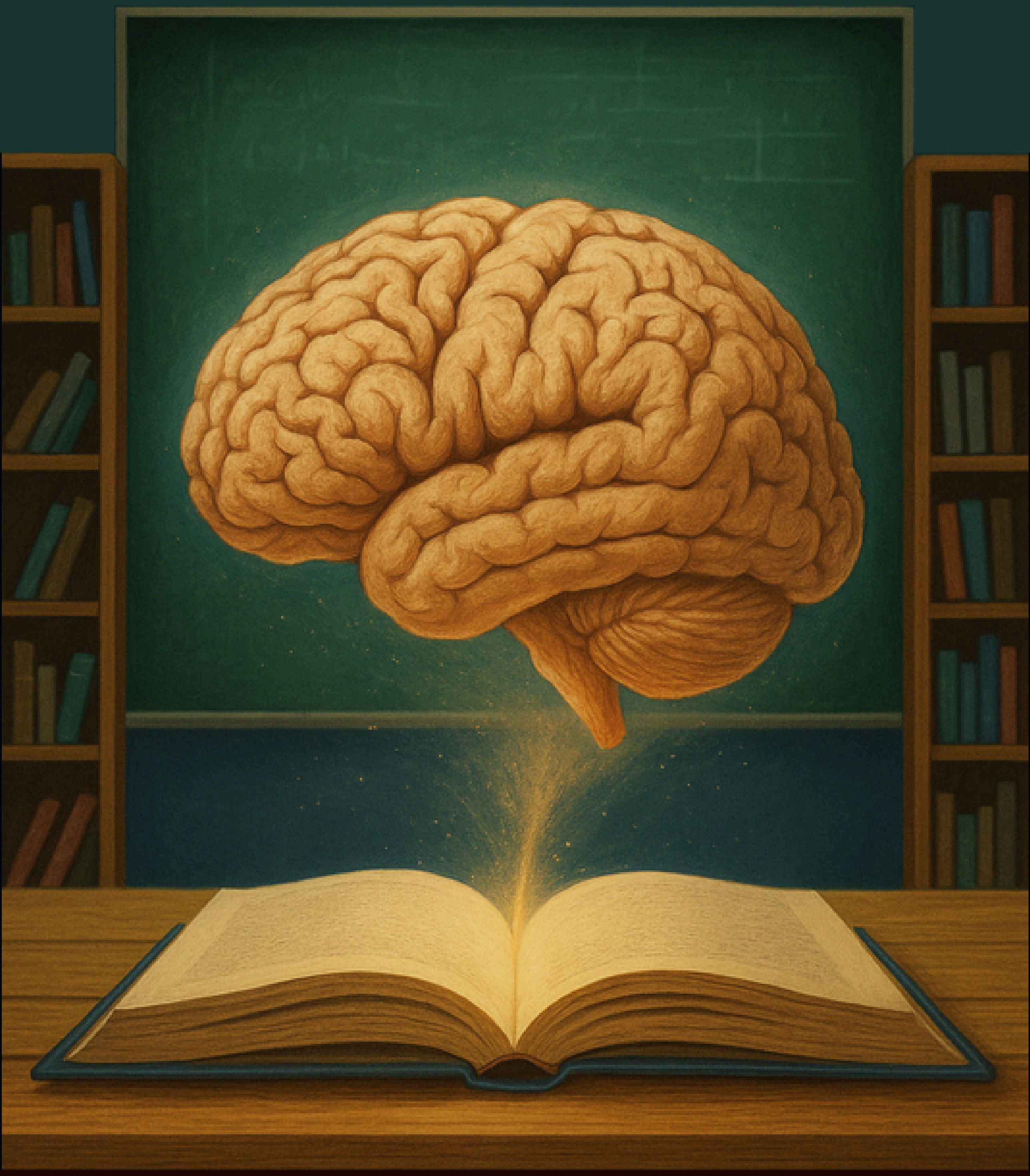
STUDENT MIND

PSYCHOLOGICAL STUDIES IN EDUCATION



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DEAR READER,

Welcome to the very first issue of *Student Mind: Psychological Studies in Education*, a space created by undergraduate scholars to explore educational psychology through fresh, personal lenses.

Our aim is simple: to empower you, both as a contributor and as a reader. If you're submitting, this is a supportive platform to share your unique insights. If you're reading, I hope you find connection, inspiration, and new ways of thinking about your own student journey.

This journal is more than an academic publication; it is a reflection of the stories, passions, and lived experiences that drive our curiosity. Whether it's a reflection on learning, identity, wellbeing, or motivation, each literature review in these pages offers a glimpse into how educational psychology resonates with real lives.

I am profoundly grateful for the dedication of our writers, the thoughtful work of our editors, and the support of everyone who made this inaugural issue possible. Their commitment has turned an idea into a platform where student voices can be heard, celebrated, and amplified.

Thank you for being part of this shared adventure, we invite you to read, reflect, and join us in shaping this growing conversation at the intersection of psychology, education, and the many disciplines that matter to our writers and readers.

Read with curiosity, empathy, and pride, this journal belongs to all of us.
Together, let's keep exploring the student mind.

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The Role of Sleep in Learning and Memory Retention

Jessica Chakramakil | *Honours Life Sciences IV*

Lay Summary

Sleep is essential for learning and memory, yet many students often underestimate its importance. Each stage of sleep contributes in unique ways: slow-wave sleep (SWS) helps store factual information, while rapid eye movement (REM) sleep supports skill development and creative thinking. Sleep spindles are brief bursts of brain activity during non-REM sleep, further strengthening learning by enhancing brain plasticity. On the flip side, sleep deprivation hampers concentration, memory, and decision-making. Students who consistently sleep less than six hours may experience cognitive declines similar to going an entire day without sleep. In addition to poor performance, lack of rest can worsen emotional stability, increasing stress and making it harder to learn. Understanding these links can motivate students to adopt healthier sleep habits. By prioritizing sleep, they can sharpen their thinking, boost problem-solving skills, and set themselves up for academic success.

Abstract

Sleep plays a foundational role in learning and memory consolidation. Different sleep stages support various cognitive processes, such as encoding, consolidation, and retrieval of information. Slow-wave sleep (SWS) enhances declarative memory, while rapid eye movement (REM) sleep supports procedural memory and creativity. Sleep spindles, which occur during non-REM sleep, help solidify learning by promoting brain plasticity. On the other hand, chronic sleep deprivation can severely impair attention, memory, executive function, and emotional regulation. Many students compromise their sleep for academic tasks, unaware of the long-term consequences. This paper explores the neurobiological mechanisms linking sleep and memory, examines the detrimental impact of sleep deprivation on learning, and discusses the importance of sleep for academic performance. The review also highlights the need for tailored interventions, such as sleep education programs and flexible school schedules, to address sleep-related challenges in student populations.

Keywords: Sleep, Memory Consolidation, Learning, Cognitive Performance, Sleep Deprivation, Academic Success

Introduction

Although sleep is well-established as vital to human health, its critical role in learning and memory is often overlooked, especially among students. Academic pressures and digital distractions frequently lead to compromised sleep schedules. However, research consistently shows that insufficient sleep impairs attention, memory consolidation, and overall academic outcomes (Killgore, 2010). Memory formation occurs in three stages: encoding, consolidation, and retrieval (Mujawar et al., 2021). Sleep particularly enhances consolidation, where the brain stabilizes and integrates new information into long-term storage. Sleep is composed of several stages, each contributing differently to cognitive processes. SWS, which occurs early in the night, plays a key role in solidifying declarative memories. REM sleep, dominant in later cycles, enhances procedural memory, creativity, and emotional regulation. Furthermore, sleep spindles occurring during non-REM sleep boost synaptic plasticity, which strengthens learning and cognitive performance (Deak & Stickgold, 2010). Despite these benefits, many students prioritize late-night study sessions or screen time, unintentionally undermining their own academic success.

Sleep and Memory Consolidation

Memory consolidation during sleep involves complex neurophysiological mechanisms. Slow-wave sleep (SWS), a phase of non-REM sleep, is vital for reinforcing declarative memories, such as facts and autobiographical events. During this

stage the hippocampus replays recent experiences, transmitting them to the neocortex for long-term storage (Paller et al., 2021). REM sleep contributes differently: it facilitates procedural memory, which governs skills and habits, and enhances creativity by enabling new connections between ideas. Additionally, REM sleep is associated with emotional regulation, making it essential for managing academic stress.

