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From Brain to Behavior: The Impact of Sleep Deprivation on Disrupting the Connectivity of the Prefrontal Cortex and Amygdala, Causing Changes in Adolescents' Mood Regulation

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Abstract: ***This review consolidates globally renowned research on the relationship between circadian rhythm, sleep, and behavioral occurrences in adolescents through a biological lens. Adolescence is a crucial stage of development, marked by rapid biological, social, and psychological changes, especially in sleep-wake cycles. Sleep is defined as a complex yet reversible state of mind that diminishes an individual's responsiveness and a species-specific posture. This paper identifies the direct relationship between worsening sleep habits and increased mental tragedies like depression and anxiety from a neurological lens. According to the U.S. Centers for Disease Control and Prevention, 72.7% of high school students report getting less than the recommended amount of sleep on school nights. The aim of the paper is to investigate how sleep deprivation disrupts connectivity between the prefrontal cortex and amygdala, which in turn causes changes in adolescents' mood regulation. Altogether, this paper examines a compilation of longitudinal, cross-sectional, and experimental studies from Australia, India, China, Canada, and the United States. Findings indicate how worsening sleep patterns are directly associated with increased symptoms of mental disorders like depression and anxiety. Each paper identifies different factors like modern disruptors, intense use of social media, and being prone to sleep disorders like insomnia, with female adolescents showing a greater vulnerability. Furthermore, the COVID-19 pandemic affected sleep patterns, but not all sleep patterns were impacted equally, with a clear socioeconomic and racial inequity. In conclusion, this review showcases sleep as a mediator between modern lifestyle and adolescents' well-being. Signalling for direct intervention through public health strategies like digital literacy, school timings, and concern for the mental health development of adolescents. However, future studies should adopt longitudinal study designs and objective wearable digital measurement instruments in order to further clarify causal relationships between digital behaviors and neurodevelopment.***

Keywords: Adolescence, Circadian rhythm, Sleep deprivation, Prefrontal cortex, Amygdala

1. Introduction

Sleep is defined as a complex yet reversible state of mind (Zisapel, 2007; Carskadon & Dement, 2011) that diminishes an individual's responsiveness and a species-specific posture. Unlike comas, delirium, etc., which are states where there is reduced receptivity to environmental changes, sleep involves REM (rapid eye movement) and NREM (non-rapid eye movement), which are generated by the central nervous system that uses specific neurotransmitters located in specific parts of the brain. There is a massive link between sleep and circadian rhythm, which are cycles of physical, mental, and behavioral changes throughout 24 hours. It is endogenous in nature, where the reaction occurs inside the body, and it is more than just the body's response to sunrise/sunset. In mammals, the master clock is situated in the hypothalamus, in the suprachiasmatic nuclei (SCN), which control the clocks of millions of cells. The clock works through periodic gene expression, where specific genes work like instructional codes; however, it displays stoichiometric behavior where the amount of protein produced determines its effects. Sleep is considered the most obvious circadian rhythm, as it is adapted to environmental changes and is endogenous in nature. This is measured via polysomnography, including brain waves, eye movements, etc. Sleep cycles have four stages: REM and non-REM, wherein REM brain activity is at its highest and vivid dreams occur. In modern society, we expect to have consolidated sleep (just a long block at night); however, research suggests that humans are naturally polyphasic, meaning we have multiple bouts of sleep throughout the day. While sleep is highlighted, adolescents in the present day tend to ignore the essence of sleep and the influence it has on their mental health, therefore becoming victims of sleep debt, which is the cumulative effect of not obtaining their full required quota of nightly sleep. In our modern "24-Hour Society", humans frequently use artificial light to extend wakefulness, adhering to a short-night sleep schedule that often results in chronic sleep deprivation. Michelle A. Short and Mia Louca conducted a study to explore the connection between sleep deprivation and mood deficits in healthy adolescents. The study aimed to determine the causal effect of 36 hours of total sleep deprivation on the discrete mood states of 12 healthy adolescents aged 14 to 18. Mood was assessed every two hours using the Profile of Mood States – Short Form (POMS-SF) to track changes in anger, depression, anxiety, confusion, fatigue, and vigor. Following one night without sleep, all six mood states significantly worsened, with scores peaking in negativity around 05:00h (the circadian nadir) and failing to recover the next day.

