

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/378017564>

Non-pharmacological treatment of Attention Deficit Disorder with or without Hyperactivity (ADHD). Overview and report of the first international symposium on the non-pharmacologica...

Article in *L'Encéphale* · February 2024

DOI: 10.1016/j.encep.2023.04.010

CITATIONS

0

READS

131

11 authors, including:



Chantal Martin-Soelch

Université de Fribourg

182 PUBLICATIONS 2,540 CITATIONS

SEE PROFILE



Véronique Parent

Université de Sherbrooke

31 PUBLICATIONS 161 CITATIONS

SEE PROFILE



Albert Ponsioen

stichting Gaming & Training, Polsbroek, the Netherlands

17 PUBLICATIONS 507 CITATIONS

SEE PROFILE



M.-C. Guay

Université du Québec à Montréal

29 PUBLICATIONS 753 CITATIONS

SEE PROFILE



Disponible en ligne sur

ScienceDirect
www.sciencedirect.com

Elsevier Masson France

EM|consulte
www.em-consulte.com



Symposium Report

Non-pharmacological treatment of Attention Deficit Disorder with or without Hyperactivity (ADHD). Overview and report of the first international symposium on the non-pharmacological management of ADHD

Prise en charge non pharmacologique du trouble déficit de l'attention avec ou sans hyperactivité (TDAH). État des lieux et compte-rendu du premier symposium international sur la prise en charge non pharmacologique du TDAH

Amélie Dentz^{a,*}, Chantal Martin Soelch^a, Cherine Fahim^a, Alexandra Torsello^a,
Véronique Parent^b, Albert Ponsoen^c, Marie-Claude Guay^d, Stéphanie Bioulac-Rogier^e,
Céline Clément^f, Michel Bader^g, Lucia Romo^h, Research consortium for
non-pharmacological interventions on ADHD

^a Université de Fribourg, Département de Psychologie, rue P.A. de Faucigny 2, 1700 Fribourg, Switzerland

^b Université de Sherbrooke, Longueuil, Québec, Canada

^c The Gaming & Training Foundation, Polsbroek, Pays-Bas

^d Université du Québec à Montréal, UQAM, Québec, Canada

^e CHU de Grenoble, Grenoble, France

^f Laboratoire Interuniversitaire des Sciences de l'Éducation et de la Communication (EA 2310), Université de Strasbourg, Strasbourg, France

^g Unité de Recherche, Service de Psychiatrie de l'Enfant et de l'adolescent (SUPEA – DP CHUV), Lausanne, Switzerland

^h EA4430 CLIPSYD, UFR SPSE, Paris Nanterre Université, Nanterre, France

ARTICLE INFO

Article history:

Received 4 April 2023

Accepted 24 April 2023

Available online xxx

Keywords:

ADHD
Attention deficit hyperactivity disorder
Adult
Child
Adolescents
Psychostimulants
Cognitive training
Mindfulness
Yoga
Neuro-feedback
Family
Cognitive behavioral therapy
Metacognition

ABSTRACT

Attention Deficit Disorder with or without Hyperactivity (ADHD) is a neurodevelopmental disorder which affects the day-to-day functioning of children and adults with this condition. Pharmacological treatment can reduce the symptoms associated with ADHD, but it has some limitations. The objective of this symposium is to determine the effects of non-pharmacological approaches on ADHD symptoms. Results indicate that the following interventions are promising approaches: cognitive behavioral therapy (CBT), mindfulness-based interventions (MBI), yoga, cognitive and metacognitive intervention, neurofeedback and parental training programs. Current research advocates multimodal approaches in conjunction with school or work accommodations integrating innovative technologies.

© 2023 L'Encéphale, Paris.

* Corresponding author.
E-mail address: ameliedentz@hotmail.com (A. Dentz).

R É S U M É

Mots clés :

TDAH
Trouble de l'attention avec ou sans hyperactivité
Adulte
Enfant
Adolescents
Psycho-stimulants
Entraînement cognitif
Plleine conscience
Yoga
Neuro-feedback
Famille
Thérapie cognitivo-comportementale
Métacognition

Le Trouble Déficit de l'Attention avec ou sans Hyperactivité (TDAH) est un trouble neurodéveloppemental qui affecte le fonctionnement au quotidien des enfants et des adultes qui présente ce trouble. Un traitement pharmacologique permet de diminuer les symptômes associés au TDAH mais présente certaines limites. L'objectif de ce symposium est de déterminer les effets sur les symptômes liés au TDAH des approches non pharmacologiques. Les résultats sont prometteurs pour les approches suivantes : la thérapie cognitive et comportementale (TCC), les interventions thérapeutiques axées sur la pleine conscience, le yoga, les interventions cognitives et métacognitives, le neurofeedback, ainsi que les programmes ciblant les habilités parentales. Les recherches actuelles préconisent des approches multimodales réalisées conjointement à la mise en place d'aménagements en milieu scolaire ou professionnel et intégrant l'apport des technologies innovantes.