Sleep spindles are short bursts of activity in non-REM sleep, also play an important role in learning. They promote synaptic changes that help encode new information and protect it from interference. These brain rhythms have been linked to improved academic performance and are particularly active during adolescence (Deak & Stickgold, 2010). Though Paller et al. (2021) provide a comprehensive overview of these mechanisms, studies by Rasch & Born (2013) and Walker & Stickgold (2006) also reinforce the critical role of sleep in learning by showing how sleep deprivation disrupts hippocampal function (a part of the brain that is important for memory) and weakens memory consolidation.

The Impact of Sleep Deprivation on Learning

The consequences of sleep deprivation on cognition are well-documented and far-reaching. One of the most immediate effects is reduced attention and focus, impairing students' ability to absorb new material. Sleep-deprived brains struggle with encoding new information, leading to forgetfulness and difficulty recalling learned content (Killgore, 2010).

Executive functions such as planning, organizing, and decision-making are also compromised. Emotional regulation deteriorates, which may increase stress and anxiety, further hindering academic performance. Deak and Stickgold (2010) describe a study in which participants slept only 4 or 6 hours per night for two weeks. These individuals showed progressive declines in performance across attention, memory, and cognitive tasks, eventually functioning comparably to those who had gone without sleep for 24 to 48 hours. Chronic sleep loss has also been associated with reduced plasticity in the hippocampus, making it harder to form new memories over time.

Furthermore, individual differences play a role: while some students can function adequately with slightly less sleep, others experience noticeable cognitive deficits. Factors like age, genetics, chronotype, and stress levels affect how much sleep a person truly needs. Future research should examine how personalized sleep interventions could enhance learning outcomes, especially for students with atypical sleep patterns.

Practical Strategies and Interventions

Understanding the relationship between sleep and memory is essential, but putting that knowledge into action is equally critical. Schools and universities can implement sleep education programs that teach students about the importance of rest and the biology behind it. Flexible scheduling, such as delayed school start times or asynchronous learning modules, may help students get the rest they need. Universities could also offer workshops on sleep hygiene, time management, and stress reduction.

On an individual level, students can improve sleep habits by limiting screen use before bed, maintaining consistent sleep-wake cycles, and creating restful sleep environments. Wearable devices and sleep-tracking apps can provide personalized data to guide behavioral adjustments. Interventions rooted in cognitive-behavioral therapy for insomnia (CBT-I) have also shown promise in helping students establish healthy routines.

Conclusion

Sleep is a cornerstone of learning and cognitive performance. Each sleep stage contributes uniquely to memory formation: SWS aids declarative memory, REM enhances procedural learning and emotional regulation, and sleep spindles promote neural plasticity. Meanwhile, sleep deprivation disrupts attention, executive function, and emotional balance, all of which are critical for academic success. Students, educators, and policymakers must recognize the profound link between sleep and educational outcomes. Encouraging better sleep habits and implementing systemic interventions can promote not only academic performance but also long-term cognitive health. Future research should investigate personalized sleep strategies that consider individual variability in sleep needs and learning styles. Ultimately, prioritizing sleep is not a luxury, it is a scientifically supported necessity for effective, resilient learning.

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How Social Media Impacts Students Wellbeing and Academics

Sheryl John | *Honours Life Sciences IV*

Lay Summary

Social Media is a large part of student life. The addition of Social Media in modern times creates benefits as well as challenges. It helps young people stay connected, find support, and access educational resources. However, excess use can negatively impact mental health, leading to anxiety, low self-esteem, and poor sleep patterns, which may affect academic performance. Some academic disruptions include distractions, procrastination, multitasking issues, reduced attention span issues, poor time management, and reduced critical thinking and deep learning. While social media can be a distraction, it also provides opportunities for learning and collaboration. This paper explores the complex effects of social media on student wellbeing and academic success, emphasizing the need for balanced use and further research to guide healthier digital habits.

Abstract

Social media has become an integral part of student life, shaping communication, social interactions, and academic experiences. While it provides opportunities for networking, self-expression, and access to educational resources, its excessive use raises concerns about mental health and academic performance. This paper explores the role of social media in fostering online communities and supporting marginalized students while also addressing the risks of social comparison, sleep disruption, and academic distractions. By analyzing both the positive and negative effects, this study emphasizes the need for digital literacy, mindful usage, and further research to better understand and manage social media's impact on student wellbeing.

Keywords: Social Media, Student Wellbeing, Academic Performance, Sleep Disruption, Digital Literacy

Introduction

Social media is a primary part of modern society, and specifically targets students between the ages of 18 and 24. Platforms such as Facebook, Instagram, twitter, and Whatsapp are the main apps used by students. While social media can offer many benefits that can include large-scale communication and access to a plethora of information, there is a growing concern about its potential negative impacts on students' wellbeing and academic performance (Nayak Manikant Rajni, 2023) . The constant engagement with social media can contribute to both positive and negative outcomes. On one hand, it fosters a sense of community, self-expression, and peer support, particularly for marginalized groups who may find solace in online spaces. On the other hand, excessive use has been linked to issues such as anxiety, low self-esteem, sleep disturbances, and academic distractions. The curated nature of social media content can lead to unhealthy social comparisons, reinforcing feelings of inadequacy and increasing stress among students. Additionally, notifications and the addictive nature of these platforms can disrupt study habits, reducing focus and productivity. This paper will examine the complex relationship between social media use and student wellbeing exploring both its potential benefits and risks, and the impact it has on mental health and academic performance.

Social Community Inclusion Within the Online Realm

Social media can offer a sense of community and connection, especially for students who share common interests and identities. It can also be a valuable resource for self expression and spread of information. Making it a good tool to stay in touch with family and friends. For marginalized students, online platforms can offer social support and a sense of belonging and unity (General , 2024). Social inclusion in the online world, refers to the way digital platforms are able to provide spaces for individuals to connect, talk, share experiences, and engage with members of similar communities and

also diverse groups that they might not have access to in their physical environments. Online communities can be empowering as many marginalized/underrepresented individuals can find others in their community or make new friends in different online communities, making it a limitless form of friendship and community acceptance (General, 2024).

Beyond personal connections, social media also plays a crucial role in activism and advocacy, giving a voice to marginalized groups and enabling collective action. Many students use these platforms to raise awareness about social issues, support movements, and participate in meaningful discussions that promote inclusivity. Additionally, professional and academic communities on social media provide opportunities for networking, mentorship, and knowledge-sharing, further enhancing a student's sense of belonging and engagement in society.

However, while social media fosters inclusion, it is important to recognize that digital spaces can also reinforce exclusion and division. Issues such as online harassment and cyberbullying can limit the benefits of social media for some individuals. Therefore, promoting responsible online behavior and digital literacy is essential to ensuring that social media remains a positive force for community-building and inclusivity.

Risks to Mental Wellbeing

Although social media can have substantially positive uses, there is major concern that excessive or problematic social media use can negatively affect student wellbeing and mental health. Having constant easy access, and exposure to curated and unrealistic portrayals of others' lives can lead to heavy social comparison, envy, and feelings of inadequacy (Alt, 2016). These forms can lead to low self esteem, body image issues, and disordered eating behaviors. Not to mention the pressure young adults and students may face trying to maintain an online persona, experiencing fears of missing out (FOMO) (Alt, 2016) . This can also take on forms of anxiety, depression and other serious conditions. Studies have shown a correlation between increased social media use and symptoms of depression anxiety and psychological distress, especially pertaining to social likes, comments, and followers can significantly impact mental health as many individuals seek validation and social esteem through these number markers (WK, 2018). A 2023 survey by Pew Research Center found that 95% of teenagers report using social media platforms, with 46% saying they are online almost constantly (Vogels, 2023).

Irregularities in Sleep Patterns impacting Academic Performance

One of the most documented negative effects of social media on students is its impact on sleep quality. The constant notifications and the addictive nature of platforms disrupt students' sleep patterns, leading to sleep deprivation (Collis & Eggers, 2022). A lack of sleep impairs cognitive function, attention, and memory retention, which are crucial for academic success. A study conducted by the University of California found that students who used social media excessively before bedtime reported lower grades and struggled with academic responsibilities (Levenson et al., 2016). It's important to regulate the usage of social media, as well as its high rates of screen time in most people nowadays. Phone usage is not necessarily a bad thing, however there is a benefit to spacing out the amount of time spent on cell phones, it's good to create a schedule throughout the day for screen time. Limiting screen time closer to bedtime can improve sleep quality and the relationship most students have with their devices.