Females were found to be more vulnerable than males, showing significant increases in anxiety and depressed mood that were not statistically significant in the male group. These findings suggest that sleep loss is a causal risk factor for mood dysregulation during the critical

developmental phase of adolescence. The relationship between sleep and emotional reactivity is a two-way street: sleep deprivation can heighten emotional reactivity, and heightened emotional reactivity can make it harder for an individual to sleep. There is a tiny part in our brain called the amygdala, an almond-shaped set of neurons located deep within the temporal lobes of the brain that serves as a primary processing center for emotions, particularly fear, anxiety, and aggression, which become hyperactive when the body experiences sleep deprivation. While the prefrontal cortex, which is located directly behind the forehead, acts as the brain's "executive center". It manages complex cognitive behaviors, including planning, decision-making, personality expression, moderating social behavior, and high-level thinking. It especially manages to stop the amygdala from making a wrong decision depending on the severity of the situation. Sleep loss causes a disconnect between the brakes and the alarm; the mPFC loses its ability to inhibit the amygdala, leading to uncontrolled emotional outbursts. It is important that an individual experiences the REM cycle in the sleep cycle, which is the phase where they experience vivid dreams and allows the brain to sort out emotional events that took place the entire day. Some parts of the brain require deactivation for healthy well-being. For people with insomnia, these areas stay active all night, leading to a state of hyperarousal. Additionally, the brain produces a neurotransmitter called 'GABA', which acts as a chemical calmer, reducing brain activity while sleeping. People with insomnia or bipolar disorder often have low levels of GABA. This deficiency makes it harder for the brain to turn off at night and harder to keep emotions stable during the day.

Neurochemistry suggests that wakefulness is promoted by neurons in the brainstem and hypothalamus. During sleep, these arousal systems are inhibited by GABAergic neurons, particularly in the ventrolateral preoptic nucleus (VLPO). There are many functions of sleep; firstly, its restorative nature, where it is essential for physical and mental well-being, as poor sleep is linked to increased risks of hypertension, diabetes, and mortality. Secondly, memory: different sleep stages support different types of memory. Slow-wave sleep (SWS) benefits declarative memory (facts and events), while REM sleep is important for procedural skills and emotional material. Sleep is closely integrated with other circadian systems, and disruption in one often affects the others: temperature, blood pressure, and immune and hormonal systems. Core temperature and sleep propensity vary inversely; a drop in temperature typically facilitates sleep. Normal sleep is associated with a 10–20% nocturnal fall in blood pressure. Loss of this profile is often due to sleep apnoea, which increases cardiovascular risks. Sleep and the immune system share bidirectional pathways; cytokines like IL-6 can promote sleepiness. Additionally, growth hormone is secreted during SWS (the third phase of the sleep cycle), while cortisol (a stress hormone) is inhibited during early sleep and peaks just before awakening. Sleep patterns change from infancy to adulthood, with newborns spending most of their time in REM-like "active sleep". As people age, the robustness of the circadian system decreases. Older adults often experience a significant reduction in SWS, leading to lighter, more fragmented sleep and an increased prevalence of insomnia. Diseases like Alzheimer's and Parkinson's are heavily associated with sleep disturbances and diminished melatonin levels.

The major objective of the review is to analyze research from various countries and identify the major gap, mainly between India and foreign countries. This article clearly identifies India's limited involvement in this field, particularly regarding the impact of sleep deprivation on students. Alongside this, it's an incentive for educators and policymakers to look into this matter and take better steps. A gap between policies was clearly visible between India and other foreign countries, which is again a major concern.

2. Review of Literature

There is a notable difference in the emphasis of research into adolescent sleep in India and the rest of the world, with Indian research being more descriptive rather than in-depth biological research. Indian research is a strong 'alarm system' showing a huge public health problem due to heavy workloads and the rapid digitalization of academics.

In Tamil Nadu and Delhi, studies have found a "perfect storm" of adolescent sleep problems, with 62% reporting suboptimal sleep quality and 12–13 years as a critical sleep phase transition age. The findings are warranted by the rigorous educational climate and early school starting times in this country that compel students to suffer from chronic sleep deprivation. In addition, Anand et al. (2024) conducted experimental studies in India where they found physiological indicators such as reduced HRV (RMSSD) in relation to positive valence emotions (happiness, interest, pride, amusement, and joy) and hyperarousal in negative valence emotions (anger and fear) following acute sleep deprivation, thereby providing specific evidence of "emotional blunting" towards positive stimuli and hyperarousal towards negative valence emotions.

