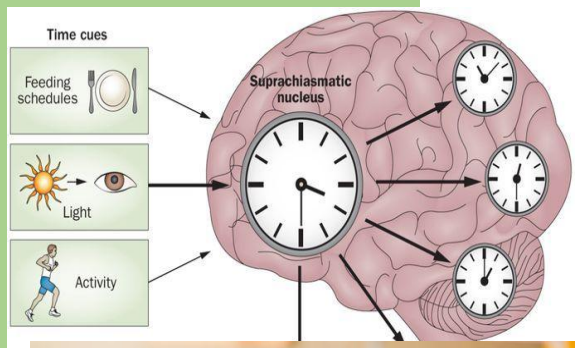
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NCERT

Research Report

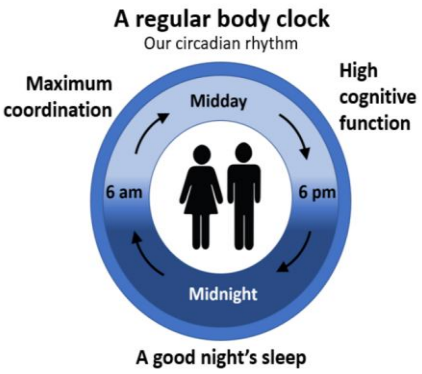
Exploring the Association of Biological Clock with Cognitive Performance and Mental Wellbeing of School Children (PAC 23.06)

Biological Clock (Rhythms of Life)









Sleep Is Important for Students

Principal Investigators

Dr Ramesh Sethy

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SHYMALA HILLS, BHOPAL

Research Report
PAC 23.06

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Year-2024-25

"Exploring the Relationship of Biological Clock with Cognitive Performance and Mental Wellbeing of School Children"

Foreword

The **National Curriculum Framework for School Education (NCF-SE) 2023**, aligned with the vision of the **National Education Policy (NEP) 2020**, emphasizes the importance of promoting **holistic development, mental health, and well-being among learners**. In recent years, growing attention has been given to understanding the factors that influence students' cognitive functioning and psychological well-being within the school environment.

One such important factor is the **biological clock**, an internal near 24-hour rhythm that regulates various physiological, cognitive, and behavioural processes. During **adolescence**, when the brain undergoes significant developmental changes, sleep plays a crucial role in supporting **cognitive growth, emotional balance, and overall mental well-being**. However, the sleep–wake cycle often shifts during this stage of life, and disruptions in this rhythm may affect students' learning abilities, behaviour, and mental health.

The present study examines the **association between sleep–wake cycle patterns, cognitive performance, and mental well-being among school-going children in the selected region**. The study is closely aligned with the objectives of **NEP 2020**, which advocates **learner-centred education and the integration of mental well-being within the educational process**. The findings of this research provide valuable insights that may inform **school practices and policy decisions**, particularly regarding **school schedules, academic workload, and the promotion of healthy sleep habits among students**.

I appreciate the efforts of the research team and all those involved in conducting this important study. It is hoped that the findings will contribute to strengthening efforts aimed at improving both the **academic development and mental well-being of school children**.

Prof. Shiv Kumar Gupta
Principal
RIE Bhopal

"Exploring the Relationship of Biological Clock with Cognitive Performance and Mental Wellbeing of School Children"

Preface

India's **National Education Policy (NEP) 2020** highlights mental health as a vital component of students' overall well-being and development, advocating a **holistic approach to education** that integrates academic learning with psychological and emotional support. One important factor influencing students' cognitive and behavioural functioning is the **biological clock**, an internal near 24-hour rhythm that regulates several physiological, cognitive, and behavioural processes in individuals.

This biological rhythm becomes particularly significant during **adolescence**, a stage when the brain undergoes major developmental changes while transitioning toward adulthood. During this period, **sleep plays a crucial role in supporting cognitive development, emotional balance, and mental well-being among school-going children**. However, the natural **sleep–wake cycle often shifts during adolescence**, and disturbances in this rhythm may affect learning abilities, attention, and psychological health.

The present study entitled **"Exploring the Relationship of Biological Clock with Cognitive Performance and Mental Well-being of School Children"** aims to examine the association between **sleep–wake cycle patterns and the cognitive as well as mental well-being of school children**. The research is based on extensive fieldwork, including **school visits and interactions with students**, and utilizes various standardized tools to assess **sleep patterns, cognitive performance, and mental well-being** among adolescents.

The study focuses on understanding **sleep quality, sleep disturbance, daytime dysfunction, cognitive performance, and mental well-being** among school children. By collecting responses directly from students, the research attempts to capture their **sleeping habits and factors that may disturb healthy sleep patterns**. The findings have been examined in light of the objectives of **NEP 2020**, which emphasizes the integration of **mental well-being, critical thinking, and life skills within the educational process**.

It is hoped that the findings of this study will contribute to ongoing efforts to improve **educational practices and policies**, particularly in relation to **school schedules, academic workload, and strategies for promoting healthy sleep habits among students**. Such insights may help create learning environments that support both the **academic development and mental well-being of school children**.

Investigators

Dr. Ramesh Sethy (PI)

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Acknowledgement

The completion of this research, "Exploring the Relationship of Biological Clock with Cognitive Performance and Mental Wellbeing of School Children" has been made possible through the invaluable support, guidance, and contributions of numerous individuals and institutions. We extend our heartfelt gratitude to everyone who has played a significant role in this academic endeavor.

We are profoundly thankful to Prof. Dinesh Prasad Saklani, Director, NCERT, for his invaluable encouragement and unwavering financial support in facilitating this research. His vision for inclusive and quality education has been an inspiration throughout our study. Our sincere appreciation goes to Prof. Shiv Kumar Gupta, Principal, RIE Bhopal, for his continuous guidance and constructive feedback. His guidance has been instrumental in shaping this research into a meaningful academic contribution.

We extend our heartfelt gratitude to Dr. Reena Mehra, Junior Project Fellow, for his dedicated assistance in data collection, field visits, and research coordination. His efforts have greatly contributed to the successful execution of this study. We also acknowledge with deep appreciation the expertise and insights of the tool finalization team comprising Prof. N. K. Agarwal Sengupta and Dr Suryanarayan Pradhan, whose valuable inputs helped refine the research tools and framework.

The data analysis team, comprising Dr Rachna Jaiswal & Dr. Udeechee, deserves special recognition for their support and critical efforts in helping us organize, interpret, and derive meaningful conclusions from the collected data. Their analytical contributions have enriched the study’s findings.

We are grateful to the Kendriya Vidyalaya, Regional Office, Bhopal, Madhya Pradesh, Navodaya Vidyalaya Samiti, Bhopal, EMRS schools, CM rise schools and private schools for their cooperation and for providing access to relevant information and field support. Their collaboration has been crucial in understanding the operational framework.

A special word of thanks goes to the principals of various schools, who extended their support in facilitating interviews, computer lab, and classroom observations. Their commitment to school education and empowerment is truly commendable. We also express our appreciation to the printer for their meticulous attention to detail and professionalism in ensuring the timely printing of this research.

We also thanks to all staff of Department of Zoology, RIE, Bhopal for their constant support during this research. We are deeply indebted to all individuals and institutions, teachers, students, parents, community members, and school administrators who have directly or indirectly contributed to this research. Their insights, experiences, and cooperation have been invaluable in making this study comprehensive and impactful.

Above all, we bow in gratitude to God Almighty, whose divine grace and blessings have guided us at every step of this academic pursuit.

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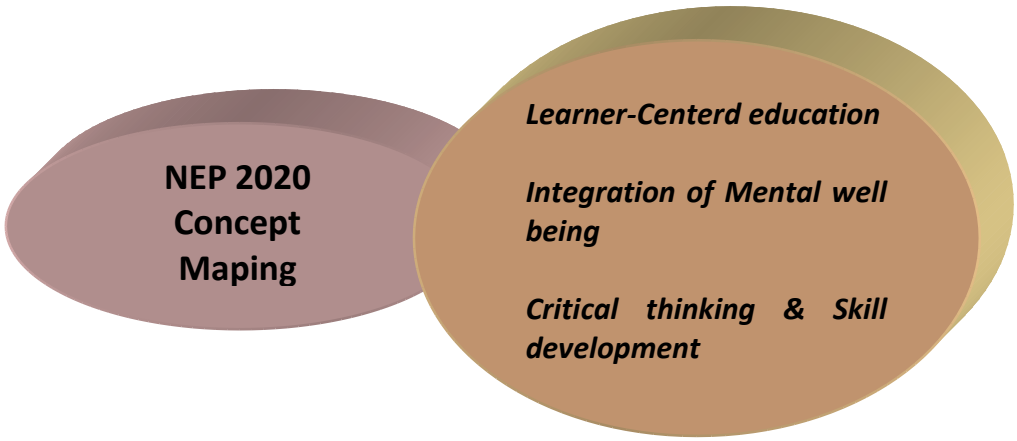
"Exploring the Relationship of Biological Clock with Cognitive Performance and Mental Wellbeing of School Children"

Chapter-I

Introduction

1.1 Introduction: Mental Well-Being & Cognitive Performance in the National Education Policy 2020

The NEP 2020 has introduced by Government of India for holistic development of school children. Its a extensive framework introduced for transformation of education system, has major Aims is holistic development, learner-centered education, and the integration of mental well-being, critical thinking, and skill development. NEP 2020 aims to create an inclusive, flexible, and quality-driven education system that prepares learners for the challenges of the 21st century. (Ministry of Education, NEP, 2020) Mental wellbeing plays vital role in education or any skill related to school children. As per the NEP Mental wellbeing is a crucial foundation for effective learning and holistic development. Moving beyond a narrow focus on academic achievement, the policy emphasizes the importance of nurturing learners' cognitive, emotional, and social capacities. NEP 2020 acknowledges that increasing academic pressure, rapid technological change, social challenges, and competitive educational environments have significantly impacted the mental health of students, often leading to stress, anxiety and emotional distress.



(Swarup and Amiruddin, 2023) This policy also emphasizes on holistic education by recognizing the close relationship between mental well-being and cognitive performance. Policy recognize that Students learn better when they are mentally fit, emotionally secure, and free from different kind of excessive stress. NEP 2020 promotes student-centered approaches, reduced academic burden, flexibility in learning, and the integration of life skills, mindfulness, and counselling support to

enhance students' emotional balance. By fostering a supportive and inclusive learning environment, the policy aims to improve cognitive abilities such as attention, memory, critical thinking, and creativity. Thus, NEP 2020 seeks to nurture well-rounded individuals with strong mental resilience and enhanced cognitive performance (Prasad and Kumara, 2025) .

For maintaining both mental and physical health, adequate and quality sleep is indispensable. Sleep directly influences emotional regulation, stress response, and cognitive processing. Importantly, sleep itself is regulated by the body's internal timing mechanism known as the biological clock. Therefore, understanding the role of biological clock patterns becomes essential in realizing the holistic objectives outlined in NEP 2020.

1.2 Concept of Sleep & Biological Clock

Sleep is basic need of human being like fundamental rights for smooth survival and optimal functioning of all living organism. Sleep is universal function of all living organism and it is as much important as food for serving a critical function in disease prevention. Approximately one third life of human being spent in sleeps and Human body need extensive sleep for proper physiological functioning.

Sleep does not occur randomly rather it follows a structured and biologically regulated cycle. The human sleep cycle consists of alternating phases of Non-Rapid Eye Movement (NREM) and Rapid Eye Movement (REM) sleep, each serving distinct restorative and cognitive functions. NREM sleep is associated with physical restoration and memory stabilization, whereas REM sleep plays a critical role in emotional regulation, creativity, and higher-order cognitive processing.

The timing, duration, and quality of these sleep cycles are regulated by the body's internal timing mechanism known as the biological clock. The biological clock operates through circadian rhythms—endogenous oscillations that follow an approximately 24-hour cycle. These rhythms determine when the body feels alert and when it becomes ready for sleep.

1.3 Circadian Rhythm

At the neurobiological level, the circadian system is regulated by the suprachiasmatic nucleus (SCN) located in the hypothalamus which synchronizes internal physiological processes with external environmental cues, particularly the light–dark cycle.

Thus, the biological clock does not merely signal sleep; it regulates the entire sleep–wake architecture, ensuring proper alignment between internal physiology and external environmental timing. When this alignment is maintained, the sleep cycle remains stable which support efficient

memory consolidation, optimal attention regulation, emotional and hormonal balance and Metabolic stability.

Extensive research has established that sleep disturbance is caused due to poor lifestyle factors such as delayed bedtime, heavy late-night meals, excessive caffeine consumption, digital screen exposure, and irregular routines adversely affect sleep quality. These factors cause disruptions in sleep patterns that lead to hormonal imbalance, mood disturbances, reduced attention span, and impaired learning capacity (Buysse et al., 2008). Further, such disturbances could negatively affect cognitive performance, mood stability, and overall mental wellbeing (Buysse et al., 2008).

Research on circadian rhythms highlights that individuals perform best at certain times of the day depending on their chronotype. Optimal performance may occur more than once within a 24-hour cycle and can vary according to the type and cognitive demands of the activity. Biological predisposition toward morningness or eveningness plays a crucial role in determining sleep–wake patterns and alertness preferences. Morning-type individuals generally prefer earlier wake and work times, whereas evening-type individuals show peak efficiency later in the day. Consequently, when individuals with different chronotypes perform the same task at the same time, variations in performance are likely to occur. (Figueiredo S, Nunes O, et *al*., 2019).

Students' mental health and wellbeing play an important role for guaranteed both in and outside school life. It's very important that school going children should be stress free and take good quality sleep. In the context of school-going children and adolescents, whose neural and emotional systems are still developing, disruption of the biological clock may significantly impair attention span, working memory, academic engagement, and psychological resilience. During adolescence (13–19 years), many lifestyle changes occur, especially when students move from school to college or university. Increased study pressure, eating fast food, irregular meal timings, and lack of sleep can disturb the biological clock. These disruptions in circadian rhythms may lead to negative health effects later in life. (Ishida N, Kaneko M,et *al*, 1993)

Sleep is basic need of human being like fundamental rights for smooth survival and optimal functioning of all living organism. Approximately one third life of human being spent in sleeps and Human body need extensive sleep for proper physiological functioning. Poor lifestyle like;late night or heavy meals, delay in bedtime, consumption of caffeine or alcohol substantially effects sleep quality & hormonal imbalance. (Cureus, 2024) Extensive research has established the critical role of sleep in maintaining psychological, cognitive, and physical health. The transition between wakefulness and sleep is regulated by the circadian rhythm, an endogenous timing system

primarily governed by melatonin secretion from the pineal gland. Disruptions in this rhythm are associated with significant adverse health outcomes. (Khan S, Nabi G, et *al*, 2018)

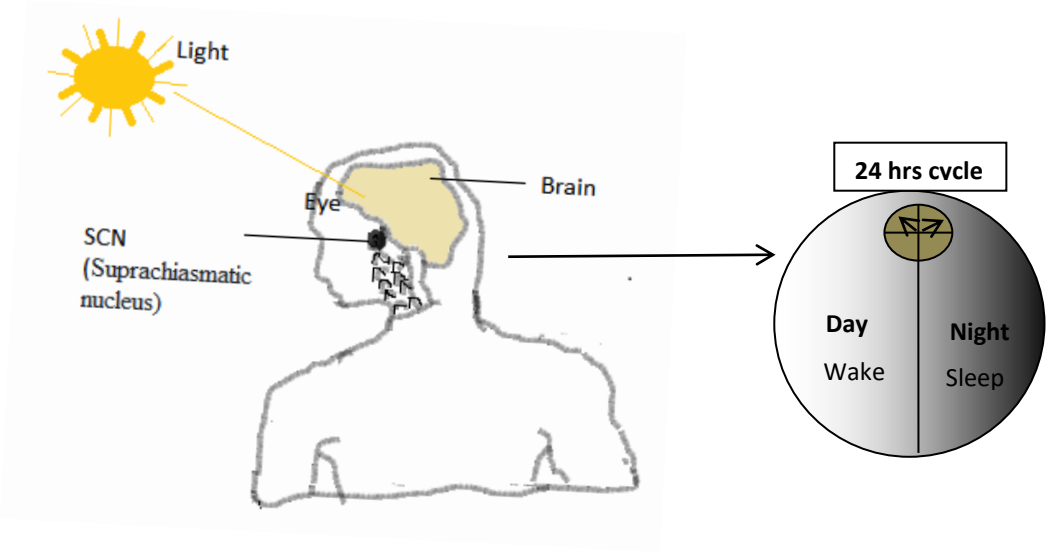
1.4 Mental health or well being

Students' mental health and wellbeing play an important role for guaranteed both in and outside school life. It's very important that school going children should be stress free and take good quality sleep. Biological clock is also known as circadian rhythm crucial process of human body and regulate in superchiasmatic Nucleus (SCN) in the brain. Biological clock gets affect from light and dark clues send signal to produce melatonin hormone which is responsible for sleep. It plays a vital role to regulate hormone like; cortisol level (stress hormone) in the morning to wake up and decrease throughout the day. A well perform biological clock makes human body healthy and maintain energy level whole day. The biological clock plays an important role in maintaining our health and well-being because it controls our sleep–wake cycle. Sleeping properly and eating meals on time help to keep the biological clock balanced and functioning correctly. During adolescence (13–19 years), many lifestyle changes occur, especially when students move from school to college or university. Increased study pressure, eating fast food, irregular meal timings, and lack of sleep can disturb the biological clock. These disruptions in circadian rhythms may lead to negative health effects later in life. (Ishida N, Kaneko M, et *al*., 1993)

Biological clock & Circadian rhythm effects are important for proper sleep wake cycle of daily life. Research on circadian rhythms highlights the importance of understanding the biological clock to identify individual temporal preferences and to optimize the execution of specific tasks throughout the day. This concept, referred to as the synchrony effect in chronobiology, suggests that individuals perform best at certain times of the day depending on their chronotype. Optimal performance may occur more than once within a 24-hour cycle and can vary according to the type and cognitive demands of the activity. Biological predisposition toward morningness or eveningness plays a crucial role in determining sleep–wake patterns and alertness preferences. Morning-type individuals generally prefer earlier wake and work times, whereas evening-type individuals show peak efficiency later in the day. Consequently, when individuals with different chronotypes perform the same task at the same time, variations in performance are likely to occur. (Figueiredo S, Nunes O, et *al*., 2019)

Biological clock & Circadian rhythm effects is important for proper sleep wake cycle of daily life. Circadian rhythms are natural internal rhythms that follow a cycle of about 24 hours. These rhythms are adjusted according to environmental signals, such as light and temperature, which

help living organisms, including humans, adapt to their surroundings. Through this synchronization, organisms can respond effectively to changes like food availability, temperature variations, and the presence of predators. (Moreno, J.P, Hannay, et al., 2022).