There is also serious academic performance decline with serious distraction and procrastination from constant urges to check notifications which cause a drift from study times. Many students attempt to study while using social media, which can decrease retention and comprehension of information. Reducing students' attention spans and generating multitasking issues. Frequent exposure to fast-paced social media content can make it harder to focus on long reading assignments or lectures. In recent years, addictive social media behaviour has also been seen to relate to higher levels of ADHD (Dekkers & van Hoorn, 2022). There is also a serious concern for the reduced critical thinking and deep learning in recent times, formed from the availability and reliability of short-form content. Platforms like TikTok and Twitter encourage quick consumption of information, which may discourage in-depth learning.Exposure to unchecked information can shape students' perspectives based on bias rather than critical analysis.

Academic Setbacks and Benefits?

Academic Setbacks and Benefits? From this there is also evidence of social media serving one of the greatest contributions of academic distraction from work. Notifications and the addiction towards checking every notification and social feed, can be disruptive of study time and reduce academic productivity. Multitasking and attempting to complete assignments while simultaneously browsing social media, has negative impacts on the quality of academic work. Research has shown that students who frequently use social media during study hours are likely to have lower grades and have difficulties concentrating (Junco, 2012).

Despite the drawbacks, social media is not always an academic setback for students and their academic success. Platforms such as YouTube and LinkedIn offer educational content and networking opportunities. Additionally, group chats on all social apps and forums can facilitate peer collaboration and access to academic resources. If social media use is done correctly and when appropriate, social media can enhance learning experiences by connecting with course mutuals, connecting with experts, and educational communities worldwide (Nayak Manikant Rajni, 2023).

Conclusion

Social media plays a complex role in student life, offering both benefits and challenges. While it fosters communication, social inclusion, and academic collaboration, excessive use can negatively impact mental health, disrupt sleep patterns, and hinder academic performance. The constant exposure to curated online content can lead to social comparison, anxiety, and self-esteem issues, while distractions from notifications and prolonged screen time can reduce students' productivity and focus.

While there is a lot of research that highlights negative impacts of social media on students wellbeing and academics. There is more that can be done to investigate this relationship. Particularly investigations of social media use during childhood and adolescence, can help raise awareness and educate students, parents, and teachers towards healthier habits and guided decisions(General, 2024). Educational initiatives can be made by focusing on promoting healthy social habits, screen time monitoring, and better consumption of online content, in a safe and responsible manner. Students and other internet users have a great responsibility in creating a more supportive environment that encourages balanced use, and also friendly online behaviors that can improve youth wellbeing. Promoting digital literacy and encouraging balanced, mindful consumption can help students maximize the benefits of social media while minimizing its drawbacks.

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The Effects of Ametropia on Academics

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Lay Summary

Many students experience difficulties in school related to vision, but these issues are often overlooked. Ametropias are irregularities in eye shape that lead to blurry vision and difficulties with different aspects of learning, such as reading up close or at the board. There are various types of ametropias, such as myopia (nearsightedness), hyperopia (farsightedness), and astigmatism. The symptoms associated with these conditions can be very mild and often go unnoticed, especially in younger students. This literature review will explore the specifics of each ametropia and its impact on academic performance, while considering the mechanisms by which these conditions develop. Potential solutions will be reviewed, including corrective lenses, screening policy, and adjustments to be made in the classroom. This will paint a complete picture of the effects of ametropia on the educational system.

Abstract

Visual impairments are some of the most commonly overlooked health afflictions that affect students' academic performance. Ametropias, specifically myopia (nearsightedness), hyperopia (farsightedness), and astigmatism are a collection of refractory errors that decrease the visual acuity of many students. These conditions can often be mild, and studies have shown that a significant portion of cases go uncorrected, yet many remain unaware of their visual limitations. This review investigates the effect of uncorrected ametropias on students' academic performance at various levels of education. It highlights individual mechanisms and how they relate to educational outcomes. Overall, hyperopia and astigmatism were found to be negatively correlated with academic performance but differed on perceived symptoms in similar situations. Myopia was positively correlated with academic performance, hinting at the mechanism of axial elongation due to hyperopic defocus. In other words, it is possible that those who engage in near vision tasks like studying involve themselves in a positive feedback loop for myopia. The review further discusses existing solutions to these conditions, including corrective eyewear, consistent screening, and classroom accommodation to counterbalance decreased visual acuity and discomfort. Through this examination, this review aims to underscore the importance of addressing ametropias to improve academic outcomes and overall success.

Keywords: Ametropia, Myopia, Hyperopia, Astigmatism, Academic Performance

Introduction

Academic success is influenced by a variety of factors both intrinsic and extrinsic. This can include individual characteristics, socio-economics, social interactions, and more, all of which can influence the overall performance of a student (Badria Alhaji et al., 2024). Personal health is also considered for student outcomes and is intuitive, given that certain afflictions can prevent students from getting the most out of their studies. Visual impairments, specifically those involving refractive errors, are one of many major health contributors. Studies have shown that among thousands of elementary school participants, approximately 69% had some sort of refractive error, highlighting the widespread nature of this issue (Canadian Association Of Optometrists, 2024). While these errors may present as very mild and benign, they may still affect students in different ways that can alter academic outcomes.

Visual impairment due to refractive error is known as ametropia, which can be further subcategorized as myopia (nearsightedness), hyperopia (farsightedness), astigmatism, and presbyopia. Students don't tend to be affected by presbyopia, which is primarily a result of aging; thus, the aforementioned ametropias will be considered. This review will evaluate existing literature on specific types of ametropias, providing a holistic view of the conditions through the lens of academic performance.

Myopia

Myopia or nearsightedness is one of the most common ametropias and affects people of all ages. The primary symptom of myopia is reduced visual acuity at long distances, while near vision is untouched. It is caused by the abnormal shape of refractive structures such as the cornea or the length of the eye. Specifically, myopia is caused by a steeply curved cornea and a longer axial length between the front and back of the eye. It is essential to understand the basics of optics and how vision is attained to understand why this is so. When light converges onto the retina, it allows a signaling cascade from the back of the eye to the brain that processes the signal as an image. This process is, therefore, reliant on the refractive component of the eyes as well as the distance between those refractive components and the retina. In myopia, the light rays of distant objects focus on a point before the retina, leading to blurriness.

The mechanism behind the apparition of these abnormalities has been hypothesized over the years and several theories have prevailed. While genetics plays a part in the development of myopia, other lesser intuitive mechanisms can cause this condition. Firstly, longitudinal studies by Gupta et al. (2021) demonstrated that myopia progression is inversely related to outdoor activity in formative years. In other words, increasing outdoor activity decreased the likelihood of developing myopia. Physical activity was also seen to have the same relationship, but studies could not conclude this as an independent factor, contrary to outdoor activity (Yang et al., 2021). Additional studies have shown evidence to the contrary but are not statistically significant or may have been biased (Russo et al., 2022). Additionally, dopamine is essential to the process of limiting axial length growth. A study by Ashby (2016) examined various animal models wearing diffusers (a lid that blocks light from entering the eyes) and identified that axial length would increase. Oppositely, removing the diffuser during 3 hours of sunlight halted the increasing length. Intravitreal dopamine injections also stopped this growth, even with limited sunlight, and dopamine antagonists had an opposite effect. Finally, near work is another key factor in the progression of myopia and causes a phenomenon known as hyperopic defocus. During long periods of close work, the peripheral retina may catch light rays that fail to be accommodated onto the retina and surpass it. This leads to compensatory responses in which the eye's axial length increases, leading to myopia. Overall, myopia's mechanism and progression lend themselves naturally to students who constantly interact with near visual stimuli.