© 2023 L'Encéphale, Paris.

1. Introduction

On Friday the 14th of June 2019, the University of Fribourg Switzerland was home to the first international symposium on non-pharmacological approaches to ADHD. The call for the symposium targeted three objectives:

- bringing together international specialists in the non-pharmacological management of ADHD;
- promoting research on non-pharmacological interventions targeting ADHD internationally;
- developing common recommendations for the non-pharmacological treatment of ADHD.

This narrative review aims to present an overview of the symposium. Attention Deficit Disorder with or without Hyperactivity (ADHD) is one of the most common neurodevelopmental disorders, with a global prevalence estimated at between 5.3% and 7% for school-aged children [1,2]. ADHD is characterised by symptoms of inattention, impulsivity and hyperactivity that do not match the expected level of development for the age of the child concerned [3–7]. Symptoms must appear before the age of 12, last six months, and interfere with daily life activities to be diagnosed as ADHD. Based on neuroscience and less on symptom expression, autism spectrum disorder (ASD) and ADHD are currently grouped together in neurodevelopmental disorders in the DSM-5 [4].

ADHD complex and heterogeneous symptoms are to be observed in at least two areas of functioning, such as school, work, social interactions, or family life to allow a diagnosis of ADHD [3]. ADHD persists into adulthood in about 60% of cases according to studies [8,9], and its prevalence in adulthood is estimated to be about 2.8% [10]. Recently, some studies argue for a decreasing prevalence of ADHD across the adult lifespan [11,12].

As a neurodevelopmental disorder, ADHD has far-reaching consequences, as it affects the social, occupational, professional, and cognitive functioning of the individual suffering from it [13]. Untreated, it may significantly impair multiple aspects of life, leading to educational underachievement, unemployment, unsuccessful marriage and criminality [12]. Many patients do not receive an appropriate diagnosis and therefore do not have access to specific interventions [14]. This is of particular interest since ADHD across several studies showed significant correlations with a wide range of comorbid disorders, including bipolar disorder, oppositional defiant and conduct disorders, antisocial personality disorder, and substance use disorder, placing a considerable burden on society and family [12]. Hence, when left untreated, the disorder can have deleterious personal, economic, and social consequences

and negatively impact the quality of life [15]. It is therefore important to promote and develop more research on ADHD, especially in its implementation.

In terms of treatment, current clinical guidelines advocate the use of non-pharmacological treatments in conjunction with medication for the management of ADHD in children and adults [16]. The pharmacological treatments mainly used are either psychostimulants (amphetamine and methylphenidate) or non-stimulants such as atomoxetine, clonidine, guanfacine) [17,18]. Both classes of medication have proven efficacy in treating ADHD symptoms [19]. However, drug treatment is associated with side effects and limitations [20]. For example, comorbid disorders reduce the effectiveness of stimulants [21]. In addition, there is still little data on the long-term effects of medication prescribed for ADHD [18,22]. In the absence of pharmacological treatment, or when the effects cease, difficulties are observed especially when children must do their homework. In addition, psycho-stimulants can also have side effects on sleep, hunger and growth [23]. These are among the reasons why parents are sometimes reluctant to prescribe psycho-stimulants [18,24]. In addition, compliance with treatment often decreases in adolescence and adulthood [25]. Although clinical guidelines internationally recommend a combination of drug treatment with non-pharmacological interventions, few non-pharmacological interventions are offered to patients with ADHD. This may be related to the fact that there is still very few clear international recommendations in this area [26]. In this recent review, Pliszka and colleagues assessed the current Clinical Practice Guidelines (CPG) in the diagnoses and treatment of ADHD. They concluded that CPGs emphasise the need for early screening, a diagnosis based on history and standardized rating scales, as well as the use of evidence-based psychosocial and pharmacologic treatments. However, they noted that although limited research has shown ADHD CPGs do change provider practice, there is no research examining if the changes in practice brought about by CPGs impact patient outcomes.

