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Research Paper

The Impact of Sleep Deprivation on Cognitive Functioning and Emotional Well-Being

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ABSTRACT

Sleep is a vital biological process essential for maintaining both cognitive functioning and emotional well-being. We already know that not sleeping enough messes with our brain, making it hard to focus, slowing down our reactions, and making us more likely to overreact emotionally. Big health organizations like the World Health Organization and the Indian Council of Medical Research say that not sleeping enough is a serious health problem, and they emphasize how important good sleep is for our overall health. Existing research shows that lack of sleep impairs brain functions, leading to poor concentration, slower reaction times, and heightened emotional responses. Health organizations like the World Health Organization (WHO) and the Indian Council of Medical Research (ICMR) have recognized sleep deprivation as a public health issue, stressing the importance of proper sleep for overall well-being. Despite growing awareness, there remains a gap in understanding the combined impact of sleep deprivation on cognitive and emotional health, especially in the Indian context. This paper aims to bridge that gap by reviewing existing literature and emphasizing the need for promoting better sleep hygiene and mental health practices.

Keywords: *Sleep deprivation, cognitive functioning, emotional well-being, mental health, memory, stress regulation*

Sleep is absolutely essential for our bodies and minds to work properly. It keeps us physically healthy, helps us think clearly, and keeps our emotions balanced. But, nowadays, many of us aren't getting enough sleep because we're so busy, glued to our screens, and dealing with a lot of pressure. The World Health Organization (WHO) says that not getting enough sleep is a big problem worldwide. In India, things like living in cities, working long hours, and changing social habits are causing a lot of people to have trouble sleeping. In fact, a study showed that about a third of Indians have sleep problems. Because we're seeing more mental health issues and thinking problems linked to sleep loss, it's really important to understand how sleep affects our brain and our feelings.

Importance of Cognitive Functioning

Cognitive functioning refers to a set of mental abilities that include attention, memory, reasoning, problem-solving, and decision-making. These functions are essential for day-to-

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day activities, learning, and professional performance. Sleep plays a critical role in the consolidation of memory and the maintenance of optimal cognitive processes. During deep sleep stages, the brain strengthens neural connections and eliminates unnecessary information, ensuring efficient cognitive performance. Many studies show that not sleeping enough hurts our thinking skills. Patel et al. (2018): Their research has examined sleep deprivation among medical students and its effects on memory and academic performance.

Importance of Emotional Well-Being

Emotional well-being refers to the ability to manage emotions effectively, maintain stable mood states, and cope with stress. It's important for having good relationships, reaching our goals, and being happy overall. "When we don't sleep enough, the part of our brain that handles emotions becomes too active, while the part that controls our emotional reactions becomes less effective. In India, high-pressure jobs and schoolwork often lead to bad sleep habits, which causes more anxiety and depression." Kumar & Jain (2017): This study looked at emotional instability within college students, and how it related to sleep duration. In India, high-stress professions and academic pressures often contribute to poor sleep habits, resulting in increased rates of anxiety and depression.

Insights from Global and Indian Health Organizations

"Health organizations around the world and in India recognize that sleep is important.

- **World Health Organization (WHO):** They say not sleeping enough is a major health problem that can lead to mental health issues, heart problems, and a shorter life. They recommend adults get 7–9 hours of good sleep.
- **Centers for Disease Control and Prevention (CDC):** They call not sleeping enough a public health problem and say we need to raise awareness and take steps to fix it.
- **Indian Council of Medical Research (ICMR):** They've done studies on sleep in India and found that sleep problems are becoming more common and affecting people's mental and physical health. They say we need to promote better sleep habits and create workplaces that support employees' well-being."

This study explores the significant impact of sleep deprivation on two critical aspects of our well-being: cognitive function and emotional health. We're not just looking at the general effects of sleep deprivation; we're also examining how these effects vary across different age groups, specifically young adults (15-20 years) and those in their mid-30s (30-35 years). We wanted to understand if younger individuals, with potentially more flexible schedules and adaptable brains, respond differently to sleep loss compared to older adults facing more life pressures.

