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Attention-Deficit Hyperactivity Disorder (ADHD)

PSX_003 Counselling Psychology
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History of ADHD

Although ADHD presents an increasing number of studies and remarkable interest around itself, there were several and distinct view of this disorders along the different decades. Based on those different views we can get a better understanding of the disorder and its components until nowadays.

The modern history of "ADHD-like medical descriptions" start to appears around 200 years ago, not existing a description of this disorder in the ancient literature (Matthews et al, 2013). It seems that one of the first examples of something close to ADHD date to 1798 by Sir Alexander Crichton, that in one of his books about mental illness characterizes a disorder that is based in ''the incapacity of attending with a necessary degree of constancy to any one object''. Crichton then defines two possibilities for abnormal inattention that are the oppositional increase or decrease ''sensibility of the nerves'' (Crichton 1798; Lange et al, 2010). After that, some authors acknowledge Frederic Still as the scientific starting point of the history of ADHD in 1902 (Barkley, 2006) after he described 20 cases of children with a ''defect of moral control as a morbid manifestation, without general impairment of intellect and without physical disease''.

An important aspect concerns the encephalitis epidemics of 1915–1920 given the fact that to several children who were infected and survived started having problems with impulsivity and over-activity – descriptions that showed many similarities with what is now known as ADHD (Matthews et al, 2013). This condition had some designations along the years and then came to be known as "minimal brain dysfunction" (MBD).
It was in 1932 that physicians Kramer and Hans mentioned "a hyperkinetic disease of infancy" that had as primary and most obvious symptom a marked motor restlessness. These children showed a remarkable motor activity, an urgency and could not stand still for very long, running up and down the room. Also, they were extremely displeased when someone would stop them from acting according to their impulses (Lange et al, 2010).

By the late 1950s, the label as "hyperkinetic impulse disorder" or "hyperactive child syndrome" had become very used and theories of cortical overstimulation, cortical under-arousal, psychoanalytic and psychosocial theories started to arise in search for an explanation or better description (Burks 1960; Chess 1960). When the second edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-II) came out, it presented for the first time a range of childhood disorders that were all interpreted as

reactions, like a psychological defense or an adaptive behavior, including the "hyperkinetic reaction of childhood" (Association, 1968). This showed the start of an argument that still lasts to the present days, regarding the opposite views about this disorder being a neurobiological or a behavioral/psychosocial problem.

In the 1970s, researchers were motivated by the progress in cognitive and experimental psychology and emphasized problems with sustained attention and impulse control in addition to hyperactivity. As a result of this interest and work, the Douglas's Model (1972), which highlighted the inclination to seek immediate reinforcement, helped to rename this disorder as "Attention Deficit Disorder" (ADD) in the 1980 version of DSM, third edition (Association, 1980). This lead the MBD term to be abandoned and a few years later, in 1987, the DSM-III revised edition came out and the disorder had been renamed as "attention-deficit hyperactivity disorder" (ADHD). The 1980s and 1990s extensive research on information and reward-processing features associated with ADHD suggested that the hyperactivity and impulsivity formed a single dimension of behavior and, as a result, in the DSM-IV (1994) this disorder had two distinct yet correlated dimensions or domains of behavior: a set of symptoms for inattention and another for hyperactive–impulsive behavior.

In the last years, ADHD has been connected to an impressive and still growing literature that includes structural and functional brain imaging as well as molecular genetic studies and there is still a lot to learn and discover about this disorder (Matthews et al, 2013).

Definition and Classification

There are two main classification systems for diagnosing ADHD: the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders – 5th Edition (DSM-5) and the International Classification of Mental and Behavioural Disorders 10th revision (ICD-10).

DSM-V

According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-V), attention-deficit/hyperactivity disorder (ADHD) is a persistent pattern of inattention and/or hyperactivity-impulsivity, which interferes with the functionality or with the

development of the person. This disorder's manifestations must be present, not only in school or at home, but in more than one context in which the person is usually inserted.

By **inattention** we mean behaviors such as manifesting some difficulties in maintaining the focus and, consequently, difficulties in performing tasks that need the attention of the person over an extended period of time. Also, lack of persistence and lack of organization are examples of inattention behaviors.

Hyperactivity is linked to motor activity that is excessive or inappropriate to the occasion. This excessive restlessness usually tires people who share their days with people with ADHD.

Impulsivity has to do with precipitous choice of actions without first reflecting on them as to the consequent benefits and damages. Impulsivity may also be linked to the desire for immediate rewards and a lack of ability to wait for them. This type of behavior can have consequences on the personal and social levels of the individual with ADHD, such as social intrusiveness and non-pondered decisions about important situations (APA, 2013).

Diagnostic Criteria

According to the DSM-V, an individual has ADHD if he presents a persistent pattern of inattention and/or hyperactivity - impulsivity that interferes with the functioning or development (**criterion A**).

For inattention, the individual must present 6 or more of the following symptoms that are inconsistent with his developmental level and that have a direct negative impact on social and occupational activities, for at least 6 months (**criterion A1**):

a. Often fails to give close attention to details or makes careless mistakes in schoolwork, at work, or during other activities;

b. Often has difficulty sustaining attention in tasks or play activities;

c. Often does not seem to listen when spoken to directly;

d. Often does not follow through on instructions and fails to finish schoolwork, chores, or duties in the workplace;

e. Often has difficulty organizing tasks and activities;

f. Often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort;

g. Often loses things necessary for tasks or activities;

h. Is often easily distracted by extraneous stimuli;

i. Is often forgetful in daily activities.

For hyperactivity and impulsivity, the individual must present 6 or more of the following symptoms that are inconsistent with his developmental level and that have a direct negative impact on social and occupational activities, for at least 6 months (**criterion A2**):

a. Often fidgets with or taps hands or feet or squirms in seat;

b. Often leaves seat in situations when remaining seated is expected;

c. Often runs about or climbs in situations where it is inappropriate;

d. Often unable to play or engage in leisure activities quietly;

e. Is often "on the go," acting as if "driven by a motor";

f. Often talks excessively;

g. Often blurts out an answer before a question has been completed;

h. Often has difficulty waiting his turn;

i. Often interrupts or intrudes on others.

These symptoms are not only about failure of understanding of tasks and instructions or manifestations of oppositional, defiant or hostile behavior. For adults or adolescents over 17 years of age, only 5 or more of the previously reported symptoms for both inattention and hyperactivity-impulsivity are necessary to be diagnosed with ADHD.

In addition, these symptoms for both inattention and hyperactivity-impulsivity must be present before the individual is 12 years old (**criterion B**), be present in two or more settings (**criterion C**) and interfere or reduce the quality of social, academic, or occupational functioning (**criterion D**). Besides that, the symptoms must not occur exclusively during the course of schizophrenia or another psychotic disorder and aren't better explained by another mental disorder (**criterion E**) (APA, 2013).

