Environmental risk factors for attention deficit hyperactivity disorder

Fatores de risco ambientais para o transtorno de déficit de atenção e hiperatividade

Juliana Vieira Queiroz Almeida¹, Renan Bezerra Muniz², Lauro Eustáquio Guirlanda de Moura³


ABSTRACT: Attention Deficit Hyperactivity Disorder (ADHD) can be characterized by inattention, hyperactivity and impulsiveness in such a way that there is interference in the individual’s functioning and development, in addition to a significant impairment of family, social, academic and behavioral functioning. ADHD is a complex clinical picture with a multifactorial etiology, with an influence of 10-30% related to environmental factors. Some of the factors related to the disorder are linked to maternal habits (during or prior to the gestational period), so that, if identified in Primary Care and avoided, it would be possible to prevent the disorder from evolving to a more serious and more symptomatic condition. With the aim of identifying and describing the risk factors for ADHD that could enable some type of prevention or better prognosis, 41 articles were selected through a literature review on The Journal of the American Medical Association (JAMA), PUBMED platforms, Scientific Electronic Library Online (SciELO) and Cochrane Library, being the main descriptors: “adhd”, “risk factors”, “premature birth” and “diagnosis”. Furthermore, 6 references were manually included, due to their importance to the topic, totaling 47 references. Inclusion criteria: articles published in the last 10 years, in English and/or Portuguese, which addressed risk factors for ADHD. Exclusion criteria: biased articles, which only addressed factors that did not influence the development of the disorder, but only the drug and behavioral interventions to be taken. After data analysis, it is concluded that some type of prevention or minimization of ADHD may be possible. This begins with identifying risk factors in women of childbearing age and pregnant women, and after childbirth. Some of the important factors to be changed for prevention and/or better prognosis were lack of family planning, use of alcohol, nicotine and acetaminophen during pregnancy, poverty, low education level, poor adherence to treatment, and contact with bisphenol A and phthalate. Some factors to be better investigated are prematurity, cultural pressure, academic demand and DHEG. We considered important to identify these factors, since it would enable a better prognosis for the child and an improvement in the family environment, since the disorder often represents a burden to the family.

KEYWORDS: Attention deficit disorder with hyperactivity; Risk factors; Socioeconomic factors; Cultural factors.

RESUMO: O Transtorno de Déficit de Atenção e Hiperatividade (TDAH) pode ser caracterizado por desatenção, hiperatividade e impulsividade de modo que há interferência no funcionamento e no desenvolvimento do indivíduo, além de um comprometimento significativo do funcionamento familiar, social, acadêmico e comportamental. O TDAH é um quadro clínico complexo e de etiologia multifatorial, com influência de 10-30% relacionada aos fatores ambientais. Alguns dos fatores que se relacionam com o transtorno são ligados a hábitos maternos (durante ou progresso ao período gestacional), de forma que, se identificados na Atenção Primária e evitados, seria possível impedir a evolução do transtorno para uma condição mais grave e mais sintomática. Com o objetivo de identificar e descrever os fatores de risco para o TDAH, que poderiam possibilitar algum tipo de prevenção ou melhor prognóstico, foram selecionados 41 artigos através de uma revisão de literatura nas plataformas The Journal of the American Medical Association (JAMA), PUBMED, Scientific Electronic Library Online (SciELO) e Cochrane Library, sendo os principais descritores: “adhd”, “risks factors”, “premature birth” e “diagnosis”. Ademais, foram incluídas manualmente 6 referências, devido à sua importância ao tema, totalizando 47 referências. Critérios de inclusão: artigos publicados nos últimos 10 anos, em língua inglesa e/ou portuguesa, que abordavam fatores de risco para o TDAH. Critérios de exclusão: artigos tendenciosos, que apenas abordavam fatores que não influenciavam o desenvolvimento do transtorno, mas somente as intervenções medicamentosas e comportamentais a serem tomadas. Após análise dos dados, conclui-se que algum tipo de prevenção ou minimização do TDAH pode ser possível. Isso começa com a identificação dos fatores de risco na mulher em idade fértil e na gestante, e após o nascimento da criança. Foram considerados alguns dos fatores importantes a serem alterados para prevenção e/ou melhor prognóstico: ausência de planejamento familiar, uso de álcool, nicotina e paracetamol durante a gestação; pobreza; baixa escolaridade; má adesão ao tratamento especializado do transtorno; e contato com bisfenol A e fulato. São fatores a serem melhor investigados: prematuridade, pressão cultural, demanda acadêmica e doença hipertensiva específica da gravidez (DHEG). Consideramos importante a identificação dos fatores, pois isto possibilitaria um melhor prognóstico da criança e melhoria do ambiente familiar, já que o transtorno frequentemente representa um fardo para a família.

DESCRITORES: Transtorno de Déficit de Atenção e Hiperatividade; Fatores de risco; Fatores socioeconômicos; Fatores culturais.

1. Medicine student at Faculdade de Minas (FAMINAS-BH), Belo Horizonte, MG, Brazil. https://orcid.org/0000-0002-4704-2318. E-mail: julianavieiraqaqui@hotmail.com
2. Graduation in medicine at Faculdade de Minas (FAMINAS-BH), Belo Horizonte, MG, Brazil. http://orcid.org/0000-0002-7771-7859. E-mail: renanbezerramuniz@gmail.com
3. Psychiatrist, Professor at Faculdade de Ciências Médicas, Department of Psychiatry, Belo Horizonte, MG, Brazil. http://orcid.org/0000-0002-7759-317X. lauroguirlanda@hotmail.com

Correspondence: Av. Cristiano Machado, 12001 – Vila Clorís, Belo Horizonte – MG, 31744-007
Introduction

Attention deficit hyperactivity disorder (ADHD) may be characterized by inattention, hyperactivity, and impulsivity that interfere with the individual’s functioning and development\(^1\) in addition to significant impairment of family, social, academic, and behavioral functioning\(^2\). Its diagnosis is clinical, complex, and ideally made by a multidisciplinary team that also involves psychology, social work, and occupational therapy professionals.

Due to this complexity, the diagnosis of ADHD is often questioned, especially if it relies on only one professional, and has several challenges\(^3\)\(^4\). The increase in the prevalence of the disorder is a challenge, since it has doubled since 1970, which can be justified by changes in diagnostic criteria and epidemiological methods, political changes addressing special education, and the spread of medications for this by the pharmaceutical industry\(^5\).

Between the years 1997 and 2016 the pharmaceutical industries and groups invested heavily in marketing carried out for health professionals, and the investment has not diminished with the new policies created to limit the influence of Big Pharma\(^6\). The worldwide production of methylphenidate, for example, from 1990 to 2006 increased by about 1,200\(^6\). Moreover, the actions practiced by these organizations, such as the “Disease Awareness Campaigns”, with an investment of 177 million in 97 and 430 million in 2016, tend to model the public and clinical perception about the benefits of drug use in to sell their products and services\(^7\). The modeling of the public can also be affected by the marketing of drugs directly to the consumer, and this form of disclosure grew in the period mentioned, from 1.3 million to 6 million dollars, and the investment in advertising went from 79 thousand to 4.6 million, 9 million of which, in 2008, were devoted to ADHD\(^8\).

