

CAUSES OF STRESS ON CHILDREN WITH ADHD AND THE ROLE OF ICTS

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Abstract

The Attention Deficit Hyperactivity Disorder (AD/HD) is the most common neurodevelopmental disorder of childhood and one of the more widespread chronic diseases that affect children school age, based on the DSM-IV. This study focuses on the influence of stress to the kids suffering from ADHD and the importance of other elements on it. This particular study was based on articles in scientific journals, with the purpose to investigate some of the factors that affect positively or negatively in the exacerbation of anxiety on children suffering from ADHD and how the prenatal and parental stress affects this condition.

Key Words: AD/HD, Attention Deficit Hyperactivity Disorder, anxiety, stress, nutrition, sugar, neurotransmitters

1. Introduction

The Attention Deficit Hyperactivity Disorder (AD/HD) with prevalence 3-5 % over the general population, is the most common neurodevelopmental disorder of childhood and one of the most widespread chronic health conditions that affect the school age children (American Academy of Pediatrics, 2013).

The Attention Deficit Hyperactivity Disorder (AD/HD), in accordance with the Diagnostic and Statistical Manual of Mental Disorders DSM-V of 2013, is a biological developmental disorder where the individual presents difficulties on three developmental levels in relation to his peers. More specifically the individual presents difficulties on the fields of attention deficit, impulsivity and/or hyperactivity. It is a common mental disorder of children and adolescents, that affects about 63 million children and adolescents worldwide (Polanczyk, Salum, Sugaya, Caye, & Rohde, 2015).

1.1. Stress

According to the World Health Organization, the issue of mental health and the disorders related with anxiety is the largest general cause of early death in Europe and that's why is essential to learn how to deal with it. The last years, the research that concerns the technology and means on how to decrease the stress, many mental health applications have been developed to manage stress (Anagnostou & Drigas, 2022).

Stress defined as the reaction of the body in any strong, mental or emotional stimulus, internal or external origin. Happens every time an individual faces a situation, on emotional or physical level, that overcomes his ability to cope with it. Stress is stagnant and creates restlessness that leads to physical and psychological discomfort. Anxiety disorders always include fear emerging from an imminent threat (Alexopoulou, Batsou & Drigas, 2020).

Controlling emotions in stressful situations is an essential aspect of mental health. On the other side, acute stress effects the control of prefrontal cortex, with a result probably the loss of the ability to control emotions. To reduce the threat, the stress response activates a number of defense systems, including the communication with hormone messenger. Everyday events are considered as stressors, in relation to the threat value of the individual and estimates of response resources. This is the idea of psychological stress, to which one's physiological response to an incident can be changed by previous experience (Bravou, Driga & Drigas, 2022).

2. The factors

2.1. Nutrition, neurotransmitters and hormones in ADHD

According to Baker et al., (2020), parabens, which are used as preservatives in foods and personal care products, are detected in almost 100% of human urine samples. Exposure to parabens is associated with DNA damage, male infertility and endocrine disruption in adults, but the effects of prenatal exposure are unclear. In part, this is due to the insufficient evaluation of exposure to the mother's urine, which can only reflect the exposure of the mother, and not of the fetus.

Meconium methylparaben was associated with preterm birth, decreased gestational age and birth weight, dysfunction of the child's maternal thyroid hormone and ADHD. Parabens are a significant health concern if they are causally related to these adverse outcomes. Studies show nutritional deficits in children with ADHD, such as fatty acids zinc and iron. In addition, some studies report a positive correlation between a nutritional deficit and the severity of symptoms of ADHD.

Anxiety disorders are a common comorbidity in ADHD and increase the severity of the condition. It has been suggested that a gluten- or casein-free diet (milk protein), a food additive exclusion diet and a oligoantigenic diet are effective in reducing the symptoms of children with ADHD, although study plans including food challenges and/or a re-introduction phase are required (Ly et al., 2017; Sonuga-Barke et al., 2013).

2.2. Sugar

The association between dietary exposures and ADHD has been investigated and some studies have identified adverse effects from higher sugar intake.

The research of Lee Blunden, Milte and Sinn (2011) comes to examine any interdependence of diet, sleep and symptoms of ADHD. The conclusion of the study was that children whose sleep is disturbed consumed more fat (monounsaturated and polyunsaturated), energy, carbohydrates and sugar. More specifically, of the sleep subscales, sugar consumption was significantly associated with the prediction of night sweating and with breathing disorders during sleep.

Anselmia et al., (2018) report that the adjusted analyses showed no correlation between the always high consumption of sucrose between 6 and 11 years of age and the incidence of ADHD, compared to people who have always experienced low consumption, both among boys. The results suggest that there is no correlation between sucrose consumption between 6 and 11 years of age and the incidence of ADHD.