Here we emphasise that, the evidence regarding the effectiveness of these interventions is partly contradictory, and the new approaches being developed still need empirical evaluations regarding their effectiveness. The most frequently used non-pharmacological approaches in the management of ADHD for which there is empirical evidence consist of cognitive training, cognitive behavioural therapy (CBT) and, more recently, neurofeedback and mindfulness [27–31]. Nonetheless, interdisciplinary tensions when developing interventions supporting individuals with ADHD were recently documented [32].

The main aim of this first international symposium on non-pharmacological approaches to ADHD was therefore to provide a first overview of research in this field, by bringing together

researchers active in the evaluation and development of different types of non-pharmacological interventions. The specificity of symptoms associated with ADHD in adolescence is also addressed to understand how to adapt non-pharmacological treatments to this age group. A second aim of the symposium was to stimulate and promote research collaborations and exchanges between experts, to create a research consortium on this topic, with the medium-term objective of developing clinical guidelines for the non-pharmacological management of ADHD. Finally, this symposium was open to the public to allow the latest research in this field to be disseminated to practitioners. In this sense, the symposium was a great success, as the audience was very large, which also underlines the need for more information and research on this topic. This symposium took place at the University of Fribourg (Switzerland) on 14 June 2019. The purpose of this article is to provide a comprehensive overview of the contents presented in this symposium. In the coming section, contents are organised according to the following themes:

- cognitive, neuro-cognitive and meta-cognitive approaches;
- mindfulness and yoga;
- age-specific approaches.

2. Cognitive, neuro-cognitive, and meta-cognitive approach

2.1. Impact of cognitive and meta-cognitive training in a population with ADHD

Cognitive training has been used in clinical practice and research with individuals with ADHD for about 20 years [26,33]. It is hypothesised that cognitive training could be beneficial as ADHD is associated with cognitive deficits [34]. Cognitive training refers to the use of a specific program or activity to improve cognitive functioning through repetition of exercise over several weeks [35]. The proposed exercises specifically target one or more cognitive functions and are usually tailored to the individual's performance [36]. Indeed, a good clinical practice should keep in mind that ADHD is a clinically heterogeneous neurodevelopmental disorder, hence clinical differences between patients may be observed [12].

Superbia-Guimarães and colleagues [37] in a review of the literature, found that cognitive training of working memory, for example with the Cogmed program, improves short-term, visual-spatial and verbal memory in young people with ADHD, for tasks similar to the exercises proposed during the sessions. These results are maintained six months after the end of the sessions. However, these results were not observed when the young people were already taking medication for ADHD before the Cogmed program was carried out, as cognitive functioning was already improved by the pharmacological treatment [38]. Of particular importance, results from several studies do not show effects on ADHD-related symptoms and functions not targeted by the Cogmed exercises, such as inhibition, attention, daily executive functioning and academic performance [34]. Although fewer in number, studies of adults with ADHD show similar findings to those of young people, showing improved working memory skills but no generalisation effects [39].

Along these lines, Veloso and co-authors [40] for their part, looked at the effects of cognitive training targeting a variety of cognitive functions and not just on working memory, as in the Cogmed program. In their review of the literature, the authors report improvements in targeted cognitive functions such as attention, inhibition, working memory, planning and cognitive flexibility, compared to a control group, in 14 studies versus four. Seven out of nine studies reported that the positive effects of cognitive training were maintained three to six months after the

end of the intervention. In terms of generalising effects, 11 out of 22 studies show a reduction in ADHD-related symptoms as assessed by parents or teachers. However, the effect sizes remain highly variable (from small to large), which makes it difficult to draw a clear conclusion on this issue. Veloso and colleagues therefore concluded that the effects of cross-functional cognitive training seemed encouraging, but that further studies systematically including an active control group and a double-blind evaluation were needed to empirically determine the effectiveness of cross-functional cognitive training with young people with ADHD.

To date, cognitive training programs, particularly those targeting working memory such as Cogmed, have been proposed without specifically identifying the impaired sub-components of this function in a population with ADHD [41]. New research perspectives on cognitive training and ADHD emphasise the importance of theoretically defining impaired cognitive functions in individuals with ADHD and then targeting them directly in cognitive training programs [42]. Within this framework, a recent study argued for the use of a modified Cogmed training (MCT) [43]. The MCT was associated with some improvement which could not be attributed to increased working memory capacity and may reflect other facets of the program. Such results question the usefulness of Cogmed but highlight considerations for optimising adherence, engagement, and the therapeutic alliance in interventions for ADHD youth.

