

Effect of Prenatal Stress on Cognitive and Behavioral Development

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ABSTRACT

While it is well-known that high stress levels detrimentally impact overall health, recent research reveals that elevated prenatal stress levels not only negatively affect the mother's health but also impair the cognitive and behavioral development of children. Mindfulness-based interventions are key in reversing these adverse effects. These interventions can be an effective way to manage stress as a complement to usual medical care. Mindfulness-based techniques have evolved from Vipassana, Buddhist, and Zen practices, stress management tools that have been around for decades. Children between the ages of one and seven suffer considerably from the effects of maternal stress; however, women can significantly lower their stress levels with prenatal mindfulness-based interventions, allowing their children to fully develop their cognitive and behavioral abilities.

Verbal and Cognitive Development in Children

Elevated levels of stress that pregnant mothers experience can have a negative influence on the child's verbal and cognitive development. Verbal development is a crucial part of cognitive development. In a study led by Aizer and her colleagues at Brown University Medical School, they concluded that an increase in levels of cortisol, a stress hormone, in mothers' bodies affects the fetal environment. Particularly, they discovered that seven-year old children who were exposed to cortisol as a fetus have "a six point lower verbal IQ" than that of fetuses who are not exposed to cortisol (Aizer et al. 539). High levels of prenatal stress can significantly decrease a child's ability to communicate, and this negatively impacts the cognitive development of the child. In another study, Ibanez and her colleagues at UPMC Paris University found a significant association between prenatal stress and poor cognitive functioning of two and three-year-old children, including hyperactivity and delay in speech (Ibanez et al. 10). Executive functioning and language delay are primary cognitive signs of children with attention deficit hyperactivity disorder (ADHD). This study exemplifies typical cognitive development issues such as language impairment that two and three-year-old toddlers experience when mothers undergo substantial stress during pregnancy.

Behavioral Development Issues in Children

Toddlers can also face a great number of behavioral problems when their mothers encounter high levels of stress throughout their pregnancy. Amici and her colleagues at the Department of Human Behavior and the Department of Women and Child Health in Leipzig, Germany conducted a study using 373 mother-child pairs. They found that when mothers undergo high stress levels, the children have an increasing risk of developing internalizing problems such as anxiety and poor self-estimation in addition to externalizing behavioral issues such as hyperactivity and aggression (Amici et al. 874). Pregnant mothers with high levels of cortisol in their bodies engender a range of behavioral issues in children. These behavioral problems not only harm the child's mental health but can also make it challenging for children to socially connect with their peers. In addition to Amici's findings, Wesselhoeft and his colleagues conducted a study at Odense University Hospital in Odense, Denmark and concluded that increased levels of prenatal stress may

result in an “imbalance of the hypothalamic–pituitary–adrenal (HPA) axis,” leading to psychological problems such as behavioral issues in children (Wesselhoeft et al. 560). Dysregulation of the HPA axis causes children to have mood disorders and altered behavioral responses to stress. While these HPA axis-related behavioral problems first appear in childhood, they worsen as children age into teenagers and adults.

Education and Awareness through Mindfulness-based Interventions

A solution to the aforementioned negative effects from elevated prenatal stress is education and awareness through mindfulness-based interventions (MBI). In a study conducted by Guardino and her colleagues at the University of California at Los Angeles, a mindfulness-based course that educates women about pregnancy, childbirth, and parenting concerns significantly lowers maternal stress and anxiety (Guardino et al. 345). By participating in mindfulness-based programs that review the pregnancy process, many women gain a better insight into how pregnancy impacts the mind and body. Pregnant women can anticipate upcoming changes and adapt accordingly, alleviating their anxiety and stress from potential pregnancy complications. In an additional study, Zhang and his colleagues at Harbin Medical University in Daqing, China analyzed the impact that weekly educational sessions focusing on the delivery process has on stressed mothers. The expecting mothers who participated in the study claim that after engaging in mindfulness interventions, they recognized “significant decreases in prenatal stress” compared to the stress they had experienced prior (Zhang et al. 56). The delivery process is the climactic process of the pregnancy journey and imparting education through mindfulness can help pregnant mothers manage the delivery process to protect their unborn from adverse side effects. Mindfulness workshops centered on certain themes, as well as at-home pain-management practice, assist expectant women in receiving the required knowledge to minimize their stress levels. Overall, this mindfulness-based educational approach helps to calm their thoughts and become fully present.

Managing Negative Emotions through a Mindfulness-based Approach

Pregnant women who use a mindfulness-based approach better manage negative emotions associated with stress. Woolhouse and her colleagues conducted a study at the Royal Children’s Hospital in Melbourne, Australia and interviewed 52 women. 20 of those women were part of the control group while the other 32 women were in the experimental group. The experimental group underwent a 6-week mindfulness-based program where each session included a 15-20 minute meditation period. An emerging theme from the interviews identified by women who participated in the program “was the way in which mindfulness practice had allowed them to reign in destructive patterns – both cognitive, emotional and behavioral” (Woolhouse et al. 11). This program allowed women to clear the stream of jumbled ideas that were crowding their minds. Women were able to take a step back, evaluate, and respond to difficult circumstances more thoughtfully rather than becoming immersed in negative thoughts and emotions. Furthermore, the study using mindfulness based stress reduction (MBSR) conducted by Zhang and his colleagues at Harbin Medical University in China used two measurement techniques, the State Trait Anxiety Inventory (STAI) and Pregnancy Stress Rating Scale (PSRS). The STAI and PSRS measured anxiety and severity of stressors respectively. When comparing pre-test and post-test scores in the STAI and PSRS, the post-test scores of the MBSR group were significantly lower than those of the control group (Zhang et al. 56). When participating in MBSR sessions, women are more aware of negative thoughts as they occur and can take constructive remedial action rather than linger on pessimistic emotions. The five and six-point decrease in the total stress score illustrated on the graph strongly suggests that women who focused on the present were better able to cope with stress (Zhang et al. 56). Hence, Zhang’s study demonstrates the effectiveness of MBSR and its potential in improving a mother’s mental health.

