



## **From Brain Development to Academic Success: Optimizing Learning Outcomes Through Lifestyle and Connection**

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### **Abstract**

Early childhood brain development plays a key role in an individual's learning capacity to learn. However, many children, especially those from low-income households, have fewer resources to allocate to developing a safe learning environment required to obtain a higher quality education, which, in turn, impacts cognitive development through reduced opportunity as opposed to innate capacity to learn. Thus, it is crucial to study this current issue to increase opportunities for academic success and ability to learn. Here, research will examine the factors that influence brain development and learning outcomes in children, particularly those from low-income backgrounds. Additionally this research will investigate how learning occurs across developmental stages in the brain. Next, lifestyle factors such as nutrition and physical activity that influence learning and the impact of socioeconomic status will be analyzed. Results will be used to propose several recommendations on methods for optimization of learning in children. The overall objective of this study is to identify strategies that can support informing educators, families, and policymakers to help improve academic progress of children, especially those from low income backgrounds, to obtain full learning potential through evaluating how brain development, daily lifestyle behaviors, and socioeconomic status influence learning outcomes in children.



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## Introduction

Research on cognitive development in young children is crucial for improving academic performance worldwide. Providing children with higher quality education is a key requirement for cognitive development as education opportunities lead to positive classroom interactions, a stable home environment, and stronger emotional relationships (Cherukunnath et al., 2022). With a stable foundation, children also experience outcomes across lifetime, with outcomes measured as a sense of purpose and the ability to achieve personal goals and opportunities to establish increased desirable job opportunities (Temircan, 2022). While it is clear, children's academic success is highly correlated to future success in personal and professional domains, studies have demonstrated that children from impoverished families are significantly disadvantaged in achieving academic success due to financial difficulties that impair even the opportunity to establish learning ability through affected aspects of daily life such as diet, physical activity, sleep, social connection, and stress management (Jirout et al., 2019).

There are many factors that influence children's development and learning beginning with proper nutrition in early childhood as it provides macronutrients and micronutrients, which include vitamins, carbohydrates, and omega-3 fatty acids required for neurodevelopment. Since nutrients play a crucial role in neurodevelopment, academic achievement in school is increased through provision of diets containing aforementioned nutrients (Maina, 2024).

Similarly, research has shown that daily physical activity is beneficial for young children. Exercising for about 1 hour daily can also increase healthy neurodevelopment (Dalal et al., 2022). Sleep maintenance through development of a consistent sleep schedule has been shown to impact learning capacity as reduced sleep quality impacts children's attention, mood, and behavior (Henríquez-Beltrán et al., 2022). Decreased and interrupted sleep can lead to sleep deprivation, negatively affecting physical and mental health which is consistent with lower academic performance due to poorer cognitive function induced by sleep deficit (Henríquez-Beltrán et al., 2022).

Another factor that affects the brain is positive social connections with family and friends. After the pandemic, there has been an increase in electronic device use by children, impacting development of social and coping skills. There are many healthy activities that have been studied for decades, for example going to playgrounds, that can help children improve their social connections and are proven to be feasible and effective in establishing social connections.

Positive family relationships provide support for when children feel overwhelmed (Dalal et al., 2022). Stress has been demonstrated to have a significant impact on children's cognitive development. Thus, managing stress is a key component to maintaining executive functions (Ritter et al., 2020). Data suggests that by taking part in mindfulness training, people have shown improvements in their cognitive flexibility, memory, and have become less reserved (Ritter et al., 2020). Again, these are all factors which play a critical role in the developing brain with respect to learning ability, highlighting the need for an encouraging environment that promotes a healthy lifestyle and academic success for children.

In today's world, socioeconomic status often affects how children maintain these habits. Families from low-income backgrounds may lack access to nutritious food, a safe place for exercise, or stable sleep routines due to economic pressure (Broer et al., 2019). In addition, limited financial resources can reduce opportunities for both the child and the parent to have healthy social interactions (Broer et al. 2019). These issues directly affect learning outcomes, as children with less access to encouraging environments struggle to achieve educational goals.

Fortunately, to optimize learning, researchers have designed interventions that provide resources for families facing financial issues to create a healthy environment. For example, alliances have been created so that all families can provide for their children with essential factors for learning ability increase including aid for provisions of healthy diets and implementing strategies to offer greater opportunities for safe environments that allow for essential physical and learning activities (Skouteris et al., 2022). Schools can also implement these programs and even include programs to minimize stress and foster stronger teacher-student connections to create an encouraging space (Reimer, 2020). Thus, family and social interventions can give children the support they need to thrive academically and emotionally.