The negative effects of sugary soft drinks were analyzed by Yung Yu et al., (2016). After the covariates were adjusted, children who consumed SSBs at moderate and high levels had 1.36 and 3.69 chances, respectively, of having ADHD, compared to those who did not consume SSBs. Our findings highlighted the adverse association between SSB consumption and ADHD and showed a dose-response effect

2.3. Hormones

Concentrations of thyroid hormones outside the normal range affect brain development, but their specific influence on behavior and mental abilities within normal values is unknown (Penderol et al., 2007).

Disruption of maternal thyroid hormone function has been associated with adverse neurodevelopmental effects in children. Among newborns, congenital hypothyroidism treated in a timely manner has been consistently associated with subsequent cognitive deficits (Drover et al., 2020).

With the present research maternal hypothyroidism during pregnancy is associated with undesirable neuropsychological development in the offspring. The aim of the study was to evaluate the effect of maternal thyroid dysfunction during pregnancy on symptoms of ADHD disorder. The results showed that the increased value of thyroid stimulating hormone (TSH) was significantly associated with the symptoms of ADHD in girls, while in boys there was no such finding. Also, no associations were observed between ADHD symptoms and low T4 levels (Päkkilä et al., 2013).

The aim of this study was to investigate whether thyroid hormone concentrations are associated with symptoms of neurodevelopment and ADHD in healthy preschool children. Children from two general population birth cohorts in Spain were evaluated in a cross-sectional study at the age of 4 years. Concentrations of thyroid hormones (free T4 and T3) and TSH were measured, and cognitive and motor development was evaluated using the McCarthy scales for neuropsychological outcomes and ADHD-DSM-IV for symptoms of attention deficit hyperactivity/impulsivity. High T4 concentrations were associated with a reduced risk of developing 1-5 symptoms of attention deficit, these findings were observed in both cohorts despite differences in mean TSH concentrations, and no associations with T3 were observed. Despite being within the normal range, high TSH concentrations are associated with lower cognitive function and high TSH and low free T4 with symptoms of ADHD in healthy preschool children (Penderol et al., 2007).

The purpose of the Modesto et al. research, (2015) was to examine whether exposure to maternal mild thyroid hormone deficiency at the beginning of pregnancy was associated with ADHD symptoms in children aged 8 years. Maternal hypothyroxinemia, characterized by low levels of free thyroxin that coexists with thyrotropin levels, also concerns childhood symptoms of ADHD. Maternal thyroid hormone levels (thyrotropin, free thyroxin, thyroid peroxidase antibodies) were measured on average at the 13th week of pregnancy. Higher scores show more symptoms of ADHD. Maternal hypothyroxinemia at the beginning of pregnancy was associated with higher scores for ADHD symptoms in children aged 8 years after adjustments for childhood and maternal factors (e.g. gender, ethnicity, maternal age, maternal educational level and income). The conclusions showed that children exposed to maternal hypothyroxinemia at the beginning of pregnancy had more symptoms of ADHD. This finding suggests that intrauterine exposure to insufficient levels of thyroid hormones affects neurodevelopment in offspring.

The purpose of this study of Bala et al., (2016) was to analyze hormones and antibodies of the thyroid, ferritin, vitamins B12 and D, adrenal and gonadal steroids and celiac disease antibodies in children with a diagnosis of ADHD and autism spectrum disorder (ASD). There was a statistically significant difference in vitamin B12 and D levels and ferritin values between the three groups. The ASD group had the highest levels of ferritin and the lowest levels of vitamins B12 and D. Vitamin D levels of the ADHD group were significantly lower compared to the health control group. Thyroid hormone levels (TSH, T4, TPO) did not appear to have a statistical difference, only one child with ADHD who developed autoimmune thyroid. The results of our study underline the importance of supplementation of vitamins B12 and D in patients with ASD and ADHD.

Chronic and child stress is involved in the development of ADHD and ADHD is largely comorbidity with anxiety. Similarly, inflammatory diseases and a pro-inflammatory condition have been associated with ADHD. However, while several papers have studied the association between peripheral inflammation and stress in emotional disorders such as depression or bipolar disorder, few have investigated this association in ADHD (Saccaro et al., 2021).

2.4. Neurotransmitters

Neurotransmitters are called biochemical compounds, which serve to transfer information from one neuron to the next. These include dopamine and norepinephrine, which help us think, focus our attention and control our behavior. The function of these substances is so important, suffice it to mention that this reaction is processed by drugs administered to treat ADHD, increasing the amounts of these substances in the brain in a chemical way. (Τζικόπουλος, 2017).