Specifiers

Depending on the presence of certain symptoms, we can specify whether there is a **Combined presentation**, 314.01 (F90.2), - if both criterion A1 and criterion A2 coexist for the past 6 months -; **Predominantly inattentive presentation**, 314.00 (F90.0), - if criterion A1 is verified but criterion A2 is not met for the past 6 months - ; **Predominantly hyperactive/impulsive presentation**, 314.01 (F90.1), - if criterion A2 is met but criterion A1 is not met for the past 6 months. We can also specify if the individual is **in partial remission**. This happens when full criteria were previously met, less than the full criteria have been met for the past 6 months, and the symptoms still result in impairment in social,

academic, or occupational functioning. Taking the severity of symptoms into account we can distinguish between **Mild** - if few, or none, symptoms in excess of those required to make the diagnosis are present, and symptoms result in no more impairment minor in social or occupational functioning -; **Moderate** - if symptoms or functional impairment between "mild" and "severe" are present - and **Severe** - if many symptoms in excess of those required to make the diagnosis, or several symptoms that are particularly severe, are present, or the symptoms result in marked impairment in social or occupational functioning (APA, 2013).

Comorbility – DSM-V

The existence of a diagnosis of ADHD is often accompanied by another disease in the individuals, and, therefore, the existence of comorbid disorders in ADHD is very frequent. In approximately half of the children with a combined presentation and in approximately a quarter of children with predominantly inattentive presentation co-occurs the oppositional defiant disorder. About a quarter of children and adolescents with a combined presentation, although depending on age and setting, also presents conduct disorder. Although only occurring in a small percentage of children with ADHD, anxiety disorders occur more commonly in these children than in the general population. It is also common for children with ADHD to have a specific learning disorder. Even if it happens only in a very small percentage of children with ADHD, it can coexist with disruptive mood dysregulation disorder (APA, 2013).

ICD-10

F90 - Hyperkinetic disorders

ICD-10 referes to ADHD as Hyperkinetic Disorder (HKD), a term widely used in Europe and included in European clinical guidelines. This classification system **defines HKD** as a persistent and severe impairment of psychological development, characterised by "early onset; a combination of overactive, poorly modulated behaviour with marked inattention and lack of persistent task involvement; and pervasiveness over situations and persistence over time of these behavioural characteristics" (Organization, 1992, p.206).

ICD-10 refers to the **characteristic problems** as lack of persistence in activities that require cognitive involvement, a tendency to move between activities without

completion and disorganized and excessive activity. All of these problems always arise early in development, usually in the first 5 years of life, but usually continue through school years and can persist into adult life. However, an individual affected with this disorder show a gradual improvement in activity and attention. Besides these problems, some **other abnormalities are usually associated with HKD**: hyperkinetic children are often reckless and impulsive, prone to accidents, and they normally breache rules without thinking which means that they do not intend to be deliberately defiant. For that reason very often they find themselves in disciplinary trouble. While they are commonly incautious and unreserved with adults being often socially disinhibited in their presence, they may be isolated and unpopular with other children, which can be hard for maintaining relationships with them. Cognitive impairment, specific delays in motor and language development and scholastic problems such as reading dificulties are more common in this group than in the general population. Therefore, **as a consequence of the disorder,** children may engage in dissocial behaviour and experience low self esteem (Organization, 1992).

Diagnostic guidelines

For a diagnosis of HKD, ICD-10 requires evidence of both **impaired attention** and **overactivity** in more than one situation (e.g. home, classroom, clinic). However, deficits in persistence and attention should be diagnosed only if they are excessive for the child's age and IQ; and the overactivity feature should be judged based on if the activity is excessive in the context of what is expected in the situation and by comparison with other children of the same age and IQ (Organization, 1992).

Impaired attention is related with a lack of preserverance in tasks involving thought and attention, and the tendency to move from one activity to the next without completing any (although laboratory studies do not generally show an unusual degree of sensory or perceptual distractibility) (Organization, 1992).

Overactivity implies excessive restlessness, could involve the child running and jumping around, leaving their seats in situations in which remaining seated is expected, excessive talkativeness and noisiness, or fidgeting and wriggling. This behavioural feature is most evident in structured, organized situations that require a high degree of behavioural self-control (Organization, 1992).

There are some **associated features** with this disorder. They are not sufficient for the diagnosis or even necessary, but help to sustain it. For example, chidren with HKD

frequently show disinhibition in social relationships, recklessness in situations involving some danger, and impulsive flouting of social rules (interrupting or intruding on others's conversations or activities, blurting out answers before questions have been completed, and showing difficulty in waiting turns).

So, although ICD-10 criteria for HKD describe similar symptoms to DSM-V for ADHD, the ICD-10 criteria are more restrictive because they require hyperactivity, impulsivity, and inattention all to be present for the diagnosis of HKD to be made (in addition the presence of at least 6 inattention symptoms, at least 3 hyperactive symptoms and at least 1 impulsive symptom). In addition, symptoms should occur before the age of 6 years, be of long duration and be present in more than one setting. Besides that, the presence of another disorder, such as mania, depression, and/or anxiety disorder, is in itself an exclusion criterion, whereas DSM-V allows these diagnoses to be made as comorbid conditions (Döpfner, 2010).

Diagnosis of HKD may also be made in adult life using the same criteria, however, attention and activity must be judged with reference to developmentally appropriate norms.

Caution is recommended in children of pre-school age and only extreme levels of hyperactivity should lead to a diagnosis in these individuals.

The application of these more restrictive criteria defines hyperkinetic disorder as the **subgroup of those patients with combined type ADHD** with the most severely impairing symptomatology, characterized by greater impairment and more impulse-control difficulties than typical ADHD (Döpfner, 2010).

Diferential Diagnosis

The major problems in diagnosis lie in differentiation from conduct disorder.

According to ICD-10, the code "**Disturbance of activity and attention"** should be used when the overall criteria for hyperkinetic disorder (F90.-) are met but those for conduct disorders (F91.-) are not. However, milder degrees of overactivity and inattention are common in conduct disorder. So, when criteria of both hyperactivity and conduct disorder are present, and the hyperactivity is pervasive and severe, **"hyperkinetic conduct disorder" (F90.1)** should be the diagnosis.

A further problem it's related to the fact that overactivity and inattention, of a rather different kind from that which is characteristic of a hyperkinetic disorder, may arise as a symptom of many other disorders. Therefore, if the criteria for anxiety disorders, mood affective disorders, pervasive developmental disorders and schizophrenia are met, this should take precedence over hyperkinetic disorder.

Epidemiology

The prevalence of the more restrictive ICD-10 hyperkinetic disorder diagnosis has been estimated to be around 1.5% in school-age children (Döpfner, 2010).

Concerning to ADHD, prevalence rates may vary depending on several factors.

Regarding to **gender**, it seems that ADHD is more frequent in males than in females in the general population, with a ratio of approximately 2:1 in children and 1.6:1 in adults (Association, 2013).

Concerning to **age**, ADHD is most commonly diagnosed in school-aged children. According to DSM-V, population surveys suggest that ADHD occurs in most cultures in about 5% of children and about 2.5% of adults (Association, 2013). Also, results from meta-regression analyses have estimated a worldwide prevalence of ADHD in people aged ≤18 years of between 5.29% and 7.1% (Polanczyk et al., 2007). A recent study (2014) which updated these analyses concluded that there was no evidence to suggest an increase in the prevalence of ADHD in children and adolescents over the past three decades (Polanczyk et al,. 2014). The worldwide ADHD prevalence in adults (aged 18–44 years) was estimated at 3.4% overall (range 1.2–7.3%) by the World Health Organization across 10 countries in Europe, the Americas, Columbia, Mexico and the Middle East (Fayyad et al., 2007).