Here, this research aims to discuss how brain development, daily lifestyles, and socioeconomic status influence learning outcomes in children. It will specifically focus on nutrition, sleep, exercise, stress management, and healthy social connections that can influence executive functions and other cognitive development. The purpose of this research is to inform people on ways to improve learning outcomes for children, especially those from low-income communities. By spreading the word, children have a higher chance of developing the skills needed for academic and life success.

### **Neuroscience of Learning**

Learning begins in the brain, which contains billions of important cells called neurons that are required for learning processes. Every neuron receives and transmits information throughout the body, resulting in thoughts, movements, and emotions. For neurons to communicate, an electrical event called the action potential releases neurotransmitters which act as chemical messengers, through a small gap between neurons called synapses (Ortega-de San Luis et al., 2022). This allows neurons to communicate with one another. Moreover, the connections created by communication of billions create neural networks in our brain that strengthen and weaken across lifetime. By repeating activities, these networks are able to adapt physically and functionally, forming new connections and weakening older ones in a process called neural plasticity (Fakhoury et al., 2022). Repeated practices, such as redoing math problems, strengthen neural networks by increasing knowledge and skills storage. This is a fundamental part of how neurodevelopment, memory, and learning are intrinsically interdependent (Fakhoury et al., 2022). In short, neurons and their ability to adapt connective strength through neural plasticity processes provide the biological foundation and architecture in the brain for learning and acquiring skills through experience and behavior.

The development of the brain strongly influences not only learning ability, but specifically how children learn, as it enhances their ability to understand diverse sets of topics quickly. In early childhood, millions of synapses form connections leading to high neural plasticity, demonstrating that the brain is able to create new connections fast, making young children adapt and learn new skills easily (Muallem et al., 2024). For example, during early childhood, children learn new languages faster because their brains are more flexible due to opportunities for novel experiences and reduced instantiated strong connectivity.

Similarly, as children grow into their adolescent years, their brains will continue to adapt to effectively navigate novel experiences. During this time, the brain goes through significant growth due to the prefrontal cortex changing (Djurakulova, 2024). The prefrontal cortex is in charge of decision-making, regulating emotions, and social behavior (Djurakulova, 2024). As this region of the brain matures, young teens will struggle with managing functions that rely on prefrontal cortex development. This explains why young teens and young adults are more likely

to take risks than those with a fully developed prefrontal cortex (Djurakulova, 2024). The challenges often seen during adolescence, such as impulse or emotional instability, reflect neurological development in real time. Additionally, an increase in white matter, a type of tissue found in the brain where there is myelination, is linked to improved cognitive functions as it improves the brain's ability to process and connect information quickly and efficiently (Genc et al., 2023). This indicates that as children progress through adolescent years, they begin to strengthen their problem-solving skills and ability to understand increasingly complex topics. Altogether, brain development in early childhood poses an influence on how individuals learn.

Even though understanding the cellular level of the brain is important to know how we learn, several brain regions that work together are crucial as learning requires interconnectivity across divergently evolved regions and cell types. The main regions associated with learning include the amygdala, hippocampus, prefrontal cortex, and cerebrum (Alexandra et al., 2022). While the amygdala and hippocampus are similar, there is a main difference between the two regions of the brain: the hippocampus is responsible for forming and retrieving memories, while the amygdala is the central hub for processing emotions and linking them to memories (Hanson et al., 2023). This means that the amygdala regulates attachment of positive or negative emotion to a learning experience. In conjunction, the amygdala and hippocampus are critical for processing emotions and influencing behavior (Hanson et al., 2023). As mentioned, the prefrontal cortex plays a crucial role in critical thinking, decision making, and ultimately is a key region which impacts how individuals behave socially (Djurakulova, 2024). Finally, the cerebrum, the largest part of the brain, is associated with motor control and regulating cognitive functions like high-order thinking and problem solving (Zhang et al., 2023). All of these connected brain areas form a foundation for learning throughout childhood and adolescence and are thus crucial to probe how to optimize learning in populations of children with a spectrum of resource availability during crucial early childhood years.

