



ROLE OF COGNITIVE BEHAVIOR THERAPY ON STUDENTS WITH SLEEP DEPRIVATION AND ITS EFFECT ON MENTAL AND PHYSICAL HEALTH: A RANDOMIZED CONTROL TRIAL

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Abstract

Objective: The aim of the current study is to find out the impact of Cognitive Behavior Therapy (CBT) on students' mental and physical health while they are undergoing extreme sleep deprivation.

Method: A Randomized Control Trial (RCT) was used in which a control group received CBT and the other control group received only medical treatment. The sample consisted of students with an age range between 15 to 24 years.

Results: The result indicated that the students who received CBT showed good mental and physical health, and their sleep improved by the 6th session compared to the students who did not receive CBT. Conversely, the students who were under medical treatment reported that their mental and physical health deteriorated due to the high dose of medicine.

Conclusion: The implication of the study suggested CBT is more effective for mental and physical health than medical treatment of sleep deprivation.

Keywords: *Sleep Deprivation, CBT, Medicine, Students.*

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1. Introduction

Sleep deprivation has emerged as a significant psychological and physiological concern among the youth population. Current trends indicate that sleep deprivation is increasing among students 12 to 18 years old, a phenomenon largely attributed to the excessive use of social media (Boer et al., 2021). The pervasive nature of digital engagement often disrupts the natural circadian rhythm, leading to chronic sleep deficits.

The consequences of this deprivation are multifaceted. On one hand, it creates specific sleep disorders such as insomnia, hypersomnia, and disturbances in rapid eye movement (REM) cycles. On the other hand, the psychological toll is severe; sleep deprivation is linked to cognitive errors, high levels of depression, anxiety, and in extreme cases, suicidal ideation in students (Scott & Woods, 2016).

Given the severity of these symptoms, finding an effective treatment modality is crucial. While medical treatment is a standard approach, it often involves pharmaceutical interventions that may carry side effects, including dependency and daytime drowsiness (Cleveland Clinic, 2023). Alternatively, psychotherapeutic interventions, specifically Cognitive Behavior Therapy for Insomnia (CBT-I), offer a non-invasive route to symptom management and have been shown to provide superior long-term results compared to medication (Mitchell et al., 2012).

The aim of the current study is to find out the impact of CBT on students' mental and physical health while they are undergoing extreme sleep deprivation.

2. Theoretical Framework

The current study is grounded in the Cognitive Model of Insomnia, primarily proposed by Harvey (2002). This framework posits that sleep disturbances are not solely physiological but are maintained by a cycle of cognitive, behavioral, and physiological processes. According to this model, individuals with sleep deprivation often engage in "safety behaviors" (such as taking high doses of medication or spending excessive time in bed trying to force sleep) and harbor dysfunctional beliefs about sleep (e.g., "If I don't sleep now, I will fail my exams").

These cognitive distortions trigger autonomic arousal and emotional distress, which in turn inhibits the natural physiological onset of sleep. In the context of the student population, this model is particularly relevant. The academic pressure and screen time create an initial sleep deficit, which is then exacerbated by anxiety regarding the consequences of sleep loss.

Cognitive Behavior Therapy (CBT) targets these maintenance factors directly. By restructuring the negative thoughts regarding sleep loss and modifying behavioral habits (Sleep Hygiene), CBT aims to break the cycle of arousal. In contrast, the Biomedical Model, which supports pharmacological intervention, targets only the physiological symptoms (sedation) without addressing the underlying cognitive arousal. This study uses this comparative framework to test the hypothesis that addressing the cognitive maintenance factors (via CBT) is superior to merely treating the physiological symptoms (via Medicine).

3.Literature Review

3.1. The Prevalence of Sleep Deprivation in Students

Sleep deprivation among university students has become a global public health concern. Research consistently indicates that the transition from adolescence to young adulthood, coupled with the demands of higher education, creates a "perfect storm" for sleep disturbances. Studies suggest that up to 60% of university students suffer from poor sleep quality (Schlarb et al., 2017). This demographic is uniquely vulnerable due to irregular academic schedules, caffeine consumption, and the "fear of missing out" (FOMO) driven by social media usage. The impact of this deprivation is not merely tiredness; it correlates strongly with reduced Grade Point Average (GPA), impaired executive function, and emotional instability.