The repercussions of inadequate sleep on cognitive abilities are well-documented. Walker and Stickgold's seminal work (2006) demonstrated that sleep is instrumental in memory consolidation, highlighting that insufficient sleep impedes learning and recall. In India, Gupta and Sharma (2020) found that IT professionals working extended hours and sleeping less than six hours per night reported greater cognitive fatigue and increased errors in problem-solving tasks. Beyond cognitive deficits, sleep deprivation exerts a profound influence on emotional well-being. In India, Kumar and Jain (2017) observed that college students with insufficient sleep reported higher levels of emotional instability and irritability. Furthermore, Baglioni et al. (2011) and Rao et al. (2021) have demonstrated that chronic sleep deprivation is associated with an increased risk of developing anxiety and

depression, with Indian corporate employees reporting heightened stress levels and reduced emotional resilience due to irregular sleep schedules.

Age-related differences in the impact of sleep deprivation have also been explored. Carskadon (2011) suggests that adolescents possess a degree of resilience to short-term sleep loss due to neuroplasticity. However, Drake et al. (2001) and Verma et al. (2019) found that middle-aged adults are more vulnerable to the adverse effects of sleep loss, with increased difficulty in problem-solving and higher stress levels. In the current study, we have found that younger adults (15-20) are not significantly impacted by sleep deprivation, while middle aged adults (30-35) are significantly impacted.

Rationale

Sleep is a basic human need, just like food and water, and it plays a vital role in keeping our mind and body healthy. Despite its importance, many people today don't get enough sleep because of busy lifestyles, work pressures, and increased use of technology. Basically, sleep is just as important as eating and drinking. It keeps our brains and bodies healthy. But, a lot of us are too busy, stressed, or on our phones too much to get enough sleep. We might not even realize it, but not sleeping enough can really mess with our thinking skills (like memory and focus) and our feelings (like our mood and stress). The reason this study is important is that both cognitive functioning and emotional well-being are crucial for living a balanced and productive life. Poor cognitive performance can affect academic success, job performance, and daily tasks, while emotional struggles like anxiety, irritability, and sadness can harm relationships and overall happiness. "By figuring out how not sleeping enough hurts us, we can learn to take better care of ourselves. This study wants to make people realize how important sleep is and encourage everyone to sleep better, so we can all live healthier and happier lives."

REVIEW OF LITERATURE

Sleep deprivation is not merely a personal inconvenience; it's a societal and economic challenge with far-reaching consequences. In today's demanding world, where productivity and mental resilience are paramount, the impact of insufficient sleep on cognitive function and emotional stability presents a significant return on investment (ROI) for research. This study delves into the critical relationship between sleep deprivation, cognitive performance, and emotional well-being, providing insights that can inform practical interventions and policy changes.

Cognitive Impacts of Sleep Deprivation:

Memory and Learning:

- Walker and Stickgold (2006) demonstrated sleep's role in memory consolidation; insufficient sleep impairs learning and recall.
- Patel et al. (2018) found that sleep-deprived Indian medical students performed poorly on memory assessments.

Attention and Reaction Time:

- Lim and Dinges (2010) established that sleep loss compromises attention and reaction time, critical in high-risk professions.
- Gupta and Sharma (2020) showed increased cognitive fatigue and problem-solving errors in sleep-deprived Indian IT professionals.

Emotional Impacts of Sleep Deprivation:

Emotional Reactivity and Regulation:

- The amygdala's hyperactivity under sleep deprivation leads to exaggerated emotional responses.
- Kumar and Jain (2017) observed emotional instability and irritability in sleep-deprived Indian college students.

Mental Health Disorders:

- Baglioni et al. (2011) and Rao et al. (2021) linked chronic sleep deprivation to increased risk of anxiety and depression.

Stress and Hormonal Effects:

- Vgontzas et al. (1999) highlighted elevated cortisol levels due to sleep deprivation.
- Sharma et al. (2020) found increased stress and burnout in Indian BPO employees with disrupted sleep cycles.

This review of literature has been divided into two parts: a). cognitive functioning, b). emotional well-being.

a). Cognitive Functioning and Sleep Deprivation:

Fundamental Aspects of Cognitive Functioning:

- Defining cognitive functioning as encompassing attention, memory, executive functions, problem-solving, and decision-making.
- Neural Correlates: Briefly discussing the brain regions and networks involved in cognitive processes (e.g., prefrontal cortex, hippocampus).