## **Psychology of Learning**

Emotions play an important role in learning, memory, and attention. Studies have theorized that positive emotions build intelligent, physical, and social capabilities that encourage adaptation (Alexander et al., 2021). This indicates that having a cheerful mood or feeling a positive emotion towards a class leads students to learn better, be more attentive, and engaged. Dopamine, a type of neurotransmitter, is also a key indicator of feeling a positive emotion, including pleasure (Costa et al., 2022). It is associated with a reward-based system that creates motivation to achieve an award (Tan et al., 2021). This indicates that students with higher dopamine levels associated with learning will have increased capacity to maintain attention and retain more material. In contrast, negative emotions generally lead to distraction and poor learning student performance (Tan et al., 2021). Negative emotions, such as feeling pressure while taking a test, will affect the brain capacity to cognate effectively under such conditions as research has found that having these emotions produces catecholamine hormones, which disrupt the biological and physiological processes of human cognition (Alexander et al., 2021). This makes it harder for an individual to concentrate in class and affects their memory in such a way non-conducive to academic success (Alexander et al., 2021). These neurochemicals and emotions directly influence how well students learn in school and thus are important to consider when optimizing the learning ability of children.

## Stress and the Brain

Stress can change how a person learns and remembers topics. Specifically, the amygdala is activated when responding to stressful situations, which tells the hypothalamic-pituitary-adrenal (HPA) axis to release stress hormones (Ross et al., 2021). The amygdala and HPA axis are connected since one is activated during stress and the other regulates how the body responds to stress. Stress results in the release of cortisol, a stress hormone that controls inflammation, increases heart rate, and enhances cognitive functions (Sitorus et al., 2025). While students will initially be more focused and have better performance due to cortisol driven alleviation of stress-induced physiology, production of cortisol has negative long-term effects though downregulating dendrite production required to receive and send information to other blood cells, affecting memory (Amran et al., 2019). Dendrites are the part of the neuron that receives messages from other neurons (Amran et al., 2019). They are important as they play a key role in transmitting information to other neurons. Impaired or reduced dendritic activity results in a decrease in communication between neurons, manifesting in impaired memory, attention, and overall weaker academic performance. Therefore, stress and the downstream biochemical impacts on regions of the brain and body is crucial to consider for long term impacts on learning ability.

## Lifestyle Factors

### Introduction

Neurological and academic development in children is influenced by lifestyle. As children grow from childhood to adolescence, habits such as diet, exercise, and sleep hygiene play a crucial role in determining how the brain develops and retains information. When these factors are addressed, children experience stronger memory, improved attention, and overall enhanced academic performance (Jirout et al., 2019). On the other hand, unhealthy habits such as consuming processed food or being less active can lead to a decrease in memory retention (Skouteris et al., 2022). Due to their importance, it is essential to examine the five pillars of lifestyle: nutrition, physical activity, sleep, social connections, and stress management.

### Nutrition

Obtaining the proper nutrition is necessary for children to foster a healthy life, especially those from low-income backgrounds. Vital nutrients such as omega-3 fatty acids, found in fish, contribute to improving cognitive outcomes, which are linked to higher academic performance (Maina, 2024). Given this, it suggests that omega-3 fatty acids strengthen students' abilities to focus in class and retain information.

Similarly, nutrients and minerals in various foods—vegetables, fruits, whole grains, dairy products, etc.—are an influential component of brain development, so that children have the energetic supply required for operating and functioning (Abbas et al., 2023). In addition to the aforementioned omega-3 fatty acids, many other nutrients are involved in the development of executive functions that are necessary for school success, including iron, zinc, iodine, vitamin B12, and folate (Costello et al., 2021, p. 1304).

Vitamin D also plays a critical role in the growth and development of the brain, as demonstrated by scenarios in which patients show a deficit of Vitamin D, such as cases of brain disorders including Alzheimer's and dementia (Eyles, 2021). As a result, children need to receive quality nutrition in order to have sufficient energy required for processing and projecting

positive behaviors and engagement in class. In contrast to this, eating unhealthy foods is related to weight gain and poor mental health in early childhood, with negative long-term health effects from adolescence to adulthood (Skouteris et al., 2022). Having poor mental health is linked to the inability to focus in class, leading to lower grades. Therefore, access to nutrient-rich foods= is crucial for academic success, long-term health, and learning ability.

### **Physical Activity**

Regular physical activity, whether it is playing sports or going on walks, is beneficial for maintaining good cognitive health. Studies have shown that exercising daily has a positive effect on brain plasticity, as it promotes the release of neurotransmitters to synapses, which is known for improving cognitive functions (Moon et al., 2019). As an individual increases exercise, brain plasticity increases in parallel, promoting improvement to memory retention, recall, and executive function

Besides showing an improvement in neurological functions, continuous physical exercise contributes to the development of academic performance. Research on children aged between seven and twelve years old has demonstrated that aerobic fitness, a type of physical activity, leads to outstanding performance in attention-related tasks (Arida et al., 2021). Aerobic exercises include those activities that elevate the heart rate including but not limited to: jogging, swimming, and cycling,

It has also been observed that fitter children aged nine to ten greatly advanced their understanding of arithmetic calculations (Arida et al., 2021). These studies indicate that regular exercise during childhood boosts educational outcomes, as fitness routines increase neuroplasticity and blood flow to the brain, thus increasing ability to focus and engage in academic settings, resulting in increased academic success. Altogether, sustaining a proper exercise routine supports both mental processes and academic achievement.