Eating and sleeping pattern directly connected with circadian rhythm. For proper functioning of circadian rhythm regular food on time and proper rest can be reset the internal clock. Adolescent aged 13-19 suffer from different transition phase as they are shifting from school to college and therefore their eating habits, sleeping pattern and lack of sleep disturbs circadian rhythm. This kind of habits negatively affects body and health. (Doan N, Parker, et *al.*, 2022) In Indian Education System have more impotence in academic performance rather than Practical learning. This resulting academic pressure on students as they are not getting proper sleep because they became used to late night studying and skipping meals or disturbed meal schedule. Such patterns can further disturb adolescents' biological clocks. A recent study conducted by researchers at Chaudhary Charan Singh University, India, examined the relationship between these lifestyle factors and circadian rhythm disruptions among students in classes IX, XII, and first-year college. (Nair S, 2020)

Now days biological clock has been change for adolescent group. Social constraint forcing adolescent to sleep light time instead of dark, these results distributed circadian rhythm. This issue is of significant concern, as circadian misalignment has been linked to sleep disturbances and reduced cognitive performance. Variability in sleep timing between work or school days and free days is similarly associated with adverse mental and physical health outcomes, as well as engagement in less healthy lifestyle behaviors. (Charoenthammanon, R. S., & Gooley, et *al.*, (2025)

1.5 Relationship between sleep and attention, memory, and learning

An expanding body of evidence increasingly demonstrates that memory consolidation relies on the reactivation of experiences during sleep. This nocturnal processing not only protects memories from decay but also enhances problem-solving abilities, fosters creativity, and supports emotional regulation. However, sleep-related memory processing can become manipulative when negative thoughts or worries are repeatedly reinforced. (Paller, K. A., Creery, J. D., et *al*,. 2021) Sleep and memory are positively correlated and shares complex relationship. When human body in resting period it collects previous memories and after waking up recall store in brain.

One research conducted by *Calhoun et al*. Reported that parents complained about excessive sleepiness in daytime affected speed and poorer working memory performance. (Sciberras, E., DePetro, et *at*., 2015).

Every adolescent requires 8-10 hrs sleep but now days it has been shifted to 6.5 t0 7.5hrs per night or less than this. (Eric S, 2023) Sleep detriment crucially affecting their life and increasing multiple risk factors likee; Psychological illness, depression, anxiety and low stream. (Casavi, V., Shetty, et *al.,* 2022). Sleep is most significant factor of adolescent life as it essential for social, mental and emotional health. Its harmful and cause serious impairment in cognition and emotion and negatively affects attention. (Sadeh, A., Dahl, et *al*., 2009).

1.6 Impact of poor sleep on academic performance

Many researchers studied that sleep is significantly affects in multiple way quality of life like; mental & physical health, cognitive function and psychological status (Yilmaz D., Tanrikulu F, et *al.,* 2017).

Now days technological interventions are in boom and consumption of digital and electronic devices became daily life routine. New terms “screen time” became more frequent for young adults or Adolescent group as it refers excessive use of internet, television, video game or electronics devices. Increased screen time adversely effecting young adult and negatively turning behavioural changes like; heightened aggression, depression and reduced self-esteem and its is also being responsible for obesity, sleep disturbance and poorer academic performance. (Choudhari N, Prasad D., et *al*., 2026). In India, changing lifestyles, increased academic pressure, screen time, and inconsistent sleep patterns are reported to be affecting children's sleep-wake cycles, physiological-mental wellness leading to concerns regarding their cognitive abilities, academic performance and mental health. This research aims to explore the relationship between biological clock of school children on their cognitive and mental wellbeing. By investigating this

relationship, the study seeks to identify critical sleep parameters (such as duration, timing, and consistency) that influence children's academic success, concentration, emotional regulation, and psychological health.

1.7 Conceptual Framework of the Study

The conceptual framework of the present study illustrates the relationship between biological clock indicators, sleep-related variables, mental well-being, and cognitive performance among school children. The framework proposes that the biological clock (BC) and sleep-related factors such as sleep disturbance (SD), sleep latency (SL), and daytime dysfunction (DD) play a significant role in influencing students' overall well-being and cognitive functioning.

These sleep-related variables are hypothesized to affect two major dimensions of mental health: behavioral well-being (BWB) and emotional well-being (EWB). Behavioral well-being refers to students' ability to regulate behavior, maintain concentration, and engage positively in school activities, while emotional well-being represents psychological stability, mood regulation, and stress management.

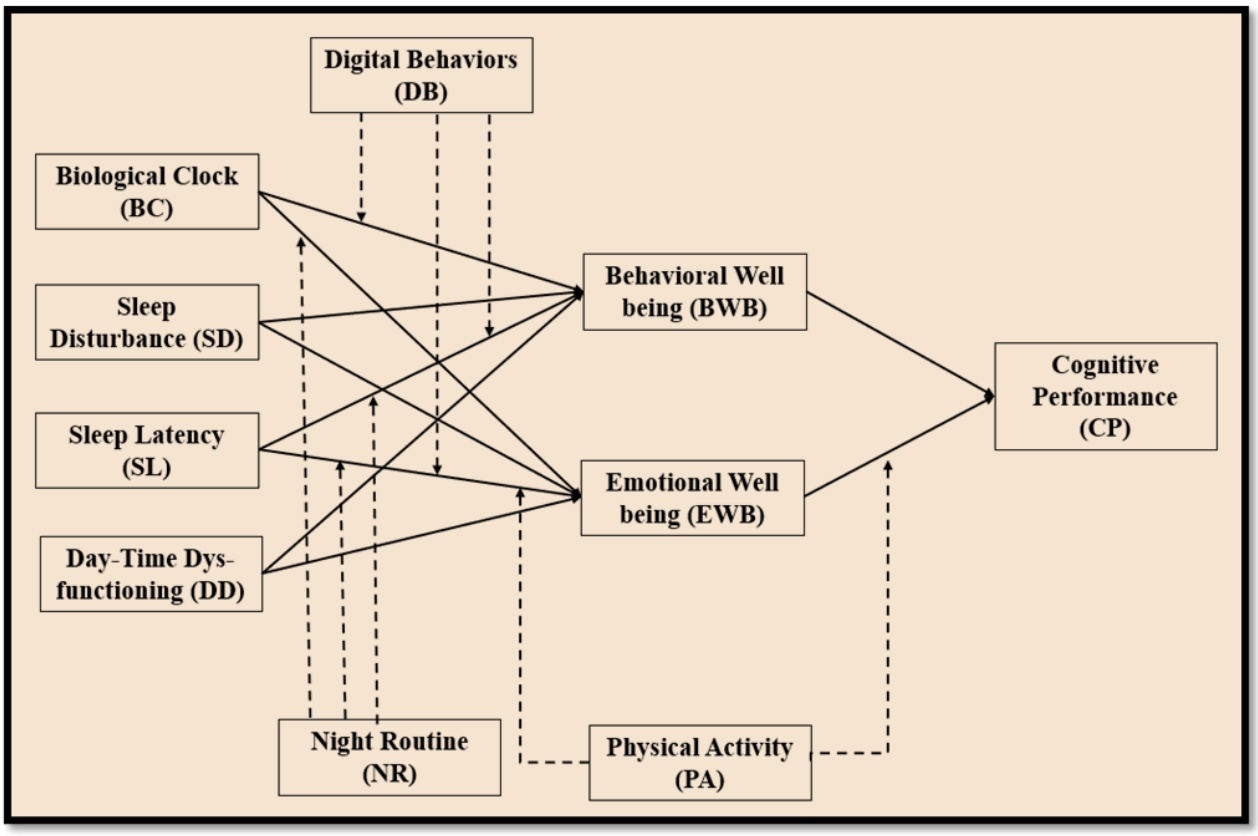


Figure 1.1: Conceptual framework illustrating the relationship between biological clock indicators, sleep quality parameters, mental well-being, lifestyle behaviors, and cognitive performance among school children**.**

The framework further suggests that both behavioral and emotional well-being contribute directly to cognitive performance (CP), which includes abilities such as attention, memory, reasoning, and problem-solving.

Additionally, the model recognizes the role of several moderating lifestyle factors, including digital behaviors (DB), night routine (NR), and physical activity (PA). These factors may influence sleep quality and circadian rhythm alignment, thereby indirectly affecting students' mental well-being and academic functioning.

Overall, the conceptual framework highlights the interconnected nature of sleep patterns, lifestyle behaviors, mental well-being, and cognitive performance, emphasizing that healthy sleep habits and circadian alignment are essential for improving students' psychological health and learning outcomes.

Chapter- II

Review of Literature

The literature on different aspects of the present study has been described in this chapter under the following heads.

1.1 National Education Policy 2020 for Mental Well-being & Cognitive performance

India's National Education Policy 2020 highlights mental health as a vital element of students' overall well-being and development, advocating for a holistic educational approach that incorporates mental health support. The policy affirms that mental and emotional well-being are fundamental to comprehensive development and should be embedded within the school curriculum. It further emphasizes that fostering capacities that enhance student wellness—such as physical fitness, good health, psychosocial well-being, and strong ethical foundations—is essential for achieving high-quality learning (NEP 2020). Mental health refers to the emotional, psychological and social well-being of an individual, and it is just as important as physical health. Mental health care and its management have become increasingly important in contemporary times. With the prevalence of mental health disorders on the rise, it is crucial that individuals receive adequate support and treatment to manage their mental health.

This policy majorly emphasizing on foundational, education, mental health awareness, including preventing care, personal and public hygiene and proper nutrition. It underscores the need for early detection and timely intervention for students experiencing mental health challenges. The policy places strong emphasis on fostering positive mental health practices and ensuring a safe, supportive school environment where students feel comfortable seeking help. Furthermore, the policy recommends addressing children's nutrition and overall health—including mental well-being—by ensuring access to healthy meals and integrating trained social workers, counsellors, and active community participation into the education system (NEP-2020). For better mental health and cognitive performance sleep wake pattern plays vital role for proper functioning. Late night sleeping or disturbed sleep affects sleep wake pattern resulting mental/physical illness.

1.2 Role of sleep wake pattern in children

Rejuvenate sleep has significantly associated to physical health, cognitive performance, and mental wellbeing. Similarly lack of sleep or disturbed sleep is linked to poor emotional functioning, cognitive dysfunction as well as adverse physical health outcomes. These synchronizations have been widely reported over the lifetime, including in young children and adolescent. Adolescent specifically represents developmental period characterized by profound

maturational changes in sleep architecture and its neuro-biological regulation, alongside significant hormonal, psychosocial, and somatic transformations. Therefore, the interplay between sleep, mental and physical health during this stage is multifaceted and developmentally sensitive. (Brand, S., & Kirov, R. 2011)) Sleep wake pattern has a positive significance with circadian rhythm and play vital role in healthy lifestyle. its natural, Internal 24 hrs cycle which is important for hormonal balance, body temperature and metabolism.

1.2 Circadian rhythm/ Biological Clock

J Cable and their group described that Circadian system is made of a central pacemaker situated in SCN (suprachiasmatic nuclei) of the hypothalamus, along with peripheral molecular clocks scattered across various organs throughout the body. Coordination of these components regulate numerous biological and physiological, including body temperature, hormone secretion, blood pressure, gene expression and immune function, all of which indicate consistent daily rhythms. Nowadays all habits like late night working or shifts, disturbed eating pattern or social behavioral are misaligned with biological clock. This is resulting severe effect on physiological and psychological functioning therefore multiple disease as in; cardiovascular disease, metabolic disorder, chronic conditions and including cancer risk factor increasing. On February 25, 2021, leading researchers in sleep, circadian rhythms, and chronobiology convened virtually for the Keystone e-Symposium, "Sleep & Circadian Rhythms: Pillars of Health," to examine emerging evidence on the bidirectional interactions among sleep, circadian timing, and health outcomes. (Cable, J., Schernhammer, et *al*., (2021).

COPERTARO A & BRACCI M (2019) reported about Human circadian rhythmicity is primarily entrained by the environmental light–dark cycle. In night shift workers, disruption of this cycle and reversal of the sleep–wake pattern may lead to circadian misalignment and consequent adverse health outcomes. This review summarizes the principal physiological mechanisms underlying circadian regulation and examines the health risks associated with circadian disruption in shift and night workers. It also emphasizes the role of the Occupational Physician in identifying clinical manifestations of circadian disturbance and implementing preventive measures aimed at mitigating related health risks. (Copertaro A., & Bracci, M., 2019).

Jing and wenxin group also discussed that Earth rotation cycle is 24hrs in a day similarly living organism display circadian rhythm in their behavior and physiology cycles last approximately 24hrs. In mammals, these rhythms are governed by the suprachiasmatic nucleus (SCN), the brain's primary circadian pacemaker, which synchronizes internal behavioral and physiological processes with the external 24-hour light–dark cycle. The SCN maintains remarkably stable rhythmic activity under constant darkness, constant light, or natural light–dark conditions. It fulfills two

essential roles in circadian regulation: first, functioning as an internal biological clock that coordinates rhythmic timing, and second, serving as a phase regulator that enables entrainment to environmental cues. Together, these complementary functions provide the fundamental physiological mechanism that allows organisms to adapt to the Earth's rotational cycle. (Feng, J., Zheng, W., et *al*., 2025).

The circadian clock serves as a vital biological timekeeping system that regulates the daily cycles of biochemical, physiological, and behavioral processes in humans. Disruptions or irregularities in circadian rhythms are associated with a range of diseases, including cancer. In the context of tumor development, disturbances in circadian timing can impair energy homeostasis, alter cell cycle regulation, and disrupt chromatin remodeling. Despite growing evidence linking circadian dysfunction to cancer, significant gaps remain in understanding the precise mechanisms underlying this relationship. A clearer mechanistic insight into how circadian disruption increases cancer risk is therefore essential. (Malik, S., Stokes III, et *al*., 2022)

1.3 Age related changes in sleep pattern

According to the developmental theory proposed by Jean Piaget, children aged 6 to 12 are in the concrete operational stage. At this stage, cognitive development is reflected in their growing ability to think logically and coherently, as well as to solve problems effectively. They are increasingly responsive to intellectual stimulation and can develop essential academic skills such as reading, writing, and arithmetic. This period is often regarded as a balanced and productive (Novianti, S. W., Andriyani, M., et *al*.,. 2022)

phase of schooling, during which children tend to learn more efficiently compared to both earlier and later developmental stages.Hun L & Bon K group studied sleeping pattern in elementary school children and their findings indicate a clear age-related decline in sleep duration, primarily driven by progressively later bedtimes rather than significant changes in wake-up times. The absence of gender differences suggests that sleep patterns in this population are more strongly influenced by developmental and environmental factors than by sex. Additionally, lifestyle and contextual variables—such as housing type, participation in extracurricular academic activities, and screen-based behaviors including television viewing and computer use—were significantly associated with variations in sleep duration. Collectively, this study shows that older children sleeping pattern more effected than younger children (Seo, W. S., Sung, et al., (2010).

Ruchi S, Jagdish C Suri group study highlights early adolescence (12–13 years) difference between sleeep routines, mood, attendance and academic performance. While associations were observed between advancing age, mood disturbances, attendance, and academic performance, the relationship between sleep variables and scholastic outcomes was not found to be direct,

suggesting the influence of multifactorial determinants and emphasizing the need for longitudinal exploration. Results shows that bedtime has been shifted to a later time. (Sleep Pattern of Adolescents in a School in Delhi, India: Impact on their Mood and Academic Performance, 2018). Marisa Schlieber a and Jisu Han research says synthesizes existing literature emphasizing the critical role of sleep in early childhood development and consolidates evidence-based strategies for promoting healthy sleep practices. Sleep disturbances are prevalent in young children and represent one of the most frequently reported concerns among caregivers. Empirical findings indicate that inadequate sleep duration, compromised sleep quality, and inconsistent sleep schedules adversely influence physical health, cognitive functioning, socioemotional regulation, and behavioral outcomes, thereby affecting overall developmental trajectories and well-being. The literature further underscores the significant influence of family environment and culturally mediated practices on children's sleep behaviors. Accordingly, the review advances research-informed recommendations aimed at improving awareness and fostering appropriate sleep practices in early childhood Schlieber, M., & Han, J. (2021).