According to DSM-V, it also seems to be differences in ADHD **prevalence rates across regions**, which appear to be attributable mainly to different diagnostic and methodological practices. There's also suggestions that cultural variation in attitudes towards the interpretation of behaviour may contribute to the differences found (Association, 2013). However, a worldwide meta-analysis of 86 studies in children and adolescents and 11 studies in adults, found no significant prevalence differences between countries, after controlling for differences in the diagnostic algorithms used to define

ADHD (Willcutt, 2012). Researchers therefore argue that ADHD is not a cultural construct associated with a particular geographical location.

In general, it appears that ADHD is a worldwide disorder and that, as long as similar methodologies are used, the prevalence rates are similar in most ethnic communities (Döpfner, 2010).

Etiology

Although ADHD is an extensively researched disorder, its origin is still a controversial subject between different authors. The etiology of ADHD is multifactorial so there are several factors that can be in the starting point of this disorder and that can be divided according to a very common question – "does ADHD qualify as a "nature" or a "nurture" disorder, or some combination of factors?" (Evans, 2013).

On one hand, the majority of researchers claim that ADHD has a genetic cause and point several aspects to support this point. Firstly, family/twin and adoption studies support that ADHD is a highly heritable disorder being that the majority of patients have a first or second-degree relative with a history of ADHD or learning disorder. Dopheide (2001) says that there is a 55% to 90% concordance rate for ADHD for monozygotic twins while Millichap (2007) points that there is a 79% concordance in monozygotic twins against 32% in same-gender dizygotic twins, thus supporting the genetic factor.

Another possible cause of ADHD that falls in the genetic domain is the claim that there is a chemical imbalance in the brain - a dopamine deficiency (Evans, 2013). In one meta-analysis, there were identified seven candidate genes that demonstrated significant pooled odds ratios for conferring risk for ADHD being that 5 of the genetic variants were explicitly involved in dopamine neurotransmission (Kollins & Adcock, 2013). One of Dopamine's effects is that it helps to regulate emotional responses, take action to achieve specific rewards and it's important for concentration or sustained attention. People with ADHD show lower levels of dopamine due to the fact that their nervous system and neurons in the brain present a higher concentration of dopamine transporters, which prevent the dopamine from going to the next cell and lessens its effect (Legg, 2016).

Finally, another aspect related with "nature" makes part of the Organic theory of ADHD and it's about the activity and constitution of the brain. Evidence shows that the

activity on prefrontal cortex and cingulate brain regions, which are involved in inhibitory control and the executive command, is deficient in people with ADHD (Millichap, 2007; Evans, 2013). Also, the prefrontal cortex, caudate nucleus and globus pallidus are smaller than usual, suggesting a "lack of connectivity of key brain regions that modulate attention…processing, and impulsivity" (Dopheide, 2001).

On the other hand, there are some aspects about ADHD that fall on the "nurture" domain, regarding Environmental Factors. Factors like having an imbalanced diet, food allergies, low levels of zinc/calcium/magnesium and omega-3 acids seem to have to effect of triggering ADHD and are not natural or genetic components (Millichap, 2007; Evans, 2013). The mentioned factors are all postnatal but there are also prenatal and perinatal factors associated with ADHD, such as maternal smoking and anemia, prematurity, low birth weight, small head circumference, cocaine and alcohol exposure, iodine and thyroid deficiency. Some illnesses in childhood can also trigger ADHD in certain cases, being some of them viral infections, meningitis, encephalitis, otitis, cardiac disease, thyroid disease, epilepsy and autoimmune and metabolic disorders. All of these are not only causes but also risk factors that people can see and take into account, helping to prevent further developments ((Millichap, 2007).

Nowadays, the "nurture" aspects have been disregarded as primary causes of the disorder, being that in the majority of the cases a genetic factor is a likely base cause and the environmental factors is probably secondary, acting as a trigger of what is already there (Dopheide 2001; Millichap, 2007). Taking this into account, the etiology of ADHD is probably a combination of both genetic and acquired factors, "nature" and "nurture" combined.

Regarding some theories of ADHD that can give us an important insight about the disorders and sometimes a starting point for an intervention and treatment, we can focus on neurobiological theories, which have been centered on two models (Matthews et al, 2013). One models focuses on top-down, controlled processing problems, associated with "cognitive control or executive functioning" (Barkley 1997). The other emphasizes bottom-up, motivational and incentive/reward response (Sagvolden et al. 2005). There is no consensus regarding these two models but evidence supports both and suggest both types of psychobiological systems are involved in ADHD.

Focusing on top-down model, one of the most know supports of this argument is the unifying theory of Barkley (1997) which suggests that symptoms of the disorder, such as atypical behavioral inhibition, "were caused by deficits in response inhibition that in turn disrupted four specific executive functions" - (a) nonverbal working memory; (b) internalization of speech (or verbal working memory); (c) self-regulation of affect, motivation, and arousal; and (d) reconstitution. Supporting this idea of Barkley, afterward studies show that ADHD appears to be related to impairment in response inhibition (Matthews et al, 2013) which is the ability to inhibit or suppress an inappropriate response in a specific context. This, along with response selection, are extremely importing in facilitating goal-directed behavior, having an important connection with ADHD.

Regarding the bottom down and emotional regulation theories, these view ADHD concerning people's problems with emotions, such as the difficulties with anger, and affect regulation (Matthews et al, 2013). Motivational or reward responding are typically viewed in terms of "approach" behavior, which can also be construed as positive affectivity, or "avoid" behavior, construed as negative affectivity. Children with ADHD present difficulties regarding this regulation, not always knowing what to avoid in certain contexts and what behavior would be positive certain time, therefore the connection between this aspects and the disorders.

As mention, there isn't consensus about these and other referred theories/approaches, although there seems to be evidence supporting the connection of various and different aspects, enlightening the multidimensional nature of ADHD.

Consequences

The consequences of this disorder go through several levels, from the social and the family level to the occupational level. The most significant consequences for children with ADHD are reduced school performance and academic achievement. These consequences result, although depending on the case, in a low level of schooling, a lower vocational performance, as well as in a low intellectual score. The consequences also depend on the type of symptoms that the individual presents, so if he presents more symptoms related to inattention, academic deficits, problems related to school and neglect of the peers are more likely to happen, whereas symptoms more related to hyperactivity-impulsivity have accidental peer rejection and injury as the most likely consequences. A

failure in consistency in performing tasks that require sustained effort is often seen as a sign of laziness, irresponsibility or unwillingness to cooperate. Also family relationships suffer from some consequences, such as discord and negative interactions between family members. Peer relationships also have some consequences, which may lead to peer rejection, neglect or teasing towards the child with ADHD (APA, 2013).

Assessment

The diagnosis of ADHD is based on clinical judgment of integrated data gathered from multiple sources to resolve conflicting observations and opinions. Since ADHD manifests itself behaviourally, three general and complementary clinical procedures are used to empirically assess the child: **interviews, questionnaires, and observations** (Coghill & Sergeant, 2010).