### **Sleep**

Experiencing fewer scenarios which provide environments for resting states leaves children feeling sleep-deprived, which in turn affects their brain function. . Studies have shown that the recommended amount of sleep for ages 2-5 years is about 12 hours and for ages 6-12 years, it is about 9 hours (Chaput et al., 2018).

Children who receive the optimal amount of sleep will face less sleepiness and fatigue during the daytime. This allows them to focus and retain information while learning in school, letting them earn higher academic achievements. However, sleep disorders such as excessive sleep and reduced amount of sleep lower the brain's oxygen supply and reduce a student's concentration level in class (Novianti et al., 2022). This results in impaired capacity to follow instructions, form memories, and is correlated with lowered intellect quotient and lower performance in school. Inadequate sleep leads to mood swings, school absences, and decreased attention, memory, and academic performance (Henríquez-Beltrán et al., 2022).

In contrast, receiving proper rest will lead to improved performance in school. Research on primary school children with and without sleep problems shows significant results. Children who sleep well receive better grades in all subjects than children who do not sleep well, showing the importance of sleep in achieving academic success (Henríquez-Beltrán et al., 2022). Operating with healthy sleep hygiene can also help children receive optimal sleep quality. Sleep hygiene includes setting up a regular wake-up time, reducing light and noise before sleeping, setting up ambient temperatures, and wearing comfortable sleepwear (Chow, 2022). Creating

these habits not only improves sleep quality but also ensures a child practices healthy sleeping habits to enhance concentration in school. Thus, ensuring children maintain healthy sleep schedules is critical for enhancing academic performance and health which further lends to learning ability.

### **Positive Family and Social Connections**

The early years of a child's life are an important time to build relationships with family and, especially, teachers to create a positive social environment for learning. Proper parental involvement, such as encouraging their child to solve educational challenges and praising effort, is consistent with increased school achievement (Schmid et al., 2021). Furthermore, having parents reinforce their child's learning at home is positively correlated with academic performance (Schmid et al., 2021). Through a supportive relationship with their family, children will become significantly motivated and confident with their coursework. Adding on to social connections, it is essential for students and teachers to build a bond to create a comfortable learning space.

A recent study investigated the effects of regular communication between secondary school students and teachers on academic performance. The results show that by understanding the students' needs, teachers were able to find small ways, such as smiling and encouraging participation, to greatly impact learning outcomes (Imran et al., 2023). These small actions were able to build up the confidence of the student, making them more motivated to improve their academic success. Additionally, teachers are able to provide feedback and necessary support, ultimately leading to an increase in students' achievements (Imran et al., 2023). Consequently, these findings show the importance of fostering a supportive learning environment for academic growth.

### **Stress**

Although stress is experienced daily, excessive or chronic stress can lead to serious consequences for children. Research shows that academic duties such as preparing for tests, writing essays, and continuous studying significantly affect college students both physically and psychologically (Deng et al., 2022). The cognitive load from the amount of work expected from students can overwhelm cognitive function thereby, placing their health at risk.

Physically, continuous stress over a long period of time causes fatigue, loss of appetite, and headaches (Deng et al., 2022). These symptoms reflect how, under frequent pressure, the body weakens, making it harder for students to concentrate inside and out of class. Moreover, psychologically, academic stress has been linked to poor health, anxiety, and depression, which is correlated with poor academic performance (Deng et al., 2022). Similar to the previous symptoms, this can disrupt focus, leading to prolonged stress and lower intellectual achievement.

Studies have also shown that chronic stress can lead to changes in the hippocampus, which is where memories are created and stored (Blashill, 2016). In addition, a study conducted with elementary students aged 10-11 found a significant relationship between stress and both verbal and visual-spatial working memory (Blashill, 2016). This implies that stress can greatly impact a student's ability to learn and properly store information, which can lead to poor school performance. These effects tend to get worse as children grow up due to the increase in workload as well as higher difficulty in coursework. In essence, excessive stress harms an

individual both physically and psychologically and can significantly affect students' long-term success.