Research internationally, however, is beyond mere description of behavioral symptoms and explores structural and societal inequity mechanisms, such as in Australia and Canada. Indian studies have also shown that 70-75% of adolescents are experiencing a "digital addiction", with internet abuse on the rise, but studies abroad indicate that this is not an isolated issue, as internet addiction is a growing problem worldwide.

The Australian studies by Jamieson et al. (2020, 2021) offer a more compelling biological explanation. They found that poor sleep in adolescence was associated with reduced myelination of the 'top-down' white matter tract of the brain, the uncinate fasciculus (UF).

A crucial result that supports their conclusion is that sleep loss is not merely a symptom but a cause of the 'emotional brain's' physical rewiring in the long term and throughout life, leading to anxiety. This comparison is extended by Canadian and Chinese research using large-scale, longitudinal surveillance and biological markers. In China, Wang et al. monitored 1,957 children for one year, discovering 63.3% did not meet sleep guidelines and morning cortisol was a biological link between poor sleep

and subsequent depression (Wang et al., 2021). Canadian research by Lafontaine-Poissant et al. (2024) and Duncan et al. (2023) also emphasizes gendered and socioeconomic inequities.

They found that problematic social media use is linked to a 3.24 times greater risk of late-night bedtimes among students on weekends and that pandemic-associated sleep improvements were not distributed evenly among students on socioeconomic and identity bases. The bottom line is methodological: while Indian papers document lifestyle risks in a developing economy, Western and East Asian research provides frameworks for both neurobiological and sociopolitical explanations. Indian studies are heavily based on cross-sectional surveys. A review of the international literature has developed causal pathways that link digital behaviors to brain maturation to mental health trajectories.

This comparison highlights the critical need for Indian research to shift from descriptive warnings to more powerful and neurobiologically informed public health policies, which is the need of the hour and could be facilitated by using objective measurement tools like wearable devices. It is worth noting that social media has become a major disruptor of the sleep cycle in adolescents through multiple interconnected physiological and behavioral pathways. On the physiological level, the blue light emitted by social media-enabled devices acts on intrinsically photosensitive retinal ganglion cells that are most responsive to light in the blue range of wavelengths (around 480 nm), leading to a reduction in melatonin output and to a delay in the circadian phase, which in turn disrupts the quality of sleep. Research studies have consistently shown that only two hours of evening light exposure lead to an average 1.1-hour circadian phase delay and that adolescents are more susceptible to such a delay as a result of pubertal changes of the intrinsic circadian timing system. In addition to light exposure, nighttime use of social media causes hyperarousal, or an increase in psychological and physiological activation, which increases latency to sleep onset and diminishes sleep quality. Behaviourally, social media content can be engaging and stimulating, such as interactive messages, watching videos, and participating in discussion forums; sleep initiation is more difficult, even when users turn off their devices. Most importantly, psychological factors like fear of missing out (FOMO) and social comparisons amplify the effects to such a degree that the notifications become a constant reminder to check, and adolescents increasingly become socially present, leading to compulsive engagement patterns at night. FOMO-motivated teens are often found with their mobile device within reach while they sleep, and they wake up looking for messages, thus disrupting and limiting sleep. The convergence of these mechanisms represents a multifactorial impetus to the inability to obtain restorative sleep and thus plays a significant role in the epidemic of adolescent sleep deprivation and its downstream consequences in mood regulation and prefrontal-amygdala connectivity.

3. Country-wise analysis

3.1 India

The cross-sectional study by Singh et al. (2018) aimed to examine adolescent sleep patterns and observe how differences in routines and phase preferences impact mood, attendance, and academic performance, while also pinpointing the age at which these biological shifts become evident. Researchers surveyed 501 students aged 11 to 15 years in a Delhi school using a self-reported school sleep habits questionnaire to evaluate sleep duration, quality, daytime sleepiness, and symptoms of depression alongside school records. The findings identified 12–13 years old as the critical age for sleep phase transition, highlighting that as students aged, their bedtimes shifted significantly later while school timings were kept constant, causing a decline in total sleep and a rise in sleep deprivation prevalence from approximately 84–87% to over 90%. Hence, older adolescents showed higher levels of depression and poorer attendance; the study found no direct association between sleep patterns and academic performance alone, concluding that the relationship between these factors is a complex, multifactorial association that requires longitudinal research to fully understand, and there are a lot of external factors involved.

