

THE EFFECTS OF ANTENATAL DEPRESSION ON ADOLESCENT
DEVELOPMENT & POSSIBLE ANTENATAL INTERVENTIONS

By

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Abstract

This literature review displays the possible effects untreated antenatal depression can have on a woman's adolescent child, as well as possible interventions that can be done during pregnancy to control those effects. This thesis goes into the proposed physiological mechanism behind how maternal depression influences child development, focusing on the role of the Hypothalamic Pituitary Adrenal (HPA) axis, but also touching on how the maternal autonomic system contributes as well. The literature included highlights the increased risk of both internalizing and externalizing neurobehavioral disorders as well as neurodevelopmental disorders in the offspring, including depression and anxiety, ADHD, ODD/CD, aggression, antisocial personality disorder, autism, and intellectual disability. Lastly, on a more positive note, the paper then focuses on possible mechanisms and practices that can be followed during pregnancy to decrease the effects antenatal depression can have. Such mechanisms include medications, bright light therapy, mindfulness, exercise, social support, yoga, and omega-3 fatty acid supplementation. Overall, this thesis indicates a correlation between antenatal depression and adverse adolescent outcomes, but it is important to note that when it comes to this type of analysis, researchers can never be completely certain whether the association between mother's mental state and childhood outcomes is a direct effect or if it can be brought on by other social or biological processes.

Introduction

According to the National Institute of Mental Illness, nearly one in five U.S. adults live with a mental illness of some kind. More specifically, 7.1% of all U.S. adults experienced at least one major depressive episode in 2017, with the prevalence being higher among adult females than adult males (National Institute of Mental Illness). It is commonly thought that depression is solely caused by an imbalance of neurotransmitters in the brain, but in reality, there are many possible influences, such as faulty mood regulation, genetics, stressful life events, medications, or medical problems (Harvard Health Publishing, 2009). Regardless of the cause, there are many ways to handle the condition, but every individual is unique and is not going through the same experience as another. Specifically, pregnancy is a time in a woman's life when emotions are skyrocketing and hormones are fluctuating. Generally, pregnancy is viewed as an exciting, happy time in a woman's life, but in truth, this is not always the case; some people simply don't feel this way. Pregnancy on its own is a tumultuous chain of events, and the addition of mental stressors, like feeling unhappy or overwhelmed, can make an already difficult experience even more strenuous. Women who experience these types of emotions may be at an increased risk of antenatal depression or anxiety (National Institutes of Health). In the past, research has mainly focused on postnatal depression but during the last decade, there has been an increase in the amount of research done on mood during pregnancy and the effect it has on offspring development, both as a fetus and during childhood (Waters, Hay, Simmonds, Goozen, 2014). The most prevalent outcomes that affect the offspring of a mother who experienced antenatal depression are: internalizing neurobehavioral disorders like depression and anxiety, externalizing neurobehavioral disorders like attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder (ODD), conduct disorder (CD), increased aggression, and antisocial personality

disorder, and neurodevelopmental disorders like autism or intellectual disability. Although there are many adverse aspects of antenatal depression, there are interventions that can be taken to help lessen the effects. These include medications, bright light therapy, mindfulness, exercise, social support, and omega-3 fatty acid supplementation. It is important to mention that because so many women who experience antenatal depression also go on to experience postpartum depression, it is hard to discern whether the effects on child development are caused by the antenatal or the postpartum exposure (Antenatal Exposure to Depression and Adolescent Depression, 2013).

Proposed Physiological Mechanism

It has been proposed that antenatal depression is an early marker of a developmental cascade that leads to future, long-lasting mental health problems for both the mother and the offspring (Waters et al., 2014). Although each mother may experience stressors of varying extents, from brief and acute distress to clinically significant depression and anxiety, the proposed mechanism for how it affects the developing fetus is fairly consistent, based on what has been hypothesized thus far (Waters et al., 2014). The most prevalent explanation of the negative effects on the offspring is an increase in activity of the Hypothalamic Pituitary Adrenal (HPA) axis. Being that the HPA axis is one of the major systems involved in stress response and regulation, it is the main focus of studies in this area. Cortisol, which is the end product of the HPA axis, is thought to be able to pass through the placenta during pregnancy, so the concentration of maternal cortisol can affect fetal cortisol levels and the development of their HPA axis. The steroid hormones, glucocorticoids, influence nearly every organ and tissue in the body, making it a main contributor to fetal programming and later health outcomes (Davis and