3.2. The Mechanism of Social Media and Sleep Displacement

To understand the root cause of sleep deprivation in this demographic, it is essential to examine the role of technology. The "Displacement Hypothesis" suggests that time spent on social media does not merely replace sleep time but actively interferes with sleep onset. This occurs through two primary pathways: physiological and psychological. Physiologically, the blue light emitted by smartphone screens suppresses the secretion of melatonin, the hormone responsible for regulating the sleep-wake cycle. When students use their phones late at night, their brains are tricked into a state of alertness, delaying the onset of REM sleep.

Psychologically, the content consumed on social media induces a state of emotional and cognitive arousal. Whether it is the stress of comparing oneself to others or the dopamine loops created by short-form video content, this arousal prevents the brain from entering the "wind-down" phase necessary for rest. For students aged 15 to 24, who are highly sensitive to peer validation, the "fear of missing out" (FOMO) creates a compulsion to stay online, often sacrificing hours of necessary rest. This specific etiology

of sleep deprivation suggests that pharmacological interventions (medicine), which do not address digital habits, are ill-equipped to solve the core problem.

3.3. Pharmacological Interventions: Benefits and Risks

Historically, the first line of defense for acute sleep deprivation has been pharmacological. Sedative-hypnotics and benzodiazepines are frequently prescribed to induce sleep rapidly. While effective in the short term for increasing total sleep time, the literature highlights significant drawbacks. Long-term use of sleep medication in young adults is associated with tolerance, where higher doses are required to achieve the same effect, and "rebound insomnia" upon cessation. Furthermore, adverse effects such as daytime grogginess, cognitive dulling, and dependency are well-documented. These side effects can be counterproductive for students who require high cognitive alertness for their academic performance.

3.4. Cognitive Behavior Therapy as a Gold Standard

In response to the limitations of medication, Cognitive Behavior Therapy for Insomnia (CBT-I) has gained prominence. The literature overwhelmingly supports CBT as a long-term solution for sleep disorders. Unlike medication, which acts as a "band-aid" for symptoms, CBT addresses the root causes of sleep deprivation: the racing thoughts and poor sleep habits. Meta-analyses of Randomized Control Trials (RCTs) generally show that while medication may provide faster relief in the first week, CBT leads to more sustained improvement in sleep latency and efficiency over 6 to 12 months.

3.5. The Mental and Physical Health Link

The relationship between sleep and health is bidirectional. Literature suggests that chronic sleep deprivation acts as a catalyst for mental health disorders, particularly depression and anxiety. Physically, it weakens the immune system and increases the risk of metabolic issues. While many studies have looked at sleep scores, fewer have directly compared how the type of treatment (CBT vs. Medicine) differentially impacts the subjective feeling of physical and mental well-being in a student population. This gap in the literature necessitates the current Randomized Control Trial to determine if non-pharmacological interventions can protect students from the side effects often reported with medical treatments.

3.6. Hypotheses

- *Hypothesis 1*

Students who receive Cognitive Behavior Therapy (CBT) will report significantly lower scores on sleep deprivation (indicating better sleep quality) compared to students who receive medical treatment.

- ***Hypothesis 2***

There will be a significant difference in mental health outcomes between the two groups, with the CBT group demonstrating higher mental health scores than the medical treatment group at the post-assessment stage.

- ***Hypothesis 3***

Students in the CBT group will exhibit significantly better physical health scores compared to those in the medical treatment group, who may experience side effects from pharmacological intervention.

4. Methodology

4.1. Research Design

The study utilized a Randomized Control Trial (RCT) research design. This experimental design was chosen to effectively compare the causal impact of two distinct treatment modalities: psychological intervention (CBT) versus pharmacological intervention (Medical Treatment).

4.2. Sample

The sample consisted of $N = 60$ students selected from the university population. The student age range was between 15 to 24 years. Participants were screened to ensure they were currently experiencing symptoms of sleep deprivation.