The impact of myopia on students has been assessed in multiple studies, and their implications regarding academic performance are interesting. In one cross-sectional study, Yang et al. (2021) observed the correlation between refractive error and students' performance from grades 1 to 9. They found that students grades 2-9 with myopia had better grades than those without it, even after controlling for confounding variables. It poses an interesting finding that myopic students likely spend more time studying, given that more time doing near-vision tasks can lead to myopia. Studies by Zhang et al. (2022) reinforce this hypothesis since they observed a negative correlation between education level and diopters of refractive error. It also shows that the increased risk of myopia among students is not necessarily from age but relative education level or amount of time spent studying. Additionally, Clark et al. (2023) have found that around 40% of the effect of education on myopia is mitigated when considering outdoor activity. This suggests that nearly half of the relationship between education and myopia is caused by time spent outdoors. It becomes clear that this condition is prevalent in the schooling system and that multiple factors should be considered when hypothesizing its mechanisms. Further studies have clarified some of myopia's expected symptoms and risk factors in academic settings (Léon Muamba Nkashama et al., 2022). Notable examples from most to least complained about are difficulty seeing the board, photophobia, blurred vision, asthenopia, headache, tearing, etc. Researchers also concluded that electronic usage in the classroom, such as smartphones and computers, was a factor in ametropia. The adverse effects of this condition can certainly hinder the learning process in classroom settings.

Hyperopia

Hyperopia (farsightedness) is a standard refractive error similar to myopia in atypical eye shapes. The cornea is often too flat, and the axial length is too short. This results in light rays from close up projected past the retina, thus getting blurry vision.

Symptoms in those affected by hyperopia are similar to those in myopic patients but for near vision tasks rather than long distance vision (Porter, 2014).

Similarly to myopia, genetics and, thus, family history play a crucial role in the development of hyperopia. However, these two conditions differ in terms of specific mechanisms. In hyperopia, patients have shorter eyeballs as a baseline and aren't as affected by external factors. Rather, hyperopic individuals are most affected by accommodative structures and their weaknesses. These structures are primarily the lens and ciliary body. Knowing that hyperopic individuals project light at a point past the retina, accommodative structures are more strained since they require an earlier convergence point and higher refraction. This is the primary difference between the mechanisms of myopia and hyperopia, which rely on anatomical and accommodative structures, respectively (Majumdar & Tripathy, 2023) (Subudhi & Agarwal, 2022). Specifically, Irribarren and colleagues found that among observed cohorts of children, those with short axial lengths had higher refractive powers, which was an adaptive mechanism. As the cohort got older, and environmental stimuli may have led to axial elongation, compensatory responses were made to reduce refractory power to maintain relative emmetropy (Fotouhi et al., 2015). Hyperopia is, therefore, a dynamic condition but less progressive over a lifetime in a sense than myopia.

The impact of hyperopia on student success has been documented throughout various studies. Mavi et al. (2022) provided an overview of studies associating hyperopia to academic performance within nine databases and found a small but significant negative correlation. Young hyperopic students had less success in the outcomes they had searched. Specifically, uncorrected hyperopes had a moderately negative correlation with reading proficiency among these students, an expected result given students' difficulty with near vision. Another cross-sectional study revealed similar findings among preschool and kindergarten children when comparing hyperopia diopters with performance on the Test of Preschool Early Literacy (TOPEL). This test measured print knowledge, definitional vocabulary, and phonological awareness. Unsurprisingly, the most considerable difference between the test scores of emmetropes and hyperopes (>4D) was from the print knowledge section, given it tests visual literacy at close ranges (Kulp et al., 2016). Overall, strong correlational data has presented between academic performance and hyperopia. However, further trials are needed to implement causality as many of the studies have compounding limitations (Mavi et al., 2022).

Astigmatism

Astigmatism is another type of ametropia characterized by an abnormal cornea, lens, or retina shape. This leads to blurriness caused by the convergence of light rays at different focal points that do not adequately converge onto the retina. Other types of astigmatism depend on myopia or hyperopia in the eye, whether it's horizontal or vertical astigmatism (based on the shape of the eye), and whether light rays converge at the same or different locations in different meridians. This condition is dynamic and tends to change with age. Approximately 40% of newborns had 1D of astigmatism, which decreased to adult levels due to natural development and globe remodelling processes. It stems naturally from the fact that many newborns and infants have some level of astigmatism since their visual pathway is still developing (Bharat Gurnani & Kaur, 2023). Similarly to the previously mentioned ametropias, astigmatism can be caused by genetics and other factors such as eyelid pressure, race/ethnicity, extraocular muscle tension, age, etc (Zhang et al., 2023). Many factors affecting astigmatism strength are mechanical and responsive to environmental cues.

Given the potential for those with astigmatism to have both myopic and hyperopic types, academic performance is an interesting endpoint given previous findings. A study by Naranayasamy et al. (2014) simulated bilateral astigmatism in 10 year old children. They then issued standardized tests on reading fluency, eye movement, and symbol recognition to determine the effects. They found a significantly negative correlation between the simulated astigmatism and performance on the test, noting a 5-12% decrease from controls to experimental groups. This suggests that overall performance decreased but leaves room for specifics, such as which elements of visual perception decrease with uncorrected astigmatism. Past studies isolated reading performance as a variable and found that

simulated astigmatism led to decreased reading speeds (Wills et al., 2012). Additionally, further studies have shown that various aspects of academic readiness in pre-kindergarten children are negatively correlated with astigmatism. This includes, among other things, worsened social skills and communication, which demonstrates the potential psychological effect this condition could have that surpasses visual deficits (Orlansky et al., 2015). However, the study was primarily based on questionnaires, and biases are natural in this investigation. Overall, the data and analyses point toward astigmatism negatively impacting academic performance and certain psychological factors should be carefully considered when considering ametropias.

Potential Solutions

While ametropias are some of the most prevalent ocular conditions, many have existing solutions that counteract their previously described mechanisms of action. Corrective eyewear is one of the most popular solutions to this problem and counteracts the aforementioned ailments in distinct ways. In myopia, concave lenses are used to bring the focal point further back and onto the retina. Hyperopia is corrected using a convex lens, bringing the focal point forward onto the retina. Astigmatism uses a variation of concave or convex lenses (based on preexisting myopia/hyperopia, respectively) that corrects for the specific needs of the abnormal curvature. In many previously mentioned studies, vision-corrected groups were used to compare and exhibited much better academic performance. Ideally, the earlier the detection and correction of ametropias are, the better the performance and quality of life. Longitudinal studies have previously shown that early screening is associated with decreased amblyopia and a 70% increase in visual acuity (Wang et al., 2011).

Programs and systems to screen for optical issues can act as preventative health measures ("Recommendations for Preventive Pediatric Health Care. Committee on Practice and Ambulatory Medicine," 1995). These systems could enable accurate visual acuity tests that assure the least discomfort in the classroom and, as has been demonstrated, increase academic performance. There are specific challenges associated with screenings, notably the lack of availability. For example, the Toronto Foundation for Student Success launched a program in 2007 named the Gift of Sight and Sound that provided visual and auditory screening for nearly ten thousand students within the inner city (Wang et al., 2011). They functioned as a nonprofit and would not only offer screening in convenient locations like directly at the schools but also provide free corrective lenses and hearing aids to the students who needed them. Medical examinations were often completed, and the child was granted improved vision/hearing. However, an unexpected barrier became apparent: many students didn't follow up with examinations, which raises concern regarding parental compliance with the recommendations. In many cases, the family had recently immigrated to Canada and refused follow-ups due to billing concerns. Overall, the project highlighted the importance of screening as a precursor to treatment for younger students. However, the findings showed that this process was beneficial and needs further systemic and formal research to see the impacts on students at a larger scale

Finally, specific modifications can be made to the classroom to accommodate for students who are known/suspected to have specific uncorrected visual impairments. While the most ideal situation would be to enable the student to get corrective lenses, specific considerations can help reduce the discomfort brought on by some of these conditions. This could include bringing students with myopia to the front of the class or allowing hyperopic students to sit in the back of the class. A scoping review was conducted to examine what has been done regarding this in the existing literature and found two parameters that can be modified to get the most optimal classroom experience for students with visual impairments (Najmee et al., 2025). The first of these parameters was classroom arrangement, and the optimal setup for the classroom layout, furniture, and arrangement of students were identified. The studies posited that following existing standards for nonimpaired students was beneficial even for impaired students on account of allowing optimal seating to those with specific ametropias. Secondly, visual comfort was found to be an important parameter, and it included lighting and color contrast. The studies found that natural lighting should be implemented when possible and that specific light intensities should be used for

different tasks within the classroom to maximize material contrast and visibility. In the same way, colour contrasts should be maximized to improve the readability of content for all students. The essence of the findings points to cooperating with existing classroom standards but with room for modification based on the needs of students with impairments.

