature also recognizes a shift from paper diaries toward digital implementations. Thorshov et al. (2023) described experiences using a digital sleep diary in symptom management, while Davíðsson et al. (2022) addressed the direction toward a digital sleep diary standard. Kristbergsdottir et al. (2023) emphasized compliance dynamics in mobile health apps using a digital sleep diary across an extended observation period, and the feasibility perspective is echoed by work on personal sleep self-monitoring devices for sleep self-management. Collectively, these studies support digital diaries and related tools as usable formats that may reduce friction and support consistency in self-monitoring routines—an important consideration for students who are already cognitively overloaded.

The move towards digital self-monitoring aligns with broader trends in educational technology adoption. Research on AI in Philippine education notes that while digital tool adoption is widespread, the use of more advanced, adaptive systems (which could include personalized wellness apps) remains limited and is often driven by individual initiative rather than institutional strategy (Rao, Tian, & Atento, 2025). This suggests that for a tool like a digital sleep diary to be effective for students, it must be low-friction, easily accessible, and ideally supported by institutional promotion to overcome the gap between general digital use and targeted health-technology adoption.

Finally, the reviewed literature situates diary-based monitoring within broader sleep strategy discussions. Rawat and Chauhan (2022) framed behavioral sleep strategies as optimizable, and Mehta (2024) argued for reframing sleep as a strategic asset tied to wellbeing and performance. Within this orientation, a sleep diary functions as a non-pharmacologic, behaviorally oriented mechanism that supports reflection, self-regulation, and the identification of modifiable triggers such as rumination and schedule instability. Lamprou et al. (2024) linked pre-sleep rumination with sleep quality within a diary-and-actigraphy context, reinforcing the relevance of targeting cognitive pre-sleep processes that commonly intensify under academic strain.

2.5 Philippine context: the normalization of "puyat" and the engineering student experience

The local literature summarized in the document adds a culturally specific dimension: sleep deprivation is not only tolerated but at times socially valorized. Gatdula (2025) described a culture that frames "puyat" as a badge of honor among engineering students, encouraging the belief that worse sleep signals greater commitment to future aspirations. Monte (2025) similarly noted increasing sleep debt among local students who treat rest as an unaffordable luxury in pursuit of high grades, with adverse effects on physical health. This cultural normalization is a meaningful contextual factor because it can weaken the motivational leverage of health messaging: students may experience guilt when choosing sleep, interpreting rest as a threat to academic legitimacy.

Local evidence also frames the functional consequences of poor sleep in terms directly relevant to engineering training. Lugay Jr. et al. (2023) cited daytime dysfunction as a significant outcome of late nights, and the document emphasizes that for engineering majors, daytime impairment is not merely inconvenient but a safety and accuracy hazard in laboratory work and complex drafting tasks. This framing strengthens the applied relevance of sleep research in engineering education by connecting sleep quality to

professional competency development where precision and sustained alertness are expected.

The culture of "puyat" can be understood through the lens of institutional and peer pressure. Research on SDG integration in Philippine higher education found that curricular choices often reflect "institutional isomorphism"—mimicking trends perceived as competitive—rather than addressing locally urgent needs (Atento, 2025). Similarly, student behavior regarding sleep may be less a personal choice and more an adaptation to a perceived institutional culture that rewards visible sacrifice. This is compounded by findings that student wellness is often compromised by behavioral routines; for instance, screen time and snacking were positively correlated with burnout markers, while sleep duration showed an inverse relationship (Quinto et al., 2025). This indicates that the poor sleep habits normalized in "puyat" culture are part of a broader, detrimental lifestyle pattern reinforced by the academic environment.