Sandman, 2012). During normal pregnancy the enzyme 11 β -hydroxysteroid-dehydrogenase type 2 (11 β -HSD2), which is highly expressed in the placenta, converts maternal cortisol to its inactive form, cortisone, to protect the fetus. However, animal studies have suggested that prenatal stress affects the function of the placenta and the expression of this beneficial enzyme. Therefore, the degree of 11 β -HSD2 enzyme expression influences the amount of maternal stress hormones the fetus is exposed to. Another potential mechanism revolves around the maternal autonomic system. Antenatal depression could result in stress-induced activation of the sympathetic nervous system and result in increased release of catecholamines, which could reduce uterine and placental blood flow, being that catecholamines are known to affect vessel tone (Waters et al., 2014). Artery resistance can limit the amount of oxygen and nutrients that reach the placenta, further impairing fetal development. Lastly, epigenetic influences, such as DNA methylation and histone modifications, have also been studied when it comes to infant outcomes. (Waters et al., 2014). Specifically, antenatal stress has been shown to decrease DNA methylation of the corticotropin-releasing hormone (CRH) gene and increase methylation of the glucocorticoid receptor gene (NR3C1), and the altered expression of these genes most likely induce increased HPA activity in offspring. It is also likely that antenatal depression can lead to altered gene expression and epigenetic profiles in placental tissue. (Waters et al., 2014).

Adolescent Outcomes

Parent mental health can have a substantial impact on the development of their children. Studies have started to look at the risk of depression in adolescents whose mothers had experienced depression during pregnancy. But once again, being that antenatal depression is often accompanied by postnatal depression, sometimes it can be difficult to separate the effects

that they have. A large cohort study done in the United Kingdom sought to determine whether antenatal depression (AND) and postnatal depression (PND) are associated with offspring depression at the age of 18, as well as determine if antenatal and postnatal depression have independent effects on the offspring depression (Pearson et al., 2013). The study found that both AND and PND have an association with adolescent depression, and after adjusting for confounding variables, determined that AND is also an independent predictor of the outcome (Pearson et al., 2013). Offspring were 1.28 times more likely to have depression at the age of 18 years with each standard deviation increase in the mother's antenatal depression score. While this study was also interested in establishing whether the mechanisms of impact for AND and PND were different, the study was not able to directly test this (Pearson et al., 2013). Regardless, via indirect evidence, they were able to conclude that the outcomes from each pathway are indeed achieved through different means (Pearson et al., 2013).

Another study done in the United Kingdom asked the specific question of whether antenatal depression predicts depression in adolescent offspring by analyzing 127 mother-offspring pairs (Barnes, 2009). The results indicated that about two-thirds of the women included in the study had at least one depressive episode during pregnancy or up until their child turned 16, and of those women, about 63% experienced more than one episode. 18 adolescents were diagnosed with depression, and all of them had been exposed to maternal depression sometime after conception. Interestingly, adolescents whose mothers first experienced depression during pregnancy were at a significantly greater risk of developing depression (Barnes, 2009). The study concluded that antenatal depression predicts depression in offspring and these effects can be mediated by repeated exposure to maternal depression. Women who experienced depression during pregnancy were nine times more likely to have another episode sometime in the future

(Barnes, 2009). Although simply the presence of depression during pregnancy can have an impact on the presence of depression in the offspring, there does seem to be a dose-effect as well; the higher the scores of antenatal depression, the greater the risk of depression in the child (Antenatal Exposure to Depression and Adolescent Depression, 2013).

Individuals who experience depression often also experience anxiety; therefore the two typically go hand-in-hand (Mental Health Conditions: Depression and Anxiety, 2018). Antenatal exposure to maternal anxiety, stress, and depression has been associated with impaired stress regulation, behavioral problems, and emotional problems during adolescence. Being that maternal cortisol doubles or even quadruples during normal pregnancy, cortisol levels will be even higher for individuals experiencing other mental health issues. (Davis and Sandman, 2012). Evidence has shown that one of the primary consequences of excess glucocorticoid exposure may be increased fear and anxiety in offspring (Davis and Sandman, 2012). This was also confirmed when children were exposed to synthetic glucocorticoid treatment, which resulted in them displaying impaired HPA axis regulation and higher levels of behavioral inhibition and social anxiety (Davis and Sandman, 2012). A study that included 178 mothers and their six to nine-year-old children tested the levels of maternal salivary cortisol and psychological state at three different times during pregnancy. (Davis and Sandman, 2012). The study found that elevated cortisol levels during gestation were associated with childhood anxiety as long as nine years later. Specifically, these children were more likely to fall in the borderline or clinically significant range for anxiety based on the Achenbach System of Empirically Based Assessment (Davis and Sandman, 2012). Since depression and anxiety share many of the same symptoms and involve thoughts and feelings, they are placed into the same category of internalizing

disorders, and therefore share similar physiological mechanisms and treatment options, making it hard to differentiate between the two in research.