4.3. Assessment Measures

To ensure the reliability of the data, the study utilized standardized self-report measures to operationalize the variables of sleep quality, mental health, and physical health.

4.3.1. Assessment of Sleep Quality

Sleep deprivation was measured not just by the total number of hours slept, but by the quality of that sleep. The assessment focused on several key components: sleep latency (how long it takes to fall asleep), sleep duration (total hours), habitual sleep efficiency (time asleep vs. time in bed), and sleep disturbances (waking up during the night). Lower

scores on this measure indicated a healthy sleep cycle, while higher scores reflected severe deprivation and daytime dysfunction.

4.3.2. Assessment of Mental and Physical Health

General health status was assessed using a composite scale that evaluated both psychological and somatic symptoms. The mental health sub-scale focused on the frequency of depressive symptoms, anxiety levels, and emotional exhaustion over the past two weeks. The physical health sub-scale assessed energy levels, physical fatigue, and the presence of somatic complaints such as headaches or body aches. Higher scores on these scales indicated a robust state of health, whereas lower scores indicated deterioration in well-being.

4.4. Procedure

The study received ethical approval from the Departmental Review Committee. Prior to data collection, formal permission was obtained from the university administration to approach the student body. Participants were recruited through purposive sampling. A comprehensive screening process was initiated where students completed a baseline assessment to determine their eligibility based on the inclusion criteria (currently experiencing sleep deprivation, age 15–24) and exclusion criteria (presence of other severe psychotic disorders or current substance abuse).

Informed consent was obtained from all participants, ensuring confidentiality and their right to withdraw from the study at any time. The 60 selected participants were randomly assigned to the two experimental conditions using a simple lottery method to ensure randomization and control for selection bias.

4.4.1. Experimental Protocol: CBT Group

The Cognitive Behavior Therapy group ($n=30$) underwent a structured, six-session intervention program. Each session lasted approximately 45 to 60 minutes and was conducted on a weekly basis. The protocol followed standard CBT for Insomnia (CBT-I) guidelines:

- **Session 1 (Psychoeducation).** Participants were educated about the physiology of sleep, circadian rhythms, and the detrimental effects of sleep deprivation. The concept of the "sleep drive" was explained.
- **Session 2 (Stimulus Control).** This session focused on breaking the association between the bed and wakefulness. Students were instructed to

use the bed only for sleep and to leave the bedroom if unable to sleep within 20 minutes.

- **Session 3 (Sleep Hygiene).** Behavioral modifications were introduced, including limiting caffeine intake, reducing blue light exposure (social media usage) before bed, and establishing a consistent wake-up time.
- **Session 4 (Cognitive Restructuring).** Participants were taught to identify and challenge automatic negative thoughts (e.g., "I will fail my exam if I don't sleep right now") that cause anxiety and delay sleep onset.
- **Session 5 (Relaxation Techniques).** Progressive Muscle Relaxation (PMR) and deep breathing exercises were practiced to reduce physiological arousal before bedtime.
- **Session 6 (Relapse Prevention).** The final session reviewed progress, reinforced learned strategies, and developed a plan for managing future periods of high stress (e.g., exam weeks) without relapsing into poor sleep habits.

4.4.2. Experimental Protocol: Medical Treatment Group

The Medical Treatment group ($n=30$) received standard pharmacological care. These participants were prescribed sleep medications by a qualified psychiatrist according to standard dosage guidelines appropriate for their age and weight. They were monitored weekly for adherence to the medication and to record any reported side effects. This group did not receive any psychological counseling or behavioral instructions during the six-week period to ensure the isolation of the treatment variable.

4.5. Post-Trial Ethical Care

Given the experimental nature of the study, ethical considerations extended beyond the data collection phase. Since the study involved a comparison where one group received a potentially superior treatment, the researchers adhered to the ethical principle of 'Beneficence.' Following the conclusion of the 6th session and the preliminary analysis of results—which indicated that the Medical Treatment group experienced a deterioration in health—a comprehensive debriefing protocol was implemented.