Conclusion

This review has highlighted the importance and effect of ametropia on student academic success. Myopia, hyperopia, and astigmatism are the most prominent forms of ametropia in student and each involves unique symptoms and challenges. The underlying mechanism of these conditions has been explored and it demonstrates the reasoning behind the causes and progressive nature of certain conditions such as genetic factors, outdoor activity, near vision work, accommodative stress, age, etc. Studies have demonstrated the correlation between ametropia and academic performance. In myopia, for instance, the condition was positively correlated with academic performance, almost paradoxically, and brings into question how hyperopic defocus (a product of near work) can increase axial length and progress myopia. However, in hyperopia and astigmatism, academic performance decreased as diopters of either condition increased, a negative relationship. With both conditions, reading fluency and speed decreased when left uncorrected. These impairments can be mitigated significantly with specific interventions, notably with corrective lenses. The availability and screening for such lenses provide a limitation that should be tackled in hope of improving academic outcomes. Classroom adjustments can also be made to accommodate students with uncorrected visual impairments. In conclusion, addressing ametropias is crucial to maximizing student success rates and quality of life in classrooms. Further research and improved screening are essential to reducing ametropia's adverse effects in the education system.

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Occupational Therapy and Students with Autism Spectrum Disorder: Enhancing Participation and Learning in Educational Settings

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Lay Summary

Students with autism spectrum disorder (ASD) often face challenges in school related to communication, sensory processing, and motor skills. These difficulties can interfere with learning, classroom participation, and emotional well-being. Occupational therapy (OT) is a type of healthcare that supports individuals in performing daily tasks. In schools, OTs work with students, teachers, and families to help children with ASD better navigate their school environment. This review explores the different ways OTs support students with ASD, including improving motor skills, reducing sensory overload, building routines, and promoting social participation. By tailoring interventions to individual student needs, OT can help create a more inclusive and supportive learning environment.

Abstract

Occupational therapy (OT) is a critical support for students with autism spectrum disorder (ASD), a neurodevelopmental condition characterized by persistent challenges in communication, sensory integration, social interaction, and motor functioning. This literature review synthesizes current research on the role of school-based OT in improving the participation, independence, and academic outcomes of students with ASD. Key areas include sensory integration, executive function, fine and gross motor development, and collaborative intervention strategies. The review highlights both the evidence base and limitations of current OT practices, underscoring the need for tailored, multidisciplinary approaches. By promoting functional participation and reducing barriers, OT contributes to more inclusive educational environments for neurodivergent learners.

Keywords: Autism Spectrum Disorder (ASD), Occupational Therapy, School-based Interventions, Sensory Processing, Motor Skills, Inclusive Education

Introduction

Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by challenges in social interaction, communication, and the presence of restricted and repetitive behaviors (American Psychiatric Association, 2013). In Canada, the Public Health Agency of Canada (PHAC, 2018) estimates that 1 in 66 children is diagnosed with ASD. Given the spectrum nature of the disorder, students with ASD can present with a broad range of strengths and difficulties, often requiring individualized supports within the classroom. These difficulties may include sensory sensitivities, delayed motor coordination, difficulties with emotional regulation, and social-communication challenges, all of which can significantly impact participation and academic achievement in school settings.

Occupational therapy (OT), grounded in the promotion of meaningful engagement in daily activities, plays a critical role in supporting students with ASD in educational environments. In schools, occupational therapists work with educators, families, and students to create personalized, goal-oriented interventions that support participation, learning, and well-being. This literature review explores the diverse interventions used by occupational therapists to support students with ASD in schools, reviewing current research on sensory processing interventions, motor development, communication and social participation, executive functioning, and collaborative consultation models.

1. Occupational Therapy in Schools

1.1 What is Occupational Therapy?

Occupational therapy helps individuals develop the skills necessary to participate in daily activities across home, school, work, and community contexts. In educational settings, this means

supporting students in accessing the curriculum, interacting with peers, managing routines, and developing independence (AOTA, 2020). For students with ASD, occupational therapy is especially important due to the range of co-occurring challenges that impact classroom functioning, such as fine motor difficulties, sensory sensitivities, and social-emotional regulation issues.

1.2 How School-Based OT Services Are Delivered

Occupational therapy services in schools can be delivered through direct, consultative, or integrated models. Direct services involve individualized sessions with the student, while consultative models focus on coaching educators and caregivers to implement strategies. Integrated services embed therapy into classroom routines and allow for real-time support within natural contexts (Bazyk et al., 2009). Each model has its benefits, and often a combination of approaches is used depending on student needs and school resources.

2. Functional challenges for students with ASD

2.1 Sensory Processing and Regulation

Many students with ASD experience differences in sensory processing, including hypersensitivity to noise, lights, or textures, or hyposensitivity that leads to sensory-seeking behavior (Ben-Sasson et al., 2009). These sensory differences can interfere with attention, participation, and emotional regulation. Occupational therapists use sensory integration strategies to help students learn to modulate their responses to sensory input. These may include sensory diets, adaptive equipment (e.g., weighted lap pads, noise-canceling headphones), and structured movement breaks.

2.2 Motor Planning and Coordination

Fine and gross motor difficulties are common in children with ASD, with studies suggesting that motor impairments can be present even in early childhood and may persist across development (Fournier et al., 2010). Fine motor difficulties can impact handwriting, drawing, and self-care tasks like dressing and feeding. Gross motor challenges may include clumsiness, poor posture, and limited participation in physical education. Occupational therapists address these issues through repetitive practice, strength-building exercises, and structured motor programs.

2.3 Executive Function and Self-Regulation

Executive functioning involves planning, working memory, organization, impulse control, and emotional regulation. Students with ASD often experience challenges in these domains, affecting their ability to manage multi-step tasks, stay organized, and cope with changes in routine (Kenworthy et al., 2008). Occupational therapists use visual schedules, checklists, and self-monitoring tools to support executive functioning, while also helping students learn emotional regulation strategies such as mindfulness, deep breathing, or progressive muscle relaxation.

2.4 Social Communication and Peer Interaction

Difficulties with pragmatic language, joint attention, and interpreting non-verbal cues can lead to social isolation for students with ASD. These challenges often manifest as limited participation in group work, difficulties with turn-taking, or conflict resolution issues. OT interventions may include social stories, structured peer interaction opportunities, video modeling, or play-based therapy that encourages cooperative play and shared attention (Ashburner et al., 2010).

3. Effective OT interventions for students with ASD

3.1 Sensory Integration Therapy

Sensory integration therapy (SIT) is designed to improve the brain's ability to process and respond to sensory input. Research by Schaaf et al. (2014) showed that SIT interventions, implemented by trained occupational therapists, led to improved goal attainment and social responsiveness in children with ASD. However, evidence is mixed, and more controlled, large-sample studies are needed to establish long-term effectiveness (Case-Smith et al., 2015).

3.2 Fine Motor Programs and Assistive Tools

Programs like Handwriting Without Tears and the Size Matters Handwriting Program have been developed to help students with ASD improve fine motor control for academic tasks (Lust & Donica, 2011). In addition, the use of assistive technology such as adapted scissors, pencil grips, or voice-to-text applications may help students complete schoolwork more efficiently and with greater independence.

3.3 Gross Motor and Movement-Based Interventions

Activities like obstacle courses, animal walks, yoga, and martial arts not only develop core strength and coordination but also promote self-regulation and body awareness. Studies show these activities can reduce anxiety and improve classroom behavior when implemented consistently by occupational therapists or trained staff (Baranek et al., 2015).

3.4 Social Participation Interventions

Social participation interventions target pragmatic language, social cognition, and relationship building. The Zones of Regulation program, for example, is frequently used by OTs to teach students how to identify their emotional state and select appropriate coping strategies. Research supports the use of peer-mediated interventions and video modeling to enhance social understanding and reduce isolation (Reichow & Volkmar, 2010).

3.5 Environmental Adaptations and Universal Design

Environmental adaptations may involve modifying seating arrangements, providing calming sensory tools, or changing lighting to reduce overstimulation. Universal Design for Learning (UDL) principles are often used by OTs to ensure that instructional strategies and classroom design support diverse learning needs. UDL includes offering multiple means of engagement, representation, and expression to accommodate sensory, motor, and communication differences (CAST, 2018).