While anxiety and depression in offspring are strongly associated as an outcome of antenatal depression, some externalizing factors have a correlation as well, the first one being, attention-deficit/hyperactivity disorder (ADHD). ADHD is a chronic condition that affects millions of children and often continues into adulthood. The condition encompasses a variety of problems, including difficulty keeping attention, hyperactivity, and impulsive behaviors, which can also accompany low self-esteem, trouble with relationships, and doing poorly in school (Mayo Clinic, June 2019). With a prevalence rate of 5.9 to 7.1% ADHD is one of the most prevalent neurodevelopmental disorders in children (Woldford et al., 2017). To determine whether or not depressive symptoms during pregnancy are associated with ADHD symptoms in their children from the age of three to six, Woldford et al. completed a study with a large sample of Finnish women. They also chose to look at whether the mediating effects were gestation-week or trimester specific. The study measured depressive symptoms biweekly starting at 12 weeks gestation until term or delivery (Woldford et al., 2017). Children of mothers with consistently high depressive traits during pregnancy showed higher levels of ADHD features between the ages of three and six. These specific children were 2.8 times more likely to be diagnosed with clinically significant ADHD symptoms (Woldford et al., 2017). Interestingly, the study found no relationship between gestation-week or trimester-specific differences in maternal depression and adolescent attention-deficit/hyperactivity disorder. (Woldford et al., 2017).

Another study performed in California found similar results, but they approached it from a different perspective. This study sought to answer the question of whether mothers of children with ADHD are more likely than mothers without ADHD to have been diagnosed with certain

health conditions, depression being one of them, in the year before the birth of their child (Ray, Croen and Habel, 2009). The study analyzed a variety of health conditions to consider a wide range of factors, and in the end, it was determined that mothers of children with ADHD were more likely to be diagnosed with several medical and mental health problems, which included depression (Ray et al., 2009) According to another study, the link between prenatal stress and offspring attention deficit hyperactivity disorder was only present in related mother-offspring pairs as opposed to step-parents or foster/adoptive parents, further supporting the idea that ADHD symptoms can be attributable to inherited factors (Rice et al., 2009). Overall, these findings correspond with the groundwork of the Developmental Origins of Health and Disease suggesting that prenatal exposure to environmental adversity may carry enduring effects on brain development, including risk for ADHD characteristics (Woldford et al., 2017).

Attention deficient hyperactivity disorder is one of the most frequent and debilitating childhood disorder, in which comorbid behavior disorders considerably worsen the prognosis (Bendiksen, 2016). Oppositional defiant disorder (ODD) and conduct disorder (CD) are often lumped into this category. Studies suggest that ADHD occurs in 14-40% of children with ODD, and CD is comorbid in up to 42% of persons with ODD. On top of that, those experiencing comorbid disorders typically have more severe and more persistent behavioral problems and symptoms (Riley, Ahmed, and Locke, 2016). In general, according to the American Psychiatric Association, ODD and CD have their own pediatric prevalence of 2-16% (Ruisch, Buitelaar, Glennon, Hoekstra, and Dietrich, 2018). These disorders exhibit a wide variety of symptoms such as anger, defiance, and vindictiveness, which are specifically seen in ODD, and aggression, destruction, and severe rule violation, seen in CD (Ruisch et al., 2018). Specific maternal behaviors and lifestyles during pregnancy, like internalizing problems and the presence of

depression, may be related to the same genetic factors that dispose offspring to distributive behaviors that lead to conditions like these (Ruisch et al., 2018). Both ODD and CD fall under the category of behavioral disorders and several studies have suggested that behavioral dysfunction is greater in the offspring of mothers who were depressed during pregnancy than those who were not (Grigoriadis, 2019). For example, in a study that followed mother-child pairs for 14 years, that extensively controlled for confounding variables like parenting behavior and postnatal depression, found that prenatal depression was statistically and clinically associated with behavioral problems like ADHD, ODD, and CD (Grigoriadis, 2019). Another study, that included maternal questionnaires at 18 weeks gestation and maternal and teacher ratings of behavioral symptoms in the children, also added evidence that prenatal environmental factors like stressful life events and depression symptoms during pregnancy are independently associated with offspring ODD and/or CD symptoms in the general population (Ruisch et al., 2018). Although these disorders aren't the only behavioral disorders that affect the offspring of mothers who experience antenatal depression, their symptoms are so commonly seen together that it could be argued that they are of particular concern.