## **Sociocultural Factors**

### **Barriers to Academic Outcomes**

Throughout the world, the biggest factor that prevents students from achieving strong academic outcomes is coming from a low-income background. This results in several lifestyle factors—nutrition, physical activity, sleep, social connections, and stress—being affected due to financial restraints. For example, these restrictions prevent families from providing necessary nutrients and minerals for their children, eventually causing malnutrition (Maina, 2024). Consequently, this leads to children's mental deterioration, contributing to academic setbacks because of difficulty concentrating and paying attention in class. Similarly, performing physical activities would not be ideal because of unsafe neighborhoods or a lack of school resources, resulting in reduced access to playgrounds (Jirout et al., 2019). Without a safe area to exercise or play, children are left inside, becoming less active and more addicted to electronic devices. This is responsible for a decrease in attention span in school and, consequently, a drop in academic performance. Additionally, children coming from a low socioeconomic background live in a noticeably more chaotic and stressful environment due to financial issues (Jirout et al., 2019). This often causes sleep disorders since children are receiving inconsistent bedtimes, not only affecting sleep quality, but also leading to mood swings, school absences, decreased executive functioning, and lower academic performance (Henríquez-Beltrán et al., 2022). This leaves a child feeling disheartened, adding to the ongoing stress cycle, resulting in the possibility of dropping out completely. Lastly, stress from financial instability can lead to symptoms such as fatigue and anxiety, hindering students' ability to focus (Deng et al., 2022). Instead of being attentive in class, children will be more worried about their situation, causing them to fall behind. Also, as schoolwork continues to pile up, their stress levels will increase, contributing to the pressure they already experience coming from a low socioeconomic background. All of these factors greatly impact low-income households, where children face difficulties that influence academic achievement in school.

### **Socioeconomic Status and Education**

In addition to the barriers children from low-income households face, inequality in socioeconomic status (SES) influences the availability of educational opportunities and learning outcomes. Families with a higher socioeconomic status can use their income to “pay for organized after-school activities, to access elite educational opportunities, or to build up valuable social networks” (Broer et al., 2019). Children from these families often attend better schools with greater accessibility to helpful resources that can raise exam scores, indicating higher school performance. Also, better connections direct them to a wider selection of opportunities aligned with their interests, preparing them for long-term success. On the other hand, children from a lower socioeconomic status have parents with lower education and therefore cannot support their child's education with many of the same opportunities (Vadivel et al., 2023).

Due to the lack of parental involvement, children start falling behind in their schoolwork, leading to lower grades, as well as low confidence and self-esteem. Overall, children from a low socioeconomic background are tied back by financial restraints (Broer et al., 2019). As a result,

the child will struggle to find the right opportunities or after-school activities to attend that are beneficial for their future. This leads to feeling demotivated in school and poor academic performance, which can prevent them from pursuing a higher education. Ultimately, the impact socioeconomic status has on a child's academic performance not only influences their education but also impacts their long-term success.

### **COVID-19 Pandemic Effects**

Although it has been five years since the COVID-19 pandemic, its effects on students' learning can still be seen throughout the world. Students switched from in-person learning to remote learning, critically affecting their learning, social connections, and mental health. Those from low-income families faced many challenges, such as a lack of electronic devices and internet access, preventing their children from attending classes. Recent studies have shown that low-income students were "unable to participate in class or complete their schoolwork due to a lack of internet access" (Katz et al., 2021). For this reason, many students began to struggle academically and received lower grades, widening the achievement gap between low and high-income students. While learning online, students also experienced a loss of in-person interaction, negatively affecting social connections, as students became isolated (Tyler, 2022). Children could not build connections with their peers and notably, when returning to school post-pandemic, many were anxious when interacting with each other. Without these connections, students lacked a supportive learning environment where they could feel motivated to learn. Additionally, the lack of social connections impacted children's mental health.

Children from low-income households faced more stress due to financial insecurities, which affected their psychological well-being with increasing high risk for anxiety and depression. Anxiety and depression interfered with concentration and memory which resulted in decline in academic performance. (Campo-Arias et al., 2021). Consequently, the pandemic highlighted the inequality in social classes in students' access to proper educational, social, and emotional support in school.