Regarding the increasing prevalence, there are studies that point out an overdiagnosis and that gender differences in the manifestation of ADHD symptoms usually influence diagnosis. Thus, the ratio of boys to girls of 3:1 may be a gender bias (i.e., a tendency to diagnose more males), since boys with ADHD, especially at preschool age, tend to be more agitated than girls\(^9\). Some diagnostic challenges involve the fact that inattention and hyperactivity are common in children, especially the younger ones, and there is no way to validate the diagnosis because it depends on clinical judgment, which can be uncertain. The use of DSM-5 or ICD-10 tends to reduce bias, but it is believed that both are not always used.

DSM-V criteria are based on symptoms of inattention and hyperactivity and impulsivity (criterion A), before the age of 12 years (criterion B), in different environments (criterion C), and on impairment of social, academic, or occupational functioning or reduced quality of any of these (criterion D), in the absence of other disorders (criterion E)\(^1\). The fulfillment of criterion C is not accurate without consultation with informants who have observed the individual in these environments\(^1\). This is because symptoms vary with context, rewards for appropriate behavior, supervision, consistent external stimuli, individualized situations (such as in a doctor’s office) and in situations that are new or in which the individual is interested\(^1\). There are no specific tests, so a detailed anamnesis about the development and course of the disease is essential, and the lack of this information is a factor that hinders diagnosis in adults\(^1\).

According to the literature, for a proper diagnosis, the following should be done: clinical examination; investigation of the child’s clinical, perinatal, and school history and development; interview and completion of systematized forms and questionnaires, such as the Child Behavior Checklist (CBCL), Conners Scale, the SNAP-IV, and the ADHD Scale; evaluation of sensory functions that may lead to attention and learning problems; neurological, psychiatric, and neuropsychological evaluation (DSM-5 criterion E), to rule out other disorders; investigation of comorbidities, requiring the participation of different professionals, such as physicians, psychologists, pedagogues, and speech and hearing therapists\(^1\)\(^8\)\(^11\).

A factor that may interfere in the diagnosis, when made only from the parents’ perspective, is the existence of factors such as parental expectations, which may influence the validation of ADHD severity; the disorder may be transient and a stage of child development, and there are debates about the diagnosis, especially in preschool age\(^1\)\(^2\)\(^3\)\(^8\)\(^11\). It is important to consider that most parents have high expectations for their children, leading to excessive stimulation of children from an early age in order to achieve socially admirable goals\(^8\)\(^3\)\(^11\). However, when the diagnosis is made in adults, a reduction in professional, personal, and relational difficulties is reported with the treatment, with an improvement in quality of life\(^8\).

Having said all these considerations, it is important to emphasize that the ADHD diagnosis also involves the assessment of environmental factors, such as exposure to toxins, maternal lifestyle during pregnancy, medication, alcohol and nicotine use, and preterm birth. It is also related to the parents’ lifestyle, regarding cultural pressures, low education, economic conditions, and affection in the parent-child relationship\(^2\)\(^3\)\(^8\)\(^11\). Furthermore, it has been estimated that there is a 10 to 30% variance in the development of ADHD related to environmental factors\(^2\)\(^7\)\(^8\)\(^10\)\(^12\)\(^13\). Furthermore, it has been estimated that there is a 10 to 30% variance in the development of ADHD related to environmental factors\(^2\)\(^7\)\(^8\)\(^10\)\(^12\)\(^13\), with the risks involved with prenatal care, prematurity, and smoking being considered the main ones, although the definitive cause is uncertain\(^2\)\(^10\)\(^12\)\(^13\).

With the increasing prevalence of ADHD\(^8\)\(^10\)\(^17\) these factors should be investigated, to reduce the chances of developing a disorder that may, in some cases, be avoided or minimized, resulting in a possible improvement in the child’s quality of life. Moreover, the diagnostic methods and treatment should consider the factors to be elucidated because of their likely importance for the development of the disorder\(^7\)\(^8\)\(^12\). Thus, this article aims to identify and describe the risk factors for ADHD, which could enable some type of prevention or improve the prognosis of those already diagnosed.

Material and Methods

A literature review was conducted in August 2019, in the following databases: The Journal of the American Medical Association (JAMA), Pubmed, Scientific Electronic Library Online (SciELO) and Cochrane Library, with the main descriptors: “ADHD”, “risk factors”, “premature birth” and “diagnosis”. The search strategy adopted was the use of descriptors and the Boolean operator “and” to associate the terms.

Given the low number of articles found in the Cochrane platform (n = 22), using only the descriptor “ADHD”, other descriptors were not associated. In Google Scholar, the descriptors “ADHD” and “diagnosis” were used, and 3030 articles were found. After screening the articles found in this search, in order to conduct a review with a larger quantity of articles about the main cultural and socioeconomic factors found, we tried to serialize the descriptors. Thus, a search was conducted on the PubMed platform, and 200 articles were found with the descriptors “ADHD” and “Family relations” and 242 articles with “ADHD” and neurofeedback”. In the JAMA platform, 279 articles were found with the terms “ADHD”, “diagnosis” and “children”; 897 articles associating “premature birth” and “risk factors”; 36 associating “ADHD” and “social adjustment”; and 22 on “ritalin” and “risk assessment”. We believe that in this way there was less bias based on the findings related to the risk factors found. A total of 4,728 articles were evaluated by title, with 394 selected by title, 156 by abstract, and 41 by reading the full article used to compose the review.

Due to their importance, two manuals (DSM-5 and social indicator from the Ministry of Health), two internet references from the Brazilian Association for Attention Deficit Disorder, one reference from the Centers for Disease Control and Prevention, and one from the National Institute of Mental Health were also used to compose the article. The manuals were found on the Internet, with the DSM-5 being a tool frequently used in clinical practice and the social indicator from the Ministry of Health being a better way to evaluate the Brazilian social situation, the use of which is important in the article, since it exposes environmental factors. The two references from the Brazilian Attention Deficit Disorder Association were also selected to highlight the Brazilian scenario. Furthermore, as many of the data found were from the United States, data from the Centers for Disease Control and Prevention and the National Institute of Mental Health were searched, also found on the Internet. The 6 manually selected documents were objectively searched on the internet and were added to Table 1, since they were used in the composition of the article. Thus, a total of 47 references were found.

The inclusion criteria for the articles were: those published in the last 10 years, in English and/or Portuguese, which addressed risk factors for ADHD. Biased articles that only addressed factors that did not influence the development of the disorder, but only the medication and behavioral interventions to be taken were excluded.