Aggression is difficult to define, being that it can be used to describe everyday behaviors like yelling, hitting or fighting, but social psychologists have tried to determine what should and should not truly be considered aggression. One source defines aggression as “behavior that is intended to harm another individual who does not wish to be harmed”, as well as emotional or impulsive aggression being defined as “aggression that occurs with only a small amount of forethought or intent and that is determined primarily by impulsive emotions” (Jhangiani, Tarry, and Stangor, 2014). Numerous pathways lead to the origins of early childhood aggression, and some do include parental characteristics and psychiatric syndromes (Reebye, 2005). A literature

review found a correlation between childbearing depression and the likelihood of aggression in children six years and younger. When maternal depression exists, early childhood aggression is more likely to occur, with both internal and external factors mediating the relationship between them (Hendricks and Liu, 2012). A prospective longitudinal study predicted that the diagnosis of depression during pregnancy was one of the key predictors of adolescent violence, even when controlling for sociodemographic factors (Hay et al., 2011). Signs of aggressiveness were assessed using reports from parents and direct observation during peer interaction while at stimulated birthday parties. Findings showed that 15% of women in the study were diagnosed with major depressive disorder and it had a significant effect on the infant's tendency to display aggressive characteristics towards their peers, like tugging on toys and use of bodily force (Hay et al., 2011). The influence of the mother's mood disorder was not explained by the mother's mood disorder before pregnancy, further supporting antenatal depression as the root cause. Although not all children use the motor skills that develop during their first year of life to exert force against others, some children do, therefore it is something to be considered when looking at the effects of antenatal depression and infant development (Hay et al., 2011).

Under the umbrella of externalizing neurobehavioral disorders, the diagnosis of antisocial personality disorder (ASPD) involves aggression as one of the possible criteria, therefore it is important to also consider ASPD when discussing outcomes of antenatal depression. (Whipp et al., 2019). Antisocial personality disorder can be described as "a mental condition in which a person has a long-term pattern of manipulating, exploiting, or violating the rights of others without any remorse" ("Antisocial personality disorder", n.d.). As with the other disorders, there are many logical hypotheses to explain the correlation between antenatal exposure to maternal depression and antisocial outcomes, whether it's direct effects on the developing fetus, familial

risk, or re-exposure to maternal depression later on in life, being that it is a lifelong, episodic illness (Hay, Pawlby, Waters, Perra, Sharp, 2010). A study done in Great Britain, which focused their attention on the effects of depression during pregnancy, specifically controlling for levels of anxiety, followed a sample of mothers and children for 16 years, providing a well-rounded look into the variety of effects that came from testing these alternative hypotheses (Hay et al., 2010). The study found that antenatal depression caused children to have a twofold risk of antisocial outcomes and a fourfold risk of violent behavior, even when the other hypotheses were taken into account. (Hay et al., 2010). Overall, antisocial outcomes have been a consistent finding not only during adolescence, but during infancy and childhood as well, and have remained significant even after other sources of antenatal and postnatal risks have been considered (Waters et al., 2014).

Although neurobehavioral disorders encompass the vast majority of childhood outcomes that result from a mother experiencing antenatal depression, there are a few neurodevelopmental disorders that have the possibility of arising as well. One of the prevalent ones is autism spectrum disorder (ASD), a disability that can cause social, communication, and behavioral challenges. It is hard to pinpoint the exact cause that leads to the development of ASD, but it has been implicated that both genetic and environmental factors play a role (Chaste and Leboyer, 2012). In past decades, the number of autism cases has drastically increased from a mere 5 in 10,000 children in the 1980s to 1 in 88 in 2008 (Rai et al., 2013). However, due to the expansion of resources and increased recognition of the disorder that has coincided with this development, it is hard to discern whether there has specifically been an increase in the incidence of the disorder or whether it is simply an increase in the number of diagnoses. When referencing studies displaying the connection between depression during pregnancy and ASD, the results are

somewhat inconsistent, but there have been studies done that have found a correlation between the two. One study collected data from ~6000 pregnant women and was able to control for in-utero exposure to antidepressants. Autistic symptoms were more common in children of women with antenatal depressive symptoms compared to women without signs of depression (Grigoriadis, 2019). A separate study compared children with and without autism and asked which group had mothers who have been diagnosed with depression. They concluded that a history of depression was more common in mothers of children with autism spectrum disorder compared to the children without ASD (Grigoriadis, 2019). Autism spectrum disorder and antenatal depression appear to have some correlation, but it is also evident that more research needs to be done on the subject to come to a clear conclusion.