2.6 Synthesis

Across foreign and local sources, three convergent propositions emerge. First, engineering education is repeatedly positioned as a high-demand context where structural workload pressures incentivize chronic sleep restriction, with plausible downstream effects on memory, concentration, mood, and quality of life. Second, subjective sleep experience is treated as consequential in its own right, both because perceived sleep quality is closely linked with mood and functioning and because objective indicators may not map cleanly onto felt restfulness. Third, self-monitoring through sleep diaries—particularly in daily or digital formats—is framed as a feasible awareness-building strategy, with potential value especially for disturbed sleepers in high-stress environments, though its effectiveness is likely moderated by persistent stress exposure and culturally reinforced sleep-sacrifice norms.

2.7 Research Gaps Addressed by the Present Study

Within the reviewed literature, a practical gap concerns the extent to which self-monitoring alone—without intensive clinical intervention—can shift perceived sleep quality among students embedded in high-demand academic structures. While diary approaches are supported as measurement and awareness tools, the literature summarized implies uncertainty regarding whether short-term diary-based self-monitoring is sufficient in settings where stress, schedule disruption, and culturally normalized sleep deprivation remain active constraints.

Studies highlight a related gap: the need for interventions that are contextually aware. Studies note that digital tools see uneven adoption (Rao et al., 2025) and that student behaviors are deeply intertwined with institutional culture and peer norms (Atento, 2025; Quinto et al., 2025). Therefore, the effectiveness of a sleep diary intervention cannot be assessed in a vacuum; it must be investigated within the specific ecosystem of the Philippine engineering student, where the "puyat" norm and academic pressure coexist. This strengthens the need for evidence generated within this local environment rather than inferred from general student populations, directly addressing how a simple behavioral tool interacts with a complex cultural-academic system.

3. Methodology

3.1 Research Design

The study employed a pilot randomized, between-subjects pretest–posttest controlled design to examine whether completing a structured digital sleep diary influences perceived sleep quality. Participants were purposively recruited from eligible second-year Bachelor of Science in Civil Engineering (BSCE) students and then allocated to either (a) an experimental group that completed a daily digital sleep diary for seven consecutive mornings or (b) a control group that maintained usual routines without sleep monitoring. Perceived sleep quality was assessed at baseline and after seven days using the Pittsburgh Sleep Quality Index (PSQI).

3.2 Setting

The study was conducted at First City Providential College (San Jose del Monte, Bulacan), focusing on students enrolled in the second year of the Bachelor of Science in Civil Engineering (BSCE) program. The population was selected due to the program's technical and laboratory demands, which are commonly associated with constrained sleep opportunities and irregular sleep routines.

3.3 Participants, Sampling, and Group Allocation

A total of N = 20 second-year BSCE students participated. Purposive sampling was used to identify students who self-reported irregular sleep patterns. After recruitment, participants were randomly allocated into two equal groups (n = 10 per group): an experimental (diary) group and a control (no-diary) group. The study's original target of 30 participants was reduced to 20 due to participant availability and institutional scheduling constraints.

To protect privacy and support longitudinal matching, participants were assigned anonymous codes (e.g., EXP-01 for experimental; CON-01 for control). Codes were communicated privately to participants.

3.4 Measures and Instruments

Pittsburgh Sleep Quality Index (PSQI)

Perceived sleep quality was assessed using the Pittsburgh Sleep Quality Index (PSQI), a 19-item instrument that yields seven component scores (subjective sleep quality, latency, duration, habitual efficiency, disturbances, medication use, and daytime dysfunction). Component scores are computed on 0–3 scales and summed to generate a Global PSQI score (0–21). Consistent with standard interpretation, scores > 5 indicate poor sleep quality, while scores < 5 indicate good sleep quality. The PSQI was administered at baseline (pretest) and after the 7-day period (posttest).

Digital Sleep Diary (Experimental Group Only)

Participants in the experimental group completed a digital, structured sleep diary for 7 consecutive days. The diary captured daily sleep-related parameters including bedtime, estimated sleep onset, wake time, and subjective restfulness reported each morning.