## **Optimizing Learning Outcomes**

### **Introduction**

Around the world, many low-income children need proper education to have a chance at a better life. As discussed in previous sections, a child's lifestyle factors influence their neurological and academic development, which is essential for building healthy habits. By combining neuroscience, psychology, and pedagogy, the next few sections explore programs and science-backed strategies that will improve the learning outcomes of disadvantaged children. Policy changes in school, such as mental health support and increased access to learning, connect students to resources and create a supportive environment. Furthermore, pedagogy, the study of teaching methods and teaching, has shown that boosting student-teacher connections by sharing experiences enhances engagement in class. Programs such as the Mind Yeti Program and the International Healthy Eating Active Living Matters (HEALing Matters) Alliance aim to promote mindfulness, nutrition, and physical activity to improve focus in school (Ritter et al., 2020; Skouteris et al., 2022). With support and a healthier lifestyle, more children will gradually gain the tools needed to improve executive functions and academic achievement.

## Supportive Learning Environments

Creating a supportive classroom setting is important for enhancing children's cognitive and emotional growth, which, in turn, supports students' engagement. Using a pedagogic plan, the process of developing a detailed lesson or learning activity, studies have shown that there are multiple ways to change a classroom setting. One way is creating a group seating arrangement or flexible seating, fostering socialization and collaboration to motivate students (Khany et al., 2025). When teachers allow students to work together, it creates an inclusive environment where students use teamwork to solve problems together, boosting cognitive growth. In addition, having optimal sensory conditions, such as natural lighting, appropriate levels of temperature, and regulated noise, reduces students' tendency to get distracted (Khany et al., 2025). If the temperature is too high or the classroom is dark, students will struggle to stay focused, which is why optimal conditions are needed to sustain active learning. Besides supporting students' cognitive growth, classrooms should also encourage positive emotional growth. By including mindfulness training, children learn ways to manage stress and increase sympathy and empathy towards others (van de Weijer-Bergsma et al., 2014). This creates an emotionally safe place where students can be more open with each other and with the teacher. Overall, designing a supportive learning environment that nurtures cognitive and emotional growth will benefit schoolchildren long-term.

## Student-Teacher Connections

Although student-teacher connections may not seem important in children's education, they can greatly impact children's educational achievements. A few ways teachers can encourage these connections include: attempting to meet students' needs, empowering students, incorporating lessons learned into daily activities, and creating opportunities for shared experiences (Reimer, 2020). Instead of quickly answering questions, teachers should try to understand why a student is confused and explain nicely to create a positive environment. Additionally, by listening to what students have to say without criticism, they will feel more confident that their question will be respectfully answered (Imran et al., 2023). This empowers students to ask more questions, making them excited to learn. What also makes learning exciting for children is to incorporate topics they are interested in into generally boring subjects. For example, an elementary school teacher had a few students who were not good at writing, but once she asked them to write about their favorite photos, they would have something written down within 5 minutes (Reimer, 2020). Despite disliking writing, the teacher found a strategy that kept students engaged while improving their academic skills. Lastly, building strong student-teacher relationships with shared experiences, such as reading stories or playing sports together, creates a special bond, which leads to higher academic achievement (Hernández et al., 2017). As teachers help form these connections, children will feel engaged and could even have fun learning in school, leading to higher participation. Overall, beginning to build student-teacher connections fosters a safe, inclusive environment, keeping students motivated throughout the school year.

## Lifestyle and School Programs

Executive functions are essential for students to achieve academically, so children must maintain a healthy lifestyle by managing stress, promoting nutrition, and engaging in physical activity. A few elementary schools have started implementing special programs such as the Mind Yeti Program and HEALing Alliance to improve students' executive functions. The Mind

Yeti Program is a digital mindfulness-learning program conducted in classrooms, featuring engaging activities like breathing exercises, guided meditations, and full-body scans; it measures subscales of executive functioning, including “inhibition, emotional control, sustained attention, working memory, organization, and cognitive flexibility” (Ritter et al., 2020, p. 546). Every session included child-friendly language, audio, and cartoon-character visuals to guide children through the activities (Ritter et al., 2020). These sessions made mindfulness training available and engaging for children, allowing them to practice regulating their emotions. Results of the Mind Yeti were mixed, showing improvements in working memory and cognitive flexibility, but no significant differences for the other subscales (Ritter et al., 2020). This suggests that although mindfulness training strengthens certain aspects of cognition, long-term practice into everyday life will be necessary to analyze a wide set of benefits. With proper mindfulness, children were able to manage stress, improve focus, and greatly enhance their executive functions.