Non-Judgmental Setting in Mindfulness-based Interventions

Mindfulness-based interventions are most successful in a non-judgmental setting. A study led by Lenz and his colleagues at the Erlangen University Hospital in Erlangen, Germany observed that stressed prenatal mothers joining together in mindfulness-based sessions and listening to audio files in a mindfulness-based stress reduction app helped promote a mindful attitude and provide stressed pregnant mothers with a non-judgmental place (Lenz et al. 1287). When pregnant women come together in a comfortable setting, it gives them a safe space to open up and talk freely about their internal worries. In an email interview, Dr. Elyse Thakur, a psychologist specializing in gastroenterology at Atrium Health Gastroenterology and Hepatology in Charlotte, North Carolina, agreed with the findings of Lenz and his colleagues. Dr. Thakur stressed her belief that the technique of mindfulness may help women engage in the moment in a non-judgmental way without focusing on the past or future (**Thakur**). The collectiveness expectant mothers feel when being surrounded by women going through similar stress helps reassure them that they are not alone in their pregnancy journey. Stressed pregnant women who are in a mindfulness-based environment can express themselves freely and gain insight without worrying about being judged by others. This is very similar to the ancient Buddhist technique Vipassana, as it involves observing one's thoughts and emotions without judging or dwelling on them.

Self-Efficacy in Mindfulness-based Interventions

In addition to participation in a non judgmental setting, self-efficacy is also key to successful mindedness-based interventions. Self-efficacy is one's belief of their ability to successfully perform the tasks that are required to achieve a certain goal. Zarenejad and his colleagues led a study at the Alborz University of Medical Sciences in Karaj, Iran that consisted of 70 women. The control group received traditional counseling sessions whereas the experimental group received six one-hour group counseling sessions twice a week. When women engaged in weekly counseling sessions and daily mindfulness meditation at home, self-efficacy scores were "significant 1 month after the intervention" (Zarenejad et al. 5). The thought of giving birth is initially overwhelming for pregnant women, and this is especially common in first-time mothers. The mindfulness breathing technique training and meditation provided in the sessions of the program could effectively help stressed women develop a perspective on childbirth and concentrate on their ability to actually give birth. Furthermore, a study conducted at the University of Kang Ning in Tainan, Taiwan found that when assessing questionnaires that were filled out pre and post intervention, the participants in the experimental group earned lower scores for stress and achieved "higher scores for childbirth self-efficacy and mindfulness than their comparison group peers" (Pan et al. 108). The control group received traditional education classes whereas the experimental group participated in a mindfulness-based program and received practice at home audio recordings. When juxtaposing self-efficacy scores, women who received mindfulness training had more confidence when birthing a child thus reducing their stress levels going into the delivery room. When partaking in the mindfulness-based program, expecting mothers reported having a higher self-esteem and felt that their self-efficacy was boosted. Not only is this beneficial to the mother, it also protects the cognitive and behavioral development of the child. While most studies demonstrate the benefits of self-efficacy on maternal stress, one study conducted by Hall and her colleagues at Monash University in Victoria, Australia found insufficient evidence "about the effectiveness of mindfulness to promote perinatal mental health" (Hall et al. 68). The Australian study does not refute the effect of managing stress through self-efficacy, it simply states that there is inadequate evidence for the effectiveness of MBI on maternal stress. Future studies can certainly continue to examine the benefits and limitations of this therapeutic approach. Additional research about mindfulness-based sessions could improve this approach of helping mothers reduce their elevated prenatal stress. Alleviating prenatal stress will aid in the mitigation of behavioral and cognitive negative effects in children.

Connection between Participation of Mothers in Mindfulness-based interventions & Effect on Children

By educating prenatal women and assisting them in managing their negative emotions, mindfulness-based interventions help lower the stress that these mothers endure. Reduced stress levels enhance children's behavioral growth. Noroña-Zhou and her colleagues conducted a study at the University of California, San Francisco on children of pregnant women who participated in mindfulness-based interventions. Compared to the treatment-as-usual-group (TAU), the "intervention group infants engaged in higher proportions of self-regulatory behavior" (Noroña-Zhou 530). In comparison, infants who were in the TAU demonstrated delay in sympathetic activation and lower proportions of self-regulatory behavior (Noroña-Zhou 532). This demonstrates the benefit of prenatal mindfulness interventions on mothers, and more importantly children. Mindfulness-based interventions are a better alternative to traditional means for reducing prenatal stress and improved well-being of children.

Conclusion

As evidenced above, prenatal stress levels run the risk of adverse cognitive and behavioral development in children, thus impeding a child's ability to grow into a healthy, normal adolescent. Mindfulness is one of many complementary and alternative medicine strategies that address this issue. When expectant mothers minimize their stress using mindfulness-based techniques, the effects on cognitive and behavioral development in children are mitigated. Being in a non-judgmental environment with mothers who experience the same stress and receiving additional education will allow for a less worrisome pregnancy. By participating in weekly mindfulness-based interventions, women will experience less stress and ultimately reduce the impact of prenatal stress on the cognitive and behavioral development of children.

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