The aims of the ADHD assessment are to evaluate whether or not patient meets diagnostic criteria for ADHD, to distinguish ADHD from other disorders and exclude other explanations for behaviours, and to assess whether patient is suffering from any comorbid disorders. A full assessment for ADHD is not a simple tasks ans requires skill, specialist training and experience with a broad range of mental health and developmental disorders. Also, it is something that requires more than one meeting and should include: Clinical interview with the parents; A separate interview with the child; Preshool, Kindergarten and school information; School observation and investigations; Intelligence/cognitive tests if there is a specific indication (Coghill & Sergeant, 2010).

Therefore, the process of diagnostic evaluation necessarily involves collection of data from every possible sources as each can provide complementary information. So, for that it's important to know the patient's history, make observations of the patient's current behaviour and the account of parents and teachers about the child's functioning in his/her places. Usually there is poor agreement between informants (children, parents, and teachers) about the child's mental health. Children often do not reliably inform about their own behavioural symptoms and can make invaluable comments about other aspects of their life and their inner worlds. Parents seem to be good informants with respect to ADHD symptoms but often are less accurate at describing emotional difficulties. Teachers have a tendency to overestimate the presence of ADHD symptoms, especially when another disruptive behavioural disorder is also present. With adolescents, the value

of the information given by teachers is often much less, as they have several teachers each of whom spends little time with each class, which prevents them from knowing each student well enough to comment accurately (Coghill & Sergeant, 2010).

Interview schedules

There are two types of interview schedule available: Structured interview, where the questions are fixed and there is an algorithm converting answers into a diagnosis, and the semi-structured clinical interview, where the clinician is given a degree of flexibility with respect to the questions asked and then evaluates the respondents answers and reaches a decision as to whether the symptom is present or not.

Examples of these two types of interviews are the structured Child and Adolescent Psychiatric Assessment (CAPA) and the semi-structured PACS-Parental Account of Children's Symptoms (Taylor et al., 1986). Also, the Development and Well-being Assessment (DAWBA; Goodman 2000) may be of particular interest in some settings as it is possible for parents to complete the interview online and for it to be scored prior to attendance at the clinic for a face to face assessment.

Clinical interview with the parents

Tasks can be divided into a general evaluation of the child, their problems and the context within which they are occuring and specific questioning about ADHD and its common comorbidities. Past clinical history of behaviour is essential for diagnostic definition, since only a small number of patients present the characteristic signs and symptoms of ADHD at the assessment appointments. The absence of symptoms at the office does not rule out the diagnosis. A detailed social and family history is also of very importance. Clinicians should pay attention to family history of ADHD, perinatal history, since various studies have found a higher prevalence of ADHD in preterm babies and low birth weight infants (Coghill & Sergeant, 2010).

The assessment can be seen as the start of a relationship between the clinical services and the family and as those with a diagnosis of ADHD will often require a prolonged period of treatment it is important to start to cultivate a strong therapeutic alliance from the beginning, llowing space and time for the parents to describe the difficulties from their perspective (Coghill & Sergeant, 2010).

Here, the use of standardized interview schedules and scales questionnaires to identify the signs and symptoms of ADHD are widely accepted, although many clinicians do not yet employ them on a routine basis.

Separate interview with the child

This is usually more helpful in addressing general adjustment and comorbidity than for assessing the presence or absence of diagnostic criteria which are usually more accurately described by parents, family members, teachers and other observers.

The interview should focus on: Functioning in the family, the school and the peer group; A general evaluation of psychopathology (especially emotional problems and self esteem); and the child's attitude to, and coping with, their disorder. Self report rating scales may be helpful as an adjunct to an interview (especially for detecting emotional problems) (Coghill & Sergeant, 2010).

Observation of behaviour during the interview can be useful especially if ADHD or other behavioural problems are observed. An observer should focus on assessing: The presence of social disinhibition; Ability to concentrate and persist; and any evidence of language disorder (Coghill & Sergeant, 2010).

With respect to the observation of ADHD behaviours within the clinic setting it is important to remember that children with ADHD will often moderate their behavioturs in novel settings. It is therefore not uncommon for these children to appear well controlled for the first few clinic appointments. So, this should not usually be used as evidence against the presence of ADHD (Coghill & Sergeant, 2010).

Questionnaires

Questionnaires also fall into two classes: Broadband, that assess for a wide range of psychopathology and allow the clinician to screen for several disorders and; narrow band, which are specific instruments designed to screen for a particular condition. An example of the former is the Child Behaviour Checklist (CBCL, Achenbach, 1991) and the Teacher Rating Form (TRF, Achenbach, 1991) and of the latter is the Conners Parent and Teachers Rating Scales (Conners, 1978).

In clinical practice, it is useful to have a standardized teacher telephone interview to ensure standardized practice. Several tools specifically designed for this purpose are available. Alternatively, it is possible to use the ADHD-RS (ADHD Rating Scale) as a semi-structured interview (Coghill & Sergeant, 2010).

Since children referred for ADHD often present with a considerable variety of associated disorders and deficits, it should be of interest use some instruments for screening and do initial evaluation in these areas. Not all these need to be included as routine but should be used if the information gathered as a part of clinical observation, history taking and evaluation of input from parents, teachers and the child is suggestive of other difficulties (Coghill & Sergeant, 2010).

Preschool, kindergarten and school information and school observations

Information from school is essential for the diagnosis of ADHD, which can be obtained from the teacher, including information about: Behaviour and behaviour problems; Development; Social functioning; and Situational variation in behaviour and symptoms that may indicate comorbid or differential diagnoses. Standardized questionnaires can help to obtain a broad coverage of information (e.g. SDQ , CBCL and Conners'). Further written reports or structure telephoned interview may also be needed to assess the coping style of the teacher, the teacher child relationship, and also to have a full view of the child at school (Coghill & Sergeant, 2010).

If there is still doubt about the diagnosis or other aspects of functioning, a school observation is conducted. Whilst there are few validated observational measures for ADHD it is known from clinical experience that a structured approach to recording observations is often very helpful. In fact although not explicitly an observational measure the SKAMP, that was designed to specifically measure the classroom manifestations of ADHD, has been used to rate observed behaviour in the laboratory school study setting (Coghill & Sergeant, 2010).

Potential domains of interest in a school observation include general information about age of child, time of day, setting, number os children, number os adults, activity (e.g. math's class, quiet time, group or individual working, etc.), room type and set up (e.g. traditional class room, open plan, individual or group desks, etc.). Our focus should be also in some observed behaviours such as overactivity (e.g. out of seat, climbing,

fidgeting, etc.), impulsivity (e.g. answering questions directed at others, butting in, shouting out, unable to wait, etc.), inattention (e.g. needs reminding to stay on task, difficulty getting started, poor task completing, etc.), oppositional behaviours (argues with teacher or peers, aggressive to others, etc.), evidence of mood lability, level of communication and interaction with others, ability to use comprehend and use language, ability to socially interact with others, reciprocal social interactions, repetitive behaviours, ability to imitate others, ability to play appropriately, evidence of anxiety (Coghill & Sergeant, 2010).