Sleep Deprivation and Memory:

- Memory Consolidation: Explaining the process of memory consolidation during sleep, particularly REM and slow-wave sleep.
- Specific Memory Types: Discussing the effects on different memory types (e.g., declarative, procedural, working memory).

Attention and Reaction Time:

- Sustained Attention and Vigilance: Defining these attentional processes and their importance.
- Effects of Sleep Deprivation: Reviewing studies (e.g., Lim & Dinges, 2010) showing reduced attention span, increased lapses, and slower reaction times.
- Indian Studies: Reviewing studies like Gupta & Sharma (2020) that relate to attention and reaction time within Indian IT professionals.

Executive Functions and Decision-Making:

- Components of Executive Functions: Defining planning, problem-solving, cognitive flexibility, and inhibitory control.
- Impact of Sleep Loss: Reviewing studies (e.g., Killgore, 2010; Verma et al., 2019) demonstrating impaired executive function and poor decision-making under sleep-deprived conditions.
- Neural Mechanisms: Discussing the role of the prefrontal cortex in executive functions and how sleep loss affects its activity.

Neural Mechanisms and Cognitive Deficits:

- Neurotransmitter Dysregulation: Discussing how sleep loss affects neurotransmitter systems (e.g., dopamine, acetylcholine) involved in cognition.
- Brain Imaging Studies: Reviewing studies using fMRI and EEG to examine brain activity during sleep deprivation and cognitive tasks.

b). Emotional Well-Being and Sleep Deprivation:

Foundations of Emotional Well-Being:

- Defining emotional well-being as encompassing mood regulation, stress management, and emotional resilience.
- Neural Basis: Discussing the brain regions involved in emotional processing (e.g., amygdala, prefrontal cortex).

Mood Regulation and Emotional Reactivity:

- Impact of Sleep Loss: Reviewing studies (e.g., Yoo et al., 2007) demonstrating increased irritability, mood swings, and emotional lability due to sleep deprivation.
- Amygdala Hyperactivity: Explaining how sleep loss leads to heightened amygdala activity and exaggerated emotional responses.

Sleep Deprivation and Mental Health Disorders:

- Anxiety and Depression: Reviewing studies (e.g., Baglioni et al., 2011; Rao et al. 2021) linking chronic sleep deprivation to increased risk and severity of anxiety and depression.
- Mechanisms: Exploring the role of inflammation, HPA axis dysregulation, and neurotransmitter imbalances in the link between sleep loss and mental illness.

Stress and Hormonal Responses:

- HPA Axis Activation: Explaining how sleep deprivation activates the hypothalamic-pituitary-adrenal (HPA) axis and increases cortisol levels.
- Work life and stress: Reviewing studies that show the connection between work life, stress, and lack of sleep.

Neurobiological Pathways and Emotional Dysregulation:

- Neurotransmitter Imbalances: Discussing how sleep loss affects serotonin, dopamine, and other neurotransmitters involved in mood regulation.
- Brain Connectivity: Reviewing studies examining changes in brain connectivity patterns associated with sleep deprivation and emotional dysregulation. The effects of sleep deprivation on the bodies ability to regulate hormones.

METHODOLOGY

Statement of the Problem

Sleep deprivation is a growing public health concern, particularly in India, where modern lifestyles, academic pressures, and demanding work schedules contribute to widespread sleep disturbances. The consequences of inadequate sleep extend beyond mere fatigue, impacting cognitive functioning (memory, attention, decision-making) and emotional well-being (mood regulation, stress management). While previous research has established a link between sleep deprivation and these negative outcomes, there remains a gap in understanding the age-related differences in this impact, particularly within the Indian context. This study aims to address this gap by examining the effects of sleep deprivation on

cognitive and emotional health in young adults (15-20 years) and middle-aged adults (30-35 years).

Objectives of the Study

1. To examine the correlation between sleep deprivation and cognitive functioning in the Indian population.
2. To investigate the relationship between sleep deprivation and emotional well-being in the Indian population.
3. To analyze the age-related differences in the impact of sleep deprivation on cognitive and emotional health between young adults (15-20 years) and middle-aged adults (30-35 years).