In addition to core sleep timing fields, the study dataset also included daily diary indicators used in the analysis:

a. Restfulness rating (recorded on a 4-point scale)

b. Morning mood/status (coded as a binary indicator; e.g., "refreshed/ready" vs "tired")

c. Caffeine use (binary indicator)

d. Stressor count / academic stressor index (recorded daily; observed as constant in the dataset)

3.5 Data Collection Procedure

Data collection followed three sequential stages:

1. Baseline assessment (Pretest): All participants completed the PSQI via an online form to establish initial perceived sleep quality.

2. Intervention period (7 days):

a. Experimental group: Participants were oriented to the digital sleep diary and submitted one diary entry per day for seven consecutive days.

b. Control group: Participants continued usual routines and were not instructed to monitor or record sleep. For implementation support and compliance reminders, participants were included in a messaging channel for general announcements; participant codes and sensitive concerns were handled privately as needed.

3. Post-intervention assessment (Posttest): At the end of the 7-day period, both groups completed the PSQI again via an online form.

3.6 Data Preparation and Management

Diary and PSQI responses were exported from online forms into the statistical software used for analysis. The sleep diary dataset comprised 70 daily observations (10 experimental participants × 7 days), enabling descriptive summaries of daily sleep patterns and related indicators captured during the intervention window.

3.7 Statistical Analysis

Analyses were conducted using Jamovi (Version 2.3). The analytic plan included:

a. PSQI scoring and categorization: Transformation of raw PSQI responses into seven component scores and a Global PSQI score. Scores were categorized using the good/poor sleep-quality thresholds described above.

b. Descriptive statistics: Means and standard deviations were computed to summarize baseline sleep quality and related sleep pattern metrics; frequencies and percentages were computed for categorical indicators (e.g., caffeine use).

c. Inferential test (primary): A 2 × 2 mixed-design repeated-measures ANOVA was used to test whether change in PSQI from pretest to posttest differed between groups (experimental vs control). Specifically, the model evaluated the Group × Time interaction as the effect of interest, reflecting whether diary use was associated with differential improvement in perceived sleep quality relative to no diary.

3.8 Ethical Considerations

Ethical safeguards included informed consent, voluntary participation, and privacy protections. Participant anonymity was maintained through the use of coded identifiers rather than names, and confidential communication of codes was conducted via private messaging when needed. In line with beneficence, the control group was designated to receive the sleep diary template and a summary of findings after completion of data collection

4. Results and Discussion

4.1 Baseline profile and initial sleep burden

The study involved 20 second-year BS Civil Engineering students with a narrow age range typical of late adolescence/emerging adulthood (mean age = 19.25 years, SD = 0.44). The sample included 13 females (65%) and 7 males (35%). Baseline screening using the Pittsburgh Sleep Quality Index (PSQI) indicated that all participants (100%) exceeded the PSQI > 5 threshold, classifying the entire cohort as poor sleepers at study entry. In terms of sleep quantity, respondents reported an average of 5.28 hours in bed per night (SD = 1.46), with some reporting as little as 3 hours, reflecting a highly sleep-restricted routine.

Baseline PSQI severity was also clinically notable. The cohort's mean Global PSQI score was 9.45 (SD = 3.28), with observed values ranging from 6 to 16 and a median of 8.50, indicating that many participants were well beyond the conventional cutoff for sleep disturbance. The combination of low reported time in bed (sleep restriction) and elevated PSQI scores (poor perceived sleep quality) suggests that the cohort experienced both quantitative sleep deprivation and qualitative sleep disruption prior to any diary exposure.

4.2 Weekly diary patterns and contextual markers related to sleep

The 7-day digital diary (experimental group) produced 70 daily observations, allowing inspection of within-week variability in sleep behavior and morning experience. Across the week, the diary indicated an average sleep duration of 5.60 hours, with some individuals occasionally reaching approximately seven hours while others remained consistently within the four-hour range on multiple nights. This pattern is consistent with an "irregular compression" of sleep typical of deadline-driven academic routines, where sleep timing and duration fluctuate markedly depending on coursework demands.