Participants from the Medical Group were informed of the study's findings and were offered the opportunity to undergo the same CBT sleep training program free of charge after the study concluded. This 'wait-list control' approach ensured that no student was left with unresolved sleep issues or negative side effects resulting from their

participation in the control condition. This step was crucial to maintaining the welfare of the students and mitigating the adverse effects of the pharmacological intervention.

4.6. Data Analysis Strategy

The quantitative data collected was processed using the Statistical Package for the Social Sciences (SPSS version 26). Before testing the main hypothesis, preliminary analyses were conducted to screen the data for any missing values or extreme outliers that could skew the results. Descriptive statistics, including means (M) and standard deviations (SD), were calculated to summarize the baseline characteristics and post-treatment scores of the sample.

To test the primary hypothesis, CBT is more effective than medical treatment—an Independent Samples t-test was employed. This parametric test was selected because the dependent variables (sleep quality scores, mental health scores, and physical health scores) were continuous in nature, and the two groups (CBT vs. Medical) were independent of each other. The assumptions of normality and homogeneity of variance were checked to ensure the validity of the t-test results. The significance level (alpha) was set at .05 for all inferential tests, meaning any *p*-value less than .05 was considered statistically significant.

5. Results

The data was analyzed using SPSS. Descriptive statistics and Independent Sample t-tests were used to compare the effectiveness of Cognitive Behavior Therapy (CBT) versus Medical Treatment on sleep deprivation, mental health, and physical health.

Table 1: *Comparison of Sleep Quality Scores (Pre-Assessment vs. Post-Assessment) across Groups*

Group	N	Pre-Treatment Mean (SD)	Post-Treatment (6th Session) Mean (SD)	t	p
CBT Group	30	14.50 (2.10)	6.20 (1.45)	12.45**	.000
Medical Group	30	14.25 (2.35)	15.80 (3.10)	-1.82	.074

*Note. Lower scores indicate better sleep quality. ** $p < .01$.*

Table 1 indicates the changes in sleep deprivation levels. At baseline, both groups showed high levels of sleep deprivation. However, results indicated that the students who received CBT saw their sleep improved at the 6th session compared to the students who did not receive CBT. The statistical analysis shows a significant improvement in the CBT

group ($p < .001$), while the medical group showed no significant improvement in sleep scores.

Table 2: Comparison of Mental and Physical Health Scores Between CBT and Medical Groups at Post-Assessment

Variable	Group	N	Mean	SD	t	p
Mental Health	CBT	30	28.40	4.25	8.65**	.000
	Medical	30	16.10	5.80		
Physical Health	CBT	30	32.50	3.90	9.12**	.000
	Medical	30	19.20	6.15		

*Note. Higher scores indicate better health status. ** $p < .001$.*

Table 2 illustrates the impact of interventions on overall health. The result indicated that the students who received CBT demonstrated good mental and physical health. Conversely, the students who were under medical treatment reported that their mental and physical health deteriorated. As shown in the table, the Medical Group scored significantly lower on health indices ($p < .001$), supporting the qualitative reports that the deterioration was due to the high dose of medicine.

6. Discussion

The primary objective of this study was to compare the efficacy of CBT versus medical treatment for sleep-deprived students. The findings of this Randomized Control Trial provide strong evidence supporting psychological interventions.

The results clearly indicated that students who received CBT demonstrated significantly better outcomes. By the 6th session, their sleep patterns had improved, and they maintained good mental and physical health. This suggests that addressing the cognitive errors and behavioral habits associated with sleep deprivation is a more sustainable solution for this age group (Mayo Clinic, 2023).

In contrast, the medical treatment group did not show similar improvements. Instead, these students reported that their mental and physical health deteriorated. This decline was explicitly linked to the side effects of the high dose of medicine required to induce sleep. This finding is critical, as it highlights the risks of pharmacological interventions in students aged 15 to 24, where physical and cognitive development is still ongoing (Galgut et al., 2024).

6.1. Interpretation of Comparative Results

The most significant finding of this study was the divergence in health outcomes between the two groups. While both interventions were aimed at alleviating sleep deprivation, the pathways and secondary outcomes differed drastically.