Treatments

Approaches used to the treatment of ADHD may vary depending on many factors. These include the professional background and training of the clinician, where there is usually a difference between medically and non-medically trained clinicians, with the first ones being more likely to select pharmacologic approaches to intervention and the second one's tending to employ psychosocial treatments at the individual or family level. Treatments for ADHD can also range from those that are relatively straightforward and involve a single approach to intervention to those that are maximally complex and require intervention at multiple levels (Johnson, McAlister, & Reader, 2008).

The core symptoms of ADHD and associated features can be manifested in a child in many different ways, therefore, treatment approaches and their degree of complexity need to be matched with an individual child's needs and with the degree to which the child displays impairment in important areas such as family, school, and social functioning. For this reason, treatment may require multimodal interventions at the individual, family, school, and perhaps community levels (Johnson et al., 2008).

In selecting treatment approaches it is also important to focus on interventions supported by research findings. Currently, interventions that enjoy the strongest empirical support include the use of stimulant medications, behaviorally oriented parent training programs, behavioural classroom-based interventions and ADHD summer treatment programs (Johnson et al., 2008; Döpfner, 2010).

Stimulant medications are generally considered to be most effective in managing the core symptoms of ADHD whereas **psychosocial treatments** are usually most valuable in dealing with the psychological and behavioral problems that children with

ADHD often display, and thus increase the psychosocial functioning of the patient and their quality of life (Johnson et al., 2008; Döpfner, 2010).

Psychosocial Treatments

Well established psychosocial interventions for reducing ADHD symptoms include psychoeducation of the patient and the parents/teachers, behavioural parent training including family interventions, teacher training, behavioural classroom management strategies as well as peer-focused behavioural interventions with social skills training and cognitive behavioural therapy of the patient (Taylor et al., 2004; Pelham & Fabiano, 2008, cited in Döpfner, 2010).

To date, it seems that the behavioural parent training and school based behavioural interventions are empirically the best established psychosocial interventions while the effects of the others mentioned above have been less well studied. Several other non-pharmacological interventions (diet, neurofeedback, play therapy) have at least some support (Döpfner, 2010).

A multimodal psychosocial treatment, which includes a combination of several of these interventions is often required since each of these interventions has its own particular strengths and treatment objectives (Döpfner, 2010).

✓ Psychoeducation

Psychoeducation is an intervention aimed at developing a therapeutic relationship with the patient and his family, in order to collect information about the individual/family beliefs and attributions regarding the disorder in question, ADHD in this specific case. Based on these beliefs about ADHD, new information about the disorder is given, like especially symptoms, etiology, course, prognosis and treatment. Then treatment goals are defined as well as a conjoint treatment plan. If there is a family agreement, teachers can be interviewed to verified their beliefs about ADHD and then provide new information about this disorder. About the treatment, teachers learns about specific behavioral techniques that they can apply in their classrooms, such as techniques including praise, planned ignoring, effective commands and time out, as well as the daily report card. It is important for teachers to know more about ADHD so that the likelihood of implementing psychosocial interventions within the school is increased. Depending on

the developmental level of the child, the education of the children must be adapted according to that level and psychoeducation is gaining more importance as the child grows. Although it is considered by many authors as essential for a mental illness therapy, psychoeducation does not present essays that support its effects for ADHD (Döpfner, 2010).

Individual Approaches to Intervention

✓ School-based Interventions (Behavioural school interventions)

Many of the difficulties that characterize ADHD may interfere with a child's classroom behavior and their ability to learn, resulting in lower academic achievement. As such, researchers have long examined effective ways of helping children with ADHD to behave appropriately in school and to perform better academically (Chronis, Jones, & Raggi, 2006). For this approach to be effective it is very important that the school can cooperate and enable the teacher to be active in the treatment of the child. It's also crucial the establishment of an effective collaboration between the home and the school, otherwise conflicts between the two can lead to frustration of the teacher and/or the parents and reduce the effectiveness of the intervention (Döpfner, 2010).

School based interventions include two main components, which are classroom interventions and academic interventions.

Classroom interventions

These include modifications of the classroom itself and strategies of behavioural classroom management.

Regarding the **classroom structure**, a common intervention is the use of individual and separated desks to achieve a decrease of distraction and the use of visual aids as posters and signals. Studies also show that traditional classroom settings with rows and opposite-sex seating can increase task engagement and lead to lower levels of distractability (Döpfner, 2010).

Behavioural classroom management generally involve regular consultation with the child's teacher regarding the use of behavior modification strategies. Consultation usually begins with psychoeducation about ADHD and identification of specific target behaviors, based upon a functional assessment of behavior (i.e.,

examination of antecedents, behaviors, and consequences). Teachers are then instructed regarding the use of specific behavioral techniques as praise, planned ignoring, effective commands, daily report cards as well as the use of contingency management techniques (e.g. incentives, reward programs, point systems, time-out) (Chronis et al., 2006; Döpfner, 2010). The DRC is a school-based intervention in which specific, challenging but attainable behavioral goals are set and the child is rewarded at home based on the attainment of these goals. It also provides parents with daily feedback regarding their child's behavior and perfonnance at school, and allows them to provide back-up reinforcement for classroom behavior. Many researchers have reported beneficial effects of the DRC intervention (Chronis et al., 2006).

Most studies show effects of the behavioral classroom management on both classroom behaviour and social adjustment but the effects on academic performance are less clear (Döpfner, 2010). Miranda (2006) demonstrated the effects of a multi-component classroom intervention which included psychoeducation for the teacher, use of contingency management, instructional management procedures as well as changes in classroom environment and use of self-instructional procedures. This programme resulted in significant improvements in ADHD symptoms, and reduced school problems and antisocial behaviour rated by both parents and teachers.

Academic interventions

Children with ADHD frequently evidence difficulties in academic achievement, high risk of comorbid learning disabilities, and high rates of expulsion, dropout, and grade retention (Daly et al., 2007). For this reason, emphasis on academic interventions is vital to the comprehensive treatment of ADHD. This approach focus primarily on manipulating antecedent conditions such as academic instruction or materials in order to improve both behavioral and academic outcomes. Academic approaches that show some preliminary support include task and instructional modifications, peer tutoring, computer-assisted instruction, and strategy training (Chronis et al., 2006).

Peer tutoring is an instructional strategy whereby two students work together on an academic task with one student providing assistance, instruction and feedback to the other, thereby simultaneously working on academic and social skill goals. The aim is to increase of on-task behaviour and enhance attention (Chronis et al., 2006 ; Döpfner, 2010).

A well described model is the classwide peer tutoring (CWPT), where tutoring is carried out by tutoring pairs with praise and points for correct answers and correction with subsequent practicing for wrong answers. CWTP has been shown to result in increased active engagement in academic tasks and reduced in off-task behaviour with a subsequent improvement in academic performance by ADHD students (Chronis et al., 2006).

Another method of academic intervention uses the **modification of tasks and instructions.** Task modifications involve revision of the curricula, whereas modification of instructions involves adapting the content and delivery of instructions to meet the needs of ADHD children (Döpfner, 2010).

For task modification it is recommended to match the tasks to each child's ability, reduce task length, divide tasks into subunits and sett goals for the child to achieve in shorter time intervals, increase specificity or visual stimulation in instruction, use enthusiastic yet task-focused presentation with the possibility of frequent and active child participation, use brief and one-at-a-time presentation of academic assignments, intercalate academic periods with brief periods of physical exercise, schedule the more academic subjects into the morning hours, allow extra time for written tests (Barkley, 2006; DuPaul & Eckert, 1998).