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<thead>
<tr>
<th>PubMed</th>
<th>Academic Google</th>
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<tr>
<td>Articles identified with the descriptors “ADHD” and “Family relations”; “ADHD” AND “neurofeedback”; n= 242</td>
<td>Articles analyzed with reading of the title; n= 3030</td>
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<tr>
<td>Articles analyzed with reading of the title; n= 200</td>
<td>Articles excluded after reading the abstract; n= 254</td>
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<td>Articles excluded after reading the title; n= 140</td>
<td>Articles analyzed with reading of the abstract; n= 311</td>
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<td>Articles analyzed with reading of the abstract; n= 311</td>
<td>Articles excluded after reading the abstract; n= 272</td>
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<td>Articles excluded after reading the abstract; n= 272</td>
<td>Articles analyzed with reading of the abstract; n= 129</td>
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<td>Articles excluded after reading the abstract; n= 129</td>
<td>Articles excluded after reading the abstract; n= 149</td>
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<td>Articles analyzed with reading of the title; n= 22</td>
<td>Articles included; n= 43</td>
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<td>Articles excluded after reading the title; n= 22</td>
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<td>Articles excluded after reading the abstract; n= 41</td>
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<td>Articles excluded after reading the abstract; n= 41</td>
<td>Articles excluded after reading the abstract; n= 56</td>
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<td>Articles excluded after reading the abstract; n= 56</td>
<td>Articles included; n= 8</td>
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Flowchart 1 - Article selection process, according to Prisma recommendation.
Parent training interventions for attention deficit hyperactivity disorder (ADHD) in children aged 5 to 18 years (Review)  
Zwi Morris, et al.  
2011  
Parent training has a positive effect on child behavior and can reduce parental stress.

Table 1 - Description of all references included in the systematic review.

<table>
<thead>
<tr>
<th>Title</th>
<th>Authors/year</th>
<th>Summary of results obtained</th>
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| Diagnostic and Statistical Manual of Mental Disorders - DSM-5        | American Psychiatric Association®  
2014                                                                 | There are environmental, genetic, and physiological factors and course modifiers that contribute to the development of the disease. |
2012                                                                 | A diagnosis restricted to clinical examination was observed, without multidisciplinary evaluation, investigation of causes other than ADHD or comorbidities. Pediatric neurologists expanded their investigation, performing a detailed anamnesis with information on pregnancy, conception, neonatal occurrences, pedagogical and school aspects. |
| ADHD, lifestyles, and comorbidities: a call for a holistic perspective – from medical to societal intervening factors | Weissbenzer S, et al.  
2017                                                                 | The article finds that environmental factors such as phthalate and bisphenol, and social factors such as life habits and parental models are associated with the disorder and increase its risk. They conclude that there is a need for evaluation of these factors for diagnosis. |
| What have we learned about the causes of ADHD?                      | Thapar A, et al.  
2012                                                                 | The genetic factor in the development of ADHD is small but cannot be predicted. Overall, there are no clear causal environmental risks, but there are clear benefits to the child’s health when mothers do not smoke, use alcohol and drugs abusively, reduce stress levels during pregnancy, maintain a good prenatals and later diet, with less exposure to toxins. |
2018                                                                 | The results showed an increase in the prevalence of ADHD diagnoses in children and adolescents aged 4 to 17 years between 1997 and 1998 and between 2015 and 2016. The study suggests that more research be done to understand the cause of the increase in prevalence. |
| Prenatal risk factors and the etiology of ADHD - review of existing evidence | Sciberras E, et al.  
2019                                                                 | Prematurity is strongly associated with ADHD. A probable increase in the risk of ADHD was found when low weight and complications during childbirth and during the child’s birth and childhood, but the relationship cannot yet be confirmed. There is a need for studies with a wide genetic and familial range, with an emphasis on parental quality of life and postnatal risk factors. |
| What causes attention deficit hyperactivity disorder?                | Thapar A , et al.  
2011                                                                 | Genetic, environmental and causal factors are important although there is no proven cause or risk factors so far. There are many factors that could be associated with ADHD, and they should be tested to see which ones are causal. |
| Social relationships, preterm birth or low birth weight, and the brain | Nosart C  
2019                                                                 | Premature or underweight children are more susceptible to injuries and abnormal development of the Nervous System. The literature shows that events in early life have the potential to affect the brain architecture related to children’s social processes, as well as their behavior in adult life. |
| Attention-Deficit/Hyperactivity Disorder (ADHD): The Basics          | National Institute of Mental Health®  
2016                                                                 | Studies show that there is an interaction between genes and non-genetics, some of which may contribute to the development of ADHD: smoking, use of alcohol or drugs during pregnancy, exposure to toxins, low birth weight and brain injuries. |
| Changes in Academic Demands and Attention-Deficit/Hyperactivity Disorder in Young Children | Brosojo JP, et al.  
2016                                                                 | From 1981 to 1997 there was an increase in time spent on academic activities for young children. Furthermore, as reading and homework activities increased, the time for play and leisure activity decreased. |
| Percentage of children and adolescents aged 5–17 years with Diagnosed Attention-Deficit/Hyperactivity Disorder (ADHD),* by Race and Hispanic Ethnicity — National Health Interview Survey, United States , 1997-2014 | Centers for Disease Control and Prevention – CDC®  
2015                                                                 | From 1997 to 1999 and from 2012 to 2014 the percentage of children with ADHD increased from 7 to 10.2%, and there was also a significant increase in prevalence in non-Hispanic white children (8.4 to 12.5%), black children, non-Hispanic children (5.5 to 9.6%) and Hispanic children (3.8 to 6.4%). From 1997 to 2014 Hispanic children were less likely to be diagnosed with ADHD. |
2010                                                                 | The article argues that the media plays an important role in disseminating ADHD information and that there is a tendency, identified in other countries, to create social conditions for the population to be reached by medication. |
| Is ADHD diagnosed in accordance with diagnostic criteria? Overdiagnosis and influence of client gender on diagnosis | Bruchmuller K, et al.  
2012                                                                 | The study finds that therapists do not strictly follow ADHD diagnostic manuals, suggesting overdiagnosis in the clinical routine. Furthermore, the gender of the patient considerably influences the diagnosis and training of the health professional, which can prevent this bias. |
In utero exposure to ischemic-hypoxic conditions and attention-deficit/hyperactivity disorder

Authors/year: Getahun D, et al.19 2013

Summary of results obtained: The study reported a greater propensity for the diagnosis of male children of white or African American ethnicity. Furthermore, hypoxic-ischemic conditions are more frequent in more premature children and have been associated with a greater chance of ADHD in all ethnic groups.

Preterm Birth and Psychiatric Disorders in Young Adult Life

Authors/year: Nosarti C, et al.20 2012

Summary of results obtained: Prematurity was strongly associated with an increased risk of hospitalization over 16 years. The results suggest that prematurity is an independent risk factor for several psychiatric disorders, or at least a risk for the most severe forms, as the analysis was performed using hospital records.

Parental psychopathology in families of children with attention-deficit/hyperactivity disorder, and exposed to maternal smoking during pregnancy/2014

Authors/year: Sengupta SM, et al.21 2014

Summary of results obtained: Based on the psychopathology of parents with children exposed to gestational maternal smoking, there are clinical, behavioral, and cognitive phenotypic changes in children. Along with epidemiological evidence, it has been proposed that children have a subtype of ADHD with conduct disorder.

Maternal diet and offspring development. addiction

Authors/year: Davis C22 2011

Summary of results obtained: Excessive maternal sugar intake can cause what has been called “fetal sugar spectrum disorder”, with symptoms similar to those of children of women who ingested alcohol during pregnancy. Approximately 20% of pregnant women are obese, which can contribute to the picture.