The CBT group's improvement aligns with the cognitive model of insomnia, which postulates that sleep problems in students are largely maintained by worry and poor habits rather than biological inability. By the 6th session, the significant *t*-values observed in Table 1 suggest that once students learned to manage the anxiety surrounding sleep, their natural sleep drive took over. This improvement in sleep quality naturally cascaded into better mental health scores (Table 2), as the reduction in fatigue allowed for better emotional regulation and cognitive focus.

Conversely, the deterioration reported by the Medical Group is a pivotal finding. Although medication can force the body into a sedated state, it does not replicate the restorative architecture of natural sleep. The qualitative reports from this group indicated that the "high dose" of medicine resulted in a "hangover effect" the following day. This residual drowsiness likely impaired their physical functioning (feeling lethargic) and mental acuity (brain fog), leading to lower scores on the health scales. This supports the hypothesis that for the student population, where cognitive sharpness is required for academic performance, the side effects of sedation may outweigh the benefits of forced sleep.

Furthermore, the deterioration in the medical group can be viewed through the lens of "loss of agency." Students taking medication may feel their sleep is dependent on an external pill, reducing their self-efficacy. In contrast, the CBT group learned active coping mechanisms, likely boosting their sense of control and, by extension, their reported psychological well-being.

6.2. Societal and Cultural Context

The findings of this study must also be interpreted within the specific cultural context of Pakistan. In this region, academic success is often prioritized over physical well-being. There is a prevailing cultural narrative that "burning the midnight oil" is a sign of dedication and hard work. Consequently, students often receive positive reinforcement from parents and teachers for staying up late to study, even if it comes at the cost of their health.

This cultural pressure exacerbates the reliance on quick fixes like medication. When students feel the pressure to perform but are exhausted from sleep deprivation, they

(or their families) may turn to pharmacological solutions to force sleep quickly so they can wake up early for classes. The results of the Medical Group in this study serve as a cautionary tale against this approach. The deterioration in health suggests that the biological cost of these medications is too high for young adults. It highlights the need for a cultural shift that values *rest* as a component of productivity, rather than an enemy of it.

6.3. Practical Implications for Educational Institutions

The superiority of the CBT intervention has direct implications for university policy and campus health services. Currently, most university health centers are equipped to dispense basic medication but lack trained professionals to deliver psychological interventions like CBT for Insomnia. Based on these findings, it is recommended that educational institutions integrate sleep health into their counseling services.

Workshops on "Sleep Hygiene" should be mandatory during freshman orientation, teaching students about stimulus control and the impact of blue light. Furthermore, universities could train peer counselors to deliver abbreviated versions of CBT techniques, making the intervention more scalable and accessible. By addressing sleep deprivation proactively through behavioral change rather than reactively through medication, institutions can likely improve not only the health of their students but their overall academic performance and retention rates.

6.4. Limitations and Recommendations

While the study offers valuable insights, several limitations must be acknowledged. First, the sample size was restricted to $N = 60$ students from a single university campus. This limits the generalizability of the findings to the broader student population in Pakistan or other cultural contexts. Second, the study relied on self-report measures for sleep quality and health. Self-report data is subject to social desirability bias, where participants might over-report their improvement in the therapy group to please the researcher. Third, the follow-up period was limited to the 6th session; therefore, the long-term sustainability of the CBT benefits versus the medical treatment effects remains unknown.

Future research should aim to replicate this study with a larger, multi-center sample to enhance external validity. It is also recommended that future studies utilize objective measures of sleep, such as actigraphy or polysomnography, to corroborate self-report data. Finally, longitudinal studies are needed to determine if the skills learned in CBT provide a protective factor against sleep deprivation during future high-stress periods, such as final term examinations.

7. Conclusion

The study concludes that Cognitive Behavior Therapy (CBT) is a superior intervention for sleep deprivation in students compared to medical treatment. The implication of the study suggests CBT is more effective for mental and physical health than medical treatment of sleep deprivation. It is recommended that clinicians prioritize CBT to avoid the adverse health effects associated with high-dose sleep medications.

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