Preeti D & Neelima B conduct their research in Urban western India. As per thuier review Adolescence is widely recognized in the literature as a critical developmental phase characterized by exposure to multiple intrinsic and extrinsic stressors that contribute to irregular and insufficient sleep–wake patterns. A questionnaire-based cross-sectional study conducted among 314 school-going adolescents aged 13–15 years (Grades VIII and IX) examined the prevalence of daytime sleepiness and sleep debt. The Cleveland Adolescent Sleepiness Questionnaire was administered alongside data on self-reported sleep duration, with supplementary information obtained from school records.Collectively, the evidence suggests that excessive daytime somnolence and chronic sleep debt are prevalent among Indian adolescents, paralleling global trends, yet remain largely under-recognized. The literature emphasizes the need for targeted interventions incorporating sleep education in collaboration with schools and families to address this growing public health concern (Devnani, P., & Bhalerao, N. 2018).

1.4 Measurement of Subjective Sleep quality, Cognitive Performance and Mental wellbeing

Buysse, D. J., Reynolds reports say sleep disturbances are highly prevalent across a range of psychiatric conditions, prompting the development of standardized tool to comprehensively assess subjective sleep quality. The Pittsburgh Sleep Quality Index (PSQI) was specifically designed to evaluate overall sleep quality in such contexts. The instrument comprises 19 self-reported items that are organized into seven component domains: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. This multidimensional structure enables the PSQI to capture both nocturnal sleep

characteristics and their daytime consequences, thereby providing a broad assessment of perceived sleep impairment (Buysse, D. J., Hall, M. L, *et al.,* (2008).

J, Elaine Allen I and group has increasingly examined the relationship between objective sleep parameters and subjective sleep assessments among older adults, particularly using the Pittsburgh Sleep Quality Index (PSQI). Evidence suggests that sleep efficiency (SE) is a salient correlate of perceived sleep disruption. Accordingly, it has been hypothesized that lower objective SE would be associated with higher levels of self-reported sleep disturbance on the PSQI. In addition, sleep onset latency (SOL), which tends to increase with advancing age and is often readily recalled by older individuals, has been proposed as a significant predictor of perceived sleep quality in this population. (Zitser, J., Allen, et al., 2022)

Kanchan S, Bhardwaj K and their group studied sleeping pattern in Indian population during COVID pandemic using PSQI tools. Emerging evidence has examined the impact of the coronavirus disease-2019 (COVID-19) pandemic on sleep health in the general population. They conducted cross-sectional online survey among 1,000 consenting Indian adults investigated changes in sleep quality before and during the pandemic using the Pittsburgh Sleep Quality Index (PSQI). The survey, disseminated via social media platforms, incorporated PSQI-based items to assess multiple dimensions of subjective sleep quality. Comparative findings revealed a deterioration in overall sleep quality during the pandemic period. Collectively, these findings demonstrate a marked decline in subjective sleep quality among the Indian population during the COVID-19 pandemic compared to the pre-pandemic period, underscoring the widespread influence of pandemic-related stressors on sleep health.

Joy J , Abraham A and group reported study on Sleep Quality among Adolescents of Three Districts of Central Kerala. They reported that Sleep is widely recognized as a fundamental biological necessity, requiring both adequate duration and optimal quality to support overall health and functioning. During adolescence, sleep assumes particular importance due to its critical role in memory consolidation, learning processes, decision-making, critical thinking, academic performance, social behavior, and cardiometabolic regulation. Consequently, the assessment of sleep quality and patterns in this age group has become an important focus of empirical research. They conducted A cross sectional study in adolscent group aged 10-18 yrs in Kerala state and using PSQI components assessed sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances and Daytime dysfunction. The finding says Adolescents exposed to stressful life events or medical conditions demonstrated comparatively lower sleep quality and higher levels of sleep disturbances. Overall, although the majority of adolescents were found to

have good sleep quality, a meaningful proportion experienced sleep-related difficulties, particularly in the presence of stress. These findings highlight the need for targeted interventions addressing psychosocial and health-related factors to promote optimal sleep health during adolescence. (Joy, J., Abraham, et *al*., (2023)

Bangalore N Roopesh studied about Malin's Intelligence Scale for Indian Children (MISIC) is among the most extensively utilized standardized measures of intellectual functioning in India. Its clinical significance has further increased following its designation as one of the two intelligence tests mandated for administration prior to the assessment and diagnosis of Specific Learning Disability (SLD) in the Indian context. MISIC provides three indices of cognitive performance: Verbal IQ, Performance IQ, and Full-Scale IQ. In light of these limitations, it has been proposed that a Verbal IQ score greater than 85 may be considered sufficient for SLD assessment and diagnosis, irrespective of the availability of a corresponding Full-Scale IQ score. This recommendation underscores the need for contextually appropriate interpretation of intelligence measures and cautions against reliance on statistically unsupported prorating procedures in high-stakes clinical evaluations. (Malin, A. J. (1969)

Anjum, Ruchi & Shushmita reported that the mental health and well-being of students form a critical foundation for holistic development, fostering essential life skills that support personal growth, resilience, and sustainable development. Research underscores that mental well-being is closely interconnected with physical, social, and emotional health, such that impairments in any domain can have cascading effects across others. Aligning with this perspective, the National Education Policy (NEP) 2020 emphasizes that children's capacity for optimal learning is compromised when they are unwell or undernourished. Accordingly, the policy advocates for integrated approaches within schools, including the provision of nutritious meals, the deployment of trained social workers and counselors, and active community engagement to promote comprehensive student health and wellbeing.

Balamurugan G, Sevak S and their group reviewed research papers and discussed Childhood and adolescence represent pivotal periods for mental health, with environmental factors significantly influencing development and well-being. Recent research in India has systematically examined mental health issues among school-aged children and adolescents. They reviewed that indicate a wide spectrum of mental health concerns, with depression emerging as the most prevalent, followed by social, behavioral, and emotional problems, anxiety, psychological distress, internet addiction, stress, social phobia, experiences of abuse, violence, and attention deficit hyperactivity disorder. These results highlight the need for culturally and contextually tailored school-based

mental health interventions in India to address diverse student needs, reduce stigma, and promote overall well-being.

Annie Bryant & Jacalyn Guy discussed in his study that children and adolescents presenting with developmental disorders have been consistently reported to exhibit an elevated vulnerability to comorbid mental health difficulties. Within this context, the Strengths and Difficulties Questionnaire (SDQ) has emerged as a widely utilized screening instrument for the identification of emotional and behavioral problems in pediatric populations. However, existing applications of the SDQ have predominantly focused on cohorts of children with formally diagnosed developmental conditions, thereby limiting its broader examination across diverse or undiagnosed at-risk groups. (Bryant A, Guy, J, et *al*., 2020).

Daniel Costa Ball, Cecilia Cracco and their group studied regarding the factorial validity of the Strengths and Difficulties Questionnaire (SDQ), recent research has sought to re-examine its dimensional structure and psychometric properties, particularly in parent-report formats for children and adolescents. They used SDQ tool for children aged 4-16yrs. Using data obtained from 621 parents of Uruguayan children aged 7 to 12 years (52% girls) representing diverse socioeconomic backgrounds, the study tested the fit of the original five-factor and alternative three-factor models through confirmatory factor analysis. These findings underscore the importance of continued empirical scrutiny of the SDQ's internal structure and highlight the need for further examination of specific items to enhance its structural validity across diverse populations.

1.5 Literature Gap

Despite the growing body of international research on sleep and adolescent development, limited empirical studies have examined the relationship between biological clock patterns, cognitive performance, and mental well-being among school children in the Indian context. Existing studies often focus on sleep duration or academic outcomes independently, without considering the broader interaction between sleep quality, circadian rhythms, cognitive functioning, and psychological well-being.

Therefore, the present study attempts to address this research gap by systematically examining the relationship between biological clock indicators, cognitive performance, and mental well-being among school children in Madhya Pradesh and Maharashtra.

Chapter III
Research Methodology

3.1 Introduction

This chapter refers the methodology employed to conduct ““Exploring the Relationship of Biological Clock with Cognitive Performance and Mental Wellbeing of School Children” on 21 selected schools in Madhya Pradesh. The methodology was decided as per the selected objectives and nature of the study. The investigator has presented the detailed information about the need of the project, objectives, scope of the project, method, sample, tools, process of data collection and technique of data analysis in the following pages.

3.2 Need and Justification of the project

Although a substantial and expanding body of global research highlights the critical role of quality sleep in shaping children’s mental health, emotional regulation, and behavioral outcomes, there remains a notable gap in context-specific investigations within India. International studies consistently demonstrate that healthy sleep duration, consistent sleep–wake schedules, and good sleep hygiene practices are associated with improved attention, memory consolidation, executive functioning, emotional stability, and overall psychological well-being among school-aged children. Conversely, irregular sleep–wake patterns, insufficient sleep, and poor sleep quality have been linked to heightened risks of anxiety, depression, irritability, impaired academic performance, and reduced cognitive efficiency.

However, despite this growing global evidence, there is a lack of empirical research examining the direct relationship between sleep–wake patterns and cognitive performance and mental well-being among school-going children in India. This gap is particularly significant given the country’s vast socio-cultural, economic, and educational diversity. Indian students are exposed to varying school schedules, early start times, academic pressures, extracurricular demands, screen exposure, family routines, and cultural practices that may uniquely influence their sleep behaviors. Urban–rural disparities, differences between public and private schooling systems, and region-specific lifestyle patterns further contribute to variability in children’s sleep habits. Moreover, the competitive academic environment in many Indian schools often encourages extended study hours, late-night preparation, and coaching classes, potentially disrupting natural circadian rhythms. Combined with increasing digital device use and changing family structures, these factors may significantly alter sleep–wake cycles, with possible consequences for attention span, working memory, problem-solving ability, emotional resilience, and overall psychological health.

Given these contextual differences, it is highly pertinent to conduct systematic research within Indian school settings to evaluate how sleep duration, sleep quality, and consistency of sleep–wake patterns influence cognitive performance and mental well-being among children. Such research would not only fill a critical knowledge gap but also inform evidence-based school policies, parental guidance programs, and public health interventions tailored to the Indian context. Understanding these relationships could ultimately contribute to improving academic outcomes, reducing mental health concerns, and fostering holistic development among school-going children across diverse Indian communities.

3.3 Research Objectives

Sleep plays a vital role in human life and affects academic and cognitive performance in school children. This study evaluates Sleeping pattern & Mental wellbeing of school children of Western region of India. The proposed research aims to contribute to the growing concern on importance of sleep for children's cognitive and mental wellbeing. This study intends to establish a clear link between sleep-wake cycle patterns and both cognitive performance and mental wellbeing in school-going children of the proposed region. Understanding the influence of sleep-wake cycles on children's academic performance and mental wellbeing is crucial, especially in the context of modern-day pressures faced by children in India. The findings could inform policies related to school timings, homework schedules, and strategies for promoting healthy sleep habits among children, leading to better educational and psychological outcomes. The following objectives have been identified for the study.

1. To examine the functioning of the biological clock, with a focus on the sleep–wake cycle, among school children in the western region of India within the context of Indian school schedules and routines.

2. To evaluate the subjective cognitive performance of school children and analyse its correlation with sleep quality parameters.

3. To investigate the influence of sleep patterns on various aspects of mental wellbeing, including stress, anxiety, depression, and emotional regulation in school-aged children.

To identify the key determinants and contributing factors associated with disturbances in the biological clock (sleep–wake cycle) among Indian school children.

4. To develop evidence-based recommendations aimed at improving cognitive functioning and promoting mental wellbeing in school children through better sleep health and circadian alignment.

3.4 Delimitation of the Study

This study is confined to the western region of India specifically Maharashtra & Madhya Pradesh. Expert member decided to limit to collect data in Madhya Pradesh as time was concern. Therefore number of schools are more in Madhya Pradesh.

The research focuses exclusively on aged group 11-18 yrs (Adolescent) and class 6^{th}- 12^{th} class students.

The study will examine the sleep pattern and effect of disturbed sleep in cognitive & academic performance in the school children.

3.5 Research Design:

The present study adopted a cross-sectional descriptive research design with quantitative analytical methods to examine the relationship between biological clock patterns, sleep quality, cognitive performance, and mental well-being among school children. A cross-sectional design was considered appropriate because the data were collected from participants at a single point in time without manipulating any variables. This design enables the researcher to observe existing conditions and analyze relationships among variables as they naturally occur within the school environment. The study primarily relied on quantitative data obtained through structured questionnaires and standardized tools to measure sleep patterns, cognitive performance, and mental well-being. Statistical techniques such as descriptive statistics and correlation analysis were used to examine patterns and associations among the variables. This approach allowed the researcher to systematically investigate how biological clock indicators and sleep-related factors are associated with students' cognitive functioning and psychological well-being.

3.6 Population and samplings

Population of the Study: The population of the present study comprised school-going children studying in Classes VI to XII in the selected regions of Madhya Pradesh. These students fall within the adolescent age group, which is considered a critical developmental stage where significant physical, cognitive, and psychological changes occur. Since the study aimed to explore the relationship between biological clock (sleep–wake cycle), cognitive performance, and mental well-being, school children from different educational settings were considered appropriate participants for the study.

The population included students from both government and private schools, as well as residential and non-residential schools, located in urban and rural areas. Inclusion of students from diverse school contexts helped in capturing a broader representation of sleep patterns and lifestyle

variations among school children. The target population also included students studying in different school shifts (morning and afternoon), which may influence sleep schedules and daily routines.

Sampling technique:

A stratified purposive sampling technique was adopted for the present study. Schools were first categorized based on relevant characteristics such as school type (government/private), school category (residential/non-residential), and location (urban/rural). From these categories, selected schools were purposively included in the study to ensure representation of different schooling environments.

Within each selected school, students from Classes VI to XII were invited to participate in the study. Participation was voluntary and conducted with the permission of school authorities. The sampling approach ensured that students representing different age groups and educational settings were included in the study, which was necessary for examining variations in sleep patterns and their possible association with cognitive performance and mental well-being.

Sample Size:

The total sample for the present study consisted of 597 school children drawn from selected schools across diffident districts of Madhya Pradesh & Maharashtra region. A sample for the present study was drawn from **21 schools** to ensure adequate representation of students from diverse educational settings. The selected schools included Kendriya Vidyalayas, Jawahar Navodaya Vidyalayas, CM Rise Schools, Government schools, and Private schools. The inclusion of these different categories of schools helped capture the diversity in institutional structures, academic environments, and daily school schedules that may influence students' sleep patterns, cognitive performance, and mental well-being. The participants were selected from Classes VI to XII, representing the adolescent stage of schooling where sleep patterns, cognitive development, and psychological well-being undergo significant changes. The selection of this age group was considered appropriate as adolescence is a critical developmental phase during which the biological clock and sleep–wake cycle often undergo noticeable shifts, potentially influencing academic performance and mental health.

Out of the total respondents, 221 students belonged to Classes VI–VIII, representing the early adolescent group, while 376 students belonged to Classes IX–XII, representing the middle to late adolescent group. This classification allowed the researchers to examine possible age-related variations in sleep patterns, cognitive functioning, and mental well-being across different stages of adolescence.

The inclusion of two distinct class groups was particularly useful for conducting comparative analyses between younger and older adolescents. Differences in academic demands, lifestyle habits, and developmental changes may influence sleep duration, sleep quality, and psychological well-being. By including students from both groups, the study was able to explore whether the relationship between sleep patterns, cognitive performance, and mental well-being varies across different stages of schooling.

Inclusion Criteria of Participants

The following criteria were used for including participants in the study:

1. Students studying in Classes VI to XII in the selected schools.
2. Students who were present during the data collection period and willing to participate in the study.
3. Students who provided complete responses to the questionnaire related to sleep patterns, cognitive performance, and mental well-being.
4. Students belonging to the adolescent age group, which was considered appropriate for studying changes in sleep–wake cycle patterns.

Exclusion Criteria of Participants

The following criteria were used for excluding participants from the study:

1. Students who were absent during the data collection period.
2. Students who did not provide complete responses to the questionnaire.
3. Responses that were found to be inconsistent, incomplete, or invalid during data screening.
4. Students who declined to participate voluntarily in the study.

3.7 Research Tools

In order to examine the relationship between the biological clock (sleep–wake cycle), cognitive performance, and mental well-being among school children, a set of structured research tools was used in the present study. The tools were selected carefully to measure different dimensions related to sleep patterns, cognitive functioning, and psychological well-being of the participants. The questionnaires were administered to students of Classes VI to XII in the selected schools.

3.7.1 Questionnaire for Assessing Sleep–Wake Pattern

To assess the sleep behaviour of students, a structured questionnaire was used to collect information related to sleep duration, sleep quality, and sleep disturbances among school children. The questionnaire included items related to bedtime, wake-up time, sleeping hours, daytime sleepiness, and disturbances during sleep.

In addition to this, the Pittsburgh Sleep Quality Index (PSQI) – modified version for school children was used to measure overall sleep quality. The PSQI tool helps evaluate different components of sleep, including subjective sleep quality, sleep duration, sleep disturbances, sleep latency, daytime dysfunction, and use of sleep medication. PSQI tools contains 17 questions in three section (Sleep quality, Sleep Latency, Sleep disturbance and Daytime dysfunction) and scored accordingly. Assessment of sleep quality were done from the Global sleep score and categorized as 0-4 -Good Sleep Quality 5-7 - Mild Sleep Disturbance 8-14 - Moderate Sleep disturbance 15-21- Severe Sleep disturbance.

3.7.2 Tool for Assessing Cognitive Performance

Cognitive performance of the students was assessed through a cognitive assessment questionnaire consisting of questions related to general knowledge, reasoning ability, mathematical ability, and basic comprehension skills. The responses provided by the students were scored and converted into an IQ percentage score, which served as an indicator of their cognitive performance. The score obtained from this tool was used to examine the association between sleep patterns and cognitive functioning among school children.