The daily indicators suggested mixed subjective functioning under constrained sleep. Average restfulness was 2.64 on a 4-point scale, and

the morning mood/status indicator suggested "refreshed/ready" mornings on approximately 64% of entries, while a substantial proportion still reflected tired mornings. Notably, tired mornings tended to coincide with shorter recorded sleep durations, which is consistent with the expected direction of association between sleep loss and next-day fatigue.

Two contextual constraints emerged from the weekly indicators. First, the academic stressor count was constant at 4.00 (SD = 0.00) across the period, reflecting a uniformly heavy workload with minimal day-to-day relief. Second, caffeine use appeared in approximately 45% of entries, indicating reliance on stimulants within the week of observation. Together, these patterns indicate that the diary period occurred under sustained academic pressure and compensatory alertness strategies—conditions that can plausibly limit short-horizon behavioral adjustment even when awareness increases.

4.3 Pretest–posttest change in perceived sleep quality and the diary effect

Across all participants, perceived sleep quality improved from baseline to posttest. The mixed-design repeated-measures ANOVA reported a significant main effect of time ($F(1,18) = 24.76$, $p < .001$), indicating that PSQI scores changed meaningfully from pretest to posttest when both groups were considered together.

At the group level, the experimental (diary) group showed a larger numerical reduction in PSQI than the control group. Specifically, the experimental group decreased from 9.45 to 8.10 (mean change −1.35), whereas the control group decreased from 9.50 to 8.90 (mean change −0.60). Despite this directional advantage, the Group × Time interaction was not statistically significant ($F(1,18) = 2.75$, $p = .115$), indicating that the rate of change over time did not differ reliably between diary and non-diary participants within this one-week window. Substantively, the data support a short-term improvement in perceived sleep quality over time, but do not provide sufficient statistical evidence that diary use alone produced a superior improvement relative to usual routine.

4.4 Integrated interpretation of what the pattern implies

Taken together, the findings point to a coherent pattern: (a) the cohort began in a state of marked sleep deprivation and poor perceived sleep quality; (b) perceived sleep quality improved over the week in both groups; (c) diary users exhibited a larger numerical improvement, but not at a statistically reliable magnitude given the sample size and study duration; and (d) persistent structural constraints—constant academic stress and frequent

caffeine use—were present during the observation window and plausibly limited the extent to which awareness could translate into immediate behavioral change. In short, the diary appears best supported as an awareness-enhancing tool under these conditions, while meaningful short-term improvement may require either a longer exposure period, complementary sleep-hygiene supports, or a context in which workload pressure is less uniformly "flat" across days.

4.5 Discussion of Findings

The findings are best interpreted against the convergent themes in the literature: (a) engineering education as a high-demand environment that structurally compresses sleep time, (b) the substantive importance of perceived sleep quality as a functional and affective outcome, and (c) the conditional value of self-monitoring tools such as sleep diaries, particularly under persistent stress constraints.

First, the baseline profile—universal classification as poor sleepers (PSQI > 5) alongside short time in bed—aligns with the literature's characterization of sleep deprivation as an embedded feature of high-stakes academic programs. Engineering students are repeatedly described as experiencing elevated stress and prolonged cognitive load, which encourages routine sleep restriction and irregular sleep timing. Consistent with this framing, the cohort's low reported sleep hours suggest that sleep deprivation is not episodic but normalized and sustained, a pattern similarly emphasized in local discussions of "puyat culture," where sleep sacrifice is interpreted as a proxy for academic seriousness. In this context, poor sleep quality becomes less a matter of isolated student choice and more a predictable outcome of workload pressures and socially reinforced performance norms.

Second, the observed changes in PSQI across the week must be understood in light of research emphasizing the meaningfulness of perceived sleep quality. Prior evidence indicates that subjective sleep experience can be closely tied to mood, emotional regulation, and daily functioning, and may not map perfectly onto objective sleep duration. This conceptualization supports the use of PSQI as a defensible outcome for student populations where daytime readiness and affective stability are salient. The overall improvement in PSQI over time, therefore, may reflect changes in perceived restfulness, symptom appraisal, or momentary improvements in routine, even if total sleep duration remains constrained.