Unfortunately, autism is often seen in comorbidity with a variety of other conditions such as epilepsy, intellectual disability, and ADHD. Intellectual disability (ID) is also considered a neurodevelopmental disorder. Therefore, sometimes it is thought to correlate with antenatal depression. ID can be described as a disability that begins in childhood and is characterized by impaired skills that manifest in the developmental period, which together determine the overall level of intelligence, including language, cognitive, social, and motor abilities (Bhat, Dar, Qadir, and Pandith, 2019). What makes intellectual disability especially difficult for children and their caregivers is that it affects everyday social and practical skills. One study aimed to assess the association between children and adolescents with ID and the prevalence of depressive and anxiety disorder in their mothers. The study included children from 6-18 years old as well as information on their mother's antenatal and perinatal history. They found high rates of antenatal factors with correlated history of developmental delays in a significant number of the children with intellectual disability, as well as a high prevalence of depression in the mothers (Bhat et al.,

2019). Overall, more research would need to be performed to come to more substantial conclusions on the effects of antenatal depression and intellectual disability.

Antenatal Interventions

A specific topic that has been controversial in the literature is whether the use of antidepressants, including selective serotonin reuptake inhibitors (SSRIs), results in complications not only during pregnancy but in the long run as well. The decision to use medications during pregnancy is an individualized risk/benefits situation that should be discussed with a health care provider. If it is decided that medications are not the ideal route, there are other non-pharmacological alternatives pregnant women can turn to during their pregnancy. The most prevalent in the literature are bright light therapy, social support, mindfulness, yoga, and exercise, and omega-3 fatty acids. Most pregnant women with depression do not pursue any kind of treatment possibly because of difficulty accessing it during pregnancy or uncertainty of whether the symptoms they are feeling are pregnancy-related or depression-related (Battle, Abrantes, Schofield, & Kraines, 2015). Therefore, it is important to make potential interventions more accessible and more recognizable to give women the chance to combat their antenatal depression before it has longstanding effects on her, as well as her child.

Despite the extensive studies utilizing animal models that have been done on antidepressant use during pregnancy, there are still conflicting views about their efficacy and the risks that they may pose. Generally, the antidepressants that have been used during pregnancy are certain selective serotonin reuptake inhibitors (SSRIs), serotonin and norepinephrine reuptake inhibitors (SNRIs), bupropion, and tricyclic antidepressants (Mayo Clinic, 2020), but SSRIs seem to be the most studied (Ornoy and Koren, 2019). The use of SSRIs during pregnancy

is steadily increasing, having reached 2-6% of all pregnancies in recent years (Ornoy and Koren, 2019) or up to 10% of pregnant women in the United States specifically (Olivier et al., 2013). SSRIs aid in the treatment of depression by increasing levels of serotonin in the brain, which is a neurotransmitter that helps to stabilize mood, well-being, and happiness. The drug blocks the reuptake of serotonin into neurons to allow for increased availability to improve messages between neurons (Mayo Clinic, Sept. 2019).

The effectiveness of SSRI use during pregnancy fluctuates on a case-by-case basis because treatment should be chosen depending on the severity of the depression. For some women, the depression may be mild enough where it can be treated with non-pharmacological interventions. However, for those women who have had a long history of depression before pregnancy, their depression is an agonizing recurrent illness that affects many aspects of their life, making SSRIs most likely the best mode of treatment (Nonacs, Freeman, Cohen, 2012). When deciding to start or stop taking medication during pregnancy, the individual needs to consult with their health care provider to help discuss her options and weigh the risks and benefits. A study showed that 68% of depressed women who discontinued treatment relapsed during pregnancy, while only 26% of those who continued treatment relapsed (Olivier et al., 2013). Medication use during pregnancy is most likely going to remain controversial for some time, one of the reasons being that it is nearly impossible to perform an ethical study involving the effects of SSRIs in humans without considering the possible underlying effects maternal depression can have since healthy pregnant women do not take SSRIs (Olivier et al., 2013).