3.7.3 Tool for Assessing Mental Well-being

The Strengths and Difficulties Questionnaire (SDQ) was used to assess the mental well-being of the students. The SDQ is a widely used screening tool designed to measure behavioural and emotional aspects of children and adolescents. The questionnaire includes items related to emotional symptoms, conduct problems, peer relationship problems, hyperactivity, and prosocial behaviour.

For the purpose of this study, the responses obtained from the SDQ were scored to derive a mental well-being score, which provided an indication of the psychological state of the participants. This score was further used to examine the relationship between sleep patterns and mental well-being among school children.

3.8 Vetting and Validation of Research tools:

The research tools used in the present study were carefully reviewed and finalized through a systematic vetting and validation process. As part of Activity III of the project, a Vetting and Tools Finalization Workshop was conducted from 4th August to 8th August 2025 at Room No. 30, Regional Institute of Education (RIE), Bhopal, Madhya Pradesh.

The workshop involved detailed discussions and expert review of the proposed research tools and questionnaires designed for assessing sleep patterns, cognitive performance, and mental well-being among school children. The workshop was facilitated by eminent experts, including Prof. N.

K. Agrawal from Garhwal University, Uttarakhand, and Dr. Suryanarayan Pradhan from Sambalpur University, Odisha, who served as external resource persons. Their expertise in the fields of statistics, educational research, and psychological assessment contributed significantly to refining the tools and ensuring their suitability for the objectives of the study.

During the workshop, the structure, content, clarity, and relevance of the questionnaire items were thoroughly examined. Based on the suggestions and recommendations provided by the experts and participating faculty members, necessary modifications were incorporated into the tools. The finalized questionnaires were designed to effectively capture information related to sleep–wake cycle patterns, cognitive performance, and mental well-being of students.

Following the finalization of the questionnaire, the validation of the research tools was carried out at the Department of Mathematics and Statistics (DMS), Regional Institute of Education, Bhopal. The validation process ensured that the tools were appropriate, reliable, and relevant for collecting data from school children, thereby enhancing the overall quality and credibility of the research.

3.9 Data Collection:

The process of data collection for the present study was carried out in a systematic and organized manner. The data were collected from selected Jawahar Navodaya Vidyalayas (JNVs), Kendriya Vidyalayas (KVs), CM Rise Schools, Government schools, and Private schools located in different districts of Madhya Pradesh and Maharashtra. A total of 21 schools were visited as part of the data collection process. The Junior Project Fellow (JPF) along with the investigators conducted field visits to the selected schools. Prior to the commencement of data collection, necessary administrative permissions were obtained from the Regional Offices of Kendriya Vidyalayas and Jawahar Navodaya Vidyalayas, as well as from the respective school authorities.

At the beginning of each session, the objectives of the study and the purpose of the research tools were briefly explained to the participants. The Head Teachers and the Junior Project Fellow introduced the study and clarified the nature of the information being collected.

Students were then provided with the questionnaires designed to assess sleep patterns, cognitive performance, and mental well-being. Detailed instructions were given regarding how to respond to the questions, and any doubts raised by the students were clarified by the research team. The data collection was carried out in the presence of teachers, ensuring a comfortable and supportive environment for the students while responding to the questionnaire.

The responses obtained from the students were carefully compiled and later organized for data entry, coding, and statistical analysis. This systematic approach ensured the reliability and completeness of the data collected for the study.

3.10 Data Analysis

The collected data were coded and entered into SPSS (Statistical Package for Social Sciences) and Microsoft Excel for statistical analysis. Descriptive statistics including mean, standard deviation, minimum, and maximum values were calculated to examine sleep patterns, cognitive performance, and mental well-being. Correlation analysis was conducted to examine the relationship between sleep quality indicators, cognitive performance scores, and mental well-being measures. Graphical representations such as bar charts and comparative tables were used to present findings clearly.

3.11 Ethical Considerations

The study followed ethical research guidelines. Prior permission was obtained from school authorities before data collection. Participation of students was voluntary and informed consent was obtained from teachers and parents where required. Confidentiality and anonymity of participants were maintained throughout the study.

3.12 Conclusion

The present chapter has given a detailed account of method, sample, tools, procedure of data collection and analysis. The collected data was entered in MS Excel and analyzed and calculated as per the objectives of the study. The detail of the analysis and interpretation is presented in chapter-IV.

CHAPTER IV

RESULTS AND DATA ANALYSIS

A. Categorization of sample on the basis of demographic details

4.1 Distribution respondents based on Gender, Class, School Location, School type and Category

The gender distribution of respondents across two class groups i.e Class 6-8 and Class 9-12 was studied. Among Classes VI–VIII, the number of male respondents (76) is slightly higher than female respondents (72). Similarly, among Classes IX–XII, male respondents (245) outnumber female respondents (199). This indicates that male students constitute a slightly larger proportion of the study sample across both class groups (Figure 4.1). Similarly, the distribution of respondents across Classes VI to XII was studied. The highest participation was observed among students of **Class XII (123)** and **Class X (122)**, while relatively fewer respondents were from **Classes VI–VIII**. This indicates that the study sample included a larger proportion of **secondary and senior secondary students**, who are more likely to experience variations in sleep patterns during adolescence (Figure 4.2).

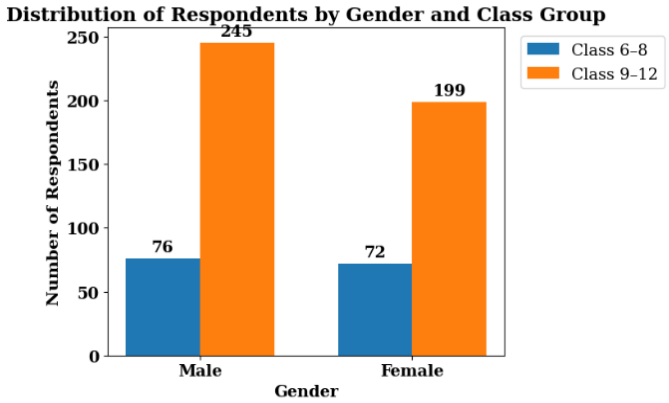


Figure 4.1A: Distribution of respondents by Gender

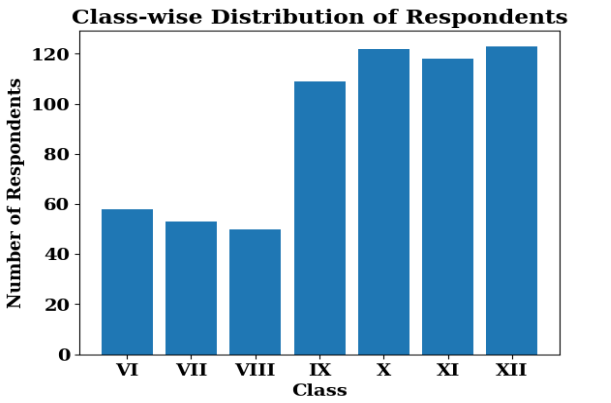


Figure 4.1B: Class wise distribution of respondents.

The respondents participating in the study belonged to schools located in both urban and rural areas of Madhya Pradesh. The figure 4.1 shows the distribution of respondents according to school location across two class groups. Among students in Classes VI–VIII, the number of respondents from rural schools (75) is slightly higher than those from urban schools (72). A similar pattern is observed among Classes IX–XII, where 233 respondents belong to rural schools compared to 212 respondents from urban schools. This indicates that rural schools constitute a slightly larger proportion of the study sample in both class groups (Fig 4.1C). The figure 4.1D shows the

distribution of students studying in residential and non-residential schools across two class groups. Among students of Classes IX–XII, a larger proportion belongs to residential schools (256) compared to non-residential schools (168). In contrast, the distribution among Classes VI–VIII is relatively balanced, with 75 students from non-residential schools and 72 from residential schools. This indicates that residential schooling is more common among students in higher classes in the present study.

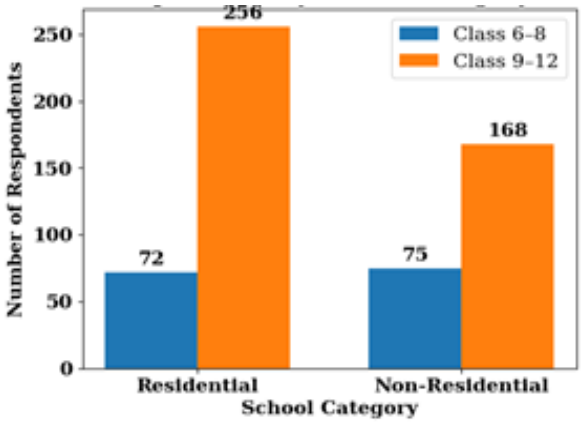


Figure 4.1C: Distribution of respondents based on school location

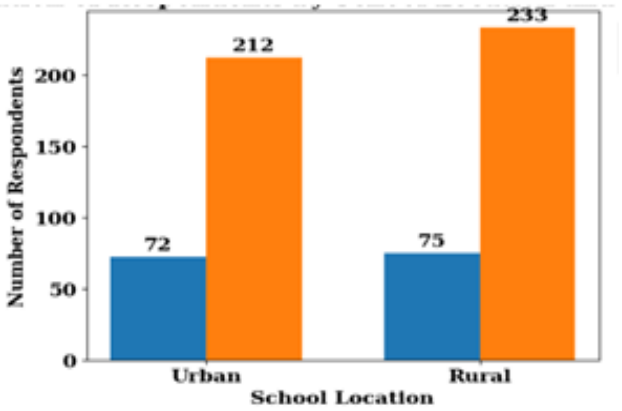


Figure 4.1D: Distribution of respondents based on school category

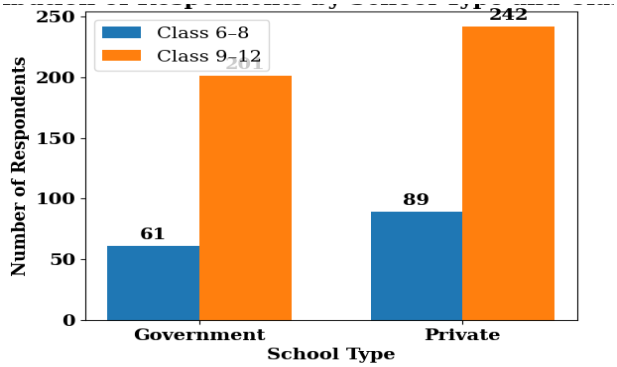


Figure 4.1E: Distribution of respondents based on school type

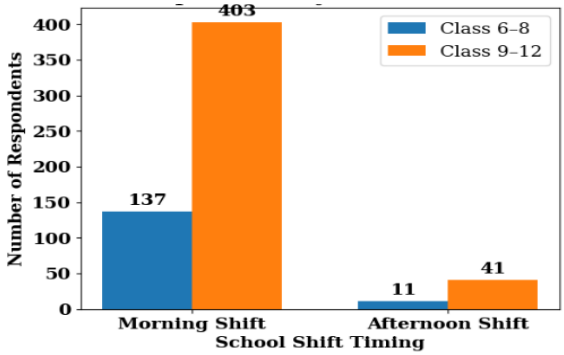


Figure 4.1F: Distribution of respondents based on school timing or shift.

The figure 4.1E shows the distribution of students from government and private schools across two class groups. Among Classes VI–VIII, a higher number of respondents belong to private schools (89) compared to government schools (61). Similarly, in Classes IX–XII, the participation from private schools (242) is higher than that from government schools (201). This indicates that private school students constitute a larger proportion of the study sample in both class groups. The figure 4.1F illustrates the distribution of respondents according to school shift timing across two class groups. Among students in Classes VI–VIII, the majority attend morning shift schools (137 students), while only 11 students attend afternoon shift schools. A similar pattern is observed in

Classes IX–XII, where 403 students belong to morning shift schools compared to 41 students from afternoon shift schools. This indicates that morning shift schooling is predominant among the sampled schools in the present study.

B. Analysis of Biological clock and Sleep pattern of School Children

4.2 Analysis of Sleep–Wake Pattern and duration of sleep of Students (Biological Clock Indicators)

This section presents the distribution of students based on different sleep-related variables such as sleep duration, bedtime, wake-up time, and sleep habits, which together indicate the biological clock patterns among school children.

4.2.1 Sleep duration on school days: The analysis of sleep duration across the two cohorts reveals a significant "Developmental Sleep Erosion." As students transition from middle school to high school, there is a clear downward shift in the total number of hours slept per night.

The data shows that there is a distinct "Sleep Shift" toward shorter durations in the senior cohort. While a higher proportion of Class 6–8 students successfully reach the 7–8 hour and 8–9 hour marks, the majority of Class 9–12 students are concentrated in the 6–7 hour and 5–6 hour categories. Specifically, the "Sleep Debt" (less than 7 hours) is significantly more prevalent in high schoolers, driven by the biological phase delay and increased academic demands.

This shift is not merely a result of academic workload but a direct consequence of the "Sleep Squeeze." High schoolers experience a biological phase delay—meaning their bodies are naturally programmed to fall asleep later—yet they are forced to adhere to the same early wake-up times as middle schoolers. This results in the loss of nearly 60–90 minutes of critical restorative sleep for high school students. This systematic erosion of the sleep window is a primary driver of the daytime dysfunction and reduced cognitive scores observed in the senior cohort, suggesting that high schoolers are in a state of chronic biological mismatch with the school environment.

Table 1: Comparative Sleep Duration by Academic Group

Sleep Duration Category	*Class 6–8 (%)*	*Class 9–12 (%)*	*Trend Analysis*
Less than 5 hours	4.3%	11.4%	Nearly 3x increase in the senior group
5–6 hours	18.6%	25.2%	Significant rise in restricted sleep
6–7 hours	35.4%	39.8%	Most common duration for both groups
7–8 hours	29.2%	20.1%	Higher attainment in younger students
8–9 hours	11.0%	2.5%	Dramatic drop in optimal sleep
More than 9 hours	1.5%	1.0%	Extremely rare across all ages

4.2.2 Distribution of Bed time and wake up time: The bedtime distribution highlights a significant biological shift in sleep onset patterns as students transition from middle to high school. In early adolescence (Class 6–8), a majority of students maintain relatively earlier bedtimes, with 32.3% retiring between 9:00 PM and 10:00 PM and 75% asleep before 11:00 PM. However, a distinct circadian phase delay is observed in the senior cohort (Class 9–12), where the proportion of students sleeping after 11:00 PM more than doubles, rising from 18.1% to 37.1%. This shift toward late-night activity reflects the maturation of the biological clock during puberty, resulting in a delayed sleep-wake cycle that often conflicts with rigid institutional schedules**.** (Fig. 4.2.2A).

The wake-up time distribution reflects a highly synchronized and early start for the majority of the student population. Across the groups, nearly **75%** of students are awake before 7:00 AM, with the largest segment (**44.1%**) rising between **5:00 AM and 6:00 AM**.

This early rising remains remarkably consistent between middle and high school cohorts, with approximately **50%** of students in both groups waking before 6:00 AM. This "forced" end to the sleep cycle suggests that morning routines are strictly dictated by institutional schedules and transit requirements, preventing students from compensating for the later bedtimes that naturally occur as adolescents age. While these results highlight a specific institutional mismatch, they underscore the broader challenge of aligning academic start times with the biological needs of school-aged children (Fig 4.2.2B).

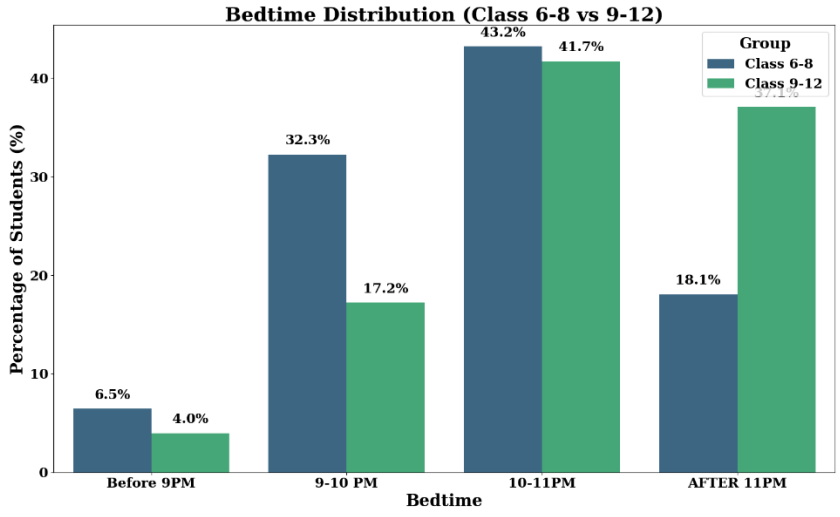


Figure 4.2.2A: A grouped bar chart comparing self-reported nocturnal bedtimes between middle school (Class 6–8) and high school (Class 9–12) students. Percentages represent the proportion of students within each developmental group to normalize for sample size differences.