3.6 Collaborative Consultation

Collaborative consultation ensures that intervention strategies are sustained across contexts. When OTs regularly communicate with teachers and families, students are more likely to generalize skills and receive consistent support. Missiuna et al. (2012) found that teachers who worked with occupational therapists reported higher confidence and effectiveness in supporting students with disabilities.

4. Benefits, limitations, and future directions

4.1 Documented Benefits of School-Based OT

Students who receive OT support often demonstrate increased independence in classroom routines, mproved attention and behavior, and better peer relationships (Watling & Hauer, 2015). Parents and educators also report reduced stress and greater satisfaction with the student's educational experience when OT is involved.

4.2 Challenges and Limitations

One of the main limitations of OT in schools is inconsistent access. Services vary by region, school board, and available funding. There is also a need for more longitudinal research to assess the long-term impact of OT interventions on academic and social outcomes. Moreover, some interventions lack rigorous empirical backing and rely heavily on anecdotal evidence.

4.3 Future Research and Advocacy Needs

To strengthen the role of OT in schools, future research should focus on identifying which interventions are most effective for specific subgroups of students with ASD. Policymakers must also address disparities in access to OT services, particularly in under-resourced and rural schools. Interdisciplinary training and professional development opportunities for educators and therapists can further enhance collaborative practice.

Conclusion

Occupational therapy is an essential component of inclusive education for students with ASD. By addressing sensory processing, motor development, executive function, and social communication, OT interventions help students overcome barriers to learning and fully participate in the school experience. With growing awareness of neurodiversity and inclusive pedagogy, the role of occupational therapy is more important than ever. Continued research, advocacy, and collaboration are critical to ensuring that all students receive the supports they need to thrive.

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The Role of Environmental Toxins and the Blood-Brain Barrier in ADHD

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Lay Summary

Attention deficit hyperactivity disorder (ADHD) is a common learning/development disorder that manifests in young children. It can be defined by difficulty focusing, paying attention, and staying still. Environmental toxins can play a role in the worsening of ADHD symptoms, which negatively impacts learning capabilities. This literature review will explore how environmental toxins impact ADHD by their disruption of the blood brain barrier (BBB) (the BBB is a barrier that keeps toxins out of the brain and separates blood from the brain). Additionally, educational strategies for children with ADHD will be discussed with the growing concerns of environmental toxins and their impact on learning capabilities in those with ADHD.

Abstract

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder that impacts socialization and learning via lacking impulse control and sustained focus abilities. Literature examines the role of environmental toxins in breaching the blood-brain barrier (BBB) and worsening ADHD outcomes, especially via prenatal and early child development exposure. Specifically, the goal of this literature review is analyzing how environmental toxins breach the BBB and increase neurodysfunction: from which neurotransmitter levels are disrupted and brain development is negatively affected. Additionally, existing research is used to highlight the connection of neurotoxin exposure to ADHD manifestation and symptom worsening, to which gut-brain axis toxin interference and genetic predisposition are also related: these aspects play a role in the etiology of ADHD, with some influencing manifestation comorbidly. Importantly, these findings can be applied in educational settings with a focus on using evidence-based strategies to manage ADHD-related outbursts and maintain homeostasis in the classroom. These strategies can be used to optimize educational outcomes in students with ADHD so they do not slip through the cracks of mainstream education systems and receive the help they need to not only succeed in educational settings, but learn strategies to set them up for a successful life.

Keywords: ADHD (Attention Deficit Hyperactivity Disorder), Environmental Toxins, Blood-Brain Barrier (BBB), Neurodevelopment, Cognitive Function

Introduction

The blood brain barrier (BBB) is an essential structure that protects the brain from harmful particles and allows nutrients to reach the brain (Alahmari, 2021). In this sense, the BBB acts as a filtration system and separates the human brain from the blood system. Because it is partially permeable, due to size, some particles can pass it freely, while others cannot.

Research has been conducted regarding BBB permeability to environmental toxins, such as heavy metals and industrial chemicals. Children in early developmental stages are especially at risk, as certain heavy metals, like lead, are readily able to cross the BBB. Heavy metals in the brain in such early developmental stages have the ability to cause developmental delays, disrupt neurological cycles, and enhance the chances of developing certain learning disorders.

Attention deficit hyperactivity disorder (ADHD) is a learning disorder that stems from dopamine deficiency in the prefrontal cortex, resulting in the brain under-releasing norepinephrine (Arnsten, 2009). These neurotransmitters play a key role in behavior regulation and impulse control, so the absence of typical levels can cause difficulty remaining still, focusing on individual tasks, and paying attention (Blum et al., 2008). With ADHD diagnoses on the rise amongst children since the

late 1990's (U.S. Centers for Disease Control and Prevention, 2024), it is important to analyze potential causes to understand how to best manage symptoms in educational settings. ADHD can cause disruptions in classrooms and obstruct learning, which is why managing symptoms is essential for creating a successful learning environment for those who have it.

As the presence of environmental toxins are found to increase incidence of learning disorders like ADHD, especially due to increased BBB permeability during early developmental stages, the interaction between these components offers a new perspective on ADHD in young children. Additionally, in a world exposed to more toxins, understanding the impact of exposure to these toxins on developing brains is vital.

1. Environmental Toxins

Environmental toxins are toxic substances found in the environment that negatively impact human health. They often manifest through industrial processes and improper waste disposing: this includes, but is not limited to agricultural runoff, manufacturing fumes, and waste incineration (National Institute of Environmental Health Sciences, 2024). Additionally, certain species of algae proliferate and produce environmental toxins as a result of nutrient pollution from industrial processes. Two critical environmental toxins groups are particularly relevant to the developing brain and are categorized as heavy metals and pesticides/endocrine blockers.

1.1. Heavy Metals

Lead and mercury are heavily referenced in literature as impacting ADHD manifestation and severity when children or fetuses are exposed during early developmental stages (Lee et al., 2018; Ke et al., 2021). Lead (Pb) is less abundantly found in modern times, however its presence can still be noted in old paint and water coming from lead pipes. Increased Pb exposure is correlated with ADHD manifestation and worsening symptoms. Pb is thought to reduce intellectual capabilities (via cell death) and halt neurological/biological cycles (Lee et al., 2018), which may explain its role in ADHD manifestation, however the true reason behind causality between Pb and ADHD, is presently speculatory. Mercury (Hg) bioaccumulates up the food chain and during pregnancy. As a result, consuming fish high in Hg or environmental exposure to Hg while pregnant can detrimentally impact developing fetuses. Similarly to Pb, Hg and ADHD are positively correlated: as Hg exposure increases, ADHD diagnoses and symptom severity increase. Hg exposure in fetus developmental stages is found to negatively interfere with dopamine release in the brain, creating the perfect environment for ADHD (Ke et al., 2021).

1.2. Pesticides/Endocrine Blockers

Pesticides are heavily relied on in agricultural settings, however below-toxic-level exposure in fetuses and during early childhood has been connected to the manifestation of ADHD (Roberts et al., 2019). Consumption of agricultural crops is the main way pesticide exposure is induced, as crops are sprayed to reduce crop loss to insects. A study conducted on a pyrethroid pesticide found that exposure changes the dopamine system during developmental stages by producing increased dopamine receptors (Richardson et al., 2015). As the brain does not produce enough dopamine for these extra receptors, it is considered to experience dopamine deficiency, which is synonymous with ADHD.

2. The BBB's Role in Neuroprotection

2.1. Structure and Function

The BBB protects the brain from toxins circulating in the bloodstream by filtering particles in a highly selective manner. Despite the BBB's protection methods, the environmental toxins previously discussed can highly compromise its structural integrity, allowing for neurotoxins to breach it. Additionally, certain environmental toxins are lipid-soluble or very small, meaning they are able to freely breach the BBB. Composed of endothelial cells, the BBB is meant to allow the passage of essential nutrients while blocking neurotoxic particles. Endothelial tight junctions (ETJ) are another part of the BBB and is comprised of proteins: these proteins are what allow certain particles in and keep others out (Kim et al., 2013).