The effectiveness of bright light therapy (BLT) has become well established, especially for depressive disorders. BLT combines direct availability, low cost, and takes into account the safety of the unborn child, so it has become a favorable treatment for pregnant women (Bais et

al., 2016). BLT is most commonly used to treat seasonal affective disorder since it mimics natural outdoor light, but it may help other types of depression or sleep disorders being that it is thought to affect the brain chemicals involved in mood and sleep, like serotonin and melatonin (Mayo Clinic, 2017). The mechanism of action for BLT hasn't been fully established yet, but it is thought to include improvements in sleep, decreased fatigue during the day, correction of circadian misalignment, and/or neuroendocrine dysregulation with a therapeutic onset of 3 to 7 days (Brandon, Crowley, Gordon, & Girdler, 2014). A study done by Wirz-Justice and colleagues included women with antepartum depression who were exposed to active BLT treatment for 60 minutes daily established within 10 minutes of waking up and compared them to a placebo group who were exposed to dim red light. The study found that the symptom improvement rate from baseline to 5 weeks into the study was significantly greater for the bright light group than the placebo group (Brandon et al., 2014). Another study that focused on women experiencing postpartum depression also found similar results. Women who were exposed to BLT for 30 minutes every morning for 4-6 weeks had a 49-75% reduction in their Hamilton Depression Rating Scale scores. Although there have been studies that have seen positive results with BLT, the use of it in treating women experiencing reproductive related depression is still inconclusive due to many of the studies having inconsistencies in their methodology and small sample sizes (Brandon et al., 2014). Despite this, bright light therapy can still be seen as a positive treatment for perinatal depression being that it can be easily implemented into a daily routine, is low cost, home-based, and has much lower side effects than using pharmaceuticals.

Many pregnant women can benefit from having a support system or network. Social relationships play a major role in shaping the quality of any individual's lives, but women may need critical support during pregnancy. The last thing a mother wants to feel while she is visibly

developing a child inside of her is that she is alone or going through it all by herself. Feeling abandoned or isolated during a monumental time like this could have a major impact not only on maternal health but on infant health as well. A study done in Los Angeles, California sought to test the effects of quantity vs. quality of support on maternal and infant health and well-being, as well as determine whether social support is more strongly associated with women who experience higher levels of stressful life events (Collins, Dunkel-Schetter, Lobel, & Scrimshaw, 1993). Women in the study were interviewed at each clinical visit throughout their pregnancy as well as 4 to 8 weeks after birth. During the interview, subjects would report how many types of support, how satisfied they were with that support, how much help the baby's father has been, how satisfied they are with the support from their healthcare providers, any prenatal stressful life events, and the extent of which they felt depressive symptoms in the past 7 days. Women who reported a higher quality of support reported less depression during pregnancy. Women with more network resources delivered babies of higher birth weight, indicating infant well-being, and had fewer difficulties during labor. Women who had lower quality support and fewer resources were significantly more depressed after childbirth. The women experienced more stressful life events, and had less support, were found to be more depressed (Collins et al., 1993). One of the proposed mechanisms that explain the link between social support and well-being is that social support may reduce the extent to which situations are perceived as stressful or it may boost self-esteem and self-efficacy. These effects may boost immune system function and influence susceptibility to illness through changes in behaviors like decreased substance abuse or increased exercise (Collins et al., 1993). Sadly, the presence of a support system isn't always something an individual can control, but it is important to understand there are ways to put effort into building one. If someone is in search of a shoulder to lean on, there are a couple of places they could start:

their partner, their parents, siblings, relatives, or friends, women in their prenatal class, health-care professionals like their pediatrician, or nowadays there are numerous online forums or blogs that women could become a part of (Dimerman et al., 2019).

Mindfulness is another intervention that has been proposed as an alternative to easing the symptoms of depression during pregnancy. Mindfulness can be described as maintaining an awareness of our thoughts and feelings through a gentle, nurturing lens, making sure we aren't judging ourselves and being sure to believe there isn't a "right" or "wrong" way to think or feel during any given moment (University of California, Berkley, 2019). Five potential mechanisms have been determined to have the opportunity to make a beneficial impact on mental health outcomes: exposure, cognitive change, self-management, relaxation, and acceptance (Woolhouse, Mercuri, Judd, & Brown, 2014). Mindfulness encourages individuals to turn *towards* the previous negative experiences they have had in their life instead of averting away from them because this will allow the individual to develop coping strategies and improve their ability to handle similar situations in the future. Acceptance is another key component of mindfulness because it teaches individuals to be confident in all aspects of their experience and remove the tendency of maladaptive avoidance strategies. What makes mindfulness particularly advantageous intervention for perinatal depression is that it is already being used in areas of stress reduction, depression and relapse prevention, and childbirth and parenting, so using it during pregnancy as well is only logical (Woolhouse et al., 2014). A study conducted at the Royal Women's Hospital in Australia implemented mindfulness-based group sessions as a means of treating women who were already experiencing symptoms of stress, anxiety, and depression, as well as women who were at risk for these symptoms. The study consisted of a six-session mindfulness group therapy program that would occur for two hours once a week.