A very specific form of instructional modification is the use of **computer-assisted instruction (CAI)** with the aim to improve academic performance of children with ADHD. CAI entails the manipulation of the task format through presentation of specific instructional objectives, highlighting of essential material, using of multiple sensory modalities, dividing content material into smaller chunks of information, providing immediate feedback about response accuracy, and limiting the presentation of nonessential and distracting features (Chronis et al., 2006; Döpfner, 2010). The few studies of CAI that have been conducted report na increase in academic achievement across multiple areas of performance such as mathematics science, oral reading fluency, and attention and concentration (Daly et al., 2007; Döpfner, 2010).

Strategy training is another form of academic intervention that involves training children in procedures to meet the requirements of a specific academic situation and which can directly address the students needs, e.g. notetaking, study skills, homework completion, or self-reinforcement procedures (Döpfner, 2010; DuPaul & Eckert, 1998). Strategy training that focuses on note-taking skills has demonstrated some preliminary efficacy with adolescents (Daly et al., 2007).

✓ Peer interventions and social skills trainings

Inumerous studies have come to the conclusion that most children with ADHD experience difficulties in developing and sustaining peer relationships due to symptoms associated with their disorder, including hyperactivity and impulsivity (Pelham, Fabiano, & Massetti, 2005).

Children with ADHD tend to be more impulsive, argumentative, and aggressive than their typically developing peers, and are often rejected by their peers. In addiction, it is also know that deficits in peer relationships and social functioning continue well into adolescence and even adulthood (Daly et al., 2007).

Therefore, these findings suggesting that peer rejection it's not only very common, but may also lead to serious long-term consequences, led to the design of psychosocial interventions that specifically target peer relationships.

These interventions include instruction in social skills, social problem-solving, and behavioral competencies. The aim is to enhance social competence by encouraging close friendships, and decreasing undesirable and antisocial behaviors (Daly et al., 2007).

Because the children with ADHD do not perceive themselves as less socially effective than their peers, the primary goal of social skills training is to promote prosocial behaviours that include cooperation, communication, participation and validation (Döpfner, 2010).

Surprisingly, interventions that employ social skills training as a stand-alone treatment for children with ADHD have not demonstrated significant effects on the children's social status or on their overall social behavior. On the other hand, social skills training envolving groups seems to represent better outcomes, with groups typically being conducted at a clinic, summer treatment program, or in school-based settings and often including parent and teacher participation. The reason to work better in a group format is because of the difficulty children with ADHD have with self-observation and self-monitoring and the opportunity in groups for feedback, modeling, and contingent reinforcement (Pelham, Fabiano, & Massetti, 2005; Daly et al., 2007).

There is evidence that combining social skills interventions with behavior management programs and parent training does improve ADHD children's behavior toward their peers. The **Summer Treatment Program**, developed by Pelham and colleagues (Pelham et al., 2005), is one example of a combining intervention components. It's an intensive 8-week behavioral treatment intervention for children with ADHD that includes social skills training, a reward and response cost system, group practice and

instruction in sports skills and team membership. Positive effects of this program including enhanced social functioning have been shown in several randomized controlled studies (Döpfner, 2010)

Therefore, knowing that children with ADHD who overcome their social problems do better in the long term (Daly et al., 2007) and that it's possible to have positive outcomes from social skills training, it is crucial to implement effective psychosocial interventions of this kind.

✓ Cognitive Behavior Therapy

Cognitive Behavior Therapy has as main objective to promote the self-control of behavior using problem-solving strategies. There are several types of cognitive behavioral treatments for intervention in children with ADHD, using various techniques such as self-reinforcement, self-evaluation and self-monitoring (Döpfner, 2010). Self-reinforcement is an intervention in which the child with ADHD performs a desirable behavior within the predetermined performance standards and when performing this behavior receives a stimulus that increases the probability of the behavior to be repeated in the future. Self-management or self-evaluation is an intervention in which the child with ADHD is proposed to monitor, classify and compare aspects of their behavior with an external pattern of behavior. Finally, the child should assess their behavior in the light of this comparison and, if the child's assessment resembles the assessment of external observers, the child is reinforced. Self-monitoring is an intervention in which the child with ADHD when performing a desired behavior should be aware that he / she has performed and should register its occurrence. This intervention can be performed more linked to attention (self-monitoring of attention) or to performance (self-monitoring of performance). Self-monitoring of attention is intended to stimulate the child's awareness of the attention he expends in a task that needs attention to be accomplished. Self-monitoring of performance I aim to stimulate the child's awareness for the accuracy of the work they performed, during or after the task accomplishment (Reid et al., 2005).

Focusing cognitive behavior therapy on the specific case of ADHD, the goal is to improve behavioral and adaptive skills of children with ADHD by teaching them how to monitor their behavior, consider, implement and evaluate the various solutions in problem situations and provide contingent reinforcement for their behavior. This goal is important since children with ADHD do not have sufficient self-regulation skills due to their hyperactivity and impulsivity. Although there is much research about the various types

of cognitive-behavioral intervention, the evidence does not show significant differences in the behavior or academic performance of children with ADHD. These results are related to the fact that children have difficulties in generalizing their abilities to different contexts, especially when they feel lack of inspiration in others (Chronis et al., 2006).

Family-based psychosocial interventions

✓ Behavioral Parent Training (BPT)

Several studies with ADHD with children and their parent showed conflicted parent–child interaction patterns and less positive parenting practice (Deault, 2010), being that daily activities became more difficult with this children, such as going to sleep or doing their homework, and their parents showed a significant increase of parenting stress (Lee et al, 2012). This enlightens the importance and need for the parents of children with ADHD to have tools and skills to manage their kid's disorder, help them cope and help them improve their kid's behavior. A known intervention to help stop stressful patterns between parents and children is the Behavioral parent training (BPT), which helps parents to "create a structured, predictable environment in which they reward positive behaviors - such as raise, positive attention, or tangible rewards - and apply negative contingencies in response to problem behaviors" that depending on the severity of the inappropriate behavior can be the loss of previously earned rewards, time-out or other contingencies such as ignoring (Johnson et al, 2008). Basically, this approach focus on reducing any positive reinforcement being unintentionally provided to the child for engaging in disruptive/defiant behavior, while simultaneously increasing the reinforcement parents provide for appropriate and compliant behavior.

A very well-known example of parent-training regimen is based on the coercion theory by Gerald Patterson (1982) that was used in his book specifically written for the use of parents and teachers, Living With Children. This program is applicable for parents with children between the ages of 6 to 16 and it leads parents to identify their sons' specific problematic behaviors that will be the targets of the treatment, ignoring or using negative consequences to deal and monitoring and rewarding positive behaviors (Johnson et al, 2008). Several studies approve the effectiveness of this social learning approach in fostering positive interactions between parents and children, being this usually developed

in sessions with parents in order to discuss the problems and respective reinforcements or contingencies.