One of the difficulties researchers face, however, is that the cognitive dysfunctions associated with ADHD remain heterogeneous [44]. Based on the results of the scientific literature, it is not possible to systematically carry out the same cognitive training exercises with individuals with ADHD, as the associated cognitive deficits are highly variable [33].

Another limitation of cognitive training is that this type of intervention has a direct action, as it trains one or more targeted cognitive functions, which does not, however, favour generalisation into everyday life [45]. According to this author, integrating metacognitive elements involving indirect action and compensatory strategies would promote self-regulation capacities and awareness of difficulties, which would allow the generalisation of acquired skills in everyday life. In order to better generalise the effects, it has been proposed to use metacognitive interventions [46]. Metacognition is the ability of the individual to become aware of their own internal cognitive processes [47,48]. With this in mind, Cella and colleagues (2019) consider that two functions are essentially targeted in metacognitive interventions: meta-knowledge, which refers to knowledge about cognitive processes and beliefs about one's own strengths and weaknesses, as well as the capacity for self-regulation, which allows one to plan, monitor, and improve behaviour and cognitive functioning to achieve a goal through internal language [49].

Metacognitive interventions, by targeting meta-knowledge and self-regulation, would improve learning strategies [50]. These metacognitive interventions could be beneficial for young people with ADHD as this disorder is also associated with difficulties in self-regulation, meta-memory and meta-knowledge [51]. Hence, metacognitive difficulties impair the implementation of learning strategies in young people with ADHD and thus impact their schooling.

The majority of metacognitive interventions use resource management and cognitive education strategies through exercises and teaching tools [45,46]. To date, there are many metacognitive interventions such as PIFAM [52], Attentix [53] and Reflecto [54,55]. These programs are available in French and often conducted in a group setting, at school or in a clinical setting. These metacognitive interventions are often used with individuals with ADHD, although these programs are not empirically validated.

Indeed, to date, few studies have been conducted to examine the effects of metacognitive interventions with children/adolescents

[56,57] and adults [58] with ADHD. Of particular interest to the present review, five studies, including a control group, have been conducted with ADHD children to examine the effects of these interventions [59–63]. The results of these studies indicate that ADHD-related symptoms, as assessed by parents, decrease following metacognitive intervention compared to a control group.

The most significant results on ADHD-related symptoms were obtained by the study conducted by Tamm and Nakonezny [62]. Their study focused on a metacognitive intervention targeting executive functions that differs from cognitive training in that it does not seek to improve an impaired function, but to implement compensatory strategies in daily life. This intervention is carried out with a group of children during twelve one-hour sessions. Parents are included in the intervention so that they can carry out the metacognitive exercises at home with their children after the sessions. The authors also highlighted the importance of including parents in metacognition sessions so that they can help their child to apply these strategies at home, to promote a generalisation of effects. In accordance with these results, Pisacco and co-authors [60] also found encouraging findings, including a reduction in hyperactivity-impulsivity symptoms associated with ADHD and an improvement in classroom behaviour following an integrative metacognitive intervention consisting of working memory training combined with metacognitive exercises. These exercises target meta-memory and self-regulation in particular. The intervention is carried out in a group during 23 sessions of 40 to 50 minutes.

Integrative approaches incorporating cognitive training targeting specifically impaired functions and combined with metacognitive intervention may be relevant for young people with ADHD. However, the results of studies evaluating metacognitive interventions should be interpreted with caution as the number of studies remains small. Furthermore, studies rarely include active control groups and double-blind evaluations. As for adults with ADHD, we note that metacognition sessions are often integrated with CBT [64].

With this in mind, studies examined the effects of an intervention incorporating those metacognitive elements in a group CBT program, which comprised 12 one-hour sessions [65,66]. The intervention focused on time management, organisation and planning. Findings indicate that this intervention reduces ADHD-related symptoms in adults with ADHD, as compared to supportive therapy.

In current studies, typical elements of CBT such as exposure, cognitive restructuring and emotion management are combined with metacognitive exercises, do not identify which are most active for individuals with ADHD [64]. Studies examining the active parts within this type of intervention are needed.

In conclusion, in view of the results of the various studies carried out with children, adolescents and adults with ADHD, integrative approaches integrating cognitive and metacognitive training and cognitive and behavioural therapy seem to be the most promising to date. This type of approach is part of a global treatment that can also include school or work environment adjustments.