Exposure to gestational diabetes mellitus and low socioeconomic status: effects on neurocognitive development and risk of attention-deficit/hyperactivity disorder in offspring

Authors/year: Nomura Y, et al.23 2012

Summary of results obtained: Gestational diabetes and low socioeconomic status were associated with ADHD at age 6 years, and when exposed to both there was greater neurobehavioral impairment and reduced language, IQ, and behavioral and emotional functioning. One test showed that the risk of ADHD increased by 14 times when exposed to these two factors.

Association of hypertensive disorders of pregnancy with neurodevelopmental disorders in offspring – a systematic review and meta-analysis

Authors/year: Maher GM, et al.24 2018

Summary of results obtained: Exposure to hypertensive disorders during pregnancy may be associated with an increased risk of Autistic Spectrum Disorder and ADHD.

Association of gestational age at birth with symptoms of Attention-Deficit/Hyperactivity Disorder in Children

Authors/year: Ask H, et al.25 2018

Summary of results obtained: Premature children had more ADHD symptoms than full-term children, with higher scores on tests of ADHD symptoms, with more inattention, hyperactivity, and impulsivity. The association appeared stronger among girls.

Maternal anxiety, depression, and sleep disorder before and during pregnancy, and preschool ADHD symptoms in the NIFEA birth cohort study

Authors/year: Vizzini L, et al.26 2019

Summary of results obtained: ADHD has been associated, in 4-year-olds, with maternal anxiety throughout life, as well as sleep disturbances and maternal depression. All estimates were increased when disorders were present during the gestational period. When absent, there was attenuation of disturbances.

The association between socioeconomic disadvantage and attention deficit/hyperactivity disorder (ADHD): a systematic review

Authors/year: Russell AE et al.27 2016

Summary of results obtained: ADHD is strongly associated with several indicators, namely: social and economic disadvantage, such as poverty, home ownership, income, single parenthood, socioeconomic index and being a mother at a young age.


Summary of results obtained: Socioeconomic indicators of the Brazilian population evaluating the labor market, standard of living, income distribution and education. Inequality of gender, color or race and age groups were also addressed.

Acetaminophen use during pregnancy, behavioral problems, and hyperkinetic disorders

Authors/year: Liew Z, et al.29 2014

Summary of results obtained: Half of the mothers reported using acetaminophen during pregnancy, and the children were at greater risk of receiving a hospital diagnosis of Hyperkinetic Syndrome, using ADHD medications, or exhibiting ADHD-like behaviors at age 7. Dose–symptom relationship was seen (higher the dose, more or stronger the symptoms).

TDAH: quando a ignorância faz vítimas inocentes.

Authors/year: Brazilian Attention Deficit Association - ABDA20 2019

Summary of results obtained: Several social myths are cited, among them, the denial of the pathology by the parents, harming the children, which occurs due to false information. In addition, non-medication can considerably harm the child, and correct diagnosis and treatment are important.

Manejando da melhor maneira possível o TDAH

Authors/year: Brazilian Attention Deficit Association - ABDA21 2019

Summary of results obtained: ADHD is very prevalent, with a remission rate of 50%, which confers an evolutionary risk factor, and the medium-term prognosis, in short, is unknown. Appropriate treatment demands multidisciplinary care and adaptation.

Does child temperament play a role in the association between parenting practices and child attention deficit/hyperactivity disorder?

Authors/year: Ullsperger JM, et al.30 2016

Summary of results obtained: Using a multiple mediation to examine direct and indirect effects of parenting on ADHD, it was seen that child temperament trait of reactive control mediated the association between parenting and ADHD. Inconsistent discipline has been found to have stronger indirect effects on ADHD symptoms.

Marital and coparenting relationships: associations with parent and child symptoms of ADHD

Authors/year: Williamson D, et al.31 2016

Summary of results obtained: It is important to consider parental symptoms of ADHD when there are other family members with the same disorder. In addition, parents’ perception of family functioning and relationships is affected by the symptoms of other family members. There are not always relationship difficulties and, if there are, these may not always be consequential to ADHD.

An attachment research perspective on ADHD

Authors/year: KissgenR, et al.32 2016

Summary of results obtained: A causal relationship between disorganized attachment and ADHD has not been established. A need for a differentiated examination of ADHD and its specific behaviors was seen to establish a better relationship and differentiation between the role of attachment and implications of ADHD.

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<thead>
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<tr>
<td>ADHD symptoms and attachment representation: considering the role of conduct problems, cognitive deficits, and narrative responses in non-attachment-related story stems</td>
<td>Scholten S, et al. 2014</td>
<td>It was reported that for disorganized attachment, related to incoherence and negative content, there were higher levels of ADHD symptoms compared to secure attachment. The relationship between attachment and ADHD is still not fully understood.</td>
</tr>
<tr>
<td>The MTA at 8 years: prospective follow-up of children treated for combined type ADHD in a Multisite Study</td>
<td>Molina BSG, et al. 2009</td>
<td>The type of treatment or its intensity for 14 months during childhood does not predict the prognosis 6 to 8 years later. It was found that children with a behavioral and sociodemographic advantage, with a better response to treatment, have a better long-term prognosis. However, when ADHD was of the combined type, there was significant impairment in adolescence.</td>
</tr>
<tr>
<td>Association between insecure attachment and ADHD: environmental mediating factors</td>
<td>Storebo OJ, et al. 2013</td>
<td>Attachment problems and mediating environmental factors were significantly associated with ADHD in childhood. Adults with ADHD had a higher incidence of insecure attachment than reported in the general population.</td>
</tr>
<tr>
<td>Use of mobile technology to calm upset children: associations with social-emotional development</td>
<td>Radesky J, et al. 2016</td>
<td>There were significant associations between low-income parents’ tendency to use technology to soothe their children and increased socio-emotional difficulties in young children. The reverse analysis may also be true, that exposure to technology affects a child’s socio-emotional development.</td>
</tr>
<tr>
<td>Institutional care deficiency increases ADHD symptomology and lower II 2.5-5-year post-adoption</td>
<td>Doom JR, et al. 2015</td>
<td>There was an improvement in the IQ 12 months after the adoption of children up to 5 years of age with more severe iron deficiency and longer stay in the orphanage. However, there was no improvement in ADHD symptoms.</td>
</tr>
<tr>
<td>Impact of early-life bisphenol exposure on behavior and executive function in children.</td>
<td>Braun JM, et al. 2011</td>
<td>It was seen that a 10% increase in BPA concentrations was associated with more anxious and depressed behavior and poorer emotional control and inhibition in the child. Gestational exposure to BPA affected behavioral and emotional regulation at age 3, mainly in girls. Benefit of reduction with consumption is not clear.</td>
</tr>
<tr>
<td>Does perinatal exposure to endocrine disruptors induce autism spectrum and attention deficit hyperactivity disorders? Review.</td>
<td>Do-cock M, et al. 2012</td>
<td>Increased ADHD risk or positive associations were seen with exposure to polychlorinated biphenyls, dialkyl phosphate and chlorpyrifos. Perinatal exposure to endocrine-disrupting chemicals has been found to be associated with autism spectrum disorder and ADHD.</td>
</tr>
<tr>
<td>Medical Marketing in the United States, 1997-2016</td>
<td>Schwartz LM, et al. 2019</td>
<td>Substantial expansion of medical marketing and increased direct-to-consumer advertising spending for prescription drugs and health services was found to account for the fastest growth.</td>
</tr>
<tr>
<td>A prescrição banalizada de psicofármacos na infância.</td>
<td>Ferrazza DA, et al. 2010</td>
<td>The overdagnosis of ADHD was questioned, especially in children, along with the medicalization of children and the expectations of parents about their children, which may contribute to the increase in prevalence.</td>
</tr>
<tr>
<td>Update the multimodal treatment of ADHD (MTA): twenty years of lessons</td>
<td>Nunez-Martinez B, et al. 2019</td>
<td>A relationship was found between the initial severity of symptoms, parents’ mental health problems and the existence of comorbidities related to the persistence of ADHD symptoms in adulthood. It has also been found to think about ADHD in the long term.</td>
</tr>
<tr>
<td>Effects of neurofeedback versus methylphenidate for the treatment of attention-deficit/hyperactivity disorder protocol for a systematic review and meta-analysis of head-to-head trials</td>
<td>Yan L, et al. 2018</td>
<td>Methylphenidate increases dopaminergic and noradrenergic activity in the cortex, contributing to its effectiveness and efficiency in ADHD. Neurofeedback is considered efficient and specific for inattention and impulsivity, with average efficiency for hyperactivity.</td>
</tr>
<tr>
<td>Age-dependent effects of methylphenidate on the human dopaminergic system young vs adult patients with Attention-Deficit/Hyperactivity Disorder – a randomized clinical trial</td>
<td>Schranette A, et al. 2016</td>
<td>About 75% of patients with ADHD met the DMS-5 criteria, and with methylphenidate there was an increase in cerebral blood flow response in children aged 10 to 12 years, but not in adults.</td>
</tr>
<tr>
<td>Quantifying the benefits and risks of methylphenidate as treatment for childhood Attention-Deficit/Hyperactivity Disorder</td>
<td>Shaw 2016</td>
<td>Methylphenidate was associated with improvement in ADHD symptoms and general behavior and overall improvement in children’s quality of life. It has been associated with many non-serious adverse events, with serious events rare. Still, the benefit is unclear due to the high risk of study bias.</td>
</tr>
<tr>
<td>Methylphenidate for attention deficit hyperactivity disorder (ADHD) in children and adolescents – assessment of harmful effects</td>
<td>Storebo O, et al. 2018</td>
<td>The proportion of participants with a serious adverse event to methylphenidate was 1.2%, with withdrawal due to any adverse event being 1.2% and adverse events of unknown severity leading to withdrawal in 7.3% of participants. Methylphenidate may be associated with serious and non-serious adverse events that lead to discontinuation of the medication.</td>
</tr>
<tr>
<td>Neurofeedback as a treatment Intervention in ADHD: current EVIDENCE and practice</td>
<td>Enriquez-geppert S, et al. 2019</td>
<td>Neurofeedback protocols were considered effective and specific, level 5, in the treatment of ADHD. It is necessary to standardize neurofeedback training.</td>
</tr>
</tbody>
</table>