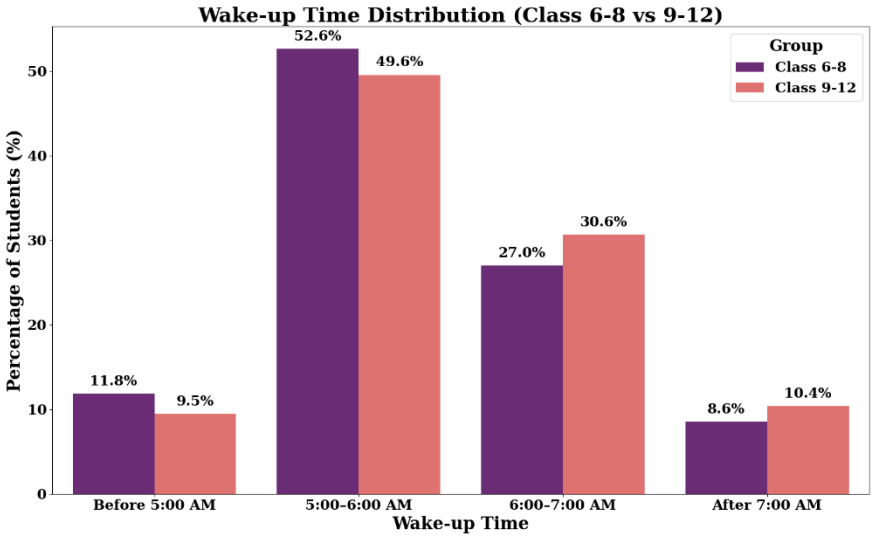


Figure 4.2.2B: A grouped bar chart comparing self-reported wake-up time between middle school (Class 6–8) and high school (Class 9–12) students. Percentages represent the proportion of students within each developmental group to normalize for sample size differences.

4.3 Analysis of Sleep quality, sleep disturbance and day time sleepiness

4.3.1 Distribution of Sleep latency (time taken to fall asleep)

The comparative analysis of sleep latency—the time required to transition from full wakefulness to sleep—reveals a significant decline in sleep efficiency as students' progress into higher grades. Among the younger cohort (Class 6–8), a majority of 54.2% reported a healthy sleep onset of less than 15 minutes. However, this figure drops sharply to 35.6% in the senior cohort (Class 9–12), indicating that nearly two-thirds of high school students struggle with delayed sleep onset.

The most common latency period for high schoolers is 15–30 minutes (46.9%), and the prevalence of severe latency (over 30 minutes) is 1.6 times higher in older students compared to their younger counterparts. This increase in the time taken to fall asleep effectively further "squeezes" the already restricted sleep window of high school students. This trend likely reflects a combination of biological changes in the circadian rhythm, increased academic stress, and the impact of pre-sleep screen exposure, all of which hinder the biological transition to rest and contribute to the systemic sleep debt identified across the student population (Fig. 4.3.1).

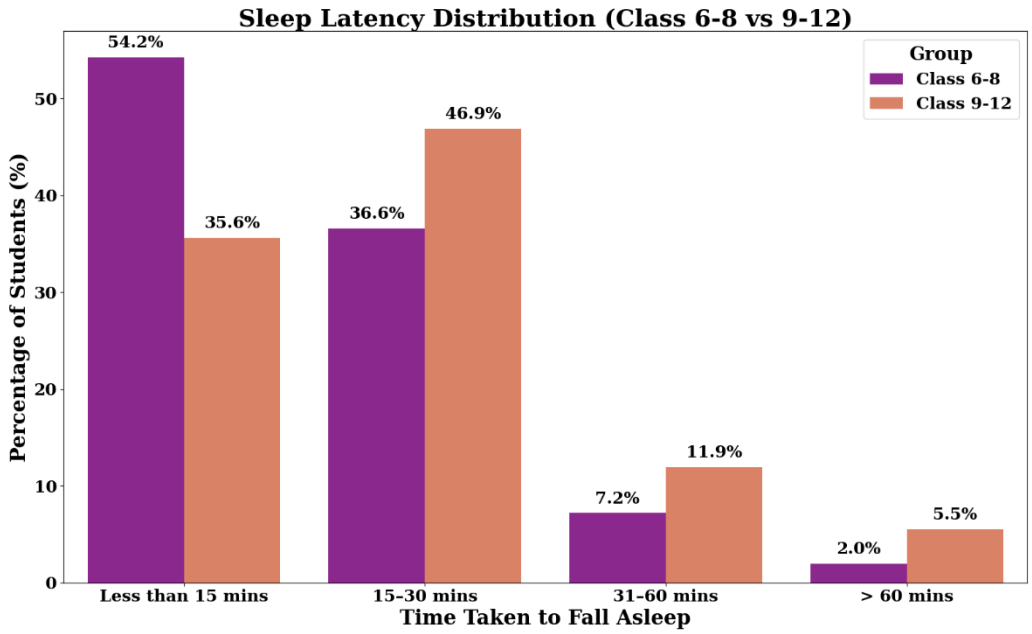


Figure 4.3.1: This chart compares the "Time Taken to Fall Asleep" (Sleep Latency) between middle school (Class 6–8) and high school (Class 9–12) students. Latency is an indicator of sleep efficiency and potential physiological or psychological arousal before bed.

4.3.2 Sleep Disturbance

Upon analysis of the sleep disturbance component scores reveals notable patterns among the participating students. Among Class VI–VIII students, the majority of respondents were observed in score category 1 (127 students), indicating relatively lower levels of sleep disturbance, followed by score category 2 (89 students) representing moderate disturbance levels. Only a very small number of students were found in score categories 0 (3 students) and 3 (2 students), indicating minimal and relatively higher disturbances respectively.

In contrast, among Class IX–XII students, the majority of respondents were found in score category 2 (202 students), suggesting moderate levels of sleep disturbance, followed by score category 1 (163 students). A smaller proportion of students were found in score category 3 (11 students), indicating comparatively higher sleep disturbances (Fig. 4.3.2).

The comparative analysis indicates that sleep disturbance tends to increase among older students, as a larger proportion of Class IX–XII students fall under higher disturbance categories compared to Class VI–VIII students. This pattern may reflect age-related changes in the biological clock and circadian rhythm during adolescence, which can influence sleep quality, daily alertness, and overall well-being.

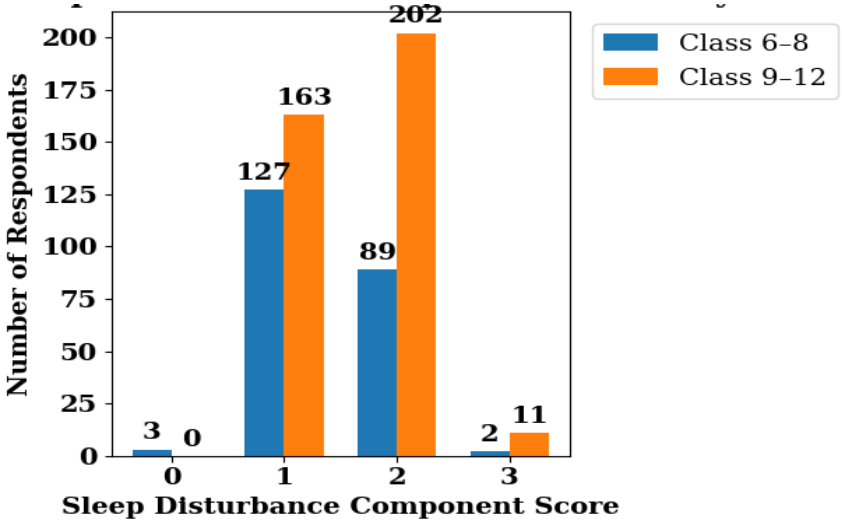


Figure 4.3.2: Comparison of Sleep Disturbance Component Scores between Class VI–VIII and Class IX–XII

4.3.3 Prevalence of Morning class Sleepiness with respect to sleep duration: The prevalence of morning class sleepiness serves as a direct indicator of the "biological grogginess" that hampers the early hours of academic instruction. According to the study data, this phenomenon is nearly universal among severely sleep-deprived students, with 72.7% of high schoolers (Class 9–12) and 66.7% of middle schoolers (Class 6–8) reporting regular morning drowsiness when limited to four hours of sleep (Fig.4.2.4).

Notably, even students who achieved a higher threshold of 7.5 hours of sleep still exhibited a sleepiness rate exceeding 35%, suggesting that early wake-up requirements are forcing students to begin their academic day before their circadian rhythms have fully transitioned to wakefulness. This persistent morning lethargy represents a significant barrier to cognitive engagement, as the first periods of the day are often spent in a state of reduced alertness, regardless of the previous night's total sleep duration. This state, often referred to as sleep inertia, highlights a systemic mismatch between the "Institutional Clock" of school schedules and the biological needs of the adolescent brain.

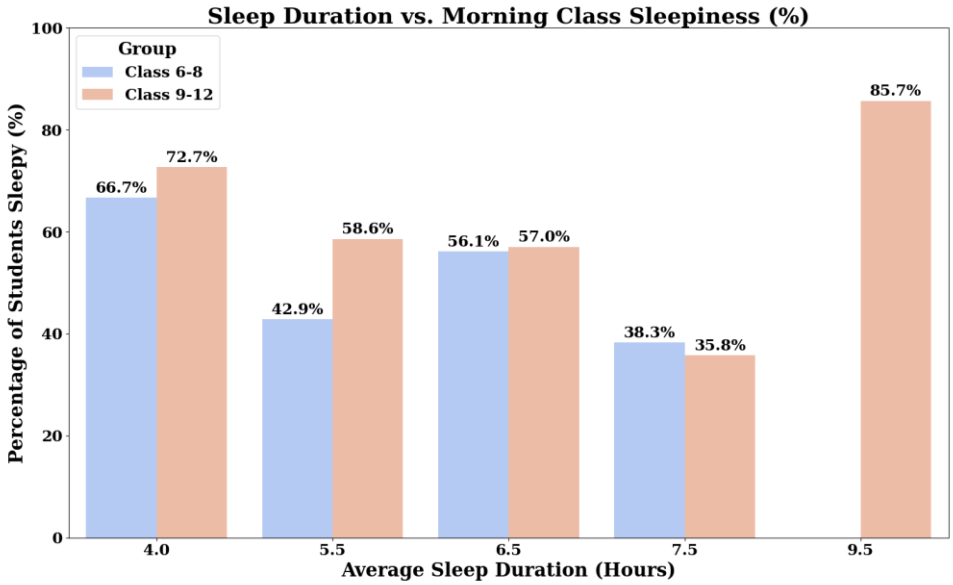


Figure 4.3.3A: This grouped bar chart displays the percentage of students who self-report being "Sleepy" or "Sometimes Sleepy" during their first morning classes, categorized by nightly sleep duration.

C. Analysis of Sleep disturbance factors among School children

4.4 Digital Hygiene and the Biological Clock

The analysis of digital hygiene reveals that pre-sleep electronic usage is a significant disruptor of the adolescent sleep-wake cycle. Our findings indicate that as the frequency of mobile phone or television use before bed increases, there is a corresponding extension in **sleep latency**. Across all levels of usage, high school students take significantly longer to transition from wakefulness to sleep than their younger counterparts. While middle school students (Class 6–8) with "Frequent" screen use average a latency of **23.0 minutes**, high schoolers in the same category average **27.8 minutes**. This 4.8-minute gap suggests that older adolescents may be more biologically sensitive to the blue light and psychological stimulation of electronic devices, or they may be using devices for longer durations/more engaging activities (such as social media or academic research) late at night.

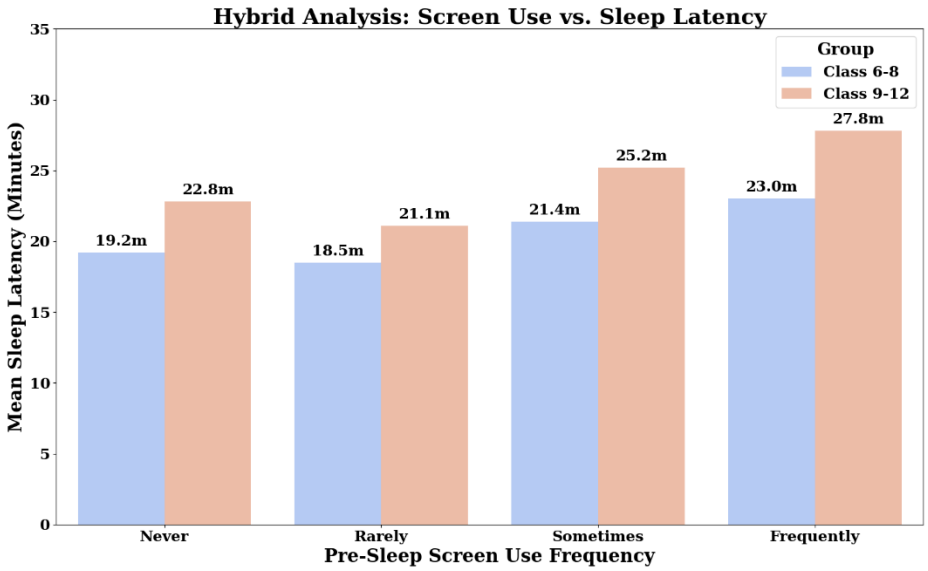


Figure 4.4: Screen Use vs. Sleep Latency; This grouped bar chart compares the mean sleep latency (minutes) across different frequencies of pre-sleep screen use for middle school (Class 6–8) and high school (Class 9–12) students.

For the Class 9–12 group, the combination of a natural biological phase delay and poor digital hygiene creates a cumulative delay in sleep onset that significantly reduces their already limited sleep window. These findings suggest that "Digital Detox" interventions would be particularly critical for high school students to help synchronize their internal biological clocks with their morning academic requirements.

C. Association of Sleep quality on Cognitive Performance and Mental wellbeing of School Children.

4.5.1 Corelation of sleep quality with Cognitive Performance and mental wellbeing

The correlation study was conducted using statistical tools to examine the association of sleep with cognitive performance and mental well-being among school children. In order to study this association, the overall sleep quality of the students was first assessed by determining a Global Sleep Quality Score derived from the sleep-related questionnaire responses. Similarly, cognitive performance was measured by calculating the IQ percentage score of each participant, which was derived from the responses to the cognitive assessment questionnaire included in the survey. Further, the mental well-being of the participants was assessed using the score obtained from the Strength and Difficulties Questionnaire (SDQ), which provided an overall measure of the psychological well-being of the students.

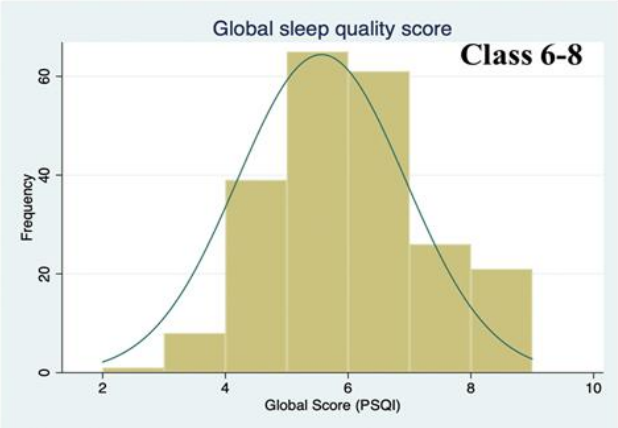


Figure 4.5.1A: The histogram with the normal curve indicates that the Global Sleep Quality Scores (PSQI) of students from 6th to 8th class follow an approximately normal (bell-shaped) distribution. Most observations are concentrated around the central value (around score 6), suggesting that the mean and median are likely close to each other.

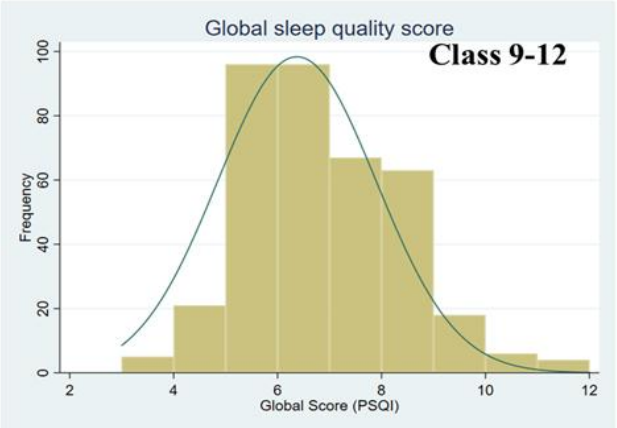


Figure 4.5.1B: The histogram of Cognitive intelligence scores of classes 9-12 shows that most participants have IQ values between 65 and 90, with the highest concentration around 70–80. The distribution is approximately bell-shaped (normally distributed) with slight negative skewness due to a few low-score observations. Overall, the data appear reasonably close to a normal distribution

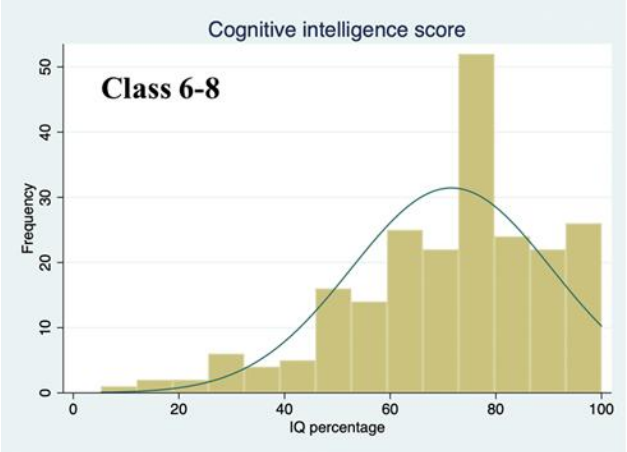


Figure 4.5.2A: The histogram with the normal curve shows the distribution of Cognitive Intelligence Scores (IQ percentage) among students of Class 6-8. Most scores are concentrated between 60 and 85, with the highest frequency around 75–80. The distribution roughly follows a normal (bell-shaped) pattern, with slight left skew due to a few lower scores. This suggests that most students have average to above-average cognitive intelligence, while only a small number fall in the lower score range.