In addition to the previous program, the HEALing Alliance aims to support socioeconomically disadvantaged families by providing nutritious food and promoting physical activity (Skouteris et al., 2022). Considering that children from low-income households face food insecurity, they could be malnourished, reducing their concentration and focus in class. With the help of this program, children receive proper nutrition and learn about how to maintain a healthy diet, leading to a healthier lifestyle. This program also promotes daily physical activity for at least one hour per day because studies have shown that it increases blood flow to the brain, enhancing synaptic functions and brain activity (Melo et al., 2024). Results of the program have revealed that by being given healthier food options and promoting exercise, children and adolescents had increased energy (Cox et al., 2024). With these results, it can be concluded that if schools provide a safe environment for children to play on the playgrounds and include PE, cognitive functions such as attention, memory, and executive functions will increase children’s academic success.

Both the Mind Yeti Program and HEALing Alliance work hard in nurturing children’s development, but there also needs to be changes in school policies. Many children in elementary schools may be bullied for being from a financially unstable family, so there needs to be disciplinary actions against the perpetrators, as well as safe counseling services (Schwartz et al., 2023). Schools should also spread awareness about bullying by creating presentations to prevent bullying from happening in the first place. Additionally, children from low-income families may not have enough money to buy school supplies, an electronic device, or WIFI. By providing children with a Chromebook, letting them borrow supplies, and creating after-school programs, this increases learning access. To conclude, changing school policies and promoting programs that benefit low-income students creates a positive school environment to strengthen academic outcomes.

## Discussion

Learning starts in the brain, where neurons communicate through synapses. This repetitive signaling between neurons helps to strengthen connections in the brain through neural plasticity. This forms the foundation for brain development, memory, and learning. Also, during childhood years, there is growth in the prefrontal cortex and white matter, which is linked to improved cognitive functions (Djurakulova, 2024). Essential brain regions like the hippocampus, amygdala, prefrontal cortex, and cerebrum work together to regulate thoughts, memories, emotions, and behaviors (Djurakulova, 2024). Additionally, emotions are connected to dopamine

and other neurotransmitters, which directly affect children's academic performance. This can change due to stress, which releases cortisol, causing short-term success but long-term effects such as impaired memory (Amran et al., 2019).

In all, there are five lifestyle factors that influence the neurological and academic development in children. First, consuming vital nutrients and minerals helps improve children's energy needed for academic success and long-term health. Moreover, doing physical activities daily, such as jogging, swimming, cycling, etc, for about an hour increases blood flow to the brain, allowing children to be engaged in school (Arida et al., 2021). It is also important for young students to maintain good sleep hygiene by sleeping for about 9 hours a day (Chaput et al., 2018). This prevents children from getting sleep problems while also creating healthy habits to enhance concentration. Additionally, by building positive family and social connections, children will feel supported and more motivated, fostering a supportive learning environment. Finally, prolonged stress should be regulated so as not to affect the student physically or psychologically. The examination of these lifestyle factors all connect to ensure children's academic performance develops positively and successfully in the long run.

In addition to maintaining the five pillars of lifestyles, the sociocultural aspect should be considered. Since low-income children may not have the resources to support a healthier lifestyle, their academic achievement in school will be affected by a few barriers. They might not be able to obtain nutritious foods, exercise in a safe area, have consistent bedtimes, live in a significantly chaotic environment, or have increased stress levels. These all affect the academic outcomes of children, leading to mood swings, lower performance, and possibly dropping out of school. Also, children from low-income backgrounds tend to have parents who work long hours, so they might not be able to help with their child's education. All of this got worse during the COVID-19 pandemic because it widened the gap between low and high-income students.

This was especially visible in regards to digital resources, where children from a higher socioeconomic status had access to electronic devices, and low-income children did not, which significantly impacted their schoolwork and progress (Katz et al., 2021). Additionally, during the pandemic, they lacked social connections, which affected their mental health. As a result, this led to increased risks of depression and anxiety, both of which lead to a decline in academic performance (Tyler, 2022). Although many children have a supportive environment, those from a lower socioeconomic class are not as fortunate. It is important to understand the various barriers different children face in order to better support their development and education.

There are several ways research can be used to inform strategies for enhancing children's cognitive and academic development. As mentioned previously, improving education for children includes several factors, such as healthy lifestyles, supportive environments, and connections, all of which are essential for building habits in the long term. Some programs, like the Mind Yeti Program and HEALing Alliance, aim to provide mindfulness training, nutrition, and encourage physical activity (Ritter et al., 2020; Skouteris et al., 2022). This not only improves children's academic outcomes but also leads them towards a healthier lifestyle. To create a better school environment, schools should also prevent bullying and provide school supplies to low-income children, ensuring everyone has a positive learning experience. Moving on to the inside of the classroom, teachers should develop strategies that allow students to enhance both cognitive and emotional growth, while also maintaining optimal conditions to improve focus. Additionally, teachers are most successful when they begin building connections with their students, encouraging an acquired love of teaching them to love learning (Hernández et al.,

2017). Ultimately, strategies such as these providing for low-income children creates an inclusive space that promotes the growth of knowledge and long-term healthy habits.