RESULTS

The 41 articles and 6 manually selected references were demonstrated in Table 1. Regarding the year of publication, we used for the review 1 reference from 2009, 2 from 2010, 4 from 2011, 6 from 2012, 3 from 2013, 4 from 2014, 2 from 2015, 9 from 2016, 1 from 2017, 5 from 2018, 9 from 2019. Of the references, 7 were in Portuguese and 40 were in English. The presentation of the results was divided into two
parts: social factors and cultural factors. The social factors were broken down into family planning and prenatal care, economic conditions, education, cultural pressure, and parent-child relationship. And the cultural factors were divided into life habits and medicalization.

**Social factors**

The social factors mentioned in the articles found related values, norms, and structures, i.e., the environment in which the individual lives and what is valued in this environment, involving the circle of friends and the family’s lifestyle. It was found that it is impossible not to relate these factors to economic, educational, and eating conditions, and consequently to comorbidities, because they are intertwined.

Furthermore, it has been reported that, worldwide, the economic conditions of a family directly influence their living habits, as well as the country’s degree of development. This report was corroborated by data from 2007 that indicate that the incidence of ADHD in the world during childhood is 5.3%, with lower rates in less developed countries. This may be due to the high rate of underdiagnosis of ADHD in developing countries, since many environmental factors mentioned throughout this article will be related to poverty. Thus, observing the environmental factors we could expect a higher ADHD rate in developing countries.

**Family planning and prenatal care**

Three articles mentioned that family planning involves the couple’s decision and will to become pregnant, the change in lifestyle and routine habits, and the financial preparation for the arrival of a child. By seeking a doctor before getting pregnant, the woman can receive guidance on changing habits, trying not to expose herself to drugs and alcohol, changing drugs that may be teratogenic, and thus ensuring improvement in the mother’s health condition and lower risk of damage to the fetus, and consequently, being a protective factor against the development of ADHD. Moreover, ischemic-hypoxic conditions that could be avoided by the measures mentioned, were associated in an article with increased chances of ADHD in all races, especially when there is pre-eclampsia, asphyxia and respiratory distress syndrome of the newborn (RANSS), which are independently associated with the disorder, and the association is stronger in cases of prematurity.

The toxicity of alcohol and nicotine are widely studied and nicotine has been shown in 2 articles to be a greater risk for the development of ADHD in early pregnancy than alcohol, and there are measures and guidelines that can be given to the mother when she does family planning and prenatal care properly, which can cooperate to reduce the use of substances. A Canadian study has proven the association of nicotine in the development of the disorder, and the genetic influence is significant, but not enough to develop the disorder alone. The relationship with alcohol was seen in a Scandinavian study, in which many problems due to alcohol exposure during prenatal care were reported, and 51% of the children followed developed ADHD. In addition, the study found that prematurity is highly associated with nicotine use, and premature babies are more likely to develop the disorder.

Considering maternal obesity, the Scandinavian study cited above directly associated it with impulsive ADHD, and the high consumption of sugar in underdeveloped and developed countries, and of alcohol, which is transformed into glucose, are considered contributors to the condition. Likewise, the ingestion of junk food, which has a high concentration of fat and sugar, causes negative effects for the fetus, which may hinder normal development and contribute to the development of the disorder.

Obesity, addressed by Nomyra Y. et al., is a risk factor for gestational diabetes mellitus (GDM), present in about 7% of pregnancies, which when associated with low socioeconomic conditions may significantly increase the risk of ADHD at age 6 years. Nevertheless, children with mothers who had GDM showed more ADHD symptoms than the groups in which the mothers did not have it. The long-term neurobehavioral consequences of GDM have been little studied, but correlations have been made with the incidence of inattention, hyperactivity, and general impairment of cognitive function, and it is unclear whether GDM increased the risk of ADHD or is a nonspecific factor in a spectrum of psychiatric disorders.

Another risk factor is pregnancy-specific hypertensive disorder (PGHD), which affects 5 to 15% of pregnant women and alters uterine conditions, possibly modifying fetal development and increasing the risk of psychiatric sequelae. The prevalence of DHEG in ADHD studies ranges from 0.1-20.8%, with the average being 5.5%, which leads the disorder to be considered the main consequence of the disease, although there are no associative patterns. Some studies show that exposure to DHEG increases the chance of developing ADHD by about 30%, but more studies are needed.