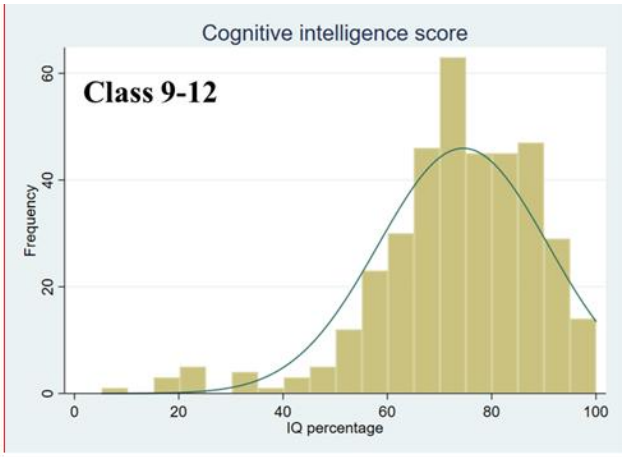


Figure 4.5.2B: The histogram of Cognitive intelligence scores of Class 9-12 shows that most participants have IQ values between 65 and 90, with the highest concentration around 70–80. The distribution is approximately bell-shaped (normally distributed) with slight negative skewness due to a few low-score observations. Overall, the data appear reasonably close to a normal distribution

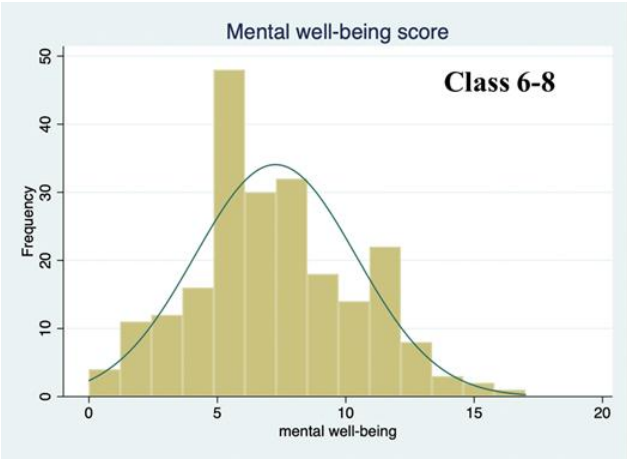


Figure 4.5.3A: The histogram with the normal curve indicates that the mental well-being scores of students of class 6-8 are approximately normally distributed. Most scores are concentrated around 6–8, showing the central tendency of the data. The spread of scores suggests moderate variability, with fewer students at the very low and very high ends. This indicates that most students have moderate levels of mental well-being, with only a small proportion showing very low or very high scores.

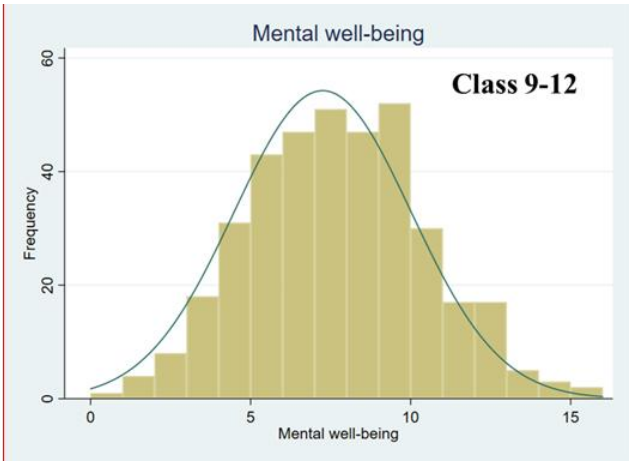


Figure 4.5.3B: The histogram with normal curve shows that the most participants fall within the range of 5 to 10 and the central value (mean) seems to lie around 7–8. The green curve represents the fitted normal distribution. The distribution appears approximately bell-shaped indicating that the mental well-being scores are close to a normal distribution.

Table 2: Descriptive Statistics

Variable	Class VI–VIII Mean	Class VI–VIII SD	Min	Max	Class IX–XII Mean	Class IX–XII SD	Min	Max
Global Sleep Score	5.57	1.37	2	9	6.37	1.52	3	12
Cognitive Intelligence / IQ (%)	71.59	18.98	5.26	100	74.54	16.28	5.26	100
Mental Well-being	7.26	3.14	0	17	7.25	2.76	0	16

Table 3: Comparative Correlation of Global Sleep Score with IQ and Mental Well-being among Students (r = Pearson correlation coefficient)

Variables	Class VI–VIII (r)	Class IX–XII (r)
Global Sleep Score vs IQ Percentage	-0.255	-0.036
Global Sleep Score vs Mental Well-being	0.438	0.337

The correlation analysis was conducted to examine the relationship between Global Sleep Score, IQ Percentage, and Mental Well-being among students of Class VI–VIII and Class IX–XII. The results reveal varying patterns in the strength and direction of relationships across the two groups.

Among Class VI–VIII students, the correlation between Global Sleep Score and IQ Percentage is negative and weak (r = -0.255). This indicates that as the global sleep score increases, the IQ percentage tends to decrease slightly. Since a higher global sleep score generally reflects poorer sleep quality, this finding suggests that students with poorer sleep patterns may exhibit relatively lower cognitive performance. Although the relationship is not strong, it implies that sleep quality may play a modest role in influencing cognitive abilities among younger students (Table 3).

In contrast, among Class IX–XII students, the correlation between Global Sleep Score and IQ Percentage is extremely weak (r = -0.036) and very close to zero. This indicates that sleep quality has almost no observable linear relationship with IQ percentage in this group. One possible explanation is that cognitive performance among older students may be influenced by multiple factors such as academic pressure, study habits, lifestyle patterns, and environmental influences, which may reduce the direct impact of sleep quality on measured intelligence scores (Table 3).

Regarding mental well-being, the results show a positive relationship with global sleep score in both groups. Among Class VI–VIII students, the correlation is moderately positive (r = 0.438), suggesting a noticeable association between sleep patterns and psychological wellbeing. This indicates that changes in sleep patterns are linked with variations in students' mental wellbeing. The relatively stronger correlation in this group may reflect the fact that younger adolescents are often more sensitive to sleep-related changes in mood, emotional regulation, and psychological health (Table 3).

Similarly, among Class IX–XII students, the correlation between Global Sleep Score and Mental Well-being is positive but slightly weaker (r = 0.337). This suggests that sleep patterns are still related to mental wellbeing among older students, though the strength of the association is somewhat lower compared to the younger group. Adolescents in higher classes often experience increased academic stress, social pressures, and lifestyle changes, which may influence their mental wellbeing alongside sleep patterns (Table 3).

Overall, the comparative findings indicate that sleep patterns appear to have a stronger association with both cognitive intelligence and mental wellbeing among younger students (Class VI–VIII) compared to older students (Class IX–XII). While the relationship between sleep and IQ is relatively weak in both groups, the association between sleep and mental wellbeing is more noticeable, particularly among younger students. These findings highlight the importance of

healthy sleep habits in supporting students' psychological wellbeing and potentially their cognitive functioning during school years.

4.5.2 Sleep duration vs Cognitive performance: The relationship between sleep duration and cognitive performance highlights a critical physiological dependency. Our findings demonstrate that, A linear relationship exists between sleep duration and cognitive output for both groups. However, the **"Cognitive Gap"** is more severe in high school students (Class 9–12). When sleep drops from "Optimal" to "Deficit," the senior cohort experiences a **21% drop** in mean performance (from **14.18 to 11.20**), whereas middle schoolers see a **16% drop** (**14.52 to 12.15**) (**Figure 4.5.1)**.

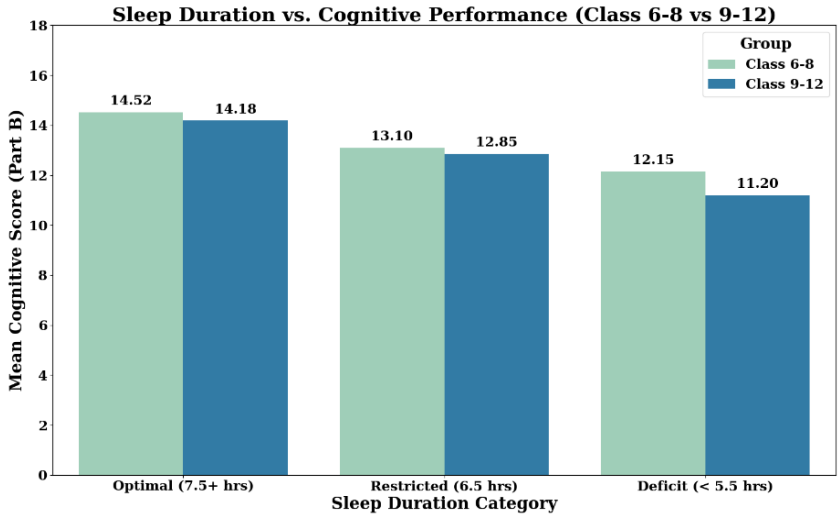


Figure 4.5.2: Analysis of Sleep Duration vs. Cognitive Performance; This grouped bar chart compares the mean scores from the Part B Cognitive Assessment across three sleep duration categories: Optimal (7.5+ hours), Restricted (6.5 hours), and Deficit (< 5.5 hours). Results are shown for Class 6–8 and Class 9–12.

This suggests that the higher-order cognitive tasks and executive functions required in senior academic curricula are significantly more sensitive to the loss of restorative sleep.

Biologically, this decline can be attributed to the lack of sufficient **Deep Sleep and REM stages**, which are essential for memory consolidation and neural plasticity. For high school students, who already face a biological "sleep squeeze" due to phase delay, falling into the deficit category creates a "Cognitive Fog" that measurably reduces their academic ceiling. These results underscore the necessity of prioritizing sleep duration as a fundamental pillar of academic achievement, particularly as students progress into more challenging grade levels.

4.5.3 Correlation between Sleep duration and Cognitive Performance

Spearman's rank correlation analysis was conducted to examine the relationship between sleep duration, cognitive performance, and mental well-being among school children from Classes VI–VIII and Classes IX–XII. The results for the two class groups reveal some differences in the pattern of association between sleep duration and the outcome variables.

Among Class VI–VIII students (N = 221), the correlation between sleeping hours and IQ percentage was found to be very weak and negative ($\rho = -0.0973$). However, the p-value ($p = 0.1492$) was greater than the significance level of 0.05, indicating that the relationship is **not statistically significant**. This suggests that variations in sleep duration do not show a meaningful association with cognitive performance among students in this age group.

In contrast, among Class IX–XII students (N = 376), the correlation between sleeping hours and IQ percentage was weak and positive ($\rho = 0.1328$), and the p-value ($p = 0.010$) indicates that the relationship is statistically significant. This finding suggests that students who report longer sleep duration tend to demonstrate slightly higher cognitive performance scores, although the strength of the association remains relatively weak.

With respect to mental well-being, the results show a different pattern. Among Class VI–VIII students, a weak positive correlation ($\rho = 0.1577$) was observed between sleep duration and mental well-being score, and the relationship was statistically significant ($p = 0.0190$). This indicates that younger students who obtain longer sleep duration tend to exhibit relatively better mental well-being.

Table 4: Correlation between Sleep Duration, Cognitive Performance and Mental Well-being for both class groups.

Class Group	Variables	Spearman's rho (ρ)	p-value	Interpretation
Class VI–VIII (N = 221)	**Sleep duration vs IQ score**	**-0.0973**	**0.1492**	**Very weak negative, not significant**
	Sleep duration vs Mental well-being	**0.1577**	**0.0190**	**Weak positive, significant**
Class IX–XII (N = 376)	**Sleep duration vs IQ score**	**0.1328**	**0.0100**	**Weak positive, significant**
	Sleep duration vs Mental well-being	**-0.0703**	**0.1737**	**Very weak negative, not significant**

Overall, the comparative analysis indicates that the association between sleep duration and mental well-being is more evident among younger students, whereas the relationship between sleep duration and cognitive performance appears slightly stronger among older adolescents. These findings may reflect developmental differences in sleep patterns and circadian rhythm during adolescence, which can influence cognitive functioning and psychological well-being.

4.6. Impact of School Schedule on Sleep

This final analysis of the Subjective Sleep Perception data provides the most direct link between the research findings and the students' lived reality. These end-of-survey questions serve as a qualitative validation of the quantitative "Sleep Squeeze" we have identified throughout the study. A striking majority of students are consciously aware of their sleep deficit. In the high school cohort, **79.2%** of students feel they do not get enough sleep, and an even higher **86.5%** explicitly state that their school schedule/timing is the primary cause. Even among the younger Class 6–8 cohort, **64.1%** identify the school schedule as a disruptive factor to their biological clock.

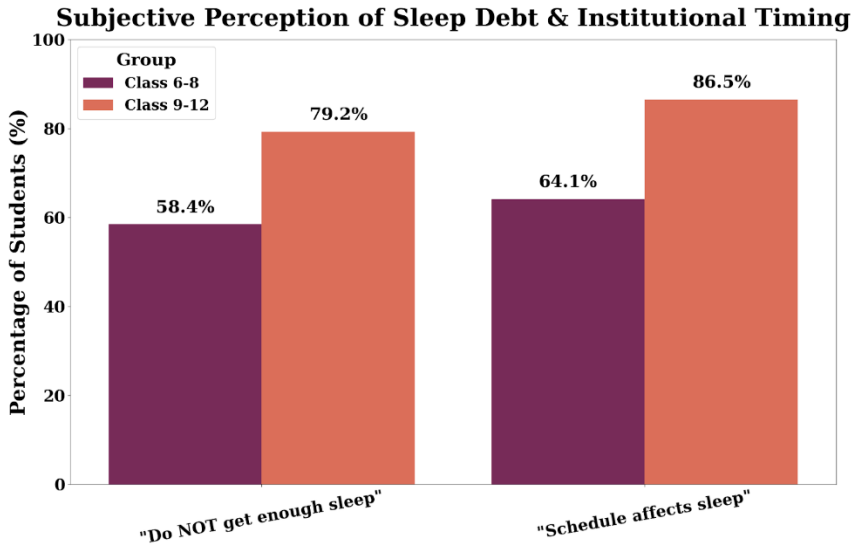


Figure: This grouped bar chart displays the percentage of students in middle school (Class 6–8) and high school (Class 9–12) who perceive their sleep as inadequate and feel that their school schedule negatively impacts their rest.

The data from 633 students confirms that the majority of adolescents are living in a state of permanent "jetlag" without ever leaving their time zone. This phenomenon is most severe in the senior cohort (Class 9-12), where the mismatch between biology and institution reaches its peak. The result is a "squeeze" that truncates the final, most restorative hours of the sleep cycle. Because the brain performs most of its memory consolidation and emotional regulation during the early morning hours of sleep, students are effectively waking up before their "biological night" has ended.

Chapter V

Major Findings and Policy Implications

The present study examined the relationship between sleep patterns, biological clock indicators, cognitive performance, and mental well-being among school students from Class VI to Class XII. The results highlight significant developmental changes in sleep behaviour during adolescence and demonstrate how these changes influence students' cognitive functioning and psychological health. The findings are consistent with a growing body of international research emphasizing the importance of sleep in adolescent development.

5.1.1 Developmental Changes in Sleep Duration

One of the major findings of the study is the decline in sleep duration as students transition from middle school (Class VI–VIII) to high school (Class IX–XII). The data show that a higher proportion of high school students sleep less than seven hours per night, whereas younger students are more likely to obtain relatively longer sleep durations.

This pattern aligns with previous research indicating that adolescents experience a natural shift toward later sleep times due to biological changes in the circadian rhythm during puberty (Carskadon, 2011). However, despite this delayed sleep onset, most students continue to wake up early due to fixed school start times and transportation schedules, leading to chronic sleep restriction.

Studies have shown that adolescents require approximately 8–10 hours of sleep per night for optimal functioning, yet most secondary school students sleep significantly less (National Sleep Foundation, 2015). Chronic sleep deprivation during adolescence has been associated with reduced academic performance, impaired attention, and increased emotional difficulties (Owens et al., 2014).

5.1.2 Circadian Phase Delay and Institutional Schedules

The present study also observed a delay in bedtime among older students, with a larger proportion of Class IX–XII students going to sleep after 11 PM. This phenomenon reflects the circadian phase delay that naturally occurs during adolescence, where the biological clock shifts toward later sleep and wake times (Crowley, Acebo, & Carskadon, 2007).

However, despite this biological shift, wake-up times remain consistently early across both groups, as most students wake up before 7 AM. This misalignment between biological rhythms and institutional schedules creates what researchers describe as "social jetlag", where students experience a mismatch between their biological clock and daily obligations (Wittmann et al., 2006).

Such circadian misalignment often results in daytime sleepiness, reduced alertness, and decreased academic engagement, particularly during morning classes.

5.1.3 Sleep Quality and Sleep Disturbances

The analysis of sleep quality indicators revealed that **sleep latency and sleep disturbances increase among older students**. Younger students were more likely to fall asleep quickly, whereas high school students required longer time to fall asleep and reported higher levels of sleep disturbances.

Several factors may contribute to this trend, including:

- Academic stress and examination pressure
- Increased exposure to digital devices
- Emotional and psychological changes during adolescence

Research has shown that stress and cognitive arousal before bedtime can significantly delay sleep onset and reduce sleep quality (Curcio, Ferrara, & De Gennaro, 2006). Poor sleep quality can negatively affect memory consolidation, learning capacity, and emotional regulation.