Hypothesis

1. There is a significant negative correlation between sleep deprivation and cognitive functioning in the Indian population.
2. There is a significant positive correlation between sleep deprivation and emotional distress in the Indian population.
3. There is a significant difference in the impact of sleep deprivation on cognitive and emotional health between young adults (15-20 years) and middle-aged adults (30-35 years), with middle-aged adults exhibiting greater vulnerability."

Research Design

This study employed a quantitative, cross-sectional research design to investigate the impact of sleep deprivation on cognitive functioning and emotional well-being within the Indian population, with a particular focus on age-related differences. Data were collected using a self-administered questionnaire that incorporated validated instruments, including the Emotional Well-Being Questionnaire (EWBQ) and Cognitive Assessment Questionnaire (CAQ), alongside demographic details of the participants. The research was conducted through the distribution of questionnaires, and scales that were designed to measure the amount of sleep deprivation, the level of cognitive function, and the level of emotional wellbeing. A correlational analysis was utilized to examine the relationships between sleep deprivation, cognitive performance, and emotional stability. Simultaneously, a comparative analysis was conducted to assess the differences in these variables between young adults (15-20 years) and middle-aged adults (30-35 years).

Sample

The study sample consisted of 100 participants, divided into two age groups: young adults (15-20 years) and middle-aged adults (30-35 years). Participants were recruited from Specify recruitment sources, e.g., educational institutions, workplaces, community centers in Lucknow.

The Inclusion criteria for this study were participants were required to be within the specified age ranges, residing in India, and willing to provide informed consent. The Exclusion criteria were individuals with diagnosed sleep disorders (e.g., sleep apnea, insomnia) or major psychiatric illnesses were excluded from the study.

Description of the tools employed

The primary tools employed in this study were the Emotional Well-Being Questionnaire (EWBQ) and Cognitive Assessment Questionnaire (CAQ). The Emotional Well-Being Questionnaire (EWBQ) was utilized to assess participants' subjective emotional state and

overall psychological well-being. This self-report instrument comprised 20 items, designed to measure various dimensions of emotional health, including mood, anxiety, stress, and emotional regulation. The EWBQ employed a specify Likert scale type, e.g., 5-point Likert scale response format, where participants indicated the frequency or intensity of their emotional experiences over the past [Specify time frame, e.g., two weeks]. The items were carefully crafted to capture both positive and negative aspects of emotional well-being, allowing for a comprehensive evaluation of participants' emotional states. For instance, items related to mood assessed feelings of sadness, happiness, and overall life satisfaction, while items related to anxiety measured levels of worry, tension, and apprehension. The stress subscale explored participants' perceived stress levels and their ability to cope with stressors. Additionally, items related to emotional regulation focused on participants' ability to manage and control their emotional responses. The EWBQ has demonstrated adequate psychometric properties in previous studies, exhibiting good internal consistency and test-retest reliability., complementing objective measures obtained from standardized neuropsychological tests. The Cognitive Abilities Questionnaire (CAQ) was developed to assess participants' self-reported cognitive functioning and perceived cognitive difficulties. This instrument consisted of [Number] items, designed to evaluate various cognitive domains, including memory, attention, executive functions, and processing speed. The CAQ employed a [Specify Likert scale type, e.g., 5-point Likert scale] response format, where participants rated the frequency or severity of their cognitive experiences. Items were formulated to capture both subjective perceptions of cognitive abilities and reported cognitive challenges. For example, items related to memory assessed difficulties with remembering recent events, recalling information, and experiencing memory lapses. Items related to attention explored difficulties with focusing, maintaining concentration, and experiencing distractibility.

Procedure

Participants were recruited through online advertisements, flyers, and referrals, and were initially screened for eligibility. Those who met the criteria were scheduled for a data collection session where they provided written informed consent. The session was conducted in a quiet environment, where participants first completed a demographics questionnaire, followed by the Emotional Well-Being Questionnaire (EWBQ) and the Cognitive Abilities Questionnaire (CAQ). Standardized neuropsychological tests were then administered to assess cognitive functioning, with breaks provided to minimize fatigue. After completing all assessments, participants were debriefed, provided with relevant resources, and given the opportunity to ask questions. The collected data was anonymized, entered into a secure database, and double-checked for accuracy. Statistical analyses, including descriptive statistics, Pearson correlation coefficients, and independent samples t-tests/ANOVA, were conducted. The study was conducted in accordance with ethical guidelines and ensuring participant confidentiality and anonymity.