The cross-sectional study by Sarala et al. (2026) aimed to investigate how sleep patterns and sleep quality influence cognitive performance and emotional health among a sample of 200 adolescents aged 13 to 18 years from urban and semi-urban schools in Tamil Nadu, India. To achieve this, researchers utilized standardized assessment tools, including the Pittsburgh Sleep Quality Index (PSQI), the Digit Span and Attention Network Tests, and the Depression Anxiety Stress Scales (DASS-21), to evaluate the participants' sleep, memory, attention, and emotional distress levels. The findings revealed that 62% of participants reported poor sleep quality and 48% were sleep-deprived (obtaining less than seven hours of sleep), showing a significant negative correlation between sleep quality and cognitive performance ($r = -0.54$) and a positive correlation with emotional distress ($r = 0.49$). The study concludes that inadequate sleep is a primary factor in diminished thinking capacities and heightened emotional difficulties, highlighting sleep as a critical mediator between modern lifestyle factors like excessive screen time and academic stress – and overall adolescent well-being.

3.2 USA

This study aimed to explore the impact of short-term, moderate sleep restriction on the mood and emotion regulation of healthy teenagers. Researchers used a home-based, counterbalanced protocol with 50 adolescents aged 14 to 17 years, involving a week of baseline sleep followed by a "sleep restriction" week (5 nights of 6.5 hours in bed) and an "extended sleep" week (5 nights of 10 hours in bed), assessing mood through the Profile of Mood States (POMS). The findings revealed that sleep restriction led to significantly higher levels of anxiety, anger, confusion, and fatigue, along with a significant reduction in vigor (strength/energy). However, this moderate level of sleep loss did not significantly perturb depressed mood, a finding that differs from results seen in total sleep deprivation studies. In conclusion, even moderate sleep restriction worsens adolescent emotional functioning, suggesting that

promoting adequate sleep is vital for maintaining psychological stability during this developmental phase.

The aim of the study is to investigate the specific emotional mechanisms, namely discrete emotion regulation strategies, that link sleep problems to mood and anxiety disorders in teenagers. To achieve this, researchers analyzed data from the National Comorbidity Survey-Adolescent Supplement, a massive, nationally representative sample of 10,148 U.S. adolescents (aged 13–18), using diagnostic interviews for psychiatric disorders and self-reports for sleep problems, life stress, and six specific emotion regulation strategies. The findings revealed that each additional sleep problem endorsed was associated with a 77% higher likelihood of mood disorders and an 82% higher likelihood of anxiety disorders. Greater sleep problems were linked to poorer emotion regulation, specifically the increased use of maladaptive strategies (suppression, rumination, and avoidance) and the decreased use of adaptive problem-solving. Furthermore, the study identified critical indirect pathways: sleep problems were associated with anxiety disorders through increased suppression and rumination and with mood disorders through increased rumination and decreased problem-solving. The study concludes that disrupted sleep increases psychiatric risk by impairing an adolescent's capacity for effective emotion regulation, suggesting that modifiable sleep-focused interventions could serve as a vital tool for improving mental health outcomes and reducing the prevalence of affective disorders in youth.

3.3 Canada

The aim of the cross-sectional study by Gibson et al. (2006) is to determine the prevalence of daytime sleepiness among Canadian high school students, identify the biological and behavioral factors explaining this sleepiness, and examine its association with academic and extracurricular performance. Researchers conducted two large-scale surveys three years apart, recruiting a total of 3,235 students from several Ontario school boards, utilizing the Epworth Sleepiness Scale (ESS) alongside self-reported data on sleep duration, bedtime routines, and school functioning. The findings revealed that 70% of students were sleep-deprived, obtaining less than the recommended 8.5 hours of sleep, and approximately 41–42% reported excessive daytime sleepiness (ESS > 10). Between 58% and 68% of students reported feeling "really sleepy" during the first two hours of school (08:00–10:00 A.M.), and higher sleepiness scores were significantly associated with being female. Inconsistent bedtime routines and consuming caffeine after 6:00 P.M. Furthermore, increased sleepiness was linearly associated with negative performance outcomes, including dropping grades (reported by 23% of students), increased school lateness, and decreased involvement in extracurricular activities. The study concludes that adolescent sleepiness is a serious and under-recognized problem resulting from the conflict between biological "sleep phase delay" and early school schedules, advocating for later school start times and improved sleep hygiene awareness among parents, educators, and clinicians