5.1.4 Morning Sleepiness and Learning Efficiency

The findings of the study show that a large proportion of students experience morning sleepiness during early classes, particularly those with restricted sleep duration. Even students who reported around 7–7.5 hours of sleep still experienced significant levels of morning drowsiness.

This phenomenon is often referred to as sleep inertia, a temporary period of reduced alertness that occurs immediately after waking (Tassi & Muzet, 2000). Sleep inertia can impair attention, reaction time, and cognitive processing, making it difficult for students to engage effectively in morning academic activities.

Several international studies have demonstrated that later school start times significantly improve student alertness, attendance, and academic performance (Wahlstrom et al., 2014).

5.1.5 Role of Digital Hygiene

The study also highlights the impact of **pre-sleep screen exposure on sleep latency**. Students who reported frequent use of mobile phones or television before bedtime experienced longer delays in falling asleep.

Exposure to blue light from electronic devices suppresses the secretion of **melatonin**, a hormone responsible for regulating sleep onset (Chang et al., 2015). Consequently, late-night screen use can disrupt the natural sleep–wake cycle and contribute to sleep deprivation.

Adolescents are particularly vulnerable to this effect due to their high engagement with **social media, online communication, and digital entertainment**, especially during evening hours.

5.1.6 Impact of Sleep on Cognitive Performance

One of the key findings of the study is the clear relationship between sleep duration and cognitive performance. Students with optimal sleep duration demonstrated significantly higher cognitive scores compared to those with restricted or deficit sleep.

The decline in cognitive performance was particularly pronounced among Class IX–XII students, suggesting that higher-order cognitive processes required for advanced academic tasks are more sensitive to sleep deprivation.

Sleep plays a crucial role in memory consolidation, neural plasticity, and learning processes (Walker & Stickgold, 2006). During sleep, especially during deep sleep and REM stages, the brain strengthens newly acquired information and integrates it with existing knowledge.

Therefore, insufficient sleep can impair problem-solving ability, reasoning, and memory retention, all of which are essential for academic success.

5.1.7 Relationship between Sleep and Mental Well-being

The study also found a relationship between sleep patterns and mental well-being. Students with disturbed sleep patterns were more likely to report poorer mental well-being.

Previous research has demonstrated that sleep deprivation is associated with increased risk of anxiety, depression, and emotional instability among adolescents (Roberts, Roberts, & Duong, 2009). Adequate sleep is essential for emotional regulation and stress resilience, which are critical during the developmental phase of adolescence.

Thus, improving sleep health among students can contribute not only to better academic outcomes but also to improved psychological well-being.

5.2 Policy Recommendations for State Governments

Based on the findings of this study, several policy interventions can be recommended for state education systems, particularly in states such as Madhya Pradesh where early school schedules and academic pressures are common.

1. Delayed School Start Times

State education departments may consider introducing later school start times for secondary and senior secondary students. Even a delay of 30–45 minutes can significantly improve sleep duration and reduce morning sleepiness.

2. Sleep Health Education in Schools

Sleep education should be incorporated into school health and life skills programs. Students should be educated about:

- Importance of adequate sleep
- Effects of sleep deprivation

- Healthy bedtime routines
- Digital hygiene practices

3. Digital Hygiene Awareness Programs

Schools should promote responsible digital device use, especially during evening hours. Programs should encourage students to avoid screen exposure at least one hour before bedtime.

4. School Timetable Optimization

Schools may consider scheduling analytical and cognitively demanding subjects during mid-morning hours, when students are more alert and attentive.

5. Strengthening School Counselling Services

Schools should strengthen mental health support systems, including counselling and stress management programs, to help students manage academic pressure and maintain healthy sleep routines.

6. Parent Engagement Programs

Parents should be involved in promoting healthy sleep routines at home, including limiting late-night screen use and encouraging consistent sleep schedules.

6. Future Research Directions

While the present study provides valuable insights into the relationship between sleep patterns, cognitive performance, and mental well-being among school students, several areas require further investigation. The present study was conducted only among students from the states of Madhya Pradesh and Maharashtra, and therefore the findings may reflect the educational and socio-cultural contexts of these regions. Future research can extend this work by including students from other states of India, which would help in understanding regional differences in sleep behaviour, school schedules, and lifestyle patterns among adolescents across the country. Additionally, longitudinal studies may be conducted to examine how sleep patterns change over time and how chronic sleep deprivation affects academic performance and mental health in the long term. Future studies could also incorporate objective sleep assessment tools such as actigraphy or wearable sleep trackers along with self-reported data. Further exploration of factors such as digital device usage, academic workload, physical activity, and family environment would provide a more comprehensive understanding of the determinants of sleep health among school children in India.

7. Conclusion

The present study highlights the critical role of sleep in influencing the cognitive performance and mental well-being of school students. The findings reveal that as students progress from middle school to secondary and senior secondary levels, there is a noticeable decline in sleep duration

accompanied by later bedtimes, increased sleep disturbances, and higher levels of daytime sleepiness. These changes appear to be influenced by both biological factors associated with adolescent circadian rhythms and external factors such as academic pressure and digital device usage. The study also demonstrates that insufficient sleep is associated with reduced cognitive performance and variations in mental well-being, emphasizing the importance of healthy sleep habits for academic success and psychological development. Overall, the results suggest that sleep health should be recognized as an essential component of student well-being and educational policy. Addressing sleep deprivation through awareness programs, improved digital hygiene, and supportive school policies can contribute significantly to enhancing students' learning outcomes, cognitive functioning, and overall quality of life.

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Appendix 1

Questionnaires

Part A: Demographic information

Code (For official use only)

School Code	
School Location	Urban ☐ Rural ☐
School Category	Residential ☐ Day boarding ☐
School Timing	Morning: ☐ Afternoon: ☐
School type	Government ☐ Private ☐
Student Code (Roll No.)	
Class	6th ☐ 7th ☐ 8th ☐ 9th ☐ 10th ☐ 11th ☐ 12th ☐
Gender	Male ☐ Female ☐
Age	
Medium of instruction in school (Hindi, English)	
Family type	Joint ☐ Nuclear ☐
Travel mode (Bus/Car/Cycles/Walk)	

Part B: Sleep pattern and Quality (Class 6 to 8)

1. What time your child usually goes to bed at night?
   आपका बच्चा आमतौर पर रात को कितने बजे सोने जाता है?
   ☐ Before 9:00 PM ☐ 9:00–10:00 PM
   ☐ 10:00–11:00 PM ☐ 11:00 PM–12:00 AM
   ☐ After 12:00 AM

2. What time your child usually wakes up in the morning?
   आपका बच्चा आमतौर पर सुबह कितने बजे उठता है?
   ☐ Before 5:00 AM ☐ 5:00–6:00 AM
   ☐ 6:00–7:00 AM ☐ 7:00–8:00 AM
   ☐ After 8:00 AM

3. How many hours your child usually sleep each night?
   आपका बच्चा आमतौर पर हर रात कितने घंटे सोता है?
   ☐ Less than 5 hours ☐ 5–6 hours
   ☐ 6–7 hours ☐ 7–8 hours
   ☐ More than 8 hour

4. How long does it usually take your child to fall asleep after going to bed? आमतौर पर आपके बच्चे को बिस्तर पर जाने के बाद सोने में कितना समय लगता है?

☐ Less than 15 minutes ☐ 15–30 minutes

☐ 31–60 minutes ☐ More than 60 minute

5. How tired your child usually feel when you go to bed? जब आप सोने जाते हैं तो आपका बच्चा आमतौर पर कितना थका हुआ महसूस करता है?

☐ Very tired ☐ Tired

☐ Slightly tired ☐ Not tired

6. How comfortable your child feels to get up in the morning? आपका बच्चा सुबह उठने में कितना सहज महसूस करता है?

☐ Very easy ☐ Easy

☐ difficult ☐ Very difficult

7. How much time does it take your children to be active after waking up in the morning? सुबह उठने के बाद आपके बच्चों को सक्रिय होने में कितना समय लगता है?

☐ Less than 15 minutes ☐ 15–30 minutes

☐ 30–45 minutes ☐ More than 45 minutes

8. In the past 2 weeks, how often did your child wake up in the middle of the night or early morning? पिछले 2 सप्ताह में आपका बच्चा कितनी बार आधी रात को या सुबह जल्दी जाग गया?

Never ☐ कभी नहीं ☐ Rarely कभी-कभार

Often ☐ अक्सर ☐ Always हमेशा

9. How often did your child feel it was hard to fall asleep after going to bed? आपके बच्चे को कितनी बार ऐसा महसूस हुआ कि बिस्तर पर जाने के बाद उसे नींद आने में कठिनाई होती है?

Never ☐ कभी नहीं ☐ Rarely कभी-कभार

Often ☐ अक्सर ☐ Always हमेशा

10. How often did your child feel tired or sleepy during the day? आपका बच्चा दिन में कितनी बार थका हुआ या नींद महसूस करता है?

Never☐ कभी नहीं ☐ Rarely कभी-कभार

Often ☐ अक्सर ☐ Always हमेशा

11. How often did your child have bad dreams or nightmares that disturbed our sleep? आपके बच्चे को कितनी बार बुरे सपने या दुःस्वप्न आते हैं जिनसे हमारी नींद में खलल पड़ता है?

Never☐ कभी नहीं ☐ Rarely कभी-कभार

Often ☐ अक्सर ☐ Always हमेशा

12. How often did noise, light, or someone waking your child disturb your sleep? कितनी बार शोर, रोशनी या किसी के द्वारा आपके बच्चे को जगाने से आपकी नींद में खलल पड़ा?

Never☐ कभी नहीं ☐ Rarely कभी-कभार

Often ☐ अक्सर ☐ Always हमेशा

13. How often did your child use a mobile phone, TV, or screen before sleeping? आपका बच्चा सोने से पहले कितनी बार मोबाइल फोन, टीवी या स्क्रीन का उपयोग करता था?

Never☐ कभी नहीं ☐ Rarely कभी-कभार

Often ☐ अक्सर ☐ Always हमेशा

14. During the past 2 weeks, how would you rate your child overall sleep quality**?** पिछले दो सप्ताह के दौरान, आप अपने बच्चे की समग्र नींद की गुणवत्ता को किस प्रकार आंकेंगे?

Very good ☐ ☐ Good

Poor ☐ ☐ Very poor

15. How often did your child loose your concentration at school due to feeling tired or sleepy? आपके बच्चे ने स्कूल में थकान या नींद के कारण कितनी बार अपना ध्यान खोया?

Never ☐ कभी नहीं ☐ Rarely कभी-कभार

Often ☐ अक्सर ☐ Always

16. How often in daytime functioning your child feel moody, irritable, or low because of poor sleep? दिन में काम करते समय आपका बच्चा कितनी बार खराब नींद के कारण मूडी, चिड़चिड़ा या उदास महसूस करता है?

Never ☐ कभी नहीं ☐ Rarely कभी-कभार

Often ☐ अक्सर ☐ Always हमेशा

Scoring Guidelines

Each question can be rated on a 1–5 scale. You may:

- Calculate **component scores** such as:
  - Sleep duration
  - Sleep latency
  - Sleep disturbance
  - Daytime dysfunction

Add a **global sleep score** for each child.

Higher scores = **poorer sleep quality**.

Part C: Cognitive Performance

1. Who was the first Prime minister of India? भारत के प्रथम प्रधानमंत्री कौन थे?

Pandit Jawahar Lal Nehru ☐ Lal Bahadur Shastri ☐

Indira Gandhi ☐ Narendra Modi ☐

2. On which date National Science Day is celebrated? राष्ट्रीय विज्ञान दिवस किस तारीख को मनाया जाता है?

5 June ☐ 28 Feb ☐

24 Feb ☐ 22 March ☐

3. What is the Normal temperature of healthy human being? स्वस्थ मनुष्य का सामान्य तापमान कितना होता है?

98.6^0F ☐ 37.2^0F ☐

96.8^0F ☐ 96.4^0F ☐

4. Which planet is known as "Red Planet"? किस ग्रह को "लाल ग्रह" के नाम से जाना जाता है?

Jupiter ☐ Saturn ☐

Mars ☐ Venus ☐

5. Where is Major Dhyanchand stadium situated? मेजर ध्यानचंद स्टेडियम कहाँ स्थित है?

a. Bhopal ☐ Ranchi ☐

b. Patiala ☐ New Delhi ☐

6. Madhya Pradesh is the central part of India; it is also known "Heart of India". It is the second largest in India after Rajasthan. Madhya Pradesh recently awarded as Tiger state of India. It has total 10 administrative blocks, 55 districts and 428 tehsils. It has rich cultural heritage, diversity and wild life sites. Bhopal is the capital of Madhya Pradesh and known as City of lakes. Madhya Pradesh shares boundaries with five states like; Uttar Pradesh, Chhattisgarh, Maharashtra, Gujrat and Rajasthan.

मध्य प्रदेश भारत का मध्य भाग है; इसे "भारत का हृदय" भी कहा जाता है। यह राजस्थान के बाद भारत का दूसरा सबसे बड़ा राज्य है। मध्य प्रदेश को हाल ही में भारत के बाघ राज्य का दर्जा दिया गया है। इसमें कुल 10 प्रशासनिक ब्लॉक, 55 जिले और 428 तहसीलें हैं। इसकी सांस्कृतिक विरासत, विविधता और वन्य जीवन स्थल समृद्ध हैं। भोपाल मध्य प्रदेश की राजधानी है और इसे झीलों के शहर के रूप में जाना जाता है। मध्य प्रदेश की सीमाएँ पाँच राज्यों उत्तर प्रदेश, छत्तीसगढ़, महाराष्ट्र, गुजरात और राजस्थान से लगती हैं।

Please read above passage carefully and give a suitable answer in one words.
कृपया उपरोक्त पैराग्राफ को ध्यानपूर्वक पढ़ें और एक शब्द में उपयुक्त उत्तर दें।

(1) Which city is known as "City of Lakes"? कौन सा शहर "झीलों का शहर" के नाम से जाना जाता है?
Ans……

(2) How many states share their boundaries with Madhya Pradesh? मध्य प्रदेश के साथ कितने राज्य अपनी सीमाएँ साझा करते हैं?

Ans……

3. How many division is in Madhya Pradesh? मध्य प्रदेश में कितने संभाग हैं?

Ans……

4. Which city is a capital of Madhya Pradesh? मध्य प्रदेश की राजधानी कौन सा शहर है?

Ans……

7. What would be the next number in sequence 3, 6, 9, ___.,15,18? क्रम 3, 6, 9, ___, 15, 18 में अगली संख्या क्या होगी?

Ans……

8. How many sides a Square have? एक वर्ग में कितनी भुजाएँ होती हैं?
Ans…….

9. If there are total 40 students in a class and 6 are shifted in another class, then now how many students will remain in the class? यदि एक कक्षा में कुल 40 छात्र हैं और 6 को दूसरी कक्षा में स्थानांतरित कर दिया जाता है, तो अब कक्षा में कितने छात्र रहेंगे?
Ans……..

10. If we cut one corner of a triangle, how many corners are left? यदि हम किसी त्रिभुज का एक कोना काट दें, तो कितने कोने बचेंगे?

Ans……..

11. Which of the following number is the greatest one? निम्नलिखित में से कौन सी संख्या सबसे बड़ी है?

-3, 0, 6, -8,

Ans…….

12. If Lemon is sour, then Sugar is ……....? यदि नींबू खट्टा है, तो चीनी……..?

13. If Winter is cold, then Summer is ……? यदि शीत में ठंडी है, तो ग्रीष्म में ……. है।

14. If Rock is too heavy then feather is…… ? यदि चट्टान बहुत भारी है तो पंख.....?

15. If Bird fly, then Fish will……...……...? यदि पक्षी उड़ेगा, तो मछली ……?

16. If Doctor works in the hospital, then Teacher would be in the……? यदि डॉक्टर अस्पताल में काम करता है, तो शिक्षक किसमें काम करेगा……?

Part D: Strength and Difficulties Questionnaires for Mental wellbeing assessment

1. Does your child feel nervous when he/she don't sleep properly?
क्या आपका बच्चा ठीक से न सो पाने पर घबराता है?

Never ☐ Sometimes ☐ All time ☐

2. Does your child worry a lot for everything related to school?
क्या आपका बच्चा स्कूल से जुड़ी हर बात को लेकर बहुत चिंतित रहता है?

Never ☐ Sometimes ☐ All time ☐

3. Does your child feel nervous when he/she face any new situation?
क्या आपका बच्चा किसी भी नई परिस्थिति का सामना करते समय घबरा जाता है?

Never ☐ Sometimes ☐ All time ☐

4. Does your child easily loose his/her temper and feel very angry?
क्या आपका बच्चा आसानी से गुस्सा हो जाता है और बहुत गुस्सा हो जाता है?

Never ☐ Sometimes ☐ All time ☐

5. Does your child never accept his/her fault at any cost?
क्या आपका बच्चा किसी भी कीमत पर अपनी गलती स्वीकार नहीं करता?

Never ☐ Sometimes ☐ All time ☐

6. Does your child find difficulty in concentration?
क्या आपके बच्चे को ध्यान केंद्रित करने में कठिनाई होती है?

Never ☐ Sometimes ☐ All time ☐

7. Does your child feel restless when new task come?
क्या आपका बच्चा नया काम आने पर बेचैन महसूस करता है?

Never ☐ Sometimes ☐ All time ☐

8. Does your child easily mixed-up with new person?
   क्या आपका बच्चा आसानी से नए व्यक्ति के साथ घुल-मिल जाता है?

   Never ☐ Sometimes ☐ All time ☐

9. Does your child usually share food/games/stationary etc.?
   क्या आपका बच्चा आमतौर पर खाना/खेल/स्टेशनरी आदि साझा करता है?