A similar treatment which effectiveness is also empirically supported is Videotape Modeling Parent Training developed by Carolyn Webster-Stratton that consists on the use of videotaped lessons that are showed in group situation and in which a therapist presents and discusses the most appropriated ways to approach a certain behavior and what responses show parents use (Johnson et al, 2008). Behavioral parent training is then a good example of a family-based treatment that has been proved to be highly effective in managing many of the disruptive behaviors displayed by children with ADHD and show be applied by the parent in a continuous way, being that studies also show that the problematic behavior of the children can start to occur again if the parent stop applying the reinforcements or punishments (Lee et al, 2012).

Structural Family Therapy (SFT)

According to Anastopoulos and collaborators (2005), family therapy tries to help families developing some patterns of organization to conduce to better child management, being some of those patterns a high level of parental cooperation in order to solve problems, a better defined hierarchy between parents and children and "supportive family relationships, clear communication, clear and moderately flexible rules, roles and routines". A meta-analysis show that this approach is effective in decreasing the ADHD symptoms (Farmer et al, 2001) and another study by Kazdin (2001) also supports the effectiveness for family based and child based intervention. However, there are different models of family therapy, such as Structural Family Therapy that is based on the mentioned assumption that families must have a well-functioning hierarchy and its role it's to challenge the family and the difficult interpersonal relationships in order to enable the existing disorganization; Strategic family therapy that views family difficulties has a result of multiple and repeated dysfunctional communications; and Brief solution-focused therapy occurs when the problems aren't so evident and tries to demonstrate to the family that they already have the solution to these problems.

Focusing on the Structural Family Therapy, Barkley and collaborators (1992) applied it on a study comparing three different approaches to for treating family conflicts in Adolescents with ADHD, being that their description of it can help us understand how it is applied. Following the principles set by Minnuchin (1974) and described by Aponte and Van Deusen (1981) in helping families to identify and alter maladaptive family

systems or interaction processes" (Barkley et al, 1992) the therapist should focus on creating transactions in the family and help to restructure the previously existing maladaptive transactions. During 8-10 weekly one hour sessions, the family dynamics are observed - including the family boundaries and the different powers applied – and the possible changes are proposed to the family. Homework involved instructions to replace ineffective family transactions with new strategies, such as empowering a weak parent authority. A meta-analysis review of studies using this treatment showed that it was more effective than alternative therapies (Hazelrigg, Cooper, & Borduin, 1987) and other authors (Mann et al, 1990) found that a multisystemic version of this therapy could be equivalent or even superior to individual child psychodynamic therapy and "more effective than a control treatment condition in treating clinic-referred boys with behavioral problems" (Barkley et al, 1992).

Psychodynamic Psychotherapy of ADHD

Psychoanalytic conceptualizations of ADHD diagnosis tends to center in two major theoretical camps – Ego Psychology and Object Relations. Ego Psychology oriented therapists conceptualize ADHD as deficits in the ego functions to synthesize, analyze, and integrate experiences and difficulty with reality. Object Relations therapists adopt a more relational view of ADHD as stemming from disturbances in object relations. These two approaches are not mutually exclusive and Ego Psychology is seen as a foundation for interpersonal relations. Additional psychoanalytic conceptualizations of ADHD include the notion of trauma and the resulting role of early interventions, explaining that trauma may be one reason for the disturbance in object relations and is being considered more in clinical work with ADHD diagnosed children (Conway, 2012).

Therefore, both the main theoretical camps seem to be key concepts used to understand the child's pathology, and for that it is important for a psychodynamic psychotherapist to consider both the quality of the object relations and the child's ego functioning when treating the child.

Key practice components for the positive outcomes of psychodynamic psychotherapy with ADHD children include working with positive transference; establishing a therapeutic relationship with the child; developing ego functions; educative supportive interventions; encouragement, reassurance and empathy; expressive component; active

listening; facilitative comments to encourage expression and reflection; summarizing a child's statement; directing attention; interpretations; "here-and-now" interpretations; parent work; collaborative conferences with teacher(s) (Conway, 2012).

By subscribing to a theoretical orientation, that determines the goal of treatment. Object relations therapist value the relationship with the client and believes that the ability to establish a therapeutic relation with a therapist offers another opportunity to examine and possibly correct or amend existing object relations. Certainly, a child's development sets the stage on which the relations with objects are built (Conway, 2012).

Overall, both object relations and ego psychology are given equal attention in regard to their importance in changing the child's behavior in therapy.

Neurofeedback and BCI

Neurofeedback is a technique that focus on helping people train themselves in order to directly affect brain function, to self-regulate a single measure of brain activity and it does so by providing the individual feedback of their brain waves (Delaimi et al, 2016; Micoulaud-Franchi et al 2014). It involves a non-invasive measurement of an individual's live brain activity using electroencephalography (EEG), which consists of using electrodes on the head of the person to collect information that will be then provided through an ongoing simplified feedback on the computer (Johnstone, 2013). This training is based on an operant conditioning process in which only the desired brain activity is rewarded (Mayer et al, 2015), trying to achieve self-control through feedback and positive reinforcement hoping to implement these self-regulation skills in every day activities (Micoulaud-Franchi et al 2014). There's been an increasing interest in applying this kind of treatment in children with ADHD, being that a series of studies support its effectiveness and the fact that it significantly improves "attention, behavior control, increases cortical activity and improves their score of IQ test and academic achievements" (Deilami et al, 2016).

A more practical and efficient way of using this method in children is using it games and brain-computer-interface (BCI) systems, which uses neurofeedback to control and extern program or device. Children like games and it has been shown that games with hidden exercises have helped overcome their concentration, control and memory problems (Ali & Puthusserypady, 2015). Focusing in more specific examples, Ali and Puthusserypady (2015) describe an application made for children with ADHD with a

virtual 3D learning playground based on the steady state visual evoked potentials (SSVEP) and that does not require any special training. "The system consists of a virtual 3D classroom where the subjects play 2D games on the blackboard while 3D distractions run inside the 3D environment. This naturalistic and realistic environment serves as training to motivate with familiarity and brings the achieved results inside the 3D classroom to the real classroom without any issues" (Ali & Puthusserypady, 2015). The mentioned distraction are realistic things, such as paper planes, children running in the hallway or peeking through the window, in order to make the experience more applicable in real life, working real aspects that would distract the child in school. The game helps children with ADHD to keep attention providing certain consequences on the movement of the character or the point score if the subjects derail the SSVEP paradigm or the objects falling down, being that neurofeedback its being collect in real time and used on the development of the game according to the child's answer and attention.

Another example it's given by Wrońska and collaborators (2015) regarding a trial that was made using an iPad, since nowadays children are more and more attached to this kind of technology. A game was installed in which children were asked to do several tasks carefully and without hurry, monitoring their points gained and the time needed to perform the tasks. This trial didn't apply neurofeedback in this instance, using it to have the opinion of the children about the visual details, difficulty and to see if they feel any difference while playing the game on a regular bases - the results were positive, the children feeling more concentrated when they could play during their day. Another study corroborates this occurrence, being that Wegrzyn (2012) analyzed the effect of playing this kind of designed games and the participants indicated that when they stopped playing, no matter what specific game they were using, they felt less focused and starting having more problem in being attentive during their school classes, were more fidgety and felt bored more easily. This shows perhaps the use of brain games is indeed effective, can help treating certain symptoms of ADHD and that in order to achieve the best results it must be a continuous application (Marcus & Mattiko, 2007).