Since an underactive dopamine may be responsible for ADHD, it is important to consider the similarities and dissimilarities in working memory between ADHD and Phenylketonuria (PKU), an inherited metabolic disorder that has been shown to represent dopamine deficiency. Both dopamine and norepinephrine are important regulators of the attention system. The

availability of dopamine has been found to affect some but not all cognitive functions mediated by the prefrontal cortex (Sergeant et al., 2003).

Serotonin and other widely known neurotransmitters, epinephrine, norepinephrine and dopamine make up catecholamine. These neurotransmitters are involved in the stress response and are possible causes of ADHD and other psychological disorders such as sleep disturbance and depression. According to the pathophysiological hypothesis about ADHD, the disorder is a malfunction of neurotransmitters in the group of catecholamines. Among the various methods that have been proposed to improve neurotransmission, exercise is known to help relieve symptoms caused by neurotransmitter deficiencies (Kyoung -Lee and Moo- Lee, 2015).

3. Maternal stress and parenting way of life

According to Saccaro et al., (2021) it is interesting that mother anxiety during pregnancy increases the risk of subsequent children with ADHD. In turn, ADHD, which is a neurodevelopmental disorder, exposes patients to stress in early childhood. In fact, ADHD symptoms potentially expose patients to conflict, neglect, or physical and emotional abuse in social, school, and family environments. Some studies have found a prevalence of behavioral problems in children associated with ADHD as a function of prenatal stress. (Rodriguez, 2005).

A broad study in Italy showed that the children of mothers who had experienced depression, anxiety and sleep disorders when pregnant had a higher number of ADHD than those of mothers who had never had such events. Another study in Finland linked stable symptoms of depression during pregnancy to higher ADHD symptoms and in children. Postnatal symptoms of depression contributed similar to pre-pregnancy symptoms, having lesser effects than manifestations during pregnancy, but played a role nonetheless (James et al., 2018). Case studies of Grizenco et al. (2012) suggest a relationship between maternal stress during pregnancy and childhood ADHD. However, mother smoking, the way of upbringing and parental psychiatric disorder are possible factors of confusion.

The study by Rodriguez, Bohlin, & Lindmark, (2000) was intended to prospectively investigate whether reports of smoking and stress during pregnancy predict symptoms associated with ADHD in 7-year-olds, while addressing specific methodological limitations of the past. First, because smokers tend to smoke more under pressure (Epstein & Perkins, 1988) and perceived stress increases the likelihood of smoking continuing during pregnancy.

Rodriguez's research (2005) involved mothers from Scandinavia and were successively recruited to their first prenatal health care visit and assessments of smoking and stress were collected in gestational weeks 10, 12, 20, 28, 32 and 36. The Swedish version of 10 elements of the perceptual stress scale (PSS, Cohen & Williamson, 1988) was used to measure perceived stress. The results showed that meeting the diagnostic criteria for ADHD is related to exposure to prenatal stress, particularly in boys. The results were not confused by socio-demographic factors or birth results.

3.1. Smoking

Also, there seems to be a well-documented relationship between mother smoking during pregnancy and ADHD. Study by Gustavson et al., (2017) used data from the Norwegian cohort study for mother and child. Pregnant women from all over Norway were recruited between 1999 and 2008 when they attended the routine ultrasound examination lasting 17 weeks. Mothers and fathers reported smoking during pregnancy, and mothers reported smoking in previous pregnancies and smoking their mother when they were pregnant with them. Mothers reported symptoms of ADHD in children at the age of 5. Information on the diagnosis of children's ADHD was obtained from the Norwegian Patient Registry. The results suggest that the association between maternal smoking during pregnancy and ADHD in offspring is not due to causative intrauterine effects.

In 2006, a study was conducted on a population of 982,856 children, aged 6–19 years, born over time and residents in Sweden. The study population consisted of 982,856 children born during the period (week 37-41) in the births of the years from 1987 to 2000, according to

the Swedish Medical Register of Birth (SMBR). The results showed that smoking during pregnancy has a strong relationship with ADHD in the offspring of the general Swedish population, but this risk is mainly explained by genetic and socio-economic confusions (Lindblad and Hjern, 2010).

Stress and smoking are relatively common during pregnancy and yet they can be prevented, these effects are important for public health. Research has shown that, descendants of mothers who experience high levels of stress during pregnancy are more likely to have problems with neurobehavioral development. The Western Australian Pregnancy Study (Raine) is a longitudinal study of women and their children recruited between 16 and 18 weeks of pregnancy from the public prenatal clinic at King Edward Memorial Hospital. Multiple regression showed that the stressful events of the mother during pregnancy significantly predicted the behaviors of ADHD in the offspring, after checking the autistic traits, ADHD and other confounding variables, both in men and women. In conclusion, this study suggests that PNMS, in the form of typical stressful life events, such as divorce or a move to a dwelling, shows a small but significant correlation with both autistic characteristics and ADHD behaviors independently, in children with age 2 years, after controlling multiple prenatal, obstetric, postnatal and sociodemographical variants (Pennell et al., 2011).