   Never ☐ Sometimes ☐ All time ☐

10. Does your child positive to learn new things?
    क्या आपका बच्चा नई चीजें सीखने के लिए सकारात्मक है?

    Never ☐ Sometimes ☐ All time ☐

Part E: Additional Information

1. Which of the following activities your child usually does before going to bed?
   आपका बच्चा आमतौर पर सोने से पहले निम्नलिखित में से कौन सी गतिविधि करता है?

   Using electronic devices (Mobile/laptop/tab) ☐ इलेक्ट्रॉनिक उपकरणों (मोबाइल/लैपटॉप/टैब) का उपयोग करना

   Using electronic devices social media ☐ इलेक्ट्रॉनिक उपकरणों का उपयोग, सोशल मीडिया

   Watching TV ☐ e-Gaming ☐ None ☐

2. Before going bed does your child take usually? सोने से पहले आपका बच्चा आमतौर पर क्या लेता है?

   Tea/Coffee ☐ Milk ☐
   Cold drinks ☐ None ☐

3. At what time your child takes your dinner? आपका बच्चा किस समय खाना खाता है?

   8:00-9:00 PM ☐
   9:00-10:00 PM ☐
   10:00-11:00 PM ☐
   After 11:00 PM ☐

4. Does your child prepare for exam late night? क्या आपका बच्चा देर रात तक परीक्षा की तैयारी करता है?

   Yes ☐ NO ☐

5. How much time in a day your child spends on social media? (Write in minutes or hrs) आपका बच्चा दिन में कितना समय सोशल मीडिया पर बिताता है? (मिनटों या घंटों में लिखें)

   Less than 30 Min ☐ 30-60 Min ☐
   01-02 Hrs ☐ More than 2:00 Hrs ☐
   None ☐

6. Does your child prefer to switch on lights during sleeping hrs? क्या आपका बच्चा सोते समय लाइट जलाना पसंद करता है?

   Never ☐ Sometimes ☐ Always ☐

7. What is your child's sleeping habit? आपके बच्चे की सोने की आदत क्या है?

   Sleep alone ☐ Sleep with Parents ☐ Sleep with siblings (Brother/Sister) ☐

8. Do you listen music? क्या आप संगीत सुनते हैं?

   Yes No

9. Listening music helps you fall asleep? क्या संगीत सुनने से आपको नींद आने में मदद मिलती है?

Yes, helps me fall asleep better ☐

No, it does not make any difference ☐

No, it makes harder for me to sleep ☐

8. I don’t listen music before going to sleep ☐

Are you involved in outdoor games?

क्या आप आउटडोर खेलों में शामिल हैं?

Never	Sometimes	often	Always
कभी नहीं	कभी-कभी	अक्सर	हमेशा

Appendix 2

List of Schools

Sr.No	School Name	Urban/Rural	Residential/Non-Residential	Govt/ Private
1.	Jawahar Navoday Vidyalaya, Bhopal	Urban	Residential	Govt
2.	KV 2, Shivaji Nagar, Bhopal	Urban	Non-Residential	Govt
3.	KV 3, Danish Nagar, Bhopal	Urban	Non-Residential	Govt
4.	Subhash School for Excellence, Shivaji Nagar, Bhopal	Urban	Non-Residential	Govt
5.	CM Rise Barkhedi, Bhopal	Urban	Non-Residential	Govt
6.	Model Hema HSS, BHEL, Pvt. School Bhopal	Urban	Non-Residential	Private
7.	EMRS Roshni, Khandwa	Rural	Residential	Private
8.	EMIS- Dhokeda, Itarsi	Rural	Non-Residential	Private
9.	Jawahar Navoday Vidyalya, (Bargi), Jabalpur distict	Rural	Residential	Govt
10.	Jawahar Navoday Vidyalya, Narmadapuram	Rural	Residential	Govt
11.	KV, Residency Club, Indore	Urban	Non-Residential	Govt
12.	KV, Army education Centre, Pachmari	Rural	Non-Residential	Govt
13.	KV2,CPE, Pathrota	Rural	Non-Residential	Govt
14.	KV, Ganj, Betul	Urban	Non-Residential	Govt
15.	Govt school, Betul	Urban	Non-Residential	Govt
16.	Govt school, Middile school, Chhindwara	Urban	Non-Residential	Govt
17.	DPS, प्रयास कैंपस, Chhindwara	Rural	Residential	Private
18.	KV, SPM , Narmadapuram	Urban	Non-Residential	Govt
19.	Sagar Public School, Bhopal	Urban	Non-Residential	Private
20.	Govt Model H S School, Jabalpur	Urban	Residential	Urban
21.	Mount Litera Zee School, Jabalpur	Urban	Residential	Private

(**Source-Primary Data**)

Appendix 3

Permission Letters

Eklavya Model Residential School, Budni, District Sehore (M.P)
E-Mail-budnicmrsschore@gmail.com website-http://www.emrsbudni.com
Disc code-23330205202 School Code-52026 CBSE Affiliation No. 1020025

S.No./Est./EMRS/2025-26/4165

Budhni, Date: 23/09/2025

To,

The Head, Extension Education Department,
Regional Institute of Education,
Shyamla Hills, Bhopal – 462002.

Subject: Request for Additional Details Regarding Research Study

Respected Sir/Madam,

With reference to your letter dated 10-09-2025 regarding the NCERT approved research study entitled "Exploring the Relationship of Biological Clock, Sleep-Wake Patterns, and Cognitive Performance of School Children," we appreciate the academic relevance of the proposed work.

However, before granting permission, kindly provide detailed information about the methodology, sample size, research duration and schedule, expected cooperation from the school, and measures for ensuring confidentiality of student data. A note on how the study findings will be shared with the school may also be included.

The school administration shall take a decision after receiving the above details.

Sincerely,

Ashutosh Kumar Mishra
Principal
EMRS, Budni, Sehore (M.P.)

कार्यालय, क्षे.शि.सं. भोपाल
आयरी / प्रेषक क्रमांक 114
दिनांक 29/9/25

नवोदय विद्यालय समिति
शिक्षा मंत्रालय
(स्कूल शिक्षा एवं साक्षरता विभाग) भारत सरकार,
क्षेत्रीय कार्यालय
एम आई जी-172/2 ए, सावेत नगर, भोपाल

NAVODAYA VIDYALAYA SAMITI
Ministry of Education
(Deptt of School Education and Literacy)
Govt. of India Regional Office
M.I.G. -172, Sector - 2A Saket Nagar,
Bhopal (MP)-462024

Phone 0755 2480637 2480343 2489946 email navodayabpl@gmail.com web site https://navodaya.gov.in/nvs/ro/Bhopal/en/home/

F. 90-01/2025-NVS(BPL)/Acad/ 2406 दिनांक 24-09-2025
25

To
Dr. Ramesh Sethy
Programme Coordinator,
DESM, RIE Bhopal

Sub :- Permission for study on "Exploring the Relationship of Biological Clock, Sleep-wake Patterns, and Cognitive Performance of School Children in NVS".

Ref :- Your office letter No. D-484 dt. 11-09-2025

Respected Sir,

With reference to the subject captioned above, it is inform that the permission is hereby accorded for study on "Exploring the Relationship of Biological Clock, Sleep-wake Patterns, and Cognitive Performance of School Children in NVS." with the following conditions :-

- The activity will not hamper the academic and residential culture of JNV.
- No financial burden on JNV.
- Strict data confidentiality.
- Study is allowed for maximum three days only.

The details of JNVs involving in study :-

State	Name of JNV
Madhya Pradesh	Bhopal Sehore Vidisha

This issue with the approval of competent authority.

Yours faithfully,
25/9/25
(Devendra Kumar)
Asstt. Commissioner (Acad)

Copy to :-
The Principal, JNV Bhopal Sehore & Vidisha – Alongwith RIE letter for necessary action.

प्राचार्य कार्यालय, क्षे.शि.सं. भोपाल
डायरी/प्रेषक क्रमांक 61
दिनांक 25/9/25

केन्द्रीय विद्यालय संगठन, क्षेत्रीय कार्यालय, जबलपुर
Kendriya Vidyalaya Sangathan, Regional Office, Jabalpur
शिक्षा मंत्रालय, भारत सरकार
Ministry of Education, Govt. of India
जी.सी.एफ.इस्टेट, साइंस कॉलेज के पीछे, जबलपुर- 482011(म.प्र.)
GCF Estate, Behind Science College, Jabalpur-482011 (MP)
ई-मेल/E mail: ro-jabalpur@kvs.gov.in; वेबसाइट/Website: htpps://rojabalpur.kvs.gov.in
दूरभाष/Telephone;उपायुक्त/Deputy Commissioner 0761-2678381(O), सा.अ./स.अ./वि.अ.AC/AO/EO-2678390

फा.22332/केविसं/क्षे.का.जबलपुर/2025-26/(शैक्षिक) 2153 - 2154 दिनांक 26.09.2025

ई-मेल

प्राचार्य
केन्द्रीय विद्यालय
क्रमांक-02 जीसीएफ जबलपुर

विषय:- एन.सी.ई.आर.टी, द्वारा अनुमोदित शोध अध्ययन हेतु विद्यार्थियों पर अनुसंधान उपकरण/प्रश्नावली प्रशासन की अनुमति के संबंध में।

महोदय/महोदया,

उपर्युक्त विषयान्तर्गत केविसं(मु) नई दिल्ली का पत्रांक 11-Acad0338T(7)/1/2019-AC(TRG)/1895-98,दिनांक 23.09.2025 प्राप्त हुआ है। उक्त पत्र के संदर्भ में सूचित करना है कि एन.सी.ई.आर.टी. द्वारा अनुमोदित शोध अध्ययन "स्कूली बच्चों की जैविक घड़ी, नींद जागरण पैटर्न एवं संज्ञानात्मक प्रदर्शन के मध्य संबंध की खोज" ("Exploring the Relationship of Bilological Clock, Sleep-wake Patterns, and Cognitive Performance of School Children") के संचालन हेतु केन्द्रीय विद्यालयों में अनुसंधान करने की अनुमति प्रदान करने का अनुरोध किया गया है।

उपरोक्त संदर्भ में मुख्यालय ने एन.सी.ई.आर.टी. द्वारा कक्षा VI से VIII के विद्यार्थियों के बीच प्रस्तावित अध्ययन की अनुमति आपके केन्द्रीय विद्यालय को निम्न बिन्दुओं के आधार पर प्रदान गई है।

1. प्रतिभागिता पूर्णतः स्वैच्छिक होगी एवं विद्यार्थियों तथा उनके अभिभावकों/अध्यापकों से पूर्व सहमति प्राप्त की जाएगी।
2. एकत्रित आंकड़े पूर्ण गोपनीय रखे जाएंगे तथा केवल शिक्षा शोध प्रयोजनों के लिए ही उपयोग होंगे।
3. सर्वप्रथम, शोध निष्कर्ष को के.वि.सं. (मुख्यालय) के साथ साझा किया जाएगा।

उपरोक्त संदर्भ में मुख्यालय से प्राप्त उक्त संदर्भित पत्र की प्रति आपकी तरफ सूचना एवं आवश्यक कार्रवाई हेतु अग्रेषित की जा रही है।

संलग्न:-यथोपरि

भवदीय,
दिग्गराज मीना 26.09.25
(दिग्गराज मीना)
उपायुक्त

प्रतिलिपि:-
प्राचार्य,क्षेत्रीय शिक्षा संस्थान,श्यामला हिल्स,भोपाल(म0प्र) को मुख्यालय,नई दिल्ली के उपर्युक्त संदर्भित पत्र की

Appendix 4

Regional Institute of Education, Bhopal

Minutes of the Meeting

Date: 29th May 2025, Time: 4:30 PM, **Venue:** Room No. 48

Subject: Modalities Discussion – PAC 23.06 Research Project titled *"Exploring the Relationship of Biological Clock with Cognitive Performance and Mental Wellbeing of School Children"*.

Members Present:

1. **Dr. Ramesh Sethy** –Principal Investigator (PI), Assistant Professor in Zoology
2. **Dr. Santosh Kumar** – Co-Principal Investigator (Co-PI), Associate Professor in Physics
3. **Dr. Kusum**– Co-Principal Investigator (Co-PI), Assistant Professor in Zoology

Agenda: To discuss the **modalities and future course of action** related to the above-mentioned research project.

Minutes:

1. **One-Day In-house Consultation Meeting:** The members agreed to organize a **One-Day In-House Consultation Meeting on 30th May 2025** at RIE Bhopal. The aim of the meeting will be to gather expert insights for the implementation of the research project.
2. **Permission Letter to Principals of the selected Schools:** It was unanimously decided that list of schools for the above study shall be identified as per the project requirement and an official letter should be drafted for the Principals of the Schools of western region seeking formal **permission to conduct the study** in their respective schools. Name of the selected School, Name of the Principal, Email ID, Contact Number shall be collected.
3. **Budget Approval:** It was also decided to place the **overall research project budget** for formal approval. Additionally, the **permission for Activity 1 (One-Day In-House Consultation Meeting)** should also be prepared and submitted for approval as a priority.
4. Both Co-PIs have been entrusted to identify the required list of schools for the above study and the Resource persons for the workshops along with their CVs as per the requirement of the project.

The meeting concluded with mutual agreement on the above points, and necessary action items were assigned to the respective investigators.

Minutes prepared by: *Dr. Ramesh Sethy*, Principal Investigator

Approved by: All Investigators Present

1. **Dr. Ramesh Sethy** – Principal Investigator (PI), Assistant Professor in Zoology 30.05.25
2. **Dr. Santosh Kumar** – Co-Principal Investigator (PI), Associate Professor in Physics 30/5
3. **Dr. Kusum**– Co-Principal Investigator (Co-PI), Assistant Professor in Zoology. 30/5/25

Regional Institute of Education, Bhopal

Minutes of the Meeting

Date: 23rd June 2025, **Time:** 10:00 AM, **Venue:** Room No. 53

Subject: Modalities Discussion – Research Project titled *""Exploring the Relationship of Biological Clock with Cognitive Performance and Mental Wellbeing of School Children"."*

Attendees:

- Prof. Jaydip Mandal, Dean (Instruction)
- Dr. Venkat Rao Suryavanshi (State Coordinator, Maharashtra)
- Dr Pradyuman Singh Lakhawat (Assistant Professor, DESSH)
- Dr L S Chauhan (Assistant Professor of Physics)
- Dr. Santosh Kumar (Co-PI, Associate Professor, Physics)
- Dr. Ramesh Sethy (PI, Assistant Professor, Zoology)
- Dr. Kusum (Co-PI, Assistant Professor, Zoology)

Agenda and Discussions:

1. **Project Overview by PI through a Power point presentation:** Dr. Ramesh Sethy, as the PI, presented a comprehensive overview of the research project, detailing its objectives, proposed methodology, and anticipated outcomes.
2. **Implementation Strategy Discussion:** The project team, along with other attendees, engaged in a constructive discussion regarding the implementation strategy. Key aspects such as data collection protocols, project timelines, and logistical arrangements were thoroughly reviewed and deliberated.
3. **Stakeholder Responsibilities:** Responsibilities were discussed and allocated among the project team members and other participants to ensure efficient execution and coordination of the research activities.
4. **Open Session for Suggestions:** This session proved highly valuable, with significant input from all attendees. The following key suggestions were received from the resource persons.
    - **Sample Size:** It was strongly recommended that Sample size for the study should be determined using appropriate statistical tools before commencing the project.
    - **Inclusion of sample:** It was recommended to include the school students for the study based on Gender, demography and socio-economic status.
    - **Schools for the Pilot study:** It recommended to conduct a pilot study for this project by selecting 2-3 schools including DMS Bhopal to enhance the methodology and credibility of the project. It was also advised by the recourse person to conduct the study in MP state first.
    - **Comparative study**: It was advised by the resource person to conduct a comparative study of data between residential and non-residential schools.
    - **Selection of Resource person:** It was advised to invite the appropriate recourse person especially related to chronobiology /sleep research to the workshop for refinement of research tools.

Actions Taken/Decisions:

- The PI and Co-PIs find all the suggestion relevant and will incorporate all the important suggestion made by the recourse person for enhancement of the current study.
- We will reach out to the appropriate **resource persons** to explore their potential involvement in the project.

The meeting concluded with the project team expressing gratitude to all the participants for their insightful contributions.

Dr. Ramesh Sethy (PI, Assistant Professor, Zoology)

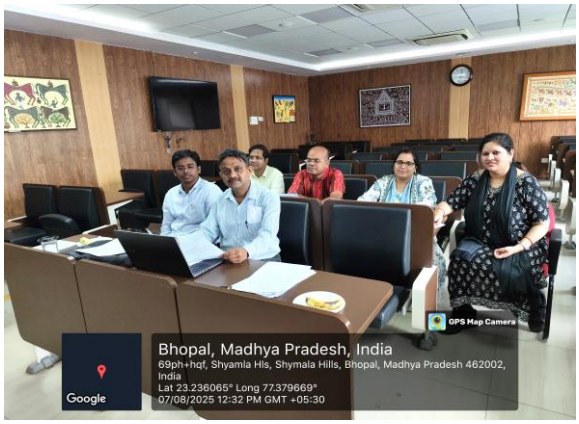
Dr. Santosh Kumar (PI, Associate Professor, Physics)

Dr. Kusum (Co-PI, Assistant Professor, Zoology)

Workshop for Vetting and Validation of Tools









Glimpse of Workshop for finalization of Data









Data Collection across various schools