2.2. A game-based intervention for ADHD

2.2.1. Background

In child psychiatry and clinical psychology, the following three myths are very persistent:

- the average is considered to be the golden standard to assess a child's skills and abilities;
- psychiatric symptoms are manifestations of latent disorders;

- the effectiveness of interventions can only be determined by comparing different groups (e.g. an experimental versus a control group in Randomized Control Trials, RCT's).

In the following sections, alternative approaches will be discussed to disprove these myths. The central theme is the personalised approach in clinical practice as well as in research, with its focus on the individual child and its unique personal background and profile of strengths and weaknesses,

2.2.2. The myth of the average

A child with a profile of average skills and abilities is probably hard to find. 'On average', those profiles have a so-called sawtooth character, and if a child is lucky its strengths fall in the domains highly valued in education (see Fig. 1A). The abilities of both children in Fig. 1A will not be appreciated fairly. The 'bright' child runs a risk of being overrated and to develop a passive learning style, then it gets easily frustrated if the learning environment becomes more demanding. The 'dumb' child runs the risk of being underrated and of identifying with the attitude "Why bother anymore, it is all too difficult for me to understand". And the second myth comes into play: "I can't learn because I have a low IQ!".

2.2.3. The myth of the latent disorders

What tells a label like ADHD about the child? The classification ADHD in the Diagnostic and Statistical Manual of Mental Disorders [4–6] is meant to be nothing more than a description of behaviour that hinders a child (or an adult) in his daily functioning. Children with ADHD may have trouble paying attention, controlling impulsive behaviours or be overly active. Classification of behavioural problems is however not to be confused with making a diagnosis, for which the background of the problems need to be clarified. This distinction between classifications and diagnoses has clinical implications. To 'explain' impulsive behaviour with the term ADHD ('This child is behaving as such because of his ADHD') is an example of circular reasoning, of using a classification as a latent factor causing the manifest behavioural problems. But those kinds of factors are, as the word 'latent' implies, invisible and their only function is to summarise a cluster of behaviours.

2.2.4. Latent factors versus networks

A more recent approach is to conceptualise mental disorders as dynamic networks of intrapersonal symptoms, interpersonal relations and external factors, with all kinds of feedback loops [67]. As Borsboom and Cramer [68] stated, to choose between these two approaches (see B) is not merely a theoretical issue but also has methodological and pragmatic aspects: "(...) For the greater part of the scientific history of clinical psychology, the common cause idea – by which a common latent disorder determines a set of symptoms – was simply the only psychometric game in town" (p. 93). Or as Pérez-Álvarez stated: "Therefore, the problems to which 'ADHD' refers should never have left the family and school educational scope, making them pass through the clinical circuit and come back as 'mental disorder'." (p. 11) [69]. The latent factor approach to ADHD is presented (Fig. 2). The network approach to ADHD is presented in Fig. 3. This approach explains the high prevalence rates of comorbid disorders [70]. This approach implies to focus on diagnostics and treatment not only on the behavioural core symptoms but also to all the known underlying factors.

The network of factors underlying a specific form of psychopathology (e.g. ADHD) gives an idea about causality. To collect these kinds of network-data, it is necessary to have reports of a person over a period of time. Experience Sampling Methods (ESM) and Ecological Momentary Assessment (EMA) offer a broad scala of paper-and-pencil or computer-assisted questionnaires of behavior, affect, and cognition (daily report scales and diaries). There is