Mindfulness was measured using a 39-item questionnaire that assessed the five different factors of mindfulness. The study supported the use of antenatal mindfulness to reduce psychological distress due to observing improvements in depression and anxiety after the six-week program concluded (Woolhouse et al., 2014). Mindfulness is something that takes time and practice but implementing it into daily life can bring a variety of physical, psychological, and social benefits across numerous different settings.

Antenatal yoga may reduce maternal anxiety and depression. It has been hypothesized that anxiety is a requisite of depression, yet despite this theory, there is still a lack of attention to antenatal anxiety due to broad conceptualizations (Newham, Wittkowski, Hurley, Aplin, & Westwood, 2014). Yoga may have a beneficial effect on both psychological and physiological correlates of maternal anxiety (Newham et al., 2014). Yoga integrates relaxation as well as breathing techniques and postures, which can be customized to make them best suited for pregnant women. Yoga is also something women can do in the comfort of their own home making it easily accessible, but it can also be done in groups, which would give pregnant women the extra social support that they need. A randomized controlled trial examined women who were bearing children for the first time (Newham et al., 2014). The women completed a questionnaire that assessed anxiety and depression before and after attending either an 8-week antenatal yoga course (treatment group) or treatment-as-usual (TAU; control group). A single session of yoga reduced anxiety and cortisol levels in the pregnant women and the effects remained consistent even after repeated sessions (Newham et al., 2014). Yoga was more effective than TAU for reducing anxiety specific to pregnancy. Interestingly, the women who were in the TAU group showed elevated levels of depression when they went in for their follow-up, furthermore supporting the idea that yoga is more beneficial than TAU. A separate study

combined both mindfulness and yoga to test its feasibility as a substitute treatment for psychiatrically at-risk pregnant women. At the beginning of the study, all participants had elevated scores based on the Edinburgh Postnatal Depression Screen. 10-weeks of mindfulness yoga (M-Yoga) reduced the symptoms of depression, while mindfulness and maternal-fetal attachment significantly increased. M-Yoga is a practical and effective option for treating pregnant women who are at a high risk of depression (Muzik, Hamilton, Rosenblum, Waxler, Hadi, 2012). All in all, yoga can be used to gain strength, flexibility, and mind-body awareness that can help fight diabetes, high blood pressure, high cholesterol, and of course depression. Yoga can also help develop appropriate breathing and relaxation techniques to allow for an easier, more comfortable labor experience while fighting the signs of depression along the way.

Similarly, increased physical activity has been seen as a mechanism to improve mood in pregnant women. Being that a mere 15% of pregnant women meet pregnancy-specific physical activity guidelines, the implementation of exercise into all pregnant women's daily agenda would be valuable. When it comes to women experiencing antenatal depression, exercise can specifically help by fighting low energy, decreased motivation, reduced pleasure, sleep disruption, and sad mood. Some women choose not to partake in physical activity during pregnancy because they believe that it is unsafe, but research has found that it does not cause adverse effects like low birth weight or preterm birth when appropriate exercises and proper precautions are followed (Battle et al., 2015). Two studies have found evidence supporting the claim that exercise offers benefits to pregnant women with depressive symptoms. One executed by Robledo et al. (2012) included 80 first time pregnant women and enrolled them into a 3-month gym-based exercise program and compared them to the control group, which continued their usual care. Women who completed the exercise program reported greater depression-

symptom reductions. Another study done by Gaston and Prapavessis (2013) enrolled 56 healthy pregnant women and had them participate in 1 of 3 physical activity conditions. Women who were able to meet the guidelines by the end of the 4 weeks experienced decreased symptoms of depression. Overall, the benefits that physical activity provides, such as reduced back pain, higher cardiovascular fitness, lower levels of depression, and more optimal gestational weight gain, outweigh the minor risks involved (Battle et al., 2015). Although it is understood that not all physical activity is suitable for pregnant women, as long as it involves low-to-moderate intensity, a gentle, gradual increase in activity, can be incorporated throughout the day and is deemed acceptable by prenatal care providers, women should not be afraid to include some physical activity in their daily routine.