2.2. Environmental Toxins and the BBB

Pb is able to pass the BBB as a "substitute" for calcium, meaning the BBB mistakes it for calcium, and, once in the brain, interferes with calcium mediated processes (Sanders et al., 2009). Once Pb crosses the BBB, it also disrupts the BBB's homeostasis, which allows normally blocked

particles to pass (Zheng et al., 2003). Hg is highly lipophilic, meaning fat soluble, an aspect that allows it to freely pass the BBB without other mediations. The chemical structure of Hg is similar to the amino acid methionine, so it is transported across the BBB by neutral amino acid carriers. Pesticides increase BBB permeability, allowing them to pass with ease, interrupt neurological processes, and increase the passage of toxic particles (Cresto et al., 2023).

3. ADHD

Globally, ADHD impacts 5-10% of children and the condition often lasts throughout adulthood. While the underlying cause of ADHD is unknown, it is thought to arise based on a combination of factors: neurologic, genetic, and environmental. While these factors act together in presentations of ADHD, genetic predisposition makes acquiring it 76% more likely (Dark et al., 2018). Mutations of certain neurodevelopmental genes are associated with increased risk of ADHD, some of which are deleterious in nature–meaning the genetic sequence is altered in a way that increases risks of developing ADHD. Prenatal exposure to harmful substances also increases the risk of developing ADHD: this includes drugs, alcohol, heavy metals, and toxic chemicals (Dark et al., 2018). Children with this condition often find it difficult to dedicate sustained attention to tasks, and may act impulsively: this could manifest as standing up in the middle of class, or speaking 'out of turn' because their impulse control mechanisms do not function in the same way as neurotypical children. Additionally, ADHD may interfere with social relationships. In adulthood, ADHD makes unemployment and substance abuse–as an attempt to fix dopamine imbalance–more likely (Ayano et al., 2023). Due to these impacts, diagnosing ADHD and implementing strategies to promote success early on is of the utmost importance.

4. ADHD, Environmental Toxins, and the BBB

While the previous sections described these topics on the individual level, this section will analyze how environmental toxins interfere with the BBB, which leads to higher prevalence and symptom severity of ADHD. Understanding mechanisms of interaction and progressive impact will clarify the complex relationship between environmental toxins and ADHD.

4.1. Environmental Toxin Mechanisms

The mechanisms in which environmental toxins disrupt the BBB include, but are not limited to oxidative stress/inflammation, gut-brain axis disruption, and cumulative build-up. Environmental toxins like Pb and pesticides induce inflammatory responses in the BBB, leading to the weakening of the tight junctions found in the BBB (Cresto et al., 2023; Kim et al., 2013). The weakening of the tight junctions is what allows their unchecked crossing of the BBB. Once inside the brain, they wreak havoc on neuroprocesses, cause cell death, and interrupt neurotransmitter networks. Gut microbiota play a vital role in brain development during the early stages of life and regulating immune responses such as inflammation (Porru et al., 2024). Environmental toxins create a pernicious environment for gut microbiota: disrupted gut microbiota increases neuroinflammation, leading to weakened tight junctions in the BBB and allowing toxins to freely cross into the brain (Khoo et al., 2024). Pesticides are also shown to heighten intestinal permeability, upon which, toxins are uptaken into the bloodstream. From this point, the inflammation caused by this process also allows them to cross the BBB and increase neuroinflammation, which is heavily linked to ADHD (Cresto et al., 2023). The accumulation of neurotoxins in the brain creates a host of problems, all stemming from the brain being exposed to a neurotoxic environment during early developmental stages, when the brain is still malleable. Such an environment decreases neurogenesis, or the formation of new neurons, in critical, developmentally formative regions of the brain (Zhou et al., 2022). Synaptic responses are also impacted by neurotoxic environments: interruption of these responses equates to neurons being blocked from sending signals to each other. These changes in brain connectivity impact brain development because they inhibit neural network formation that aids in developing a healthy brain; instead, these inhibitions cause underdevelopment in some areas and overdevelopment in other areas.

4.2. Evidence of Toxins Impacting ADHD

As explored by Kim et al., many studies have found a connection between postnatal blood Pb levels and development of ADHD (2013). While higher blood Pb levels are classified as more than 10 μg/dL, these studies found Pb ADHD association to occur at 2 μg/dL or lower, indicating that slight exposure is enough to have detrimental effects. These studies

were conducted in the United States, so applications to a wider demographic variety is warranted. Since the United States has similar diversity to Canada, it can be inferred that Canadian-conducted studies would yield similar results.

Ke et al. found that prenatal Hg exposure, through maternal consumption, to be linked to presentations of ADHD during postnatal developmental years (2021). Specifically, trace amounts of Hg measured in umbilical cord blood were found to impact dopamine regulation via creating lasting changes to fetus neurochemistry.

Furthermore, many studies have connected early pesticide exposure to ADHD development. Eskenazi et al. found that organophosphate pesticide metabolite levels found in the blood serum of two-year-old Mexican-Americans were positively correlated with ADHD diagnoses to a statistically significant degree (2007). Petit et al. found that in relation to agricultural activities with increased pesticide exposure prenatally in France, 3 year olds were negatively impacted in brain development (2010).

Existing literature linking environmental toxins to neurological damage that causes ADHD is extensive and compelling. Overall, they play a role in weakening the defense mechanisms of the BBB, disrupt neurological processes, and negatively impact neurotransmitter uptake and release.

5. Educational Interventions

5.1 ADHD Impacts on Learning Outcomes and Classroom Behaviors

As discussed previously, ADHD can seriously hinder learning outcomes of diagnosed children. When children with ADHD have trouble maintaining focus on tasks, assignments may remain incomplete. Trouble staying seated can cause disruption in the classroom, not only impacting their learning, but the rest of the classroom's as well. ADHD also creates issues with social cues, which may lead to verbal interruption with teachers and peers: this places strain on classroom and peer relationships. Despite these difficulties, controlled interventions can be applied by teachers, parents, and the diagnosee to improve their social and academic life.

5.2. Strategies to Reduce Environmental Toxin Exposure

Given the severity of environmental toxin exposure to the brain, implementing solutions to avoid these exposures is critical to protect developing minds. Healthcare providers and schools can host programs for expecting mothers to inform about the dangers of environmental toxins. These programs can suggest solutions, such as avoiding foods high in heavy metals during pregnancy and switching to non-toxic household cleaners. In neighborhoods with higher risks of environmental toxin exposure, healthcare providers should urge schools to form a partnership to screen children for toxin exposure from young ages. Blood and urine samples are used to screen for environmental toxin exposure. In order to create safe learning environments, schools can hold regular safety inspections to examine their facilities for environmental toxins: mitigations include water and paint testing, using non-toxic cleaning supplies, and changing air filtration systems frequently to meet safety standards. Additionally, schools can provide nutritious foods for their students that are high in antioxidants to minimize environmental toxin absorption.

5.3 Coping with ADHD in the Classroom

Many teachers are unaware about strategies for managing children with ADHD in classroom settings (Ward et al., 2021). As a solution, Bachelor of Education degrees should implement mandatory teachings on learning conditions such as ADHD and how to cope with them to improve quality of learning in the classroom.

ADHD often poses time management and routine issues. To address this, providing students with a task list that outlines daily expectations with timelines can be a useful tool that facilitates task completion (DuPaul et al., 2014). Additionally, immediately rewarding positive behavior helps to promote sustained positive behavior and decrease classroom disruption (DuPaul et al., 2014; Tresco et al., 2010); opposingingly, reprimanding negative behavior immediately is just as vital–immediacy reinstates the connection between behavior and teacher response, whether it is positive or negative. Tresco et al. also pose an intervention strategy by the name of CISS-4: Consistency, Immediacy, Specificity, Saliency, and 4 positive responses for every reprimanding response. DuPaul et al. also suggest to alert students with ADHD of activity

changes before they occur to lessen resistance to new tasks and constantly keep an eye on them throughout the day (2014); they also pose, to reduce the threat of minor negative behavior disruptions from turning into major outbursts, redirecting minor outbursts by handling them in a even keeled tone to reduce outbursts in the future (as these behaviors are often attention-seeking in nature). Short frequent breaks have also been shown to reduce academic outbursts, whether they involve movement, short brain activities, or free time (Li et al., 2023; Arenas et al., 2024).

Conclusion

With a focus on prenatal and early developmental impacts, this review has examined the conjunction between environmental toxins, BBB function and permeability, and ADHD outcomes. Many environmental toxins, beyond what was discussed, cause developmental disruption, and exposure during early developmental stages should be avoided at all costs as a protective measure. Toxins in the brain destroy homeostasis and lead to development of ADHD and the worsening of symptoms: genetic predisposition also plays a role in these outcomes. These findings can be applied in educational settings to control the struggles children with ADHD face from a young age.