Third, the diary group's larger numerical improvement, alongside the non-significant group × time interaction, is consistent with literature describing diary-based self-monitoring as an awareness mechanism whose short-horizon effects may be modest and context-dependent. Sleep diary use can act as a "reality-check" by making patterns visible and prompting reflective adjustments; however, evidence also suggests that monitoring may yield limited measurable differences among individuals whose sleep is already constrained by external demands. The present pattern fits this conditional claim: self-monitoring may have supported a directional improvement in perceived sleep quality, but the combination of a short intervention window and persistent academic pressures likely limited the extent to which awareness could translate into substantial behavioral change within one week.

This interpretation is reinforced by the diary indicators showing sustained contextual constraints during the observation period. The constant academic stressor index suggests that participants remained under uniformly high workload pressure across days, offering limited "recovery space" for sleep extension or consistent scheduling. Additionally, the frequency of caffeine use indicates compensatory alertness strategies that can maintain daytime functioning while potentially undermining sleep onset and continuity. Together, these constraints align with the broader literature emphasizing that stress exposure, coping demands, and pre-sleep cognitive activation (e.g., rumination) are key determinants of sleep quality. Under such conditions, a diary can clarify the problem and may slightly improve perceived regulation, but meaningful improvements may require either a longer monitoring period, complementary behavioral guidance, or institutional-level adjustments that reduce the structural drivers of sleep deprivation.

Overall, the discussion supports a balanced conclusion consistent with best practices in intervention reporting: the sleep diary appears feasible as a low-cost self-monitoring tool and may produce a directional improvement in perceived sleep quality, yet the evidence from this short-window, small-sample comparison does not support a strong claim of superiority over a no-diary condition. The findings therefore contribute most clearly as a context-specific account of sleep burden in engineering students and as preliminary evidence

on the limited—but potentially meaningful—role of diary-based self-monitoring under sustained academic strain.

5. Conclusions and Recommendations

5.1 Conclusions

The study examined whether maintaining a digital sleep diary over a short monitoring period is associated with changes in perceived sleep quality among second-year Bachelor of Science in Civil Engineering students. At baseline, the cohort exhibited a substantial sleep burden: all participants were classified as poor sleepers based on PSQI thresholds, and reported time in bed indicated persistent sleep restriction. This pattern is consistent with a learning environment characterized by sustained workload demands and a culture of sleep sacrifice, reinforcing that sleep deprivation in technical programs functions as both a wellbeing concern and a performance-related risk.

Across the one-week period, perceived sleep quality improved over time in both groups, indicating that sleep-related perceptions and symptoms were not static. The sleep diary group showed a larger numerical reduction in PSQI than the control group; however, the evidence did not demonstrate a statistically reliable advantage of diary use over routine behavior within the observation window. The most defensible interpretation is that diary-based self-monitoring may contribute to awareness and modest perceived improvement, but that short-term effects are constrained when academic stress remains uniformly high and compensatory behaviors such as caffeine use remain active. Accordingly, the diary is best characterized as a feasible entry-level self-regulation tool rather than a standalone solution capable of producing rapid, robust improvements in perceived sleep quality under intensive academic conditions.

5.2 Recommendations

Several practical recommendations follow from the findings, aligned to the limited but informative scope of the study. First, sleep diary self-monitoring may be adopted as a low-cost wellness support within engineering cohorts, particularly as an awareness-building tool that helps students identify patterns of late-night studying, irregular schedules, and the relationship between short sleep duration and daytime dysfunction. Implementation would benefit from structured guidance on how students should interpret diary entries (e.g., recognizing high-risk patterns and identifying feasible adjustments), rather than treating monitoring as purely record-keeping.