Many women have started including omega-3 fatty acid supplementation into their prenatal care because of evidence that some women develop a deficiency during pregnancy due to much of it being redirected to the fetus (Nonacs and Freeman, 2013). The reduction of omega-3s often seen during pregnancy has been shown to have an impact on the development of depressive moods, negative attitudes towards life, and engaging in suicidal behaviors (Kaviani, Saniee, Azima, Sharif, and Sayadi, 2014). Therefore, omega-3 fatty acid supplementation, which can include eicosapentaenoic acid (EPA) or docosahexaenoic acid (DHA), has demonstrated a broad range of health benefits, such as treatment of mood disorders (Nonacs and Freeman, 2013). To test the efficacy of omega-3 therapy, a study that included 36 pregnant women with major depressive disorder randomly designated half to an omega-3 group and the other half to a placebo group (Su et al, 2008). The researchers found that the omega-3 group had significantly lower depression ratings at the end of the 8-week study, and there were no adverse effects on the subjects or newborns (Su et al, 2008). Another study that included 80 women also divided them

into an experimental group that received a 1-gram omega-3 capsule every day for six weeks and a placebo group that received an olive oil pill (Kaviani et al., 2014). It was reported that there was a considerable decrease in depression scores in the subjects that received the omega-3 supplement (Kaviani et al., 2014). It is important to note that there have been some studies that have failed to find a relationship between depressive symptoms during pregnancy and omega-3 supplementation. It has been speculated that this may be due to the dose of EPA and DHA that is given or due to dietary intake or genetic differences in omega-3 fatty acid metabolism between responders and non-responders (Nonacs and Freeman, 2013). However, due to the potential antidepressant effects omega-3 fatty acids can have, they should be considered as an alternative treatment for antenatal depression.

Conclusion

With prenatal depression becoming the most common psychiatric disorder in pregnant women, and the lifetime risk being 10% to 25%, it is important to highlight some of the possible adverse adolescent outcomes that can occur and some of the acceptable intervention options for pregnant women who indicate signs of depression, as well as the women who are at risk in the future (Battle et al., 2015). The use of antidepressants during pregnancy is an arguable topic, but it is important to note that every woman and every pregnancy is unique. Some women may benefit from the use of SSRIs, while others may benefit from non-pharmacological interventions. Therefore, it is best practice to discuss the best option for each individual with a medical professional. Bright light therapy (BLT) is a promising treatment for pregnant women being that it can be done right at home and requires little effort from the mother. BLT helps to synchronize the biological clock, therefore, shifting circadian rhythms to enhance sleep and keep melatonin

and cortisol levels under control. Mindfulness can be utilized by anyone and it may be particularly beneficial to pregnant women. It can bring a variety of benefits from elevating brain function, calming the mind, reducing stress, lifting people's moods, and many more. It is ideal for pregnant women because it is home-based, non-pharmacological, and does not pose any harm to the fetus. Pregnancy can be an overwhelming time for women and if they have to go through it alone, it can be extremely challenging. This is why the presence of a support system makes an immense difference in their lives. Social support can reduce depression and anxiety and overall stress, therefore it would be helpful for pregnant women who experience some ups and downs to create a list of the friendly, sympathetic people in their life to reference during their times of need. Additionally, yoga and physical activity can both be ways that women can take part in forms of mind-body medicine as a way to repress some of their depressive symptoms. Physical activity has been seen to be just as effective as traditional depression treatments while allowing the individual to take control of their body and promote important health benefits. Omega-3 fatty acids have shown therapeutic benefits for depression during pregnancy. Therefore, incorporating a daily supplement into prenatal care is something a woman may consider discussing with their doctor.

The prenatal period represents a time of extremely rapid changes in brain development rendering the fetus susceptible to beneficial and detrimental influences, therefore causing maternal stress to have a dominant influence during that time (Davis and Sandman, 2012). The presence of antenatal depression is a risk factor for a long list of possible outcomes that can be seen in the offspring during childhood or adolescence. These could include depression and anxiety, ADHD, ODD/CD, aggression, antisocial personality disorder, autism, or intellectual disability. Exposure to maternal cortisol during gestation may influence the development of

some of these outcomes by modifying fetal development in regions that are particularly sensitive to excessive levels of glucocorticoids (Davis and Sandman, 2012). It is also important to note that the environment in which a child grows up can have a major impact on the development of some of these adverse outcomes as well, therefore some of the effects may be minimized if the child was raised in a good home environment (Ornoy and Koren, 2019). It is important to acknowledge that it is difficult to keep antenatal and postnatal separate since depressive symptoms that occur during pregnancy often persist during the postpartum period as well. For this reason, it is important to fight the signs of depression while it is in the early stages and prevent it from getting worse. Deciding how to treat depression during pregnancy is not easy, that is why it is important to speak with a health care provider to devise the best plan that will provide each individual woman and their children the best possible long-term outcome (Mayo Clinic, 2020). Prenatal depression may be the most common psychiatric disorder experienced by pregnant women, but if the above interventions are applied more broadly we can start to decrease its prevalence and alleviate the adverse manifestations women are experiencing and prevent negative outcomes for their children.

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