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Maternal SES and Stress on the Developing Child's Brain

Abstract

In this white paper, the impact maternal socioeconomic status (SES) and stress have on the developing brain of the child, both antepartum and postpartum, is discussed. SES consists of household income, education, and occupational prestige.² Research on this topic is discussed both in terms of the brain structural differences and how this correlates to behavioral differences, such as differences in language, memory, and executive function. Current interventions are summarized before a discussion on how this research can be translated into public policy.

Introduction

Maternal stress and socioeconomic status (SES) interplay to affect a child antepartum and postpartum. These factors are interwoven; a low socioeconomic status often increases the stress of the mother. The hormones of the mother are circulated through the blood and the placenta to reach the developing fetus, having a direct impact on the development of the brain and the endocrine system. These factors can be detrimental to the child, causing them to be at a potential disadvantage as compared to their peers before they are born. Low SES exacerbates this problem as the child enters school due to its correlation with brain function. In this paper, I will focus mainly on function rather than structure of the areas of the brain involved. The function of the brain areas associated with low SES show how these differences lead to disadvantages in the classroom. I will address the impact that these factors can have on the child's brain and the measures that need to be taken to better the mother's home environment, which in turn will better the child's environment to even the playing field in terms of academics and achievement for all children, regardless of SES.

Antepartum differences

The differences in brain structure that are associated with low SES have an impact before the child is born. These differences start while the child is in the womb, influenced by the SES and health of the mother. Low SES environments are often stressful with factors such as crime, financial uncertainty, and a weak support system.⁷ When an expecting mother is in this environment, a stress hormone called corticotropin-releasing hormone (CRH) can be secreted in higher amounts than in a non-stressed mother.⁹ This hormone is then circulated through the bloodstream and through the placenta to the developing fetus. This can cause preterm labor, reduced birth weight, and a slower growth rate.⁹ In rats, a mother in distress while pregnant often causes the newborn rat pups to have increased CRH in the amygdala, a brain region associated with emotional processing,

causing depressive behavior.⁷ This includes decreased response and movement, decreased motivation, decrease in normal reactions to reward, and lack of pleasure in the rat pups.⁹ This effect is still seen if the rat pup is raised by a non-stressed foster mother although the depressive behaviors can be decreased, showing that there is a biological cause but that these effects are malleable.¹⁰ As a result, children born into stressful environments are at a disadvantage before they even enter the world. However, the rat pups showed that the effects of stress can be reversed if they are raised in a non-stressful environment.

Postpartum differences

Once the child is born, low SES continues playing a role in the child's life. Low SES is correlated with lower test scores in adolescents, being more likely to drop out of high school, and being placed in special learning programs.⁸ Low SES is also correlated with differences in language, skills in math, executive function, and stress, which can cause children to be at a disadvantage because these skills are necessary to perform well in school.⁸ Low SES households tend to be less cognitively enriching; cognitive enrichment includes linguistic interactions between children and adults and books to read.⁸ Studies have found that average language vocabulary was half the size in children from families on welfare compared to professional families.²

These brain differences in SES can be seen via brain imaging. Using magnetic resonance imaging (MRI) to find volumetric differences in the gray matter of the brain, 60 socioeconomically diverse adolescents were scanned.⁷ It was found that higher parental education was significantly correlated with reduced size of the amygdala, which is important for emotional processing.⁷ A smaller amygdala size could be correlated with less stress and less depressive behavior, as seen by the rat pups discussed above.⁷ It was also found that family income was positively correlated with hippocampal volume, which is important for memory.⁷ This implies that higher income is correlated with better memory, an important skill for school.⁷ These results can be seen in **Figure 1**. In a later study, the work was expanded to 1099 children and young adults to look at SES differences in cerebral cortex. It was found that SES was positively correlated with surface area of cerebral cortex in areas related to language, reading, and spatial skills.⁶ It is important to understand that the differences seen in children of high and low SES backgrounds can be seen in the brain. Although behavioral assessments are valuable, the neurocognitive differences of SES will allow more of an impact in the long run to better interventions.

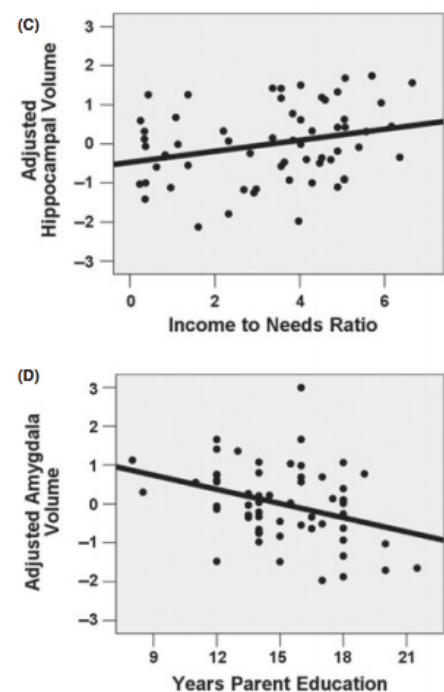


Figure 1: Results from Noble's 2012 study, showing that as income to needs ratio increases, hippocampal volume size decreases. It also shows that as parent education increases, adjusted amygdala volume decreases.⁷

Interventions

Longitudinal studies are currently being run to see if interventions can combat these trends in low SES youth. One such program is the Abecedarian Program that provided full day care to low SES children from the ages of 4 months to eight years-old.⁸ They then compared these low SES children enrolled in the program to low SES children not enrolled in the program. In this program, the children were benefitting during the study with increases in test scores, but these results seemed to fade once the study was over.⁸ However, at 21 years old the children previously enrolled in the Abecedarian Program were more likely to have graduated from high school, have gone to college, and have owned a home.⁸ This shows that providing care to these children can make a difference in the long-run.

A study is currently being performed to try to find causality between SES and child outcome, specifically looking at income. The plan is to give a cash stipend to mothers of either \$333 or \$20 monthly at the time of birth and track the child over three years to see if a direct increase in income is correlated with less stress for the family and better cognitive functions of the child, such as better development of visual, auditory, and other cognitive skills.⁵ Until the results of this study are published in ten years, it is unclear if income alone is causing the differences seen in neural function.

Recommendations

Translating this research into policy is a sensitive subject. There are major criticisms about applying neuroscience to social policy on poverty and SES. Criticisms that are important to consider include: finding a neurological basis to inform policy treads on a fine line of blaming those with low SES, glorifying middle class values, or inferring low SES brains are biologically inferior.¹ To avoid this, we have to be careful as we try to inform policy.

We need to further study the structures and pathways involved in low SES to learn what interventions need to be taken so every child can be on an even playing field to succeed at the time they are born. We also need to think about the tangibility of these programs to become implemented nationwide and to have the ability to enroll more families. To reach more people, we need to enroll patients at prenatal clinics, hang flyers at hospitals, and put flyers up on college campuses for volunteers. Public policy is needed to make this a reality. We need interventions that will put low SES children at an advantage for the duration of their lives, and not just during their time in the program: this includes free daycare and after school care for the children. Daycare should have activities focusing on memory and executive function, using memory games and puzzles. There also needs to be counseling for the parents before and after labor, to focus on stress-reduction and advice for how to help their children succeed.

Conclusion

Research will not affect public policy without advocates. Everyone deserves an equal chance the second they walk into a classroom. Children should not be at a disadvantage due to home environmental factors that they cannot control. This will not be possible until we change our policies to ensure the most amount of families are reached, and the interventions are focused on the brain differences that we know persist in low SES families.

Citations

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