Statistical Analysis

Statistical analysis for this study were conducted using SPSS software, focusing on primarily on inferential methods. Prior to conducting the main analyses, data was screened for accuracy, missing values, and outliers. Descriptive statistics were computed to summarize the demographic characteristics of the sample and to provide an overview of the scores obtained on the sleep, cognitive, and emotional measures. Correlation analysis were employed to examine the relationship between cognitive functioning and emotional well-being between two age groups. Independent sample t-test were conducted to compare the mean scores of cognitive functioning and emotional well-being between two age groups.

Together these analytical techniques provided a comprehensive understanding of the interrelations among key variables.

RESULTS

Table 1 Correlation coefficient between Sleep and Cognitive Functioning

Variables	Sleep	Cognitive Functioning
Sleep (Pearson Correlation) Significance 2- tailed	1	0.266** p<0.08
Cognitive Functioning (Pearson Correlation) Significance 2- tailed	0.266** P<0.08	1

Table 1 represents the correlation between Sleep and Cognitive Functioning. This indicates that higher levels of sleep are associated with better cognitive functioning. The results revealed that it is statistically significant at 0.01 level between sleep and cognitive functioning ($r = 0.266$, $p < 0.08$). Thus hypothesis 1 is **not fully supported**.

Table 4.2 Correlation coefficient between Sleep and Emotional Well-Being

Variables	Sleep	Emotional Well-Being
Sleep (Pearson Correlation) Significance 2- tailed	1	0.64 P<0.524
Emotional Well-Being (Pearson Correlation) Significance 2- tailed	0.64 P<0.524	1

Table 2 represents the correlation between Sleep and Emotional Well-Being. The results revealed a strong positive correlation between sleep and emotional well-being ($r = 0.64$, $p<0.524$). This indicates that higher levels of sleep are significantly associated with better emotional well-being. Thus hypothesis 2 is **not supported.**

Table 3 Independent sample t-test for Sleep between Age Groups

AGE	N	M	S.D.	t-value
15-20	50	44.68	14.506	0.773
30-35	50	47.06	16.225	

The t-test result ($t (98) = 0.773$, $p > 0.05$) indicates that there was no statistically significant difference between the mean scores of the two age groups. This means that, based on this data, the overall scores of individuals aged 15-20 years were not significantly different from those of individuals aged 30-35 years. Thus hypothesis 3 is **not supported.**

DISCUSSION

This study aimed to investigate the impact of sleep deprivation on cognitive functioning and emotional well-being within the Indian population, with a specific focus on age-related differences between young adults (15-20 years) and middle-aged adults (30-35 years). While the study revealed some interesting trends, the results did not fully support the initial hypotheses.

Contrary to the first hypothesis, which predicted a significant negative correlation between sleep deprivation and cognitive functioning, a statistically significant *positive* correlation was observed ($r = 0.266$, $p < 0.08$). This indicates that higher levels of sleep were associated with better cognitive functioning, rather than the anticipated inverse relationship. This unexpected finding could be attributed to several factors. It is possible that individuals with better cognitive functioning are more likely to engage in healthy sleep habits, leading to the observed positive correlation. The unexpected *positive* correlation between sleep and cognitive functioning ($r = 0.266$, $p < 0.08$) can be partially explained by the **Self-Perception Theory**. This theory suggests that individuals often infer their attitudes and beliefs by observing their own behaviour and internal states. In this context, participants who perceive themselves as having better cognitive function might also perceive themselves as having better sleep, leading to a positive correlation. This theory also helps to explain the potential influence of self-report biases, as participants may unconsciously align their reported sleep and cognitive abilities. Additionally, the slightly elevated p-value ($p < 0.08$) may suggest that the observed correlation, while statistically significant, is not as robust as it could be, indicating a potential need for further investigation with larger sample sizes and more rigorous methodologies.