The cross-sectional study by Lafontaine-Poissant et al. (2024) aimed to examine the associations between social media use (SMU) and seven distinct indicators of sleep health in a large sample of Canadian adolescents, while also investigating whether these relationships were influenced by age or gender. To achieve this, researchers analyzed data from 12,557 participants (aged 11–17 years) from the 2017–2018 Health Behavior in School-aged Children study, categorizing SMU by frequency (non-active, active, and intense) and the presence of addiction-like symptoms (problematic) to evaluate their impact on sleep metrics such as insomnia, daytime wakefulness, and bedtime regularity. The findings revealed that intense and problematic SMU were both significantly linked to worse sleep health compared to active use, with problematic users exhibiting the highest risk for poor outcomes, including a 3.24 times higher likelihood of late weekend bedtimes. Furthermore, the study found that associations were stronger among girls than boys, particularly regarding later bedtimes, yet the magnitude of these effects did not vary significantly across different age groups. The study concludes that high-intensity and problematic social media habits are major risk factors for adolescent sleep disturbances in Canada.

3.4 Australia

The study by Bauducco et al. (2024) investigated the associations between sleep habits and mental health among Australian adolescents and determined if maintaining healthy sleep patterns served as a protective factor against depression and anxiety during the COVID-19 pandemic. To achieve this, researchers analyzed three waves of data over two years from 2,781 adolescents (average age 12.6 years), using latent class growth analyses to identify distinct symptom trajectories for depression and anxiety based on sleep characteristics such as duration, latency, and chronotype. The findings identified four distinct paths for depression (with 64.3% in a low-stable group) and three for anxiety (74.8% low-stable), revealing a "tight coupling" where sleep patterns shifted in the same direction as emotional well-being; specifically, those in low-risk groups reported longer sleep duration, shorter sleep latency, and earlier chronotypes. In conclusion, healthy sleep is a vital strategy for protecting adolescent mental health during periods of high environmental stress.

The review article by Cardinali (2000) aimed to examine how the endogenous circadian pacemaker, located in the hypothalamic suprachiasmatic nuclei (SCN), regulates cycles of sleep and wakefulness and influences emotional states. By synthesizing existing chronobiological research, the paper highlights that human behavior is not a passive response to the environment but is driven by an internal clock entrained by light-dark cycles. However, modern lifestyle factors such as artificial light and the shift toward indoor living have insulated humans from natural cycles, leading to highly consolidated but often insufficient sleep schedules. Key findings include the strong link between circadian disruption and mood disorders: Seasonal Affective Disorder (SAD) is tied to latitude and light availability, while non-seasonal depression is characterized by altered REM sleep timing and dampened circadian amplitudes. The study also introduces the concept

of "chronobiotics", primarily melatonin, which can effectively reset internal clocks to treat rhythm disorders like jet lag, shift-work maladaptation, and age-related sleep disturbances. The author concludes that maintaining circadian synchronization is vital for mental health, noting that our modern "24-Hour Society" imposes demands on a "grossly inadequate physiological design" that is unable to maintain constant alertness regardless of the time of day.

3.5 China

The longitudinal study by Wang et al. (2021) aimed to investigate the sleep situations, specifically habits and problems, of Chinese adolescents and determine the long-term associations with the subsequent development of depressive and anxiety symptoms. To achieve this, researchers conducted a school-based study in Guangzhou involving 1,957 high school students, collecting baseline data in January 2019 and follow-up data one year later while tracking sleep duration, sleep quality, and mental health symptoms alongside biological markers like morning cortisol levels. The findings revealed that 63.3% of adolescents failed to reach the recommended 8-hour sleep duration on weekdays, and shorter weekday sleep and more sleep problems were significantly associated with more severe depressive and anxiety symptoms a year later. Furthermore, longer weekday-weekend catch-up sleep predicted worse mental health, and the prevalence of short sleep increased as students grew older, which the authors attribute to the biological onset of puberty and heavy academic workload. The study concludes that insufficient and low-quality sleep are critical risk factors for adolescent psychiatric well-being, urging parents and schools to prioritize regular sleep schedules, reduce bedtime screen use, and implement mental health awareness and surveillance programs to protect students' emotional health.