The factors mentioned above have been related by four articles to increased risk of prematurity, and newborns exposed to these situations have immature nervous systems that are susceptible to injuries and abnormal development. As it is believed that the neural circuitry can be influenced by social processes and that of newborns matures during infancy, it is suggested that there is an environmental influence. Thus, early experiences may affect the neural architecture of children, as well as their behavior in adulthood. At 35 weeks of gestation, the fetal brain weight is equivalent to 60% of the weight of a full-term NB, with a higher risk of postnatal complications.
and there may be volumetric loss of some specific regions and cognitive abnormalities in these children\textsuperscript{25}. Moreover, a study cited that magnetic resonance imaging showed that young adults born very prematurely have neuroanatomical changes also found in psychiatric populations\textsuperscript{18}, but, despite the correlations, the exact relationship of low birth weight and prematurity with ADHD is still unknown\textsuperscript{13,18,20}.

According to a study in Switzerland of about 1,300,000 individuals, prematurity was strongly associated with increased risk of psychiatric hospitalization in adulthood, taking into account APGAR, maternal characteristics such as education and psychiatric history, and socio-demographic variations, among others. In this, it was found that extreme prematurity (less than 32 weeks), impaired fetal growth and hypoxia related to birth are the factors most associated with psychiatric disorders\textsuperscript{20}.

Regarding maternal symptoms before and during pregnancy, a cohort study found that ADHD in 4-year-old children was related to chronic anxiety, sleep disturbance, and maternal depression. When these were present during pregnancy, the association was greater, and when present only in the pre-pregnancy period, the relationship was less. That is, these factors are relatively associated with increased ADHD symptoms in preschoolers\textsuperscript{26}. Prematurity has also been related to a higher frequency of symptoms in children in this age group, especially in females, and inattention in schoolchildren\textsuperscript{25}.

**Economic conditions**

Poverty and lack of resources associated with single-parent families have been related to higher ADHD incidence\textsuperscript{27}, and the lower the income, the higher the probability of developing ADHD\textsuperscript{10,13,18}, which may be linked to nutritional deficiencies, considered as something to be studied\textsuperscript{10,13}. Moreover, unfavorable socioeconomic status is related to higher exposure to pollution, higher rates of smoking and alcoholism, unfavorable prenatal care, unhealthy lifestyle, and family problems\textsuperscript{10,12,20}. Furthermore, data from 2007 indicate that the incidence of ADHD during childhood is 5.3\% worldwide, with lower rates in less developed countries\textsuperscript{10,12}. Although the reason for this difference is unknown, it is believed that it may be due to fewer diagnoses, less access to health care, or less contact with some factors that may influence the incidence of the disease. It may also be that the culture of developed countries tends to demand more of children to perform well at school, and those who have minor difficulties at school may be misdiagnosed as having ADHD. Therefore, it has not been possible to associate this increase directly with economic factors. However, it is known that worldwide, the economic conditions of a family directly influence their living habits, as well as the country’s level of development\textsuperscript{10}.

Unfortunately, there is a relationship between financial income and race; in the richest 1\% of the population, 2 out of 10 individuals are black, and among the poorest 10\%, 8 out of 10 are black\textsuperscript{28}. There is also a relationship between schooling and race, which will be dealt with in the following topic: only 12.8\% of people in high education were brown or black, and 53.2\% of brown or black students were behind in school, while only 29.1\% of the white population in higher education had the same situation\textsuperscript{28}. Race is an important factor in data collection, because the prevalence of ADHD is higher in non-Hispanic black individuals\textsuperscript{10}.

**Schooling**

The education of the family of the child with ADHD was considered a risk factor by 4 articles\textsuperscript{12,18,10,29} and it tends to influence the mother’s behavior during pregnancy and may affect the indiscriminate use of medication. A study evaluated more than 64,000 children between 1996 and 2002 and showed that when paracetamol was used during pregnancy, the children, in majority, presented hyperkinetic, so that after evaluation of the children\textsuperscript{29}, the correlations were positive with the degree of exposure and ADHD\textsuperscript{12,29}.

A study evaluated the changes in children’s academic activities, noting over the years an increase in the time devoted to “homework” and reading, while free time for play decreased\textsuperscript{6}. Reading time from 1981 to 1997 for 3- to 5-year-olds varied from 29min/week to 84min/week and the percentage of children enrolled in all-day programs increased from 17\% in 1970 to 58\% by 2000. There is evidence that increased academic demand in very young children coincides with increased prevalence of ADHD, but no causal relationship has been proven\textsuperscript{6}. Since ADHD is diagnosed by behavior, which depends on age and varies with environment, from the observation of parents and teachers, it can be considered that they may be influenced by observers’ expectations, who especially with the investment in academic activities, may expect higher school performance\textsuperscript{6}.

**Cultural Pressure**

ADHD seems to have a certain cultural bias, with higher prevalence cited in the United States of America (USA) and Western Europe. According to Weissneberger et al.\textsuperscript{12}, some countries, such as Brazil, tend to follow American influences. Thus, the author assumes that the increase in diagnoses in the USA and Europe leads to an increase in diagnoses in Brazil\textsuperscript{13}.

Moreover, according to the Brazilian Attention Deficit Disorder Association (ABDA), with the dissemination of misinformation, such as relating ADHD to children’s unwillingness, lack of a stricter education or lack of motivation, some parents stop treating their children\textsuperscript{29}. This is a result of other erroneous statements that claim pharmacological intervention is not effective, that children become
“zombies”, among others, while medication increases the quality of life of those with the disorder who take it. When one chooses not to use any treatment, there may be functional remission (10-20% of the cases) or heterogeneous evolution, in which there may be minimal symptoms that interfere little with functionality or more complex pictures with evolution to other comorbid disorders, such as conduct, anxiety, and depression disorders, among others. Thus, the dissemination of misinformation is a risk factor for heterogeneous evolution and other disorders.

**Parent-child relationship**

The relationship between parents and children from the beginning of life is important for any child, but the importance may be even greater for children with ADHD. Four authors have cited those children with negligent and inconsistent parents show improvement in ADHD symptoms when parents later become more involved. Furthermore, the way parents deal with and treat their children was directly related to the disorder by 4 articles, because there are predictive and protective factors related to the upbringing way, such as substance abuse. Regarding upbringing, we can consider 4 models cited, which vary according to culture, but commonly have as an ideal model: communicative parents, warm and who set well the limits for the child. The other three models are dysfunctional: authoritarian parents, not very warm, with many restrictions and little communication; permissive parents, their role being uncertain, with few limits, and unclear communication; and, finally, negligent parents, who do not meet the child’s basic needs or even abandon the child. A Canadian study showed that dysfunctional, single-parent, hostile families with many conflicts are related to ADHD.

Considering that the bond between parents and children is developed from birth, studies have shown that bonds close to the ideal model have a positive effect on the child. In dysfunctional models, children are more likely to have problems dealing with feelings and with behavior regulation, both of which are related to ADHD symptoms. No direct association between dysfunctional bonding and the disorder was cited, but one article considered it likely that problems related to it can be prevented by guiding parents on how to react toward their children.