In the present study by Liang Zhu et al., (2014) the association with breast smoking and the use of nicotine substitutes during pregnancy was investigated, using the association with smoking by the father as an indicator of possible genetic or social confusion. Included were 84,803 children who participated in the Danish National Nativity Cohort. Smoking by mother and father during pregnancy was associated with an increased risk of ADHD defined by hospital diagnosis, medication and hyperactivity/carelessness score, but the association was stronger for maternal smoking than for smoking by father. Also, a higher risk of ADHD was observed in children of mothers who used nicotine substitutes during pregnancy.

3.2. Parental stress

Parental anxiety can be described as anxiety that arises when parents' perceptions of parental responsibility requirements exceed their resources to address them (Deater Deckard, 1998). The increased anxiety of parents is associated with numerous negative outcomes for children with ADHD and their parents, such as: worsening of a child's ADHD symptoms, decreased response to intervention, decreased quality of the parent-child relationship and decreased parental psychological well-being (Johnston & Mash, 2001; Modesto-Lowe, Danforth, & Brooks, 2008; Theule et al., 2013).

Crnic and Acevedo emphasize the "daily parental sufferings" and describe them as routine responsibilities of care and upbringing of children that parents may, in the form of chronic demands, find disturbing and frustrating. High levels of daily parental suffering have been shown to be associated with lower life satisfaction, more negative mood and emotion, and increased maternal discomfort. When considering the possible effect of these daily stressors on parents, it is notable that Crnic and Greenberg (1990) found that daily parental sufferings are even more stressful for parents than important life events (Johnson & Reader, 2002).

Careless and overactive-impulsive behaviors typical of children with attention deficit hyperactivity disorder are known to have a negative impact on the quality of parent-child interactions (Mash & Johnston, 1990; Webster-Stratton, 1990) and significantly increase parents' stress levels (Anastopoulos, Guevremont, Shelton, & DuPaul, 1992; Breen & Barkley, 1988; Mash & Johnston, 1983).

Mash and Johnston (1983) found mothers of hyperactive children reporting higher levels of parenting anxiety than parents of typically developing children, and that child characteristics, including "divided attention" and "perceived degree of discomfort" accounted for the greatest discrepancy in parents' anxiety scores.

The Ana Miranda et al. study (2015), tried to compare the anxiety of parents experiencing parents of 121 children aged 5 to 9 years with autism spectrum disorder (ASD),

attention deficit hyperactivity disorder (ADHD), ASD+ADHD comorbidity and typical development in different areas related to the characteristics of the child and parent using the Parents Stress Index. The participants in this study were parents from 121 children from 5 to 9 years old. Our results also showed some significant differences between clinical groups. Thus, the parents of the ADHD group had higher levels of parental anxiety than that of the ASD group and the CG for attachment.

The purpose of the Leitch et al. study (2019), was to investigate the anxiety of Australian parents of children with ADHD who identified themselves as stressed, using a qualitative methodology aimed at identifying the needs of parents to inform about future interventions designed to support parents and ultimately their children. Thirteen parents of children with ADHD participated in two focus groups. Parents attribute their high anxiety to their children's behavior, unfulfilled needs for support and social stigma. Parents are asking for support to be able to cope and appear to represent a clinical population that needs mental health care and support.

4. Conclusions and the role of ICTs

Based on the official definition of ADHD, it is the most common neurodevelopmental disorder of childhood where the person has deficits at 3 developmental levels. In particular, in areas of attention deficit, observation and hyperactivity.

Based on the research studied, there seems to be a great effect of thyroid hormone. Maternal hypothyroidism during pregnancy has been associated with symptoms of ADHD in offspring. Thyroid stimulating hormone (TSH) values increase the risk of developing ADHD and affect children's low cognitive function more. In addition, vitamin D seems to affect children with ADHD as levels are at low grades. ADHD is largely comorbidity with anxiety and based on this, evidence of immune indeterminacy has been found as a result of a neuroendocrine response to oxidative stress and other, such as, steroid hormones, enzymes or cytokines.

The incorporation of digital technologies in education domain is very productive and successful, facilitates and improves the educational procedures and in parallel improves stress levels of the students, via Mobiles [22-28], various ICTs applications [29-36], AI & STEM [37-41], and games [42-46] Additionally the combination of ICTs with theories and models of metacognition, mindfulness, meditation and emotional intelligence cultivation [46-48] accelerates and improves more over the educational practices, the ability of stress control of the students and ADHD symptoms.

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