Evidence-based strategies can help teachers maintain control in the classroom, while ensuring peak educational quality for all students: immediate praise and reprimanding, daily personalized schedules, and frequent breaks can all help with behavior control. Future research should focus on dietary adjustments, such as inclusion of antioxidants to reduce the negative effects of environmental toxins. Policy changes should work towards eliminating or drastically reducing the toxin levels children and prenatal mothers are exposed to in their environments.

Overall, the best strategies stem from reducing prenatal and early child developmental toxin exposure: it is of governmental concern to direct more attention to these issues in order to protect the brain development of generations to come.

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Effects of Academic Stress on Oral Health

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Lay Summary

Academic stress is a common challenge for students, often leading to psychological strain, but its impact on oral health is less recognized. This paper explores how stress affects oral health by triggering physiological responses that lead to conditions like teeth grinding (bruxism), jaw disorders, dry mouth, and gum disease. Additionally, stress can contribute to unhealthy behaviors such as poor oral hygiene, unhealthy eating, and substance use, which further harm oral health. To combat these effects, students should adopt stress management techniques like meditation and exercise, maintain proper oral hygiene, eat a balanced diet, and schedule regular dental checkups. Taking a holistic approach to stress and oral health can help students maintain overall well-being.

Abstract

Academic stress is a significant issue for students, characterized by high workloads, expectations, and competition. While its psychological effects are well-documented, its impact on oral health is less studied. This paper examines the physiological responses to stress, including activation of the hypothalamic-pituitary-adrenal (HPA) axis and the release of stress hormones like cortisol and adrenaline, which contribute to oral health conditions such as bruxism, temporomandibular joint disorders (TMJD), dry mouth, and periodontal disease. Additionally, stress-induced behavioral changes, such as neglecting oral hygiene and consuming unhealthy diets, further exacerbate oral health risks. The paper discusses strategies for mitigating these effects, including stress management techniques, proper oral hygiene, a balanced diet, and regular dental visits. Addressing both stress and oral health together promotes better overall well-being for students.

Keywords: Academic Stress, Oral Health, Bruxism, Periodontal Disease, Stress Management

Introduction

Academic stress is a loaded issue for most students, resulting from heavy workloads, high expectations, and intense pressure to succeed. While the psychological effects of academic stress are well-documented, its impact on physical health, including oral health, receives less attention. This paper explores the connection between academic stress and oral health, examining physiological responses to stress and the resulting oral health issues, such as bruxism, temporomandibular joint disorders (TMJD), dry mouth, and periodontal disease (Bruxism (teeth grinding), 2024). Recommendations for mitigating these effects are also discussed, emphasizing the importance of holistic health management.

While the psychological effects of academic stress are well-documented, its impact on oral health receives a rather low priority of attention. There are a variety of oral implications that can occur when students live in high stress conditions for long periods of time. This paper explores the connection between student academic physiological stress responses presenting in oral health issues. Issues such as the relationship of physiological stress and jaw/teeth alignment changes, joint disorders, dry mouth, periodontal diseases, cavities and tooth decay, sleep relations to oral health, and lastly poor diet implications on oral health (Chris, 2024). Some recommendations are also discussed, which draws an emphasis on relieving stress, and taking a holistic approach to health management.

1. The Physiological Impact of Stress

When humans face stress, the body activates the hypothalamic-pituitary-adrenal (HPA) axis, leading to the release of stress hormones such as cortisol and adrenaline (Gunepin et al., 2018). These hormones prepare the body for a "fight or flight" response, affecting multiple systems, including the oral cavity. The “fight or flight” response hormones are part of what's causing reduced saliva production (dry mouth), teeth grinding and jaw tension, increased inflammation and weakened immunity. The reason this is important to note is

because these hormones are essentially making the oral cavity highly susceptible to damage under chronic stress.

Teeth grinding which is also known as Bruxism, is a common response to stress and is often increased by academic pressure. Bruxism can occur day and night, and it results in symptoms such as jaw pain, wear in teeth, and headaches. Over time bruxism can turn into TMJD which is Temporomandibular joint disorders (Bruxism (teeth grinding), 2024)). Stress hormones can also influence salivary gland functions, causing fluctuating salivary levels, reducing saliva production commonly causing dry mouth/ Saliva is important because it helps maintain oral health by neutralizing acids, washing away food particles, and its effects of microbial agents (Iorgulescu, 2009). Having a lack of saliva can increase risks of cavities and oral infections, as well as bad breath.

Chronic stress has an impact on the immune system as it encourages infection by immunosuppression (Dhabhar, 2009). This can affect gum tissue and lead to periodontal infection, causing infections of the tissue supporting the teeth. Through academic stress this is a common occurrence that often goes unnoticed. This also leads to a decreased ability for the body to fight off bacterial plaque. Most stress-induced behaviors often have people neglecting oral hygiene, and this leads to further implications of periodontal problems, possibly worsened conditions in older aged teeth over time (Gunepin et al., 2018).

1.1 Behavioral Factors Contributing to Oral Health Issues

In addition to physiological stress responses, stress influences behavior to also negatively impact oral health. Many students often neglect oral hygiene routines, skipping brushing and flossing due to lack of time or tiredness and convenience. During periods of high academic stress, poor oral hygiene can lead to great accumulation of plaque, which increases risks of cavities and gum disease.

Stress also finds people prompted to unhealthy dietary habits, such as caffeinated beverages, sugary snacks, and these contribute to tooth decay (World Health Organization, 2017). Stress in students also leads to smoking, or increased alcohol/substance problems. Patterns of substance use alongside poor oral hygiene can have long lasting negative impacts on the mouth, and oral cavity. Some students also use over-the-counter substances to manage stress, which also can have an impact on oral health. Medications such as antihistamines and certain antidepressants can cause dry mouth, and lead to more oral conflicts (Daly, 2016)

1.2 Several strategies can help mitigate the oral health consequences of academic stress

Some recommendations to reduce the oral health consequences of academic stress in students can begin with stress management techniques. Things such as mindful meditation, breathing exercises, physical stimulation, can reduce stress levels. This can include spending time creating a schedule that offers balance in ways like limiting recreational screen time and instead using that time to make a trip to the gym, or taking time to make a healthy nutritious meal. Sometimes even just daily positive affirmations can help stay on track and also generate positive motivations. Another key idea in relation to oral health is maintaining a consistent oral hygiene routine, this means that even during high stress periods, students are maintaining proper dental care. This can be guided through setting reminders, or writing down a list and including oral hygiene as a priority.

Reducing sugary foods and acidic foods/beverages, can help lower risks of gum diseases and cavities (World Health Organization, 2017). Working on eating healthy can support the body and mind for success. Lastly it's important to schedule regular dental check ups, and visits for early detection and management of oral health conditions that may be present or at risk. Dentists can provide professional advice tailored to stress-related concerns.

Conclusion

Academic stress not only affects students' mental well-being but also has significant consequences for oral health. The physiological response to stress can lead to bruxism, TMJD, dry mouth, and periodontal disease, while behavioral changes associated with stress can further exacerbate oral health problems. Protecting oral health is essential not just for maintaining a confident smile but also for overall well-being. Oral health plays a crucial role in daily functions such as eating, speaking, and even self-esteem. Poor oral health can lead to painful conditions, difficulty in concentrating, and long-term dental complications that require costly

treatments. Given the strong link between academic stress and oral health, students should take proactive measures to safeguard their teeth and gums. By managing stress effectively and maintaining good oral hygiene, individuals can prevent serious dental issues that might affect their quality of life. Encouraging awareness and adopting preventive care strategies will not only help students succeed academically but also ensure long-term health and well-being. Taking care of one's teeth is an investment in future health, making it essential to prioritize oral care alongside academic responsibilities. Addressing these issues requires a holistic approach that includes stress management, maintaining consistent oral hygiene practices, adopting a healthy diet, and seeking regular dental care. By recognizing and mitigating the oral health impacts of academic stress, students can improve both their academic performance and overall well-being. Encouraging awareness and proactive care will help students develop lifelong habits that promote better oral and systemic health.

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STUDENT MIND

Psychological Studies in Education