Another factor that affects the relationship between parents and children is the use of electronic devices, which has increased in the lives of children in recent years and has become increasingly common, with children often being given the devices to stay well-behaved and quiet. One study found that children’s use of technology is related to increased social and emotional difficulties when compared to those who do not use technological devices. In this study, it was also strongly associated with the tendency of low-income parents to have the habit of using technology for this purpose, which can damage the family relationship. Another factor mentioned by 5 studies is adoption, and it is important to guide the birth mother, the adoptive mother, and the social service that adopted children and babies tend to develop ADHD, which may be related to stress in early life, a factor that can potentiate the disorder, allowing a closer monitoring of the child.

**Life habits**

We know that ADHD is a disorder that has an important genetic influence. However, according to three articles, no gene has been identified so far that is directly linked to the occurrence of ADHD. However, lifestyle and environment are cited as being able to alter the sensitivity of genes by 2 articles. Exposure to toxins is a variable factor, with 3 articles considering that in poorer places it probably occurs due to a lower cultural level and less interest in healthy habits, and in wealthier places, due to neglect of environmental rules and exposure to various types of pollution. Furthermore, there are several plastic products that are toxic to children, the most important being phthalate and bisphenol A.

Phthalate, an additive that makes plastic more malleable and is present in toys and cosmetics, is toxic to children, and has been linked by Weissenberger et al. to hormonal disturbances and the development of hyperactivity symptoms, like ADHD. Animal studies have been cited that found direct relationships between exposure to this additive during prenatal care and the neural development of ADHD and autism. Furthermore, higher concentrations of this substance have been found in the urine of children diagnosed with combined ADHD (hyperactivity-impulsivity) than in normal children.

Bisphenol A (BPA), another additive mentioned, is a polycarbonate found in baby bottles and cups and in food packaging, which has been correlated to insulin dysfunction and may influence intrauterine and fetal development, with direct action on the dopaminergic system in early development. Furthermore, it was reported that most studies of ADHD believe that the disorder occurs due to a dysregulation in the dopaminergic system. Dos with articles cited that exposure to minute doses of this polycarbonate in rats caused ADHD-like symptoms and 1 article cited that 3-year-old children with higher urine BPA concentration met the criteria for the disorder.

In addition, a systematic review was cited with these two substances that showed a significantly positive correlation with ADHD and autism, as they lead to hormonal and neurological changes that result in hyperactivity and symptoms associated with the disorder.

**Treatment**

Considering the above, the professional care must be done not only for the child, but also for the parents, because...
they make up the environment in which the child lives and the absence of proper care can lead to an improvement or worsening of the condition. Thus, one should think not only about improving life, but also about preventing other comorbidities, especially if the couple wants to get pregnant again, instructing them about the importance of prenatal care, the management of comorbidities, and the risk they can cause in the fetus\textsuperscript{23}. Thus, the guidance of a couple with a child with ADHD may lead to preventing the generation of another child with the disorder, in addition to cooperating to a better prognosis of the child with the disorder\textsuperscript{29}.

The Multimodal Treatment Study of Children with Attention-Deficit/Hyperactivity Disorder (MTA), a prospective longitudinal study that followed children from 7 to 9 years old until adolescence, defined as consensus and gold standard for treatment a multimodal approach, with medication associated with other measures, defined according to the need in each case, always seeking symptom reduction\textsuperscript{31,36,42}.

Currently, ADHD treatment is primarily carried out by using psychostimulant drugs such as methylphenidate and lisdexamfetamine dimesilate, due to their high efficacy, actually leading to improvement in the quality of life of patients with the disorder\textsuperscript{2,4,5,41,44,45}. However, these do not necessarily generate long-term improvement, and when the drug is withdrawn, symptoms may immediately return\textsuperscript{2,4,5}. Moreover, one article cited that psychostimulants, which increase brain dopamine, and drugs from other pharmacologic groups, such as antidepressants, can be prescribed, usually when psychostimulants do not work (or are not tolerated)\textsuperscript{16}.

A Cochrane systematic review showed that 40\% of the studies conducted until 2015 were sponsored by the pharmaceutical industry, which contributes to suspicion of underreporting of grievances, in addition to the fact that almost 10\% of patients withdrew from treatment for adverse effects of unknown severity\textsuperscript{46}. Furthermore, two reviews reported that methylphenidate\textsuperscript{45,46} does not increase the risk of serious adverse effects when used for up to 6 months, but its use is related to increased risk of minor adverse events, and it is necessary to evaluate the potential risks and benefits for each patient, collecting data on neural development and family health problems, as well as conducting studies of longer duration\textsuperscript{46}. One study cited that methylphenidate caused alterations in the dopaminergic system of animals, due to the increased cerebral flow resulting from the higher level of circulating dopamine, such as the expression of D3 receptors in the frontal cortex, reduced excitability of prefrontal neurons and synaptic transmission, and this effect does not occur in adults\textsuperscript{44}. In human studies it was shown that the medication alters neural maturation, with differences being observed in individuals treated and untreated for the disorder\textsuperscript{44}. Furthermore, a prospective study showed that drug treatment was associated with increased antisocial behavior, occurrence of accidents and fines, and lower levels of anxiety and depression\textsuperscript{16}.

As for behavioral therapy, a higher number of psychiatric hospitalizations, lower frequency of accidents and fines, and lower levels of aggressiveness have been reported\textsuperscript{36}. Furthermore, some schools offer special education for children with ADHD, involving teachers, parents, and the child, so that he/she can be more successful in his/her activities\textsuperscript{16}.

Two articles cite parent training, stress management techniques, participation in support groups, and family therapy as forms of parental treatment that influence the child to teach them how to deal with the child’s challenging behavior\textsuperscript{2,16}. In parent training the couple learns about the disorder and how it affects the child’s functioning and behavior. In addition, the couple is oriented about the reward mechanism in the child, which can generate a positive effect on the child, with a consequent reduction in stress and increased trust between the couple\textsuperscript{2,16}. Treatments such as cognitive training, neurofeedback, and behavioral changes have been found to be significantly effective and may improve the prognosis of the disorder\textsuperscript{16}.

Neurofeedback (NF), a computerized behavioral training that allows self-regulation of brain aspects monitored by electroencephalogram (EEG), can change the neural, cognitive, and behavioral mechanism while the child practices exercises for about 30 minutes, which, according to the maintenance time of the activity of specific neuromarkers, leads the child to be rewarded\textsuperscript{11,47}. In summary, the NC evaluates and stimulates the mechanisms of attention regulation, calculating the individual’s reaction time, stimulus detection, and short-term memory, among others\textsuperscript{47}. One article mentions that with the NF there is maintenance and increase of attention for 6 months after the end of the treatment, but the use of this treatment has not yet been regulated\textsuperscript{47}. One article considered that NF was an efficient and specific method for inattention and impulsivity, and of medium efficacy for hyperactivity\textsuperscript{43}.

Moreover, a way to cooperate with a favorable prognosis for the child is the adequate treatment of other comorbidities\textsuperscript{2,5}. This occurs because children diagnosed with ADHD often have other comorbidities such as anxiety, depression, defiant behavior, and difficulty in relating, so that other forms of treatment seem appropriate\textsuperscript{2,5}. Thus, 2 articles considered that especially for children with less severe symptoms or with little or no response to medication, behavioral interventions should be given priority\textsuperscript{2,5}.