Table 1: Country-wise analysis of studies related to sleep deprivation and mood regulation in adolescents

Date	Country	Citation	Objective
16 March 2018	India, Delhi	Singh R, Suri JC, Sharma R, Suri T, Adhikari T. Sleep Pattern of Adolescents in a School in Delhi, India: Impact on Their Mood and Academic Performance. Indian J Pediatr. 2018 Oct;85(10):841-848. . doi: 10.1007/s12098-01 8-2647-7. Epub 2018 Mar 16. PMID: 29546661.	Aim: To investigate adolescent sleep patterns and their impact on mood, attendance, and academic performance in students aged 11–15. Key Findings: Bedtimes shifted later with age, significantly reducing sleep duration due to fixed school timings. Sleep deprivation prevalence exceeded 90% in older students, who reported higher depression levels. While mood and attendance worsened, no direct association between sleep duration and grades alone was identified
2024	India, Tamil Nadu	Sarala, G., et al. "Impact of Sleep Patterns and Quality on Cognitive and Emotional Health Among Adolescents." Adolescência e Saúde 21.1 (2026): 426-422.	The objective of the study was to explore the impact of sleep patterns and quality on adolescents' cognitive and emotional health. The researchers conducted a cross-sectional survey of 200 adolescents aged 13 to 18 years from urban and semi-urban schools in Tamil Nadu, India. The study found that a significant majority of adolescents are not meeting healthy sleep benchmarks, which directly correlates with poorer health outcomes. 62% of participants reported poor sleep quality, and 48% were sleep-deprived, obtaining less than seven hours of sleep per night. There was a significant negative correlation between sleep quality and cognitive performance. Adolescents with poor sleep quality showed declines in cognitive performance, such as mood and attention span. Additionally, a positive correlation was seen between poor sleep and emotional distress. The paper concludes that sleep serves as a critical mediator between an adolescent's lifestyle and their overall development.
30 July 2013	USA	Baum, K.T., Desai, A., Field, J., Miller, L.E., Rausch, J. and Beebe, D.W. (2014). Sleep restriction worsens mood and emotion regulation in adolescents. J Child Psychol Psychiatr, 55: 180-190. https://doi.org/10.11 11/jcpp.12125	The study aimed to determine the impact of short-term sleep restriction on both positive and negative mood states in a sample of 50 healthy adolescents aged 14 to 17 years. Findings complement prior correlational study results to show that after only a few days of shortened sleep, at a level of severity that is experienced regularly by millions of adolescents on school nights, adolescents have worsened mood and decreased ability to regulate negative emotions.
2018	USA	Palmer, Cara A., et al. "Associations among adolescent sleep problems, emotion regulation, and affective disorders: Findings from a nationally representative sample." Journal of Psychiatric Research 96 (2018): 1-8.	The aim of the paper was to explore the associations among adolescent sleep problems, emotion regulation, and affective disorders. The study was conducted by the National Comorbidity Survey-Adolescent Supplement (NCS-A), with a massive, nationally representative sample of 10,148 adolescents in the United States aged 13 to 18. This study confirmed that sleep problems are a powerful predictor of mental health issues. Each additional sleep problem endorsed was associated with a 77% greater likelihood of qualifying for a mood disorder and an 82% greater likelihood of qualifying for an anxiety disorder. Teens with more sleep problems reported poorer emotional regulation. They used more maladaptive strategies than adaptive ones. The authors conclude that disrupted sleep increases vulnerability to psychiatric disorders by impairing an adolescent's ability to manage their emotions. Because sleep is a modifiable risk factor, the study suggests that targeted sleep interventions could improve emotion regulation and reduce the overall prevalence of anxiety and depression in youth
2006	Canada	Gibson, Edward S., et al. "Sleepiness" is serious in adolescence: Two surveys of 3235 Canadian students. "BMC Public Health	Aim: To evaluate daytime sleepiness among 3,235 Canadian students and its association with academic and extracurricular performance.