Throughout these sections, several topics overlap, such as the science behind learning and lifestyle factors, supportive learning environments and connections, as well as the effects of low income. For example, regular physical activity that elevates the heart rate not only boosts educational outcomes but also positively correlates with the improvement of cognitive functions since it releases more neurotransmitters to synapses and promotes brain plasticity (Moon et al., 2019). Using neuroscience to explain the benefits of physical activity on students further supports the ties between these two sections. Also, when observing favourable learning environments and student-teacher connections, there is an increased sense of motivation when teachers provide optimal sensory conditions, such as appropriate levels of temperature and natural lighting (Khany et al., 2025). This allows students to be more open with the teacher, which creates opportunities for both of them to have bonds that encourage education. However, children from low-income families often face hardships, leading to increased stress that affects their connections with teachers and their brain development. Demonstrated in one of the articles, students from low-income backgrounds lack access to healthy food, a safe exercise environment, and stable sleep routines, which can all affect their academic outcomes (Broer et al., 2019). Yet some components do not seem to align, such as the results of the Mind Yeti program. Even though overall, it has shown improvement in cognitive flexibility, there were no significant differences in other areas, such as emotional control (Ritter et al., 2020). Research has shown that this program can be used as mindfulness training for elementary school students, but there could be minimal improvements seen. With everything considered, the research supports the idea that the science behind learning, lifestyle factors, learning environments, and student-teacher connections can all be impacted for low-income students.

Currently, there are numerous studies on how coming from a lower socioeconomic background could affect learning and the scientific side of learning, yet additional research needs to be done. Generally, research revealed short-term results, such as sleep deprivation causing a decreased attention span in school, but long-term results should also be included (Novianti et al., 2022). Being shown evidence of how lifestyle factors such as nutrition, exercise, sleep, family environment, etc., can affect a student over a long period of time could provide more insight into their developmental needs. Additionally, there is limited evidence on how one of the school mindfulness programs, Mind Yeti, will benefit students over time. Even though it showed positive results overall, when looking at each area it benefits in detail, there were a few discrepancies, showing that the program may not have a big impact on academic outcomes. By addressing these matters, future studies can be done to improve students' cognitive and academic results and design evidence-based interventions that promote more holistic education.

Overall, this research highlights different areas that correlate with each other, including the biological, psychological, and social factors that influence how a child from a low-income background learns. By understanding these factors, communities can collaborate to create a supportive and healthier environment where everyone has an equal opportunity to learn. Policymakers could set up special programs, similar to the HEALing Alliance, that provide proper nutrition, free school supplies, and mindfulness training to improve academic performance. Educators and families can develop interventions in schools to ensure that disadvantaged students feel seen and supported while learning. In the long term, adequate resources and programs will allow children to break out of the poverty cycle and pursue a better



life. Over time, these benefits can lead to a better education system, where inequalities will not so heavily affect a child's academic success, no matter what background they come from.

### **Conclusion**

This research further evaluated the significance of understanding what factors affect brain development and learning outcomes in children from low-income backgrounds as required for promoting educational outcome and success across life. Neuroscience describes that learning occurs, both on a cellular and physical level through developmental years as children transition from early childhood to adolescent years. Here this research supports the finding that specific lifestyle factors such as proper nutrition, regular physical activity, adequate sleep, positive connections, and reduced excessive stress further provide healthy conditions for cognitive growth and academic performance.

However, sociocultural factors, especially socioeconomic status, prevent low-income children from finding educational opportunities and healthier life habits resulting in reduced opportunities to pursue academic development. This therefore confounds the measure of educational success as a metric of cognitive potential. To address this issue, several specialized programs such as the Mind Yeti and HEALING Alliance Healthy lifestyle were created to provide basic necessities as well as initiate proper mindfulness to enhance executive functions in children. Overall, research has revealed that brain development and lifestyle are deeply intertwined, which greatly impacts learning outcomes. As a result, future research should focus specifically on developing and improving upon programs that will ensure disadvantaged children feel supported across many communities. Findings from evaluation in this research recommends that educational success can be made for low-income children by combining scientific research, in this case neuroscience of the developing brain, with education to guarantee students will achieve their full potential in school and in the long term.

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