Dietary Interventions

The numerous alternative or nonmedical treatments that have been proposed for ADHD over the years include several kinds of dietary interventions.

Numerous food additives have been proposed to have a substantial impact on ADHD symptoms. Essential omega-3 and omega-6 fatty acids (phospholipids which are

contained in neuronal cell membranes of the brain), are supposed to exert a positive effect on neurotransmission and so it has been hypothesized that a lack of those polyunsaturated fatty acids may play a major role in the pathogenesis of ADHD. These fatty acids cannot be synthesized by the human body and therefore have to be obtained from foodstuffs or added as food supplements. However, it seems that investigations of the effects of omega-3 and omega-6 fatty acid supplementation have reported inconsistent results, so a sensible conclusion would appear to be that these treatments are still in an experimental phase (Döpfner, 2010).

Also, some food components have been postulated to have a negative impact on behaviour and it has been supposed that the elimination or restriction of those components from the diets of children with ADHD will decrease ADHD-symptoms. Such substances include sugar, several preservatives, food colourings, and potentially allergenic foodstuffs. In the main evidence for their effects on ADHD symptoms is rather weak and for sugars there is considerable evidence that it does not result in hyperactivity (Döpfner, 2010). Therefore, further studies are needed to address the question whether restricting these additives in the diets of children with ADHD will reduce their symptoms.

Relaxation Therapies and Mindfullness

Relaxation therapies have been studied in the treatment of ADHD. Since hyperactivity symptoms exacerbate when there is an inability of relaxation and muscle tension, the practice of yoga seems to be a good answer to this problem, having a calming effect, such as the reduction of hypertension and heart and respiratory rate. An intervention taking into account the practice of yoga has also revealed influence on the activity and neurological and physiological behavior. Relaxation can be performed according to different activities, such as **respiratory training** - selectively using the nasal and oral routes for the respiratory flow, so as to raise awareness of the child's breathing and to train the child to breathe with both nostrils; **postural training** - using stretching, backward, forward and side pushing, and also extensions and inversions made in sitting, standing, supine, and prone positions -; **relaxation training** - relaxing the body and tensing and relaxing muscles, in order to help the child to be aware of his own body - and **concentration training** - using *Trataka*, a technique in which children focus on a word or form and They see with their eyes closed, and then on a sheet of white paper. The efficacy of this treatment modality in children with ADHD is not yet widely studied, but

according to existing literacy, yoga is important for stabilizing emotions and reducing oppositional behavior (Jensen & Kenny, 2004).

Stress can interfere in several areas responsible for executive functions, such as behavioral, cognitive inhibition and working memory. Thus, it is important to intervene in children with ADHD in order to reduce stress, since interventions for reducing stress in ADHD are usually focused on parents and their interaction with the child. **Meditation** techniques are a habitual way of dealing with stress and improving psychosocial factors. Meditation may be oriented toward concentration techniques or contemplation techniques, each of which has different process and consequently different effects. Concentration techniques are, for example, Zen meditation, in which the individual focuses on something specific (event, image, sound), turning all his attention to that single focus. Contemplation techniques, such as mindfulness, aim to make the individual aware of all his thoughts and feelings while trying not to judge or become actively involved in the thoughts. According to existing research, meditation is capable of altering neuronal activity and dopamine levels in the brain, as well as improving the self-esteem and family relationships of children with ADHD (Grosswald et al., 2008). The practice of **mindfulness** is meant to sift all attention into purpose, giving full attention to that task. Thus, it allows a greater capacity to focus, sustain attention and attribute cognitive resources. Although it may seem an easy practice, for children with ADHD who find it difficult to sit quietly for a long period of time or to focus their attention on a single point, it can be an uncomfortable practice. Therefore, it is important that there are strategies For cases where the discomfort is becoming harmful (Murrell et al., 2015). By focusing attention on the present moment, attention is directed to internal experiences such as bodily sensations, emotions, thoughts and tendencies of action, and to environmental stimuli such as smells and sounds. This practice gives children greater control over their own attention by helping children respond to stimuli, rather than reacting to stimuli, since by being aware of their thinking, emotion, and reaction patterns, the child may interrupt and change them. Although the existing studies demonstrate that the practice of mindfulness presents improvements in the life of the children with ADHD, this is not a field well studied and needs more studies of effectiveness (Meppelink et al., 2016).

Another stress reduction technique that helps in intervention with children with ADHD is **transcendental meditation**. This technique is not part of the techniques neither of contemplation nor of the techniques of concentration, being a technique to transcend without effort. In this sense, it is suggested that the child feels with his eyes closed for 10

to 20 minutes, in the morning and again in the afternoon. While performing this activity the active mind settles down to a silent yet fully awake state of awareness, the mind being alert while the body is in relaxation. During this process, there is activation in frontal and parietal attentional areas of the brain responsible for attention, executive function and emotional stability. This technique, although with little literature that supports its effectiveness, shows improvements in behavior and school performance, decrease in oppositional behavior, better emotional regulation and well-being (Grosswald et al, 2008).

Pharmachological Treatments

Clinical guidelines support the use of pharmacotherapy as one of several treatment options for ADHD in children and adults (American Academy of Child and Adolescent Psychiatry, 2002) being that this has been one of the most widely known and recommended interventions for the last 30 years (Pelham et al, 2000). Methylphenidate (MPH) or mostly know as Ritalin is the most prescribed stimulant in these cases and it's responsible for produce psycho stimulation by inhibiting the presynaptic uptake of impulse-released dopamine. Untreated ADHD patients show a significant increase of the dopamine transporter and after being treated with methylphenidate this concentration decreases (Roman et al, 2002) and so do the restless behaviors, the unthoughtful actions and there's a better ability to concentrate and focus. It seems to modulate dopamine and noradrenaline signaling in brain regions associated with motivation and reward and, by blocking the dopamine transporter molecules, it increases the extracellular levels of dopamine – being that lower levels of dopamine represent less concentration (Pelham et al, 2000). Although, it is important to mention that stimulants have not been shown to produce long-term changes in achievement or long-term prognosis, only 70–80% of children with ADHD respond positively to a stimulant regimen and few show sufficient improvement for their behavior to fall entirely within the normal range (Pelham et al, 2000).

Multimodal Interventions - Conclusion

As a result of the limitations associated with employing either stimulant therapy or behavior modification as a stand-alone treatment, combined or multimodal interventions often are viewed as the gold standard for ADHD treatment (Daly et al., 2007).

Behavioral techniques seem to be useful to improve ADHD symptoms and they may have a larger impact than stimulant medication on associated impairments, while stimulants may have a larger impact on specific symptoms associated with ADHD (Daly et al., 2007).

Specifically, Bennett and colleagues (1999) argued that to effectively increase prosocial behaviors in children with ADHD it may be necessary to combine stimulant use with adjunctive psychosocial therapies, such as social skills training or behavioral management.

Also, Hinshaw and colleagues (2006) found that the combined intervention was most effective in mitigating related areas of functional impairments including troubled family relationships, social skills deficits, defiant and oppositional behavior, and poor academic achievement.

Therefore, as a conclusion, it seems that the inherent limitations of both behavioral approaches and pharmacotherapy may be best addressed through a combination of pharmacotherapy and behavioral treatment.

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