		6.1 (2006): 116.	Key Findings: 70% of students slept <8.5 hours, while over 40% reported excessive sleepiness. Higher sleepiness correlated with being female, short sleep duration, and caffeine use
2023	Canada	Lafontaine-Poissant, Florence, et al. "Social media use and sleep health among adolescents in Canada." Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice 44.7-8 (2024): 338.	Aim: The aim of the study is to investigate the association between various levels of social media use and sleep indicators in the Canadian population, while considering the gender ratio. Key Findings: Problematic social media habits were a risk factor for poor sleep. It was more prominent in girls than boys but around the same adolescent ages.
2024	Australia	Bauducco, S., Gardner, L. A., Smout, S., Champion, K. E., Chapman, C., Gamble, A., Teesson, M., Gradisar, M., & Newton, N. C. (2024)	Aim: To investigate longitudinal associations between sleep and mental health in 2,781 Australian adolescents, examining if healthy sleep patterns protected against depression and anxiety during the COVID-19 pandemic. Key Findings: Sleep and mental health trajectories were tightly coupled, shifting in the same direction. Low-risk individuals (primarily boys) reported longer sleep, shorter latency, and less sleepiness. Maintaining healthy sleep is a vital protective strategy during high-stress periods
2021	Australia	Jamieson et al. (2021)	Aim: To investigate the neurobiological relationships between sleep quality, white matter (UF) integrity, and psychological distress in early adolescents (12–14 years) to model anxiety disorder risk. Key Findings: Poor sleep quality correlates with increased distress and stunts uncinate fasciculus (UF) myelination. This disrupts fronto-limbic connectivity, impairing the top-down executive control over emotional responses necessary to mitigate anxiety.
2015	Australia	The Laboratory Mood Study Short, M. A., & Louca, M. (2015). Sleep deprivation leads to mood deficits in healthy adolescents. Sleep Medicine, 16(8), 1037-1043	Aim: To investigate how 36 hours of total sleep deprivation affects discrete mood states in 12 healthy adolescents. Key Findings: All mood states significantly worsened. Females showed greater vulnerability, specifically reporting increased anxiety and depressed mood compared to males
2021	China	Wang, W., Du, X., Guo, Y., Li, W., Teopiz, K. M., Shi, J., Guo, L., Lu, C., & McIntyre, R. S. (2021). The associations between sleep situations and mental health among Chinese adolescents: A longitudinal study. Sleep Medicine, 82, 71-77.	Aim: To investigate longitudinal associations between sleep habits and the subsequent development of depressive and anxiety symptoms in 1,836 Chinese adolescents. Key Findings: 63.3% failed to reach recommended weekday sleep duration. Shorter weekday sleep, increased sleep problems, and significant irregular sleep (large differences between weekend and weekday sleep) all predicted more severe depressive and anxiety symptoms one year later

4. Conclusions

After going through all country-wise papers, it was evident that India's actions were minimal compared to all other countries. India differs from the rest of the world by treating sleep primarily through the lens of individual lifestyle, stress management, and mental well-being rather than policies. The issue of sleep deprivation is well-documented in Indian studies, which continue to show a high prevalence of sleep deprivation among older adolescents, along with increased depression and less achievement in school; however, these studies fail to go beyond raising awareness, and there is no law in India that mandates school start times or a specific sleep standard. Other countries have taken more extreme steps. The United States is the first to pass legislation based on the AAP recommendation and explicitly on circadian science, mandating later start times (no earlier than 8:00 AM for middle school, 8:30 AM for high school) and citing evidence for the association between later school start times and decreased sleep loss, depression, and suicide among adolescents. China took it to the extreme level with its 2021 Ministry of Education guidelines, which included minimum sleep requirements (8-10 hours), a bedtime ban, a gaming curfew for children (10 pm–8 am), and even incorporated sleep hours into school assessments – although the average sleep period is still not up to scratch. Canada and Australia embraced a strict but non-enforcement approach, incorporating sleep (8-10 hours for ages 14-17) into nationally endorsed 24-hour movement guidelines which also include activity and screen time, with strong links made between adherence and emotional regulation and mental health. When we look at these collectively, I can see a clear continuum from binding legislation (US) through state-mandated (China) to evidence-informed guidelines (Canada, Australia) to the near absence of structural intervention to address Indian adolescents' sleep vulnerability (India), which leaves their brains vulnerable at an individual level.

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