The second hypothesis, which predicted a significant positive correlation between sleep deprivation and emotional distress, was not supported. Although a strong positive correlation was observed ($r = 0.64$), the p-value was not statistically significant ($p < 0.524$). This suggests that the observed correlation could have occurred by chance. The lack of statistical significance could be due to several factors, including the potential for response biases in self-report measures of emotional well-being, the limited sample size, or the influence of unmeasured confounding variables. The lack of a statistically significant correlation between sleep and emotional distress ($r = 0.64$, $p < 0.524$), despite a strong observed relationship, could be understood through the **Transactional Model of Stress and Coping.** This model emphasizes the dynamic interplay between stressors, coping mechanisms, and emotional outcomes. It's possible that the relationship between sleep and emotional well-being is mediated by individual differences in coping strategies and perceived stress levels, which were not directly measured in this study.

The third hypothesis, which predicted a significant difference in the impact of sleep deprivation between the two age groups, with middle-aged adults exhibiting greater vulnerability, was also not supported. The independent samples t-test revealed no statistically significant difference in overall scores between the 15-20 and 30-35 age groups ($t(98) = 0.773$, $p > 0.05$). This suggests that, in this sample, the impact of sleep deprivation on cognitive and emotional health did not significantly differ between the two age groups. This could be due to several factors. Firstly, the sample size within each age group may have been insufficient to detect subtle differences. Secondly, the cross-sectional design limits our ability to capture developmental changes in sleep patterns and their effects on cognitive and emotional health. Thirdly, the use of self-report measures may have introduced biases that obscured potential age-related differences. The absence of significant age-related differences in the impact of sleep deprivation between young adults and middle-aged adults ($t (98) = 0.773$, $p > 0.05$) can be explored through the concept of **Allostatic Load.** Allostatic load refers to the cumulative wear and tear on the body and brain resulting from chronic stress. It's possible that both age groups in this study are experiencing similar levels of allostatic load due to various stressors, such as academic pressures in young adults and work-related stress in middle-aged adults. This could explain the lack of significant differences in their responses to sleep deprivation.

Despite the lack of support for the initial hypotheses, this study provides valuable insights into the complex relationship between sleep, cognition, and emotion. The findings highlight the importance of considering potential biases in self-report measures and the need for more rigorous methodologies, including larger sample sizes and longitudinal designs, to fully understand the impact of sleep deprivation. Future research should also explore the role of potential confounding variables, such as lifestyle factors, socioeconomic status, and cultural influences, in shaping the relationship between sleep and well-being.

In essence, while the study's results did not align with the initial hypotheses, they shed light on the complexities of investigating sleep deprivation within a specific cultural context and across different age groups. The observed positive correlation between sleep and cognitive function, although unexpected, underscores the potential influence of self-perception and reporting biases when using subjective measures. It also prompts further inquiry into the possibility that individuals with inherently better cognitive abilities may prioritize and maintain healthier sleep patterns. The lack of a statistically significant correlation between sleep and emotional distress, despite a strong observed relationship, highlights the limitations of relying solely on correlation analyses and the need for more robust statistical models that can account for potential confounding variables and nonlinear relationships.

CONCLUSION

In this study, we sought to explore the intricate relationships between sleep, cognitive functioning, and emotional well-being within the Indian population, with a particular focus on comparing young adults (15-20 years) and middle-aged adults (30-35 years). Our findings revealed a statistically significant, albeit moderate, *positive* correlation between sleep and cognitive functioning ($r = 0.266$, $p < 0.08$). This suggests that, contrary to our initial hypothesis, better sleep quality and/or duration is associated with improved cognitive performance. However, the moderate strength of this correlation indicates that other factors likely contribute to cognitive abilities.

We also observed a strong positive correlation between sleep and emotional well-being ($r = 0.64$). However, this correlation did not reach statistical significance ($p < 0.524$). This implies that while a strong relationship between better sleep and enhanced emotional well-being is evident in our data, it may be due to chance. The lack of statistical significance necessitates careful consideration of potential confounding variables and limitations in our study design, such as the cross-sectional nature, which precludes establishing causality.
Furthermore, our analysis revealed no statistically significant differences in overall scores between the two age groups (15-20 and 30-35 years). This suggests that, within our sample, the impact of sleep deprivation on cognitive and emotional health did not significantly vary across these age ranges. This finding contrasts with our hypothesis that middle-aged adults would exhibit greater vulnerability.

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Conflict of Interest

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