One article considered that the main reason why non-pharmacological treatment is important is that longitudinal studies suggest that hyperactivity is a risk factor for unfavorable consequences such as increased risk of some psychiatric disorders, aggression and violence, behavior problems, being a risk for the individual and for society\textsuperscript{2}.

Discussion

Although there is no definite association established between sociocultural factors and the development of
ADHD, through the data shown, one can notice the importance of patient education regarding family planning and prenatal care, which should not be undervalued. It was observed that environmental factors should be modified before the child is born, to prevent the disease, and during the child’s growth, which can influence the prognosis. Furthermore, there are evident benefits when the mother acquires better habits, such as smoking cessation, alcoholism, and drug use, due to the association of these factors with the birth of preterm and small for gestational age children.

An adequate prenatal care, with clear guidance on exposure to toxins, risk of comorbidities, and the gestational process is very important, especially when the mother has little education and little understanding of the process and the risk factors involved. Offering psychological support to the woman and encouraging the father of the child to participate in the whole process, when possible, can also improve the family relationship, to reduce pregnancy stress, and should be encouraged.

The measures mentioned can be classified as preventive, so that they can reduce the incidence or severity of the disorder. Naturally, the maintenance of these measures is also beneficial during the child’s development. In addition, healthy living habits hinder the development of genes, so that genes that should be inactive will not be activated.

In general, of the social factors mentioned, it is observed that most of them are or have modifiable factors, such as: alcohol and nicotine toxicity; maternal obesity; GDM; SCDM; cultural pressure; and relationship between parents and children. Therefore, the couple’s orientation and information provision favor a better prognosis and may prevent the development of ADHD. Furthermore, it is important to encourage professionals, especially in primary care, to guide or conduct campaigns to guide pregnant women in relation to lifestyle habits and how these can affect the child.

In relation to diagnosis, an important problem is the fact that the child often does not go through the evaluation of more than one professional and is not evaluated in more than one environment or by a different narrator, using only the mother’s or guardian’s report as the basis for the diagnosis. When there is another report or a form filled out by another individual, the bias is reduced. Furthermore, it is important to guide professionals about the limitations of the DSM-V, a widely used method. Since it is a diagnosis based only on behavioral reports, one should also try to exclude other possible diagnoses and include the child’s environment as a factor related to the behavioral changes found. The importance of a well elaborated diagnosis and the evaluation by more than one professional is in the treatment planning, which can improve the child’s prognosis when well done. The child acts differently according to the place where he or she is, and a different look at the child’s attitudes can cooperate in identifying factors to be treated that would not be noticed by another observer.

Also, consideration must be given to socio-cultural factors and to explaining changes in lifestyle habits to the caregiver. Although some factors related to lifestyle habits are not yet proven, they can act in combination to generate the disorder. In addition, changing these habits tends to reduce or prevent comorbidities, so that the change, in any case, tends to be beneficial.

Computerization and easy access to mobile devices can also favor treatment. Currently there are support groups in social networks that disseminate behavioral techniques, support messages, information about the disorder, among others, which can help the child to understand the disorder and improve, being the child most affected by ADHD. Moreover, this access is also important for the family to learn how to deal with the child and change the way they act with the child, especially in places with little access to health care.

As for treatment, it is important to evaluate the child’s family, and it would be good, if possible, if all the individuals who live with the child could attend the consultation or participate in some way in the treatment. The child’s environment and the relationship with parents are contributing factors to the severity of the disorder, which can worsen the quality of life for the child and the family if not addressed. Since there are dysfunctional families with coexistence problems even without the presence of an individual with ADHD, there is no reason to fear referring the child and the guardians to a psychologist.

As discussed in the results, the MTA and the Brazilian Attention Deficit Disorder Association recommend a multimodal treatment, i.e., not only pharmacological, but also non-pharmacological, according to the needs and life stage of each patient, allowing for a better prognosis. What can be concluded is that the absence of a diagnosis should not be a possibility because it is related to a bad prognosis.

Some non-pharmacological treatments are still not made available by the Single Health System (SUS), such as neurofeedback, which is still being studied, but psychological monitoring and participation in support groups are usually accessible. Therefore, these types of treatments should be encouraged.

As discussed throughout this paper, risk factors play an important role in the complex ADHD diagnosis, so by acting on them, it is possible to improve the quality of life, not only of the child with ADHD, but also of those who live with the child.

Conclusion

We can conclude that when the child has been born and ADHD is already present, investigation of the discussed factors should be done by collecting maternal history, birth history, and developmental history of the child. This strengthens the association between factors that have or have not yet been directly correlated with ADHD.
and increases the likelihood of choosing the best treatment for each child.

The proper filling out of the child and adolescent booklet is one way to make this happen; it can see the child’s history in detail and even facilitate early interventions. The booklet provides the professional with information that tends to get lost in the system and can improve the child’s prognosis. Thus, it is important to guide the physician and health professionals to always fill it out and the child’s guardian to always bring the booklet to the appointment.

ADHD, as a disorder with a complex clinical diagnosis, has several risk factors that could be identified in Primary Care. We consider as factors or potential risk factors or cooperators for the development of ADHD absence of family planning, due to less monitoring and guidance to change environmental factors; use of alcohol and nicotine during pregnancy, already related to a higher risk of ADHD; increased circulating levels of glucose, in view of the relationship between obesity, junk food intake and GDM; poverty, for being related to the lower degree of education and medical monitoring, among others; low education, as it affects maternal behavior before and during pregnancy and the understanding of the disorder by the child’s parents; use of paracetamol during pregnancy; dysfunctional parent-child relationship; inappropriate use of electronic devices; contact with bisphenol A and phthalate; and, finally, poor adherence to treatment, being considered an environmental factor because, especially in childhood, it is guided and carried out by parents, which may show lack of care for the child.

The relationship between prematurity and low weight with ADHD is uncertain; however, based on the findings, we believe that this may also be secondary to other factors and not necessarily a causative or cooperating agent for the disorder. However, more studies are needed to establish the relationship, as well as the relationship with DHEG. Cultural pressure and academic demands by parents should not be risk factors if diagnostic methods are applied properly. Thus, studies evaluating these factors are needed.

It is worth mentioning that prevention begins with the identification of environmental risk factors in pregnant women, but after the child’s birth, when these are identified, they can be changed and cooperate to a better prognosis for the child. Furthermore, the identified factors can be considered, after further studies, as factors to be evaluated to cooperate with the diagnosis of the child. In this way, a less biased diagnosis of ADHD in the child could be made.

More studies are needed that evaluate the maternal and child history to better stratify the risks of environmental factors. Thus, ADHD prevention is favored, through pregnancy planning and avoidance of risk factors, and prognosis is improved, seeking to change modifiable environmental factors and a qualified treatment for the child and family to minimize the severity of ADHD.

Authors’ participation: JVQA - Responsible for the idealization of the work, data analysis and interpretation, writing the manuscript and submitting the article; RMB - Guidance of the work; LEGM - Responsible for revising the article and guiding the work. All authors approved the final version submitted.

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Recebido: 2020, January 28
Aceito: 2023, May 12