Second, given the apparent constraints imposed by sustained academic stress, sleep-focused interventions should be paired with workload-sensitive supports. These may include time-management coaching targeted to engineering course demands, scheduling practices that reduce clustering of high-stakes requirements within the same week, and faculty-level coordination to prevent deadline congestion. Without such contextual adjustments, individual-level awareness tools may produce only limited short-horizon gains.

Third, student guidance should explicitly address stimulant reliance and pre-sleep activation. Health promotion initiatives may incorporate brief evidence-informed advisories on caffeine timing, screen use, and cognitive wind-down strategies, recognizing that these factors can undermine sleep onset and continuity even when students intend to rest earlier.

Fourth, future research using the same general approach should prioritize stronger reporting and evaluation practices: documenting diary completion rates, clarifying diary variable coding, and reporting effect sizes alongside statistical significance to support interpretation in small samples. Where feasible, extending the monitoring window beyond one week and incorporating complementary measures (e.g., simple sleep hygiene adherence indicators) would help determine whether diary use has cumulative effects over time or whether structural barriers dominate across longer horizons.

Finally, institutions may consider integrating sleep quality screening into student support services for high-demand programs. Routine use of brief, standardized tools such as the PSQI can help identify cohorts with pervasive sleep disturbance and guide targeted interventions that balance academic rigor with sustainable student functioning.

5.3 Limitations and Future Research Directions

Limitations

Several limitations should be considered when interpreting the findings. First, the study used a small pilot sample (N = 20) drawn from a single cohort of second-year civil engineering students in one institution. This limits statistical power to detect modest intervention effects and constrains generalizability to other year levels, engineering disciplines, and institutional contexts.

Second, the evaluation relied on self-reported perceived sleep quality using the PSQI. While perceived sleep is substantively meaningful and defensible as an outcome, self-report measures remain vulnerable to recall bias and expectancy effects, particularly when participants are aware of

being observed or are engaged in daily self-monitoring.

Third, the intervention window was short (7 days). Short monitoring periods may be sufficient to increase awareness but may be insufficient for durable behavior change in sleep routines, especially within a high-demand academic environment.

Fourth, the feasibility interpretation is constrained by limited reporting on implementation fidelity (e.g., completion consistency across days, missed entries, or variations in diary adherence). Without stronger fidelity detail, it is difficult to determine whether the observed pattern reflects the diary mechanism itself or variation in compliance.

Finally, the diary period appears to have occurred under uniformly high academic pressure, as reflected by the constant stressor indicator and the frequency of caffeine use. While these contextual features are informative, they also imply that structural constraints may have bounded the magnitude of achievable change within the study timeframe.

Future Research Directions

Future work may extend this pilot evidence in several directions while retaining the core pretest–posttest controlled design and the self-monitoring logic. First, researchers should test the diary approach using larger samples across multiple sections, year levels, or institutions to improve power and assess whether the directional improvement observed here replicates under varied academic conditions.

Second, studies may examine whether diary-based self-monitoring produces stronger effects when implemented over longer observation windows (e.g., multiple weeks), enabling assessment of cumulative learning, habit formation, and whether perceived sleep quality stabilizes as students adapt to monitoring.

Third, future research should incorporate more explicit process evaluation, including compliance metrics, participant feedback on usability, and descriptive patterns of change across days. Such process data can clarify whether improvements occur through awareness, scheduling adjustments, reduced stimulant reliance, or other plausible pathways consistent with the self-monitoring mechanism.

Fourth, future studies may consider triangulating perceived sleep quality with simple corroborative indicators (e.g., consistent timing records, sleep duration summaries, or non-invasive sleep tracking summaries when available) to better understand the relationship between subjective improvement and behavioral change in sleep routines.

Finally, research may examine how academic structure variables (deadline clustering, laboratory schedules, commuting patterns) interact with self-monitoring interventions, recognizing that sleep behavior in engineering education is embedded within institutional rhythm rather than determined solely by personal intention.

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