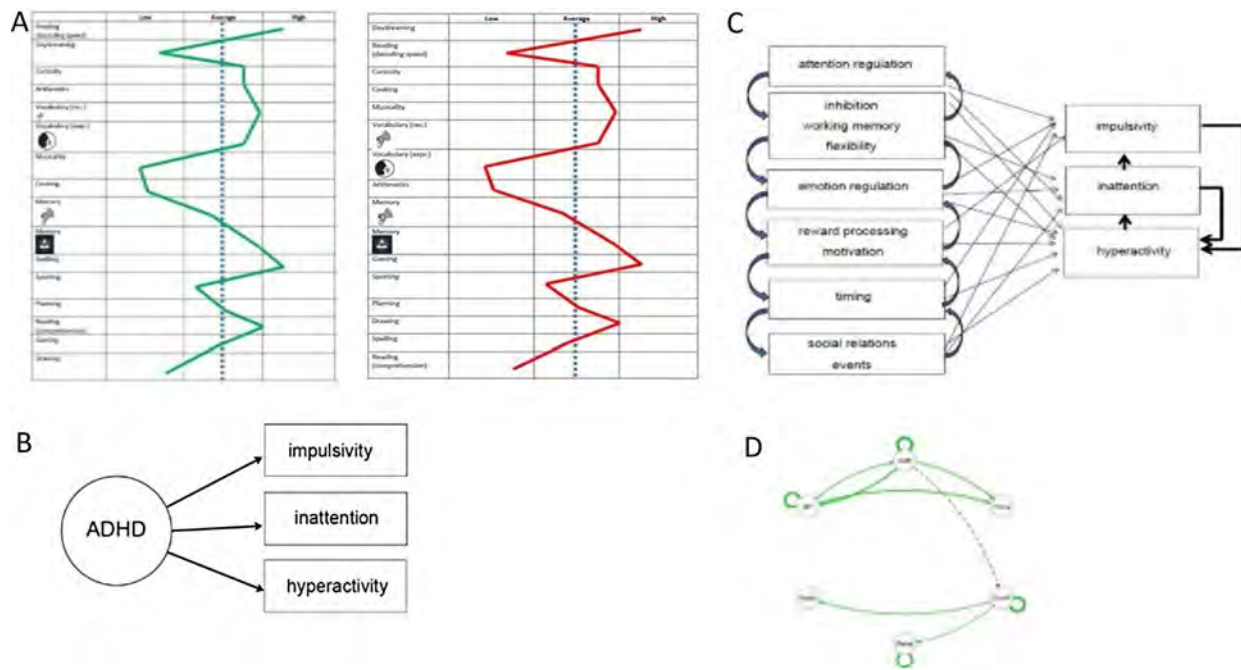


Fig. 1. Profiles of learning strengths and weaknesses of a successful pupil (left figure) and a pupil with learning disabilities (right figure).

an increasing supply of electronic devices (the so-called wearables) to collect for example stress-related bio-physiological data.

Clinically relevant is the information about the factor(s) playing a central role in network. A graphical display of an individual network of ADHD-symptoms is shown in Fig 3.C. The direction of an arrow shows the causal relation between two factors, the colour of the arrow, the valence of the relation (green = positive; red = negative), and the thickness the strength of the relation. A circular arrow is an indication of the autocorrelation within a factor: the stronger this correlation is, the more the factor can be considered as a central factor in the network and a good starting point for an intervention (in Fig. 4, the attention regulation seems to be the central problem in the network, in combination with the executive functions).

2.2.5. Executive functions (EF) and Braingame Brian

The network approach has implications for the clinical practice. To tune in on the individual characteristics of a child, information about its profile of strengths and weaknesses must be gathered, and not only from test sessions in low-stimulus offices, but also from daily life situations. And to have an idea of causal relations between the relevant factors underlying the behavioural problems, information of the child's background, development, parents, school, etc. is needed. Only when the relevant factors in play are sufficiently known, a personalised intervention can be implemented.

The last decades witnessed a plethora of research on the relationship between executive functions and ADHD-behaviour [71-73]. Within these studies, the role of reward processing is particularly recognised. For example, there is some evidence that children with ADHD are less stimulated by reinforcement (i.e., reward) than typically developing children [74].

If EF-problems are crucial in maintaining a pattern of dysfunctional behaviour, it seems logical to specifically target interventions on these problems. However, an easily neglected aspect of many interventions is the training part of it. If new skills must be learned by a child (or an adult), it takes time not only to learn, encode, and retrieve these skills but also to execute them when needed. The new skill needs to be part of the behavioural repertoire of a person to take full advantage of it (see the automatic vs. conscious

processes in Fig. 4). Training involves repeating the same activity for a long period of time. For most people, often a boring endeavour for which one must be strongly (internally or externally) motivated. For children with ADHD, who are not often unfamiliar with motivational problems, these kinds of training do not seem to be very suitable. To combine both elements, training of EF-skills and to take account of the motivational problems, a computerised intervention, Braingame Brian, was developed. Training tasks to strengthen the three so-called cold EF's: inhibition, working memory and flexibility [75] are included in Braingame Brian embedded in an environment with motivating game elements (characters, a game world with assignments, and graphics connecting with the world of experience of children from 8 till 12 years of age). However, before describing a study on Braingame Brian, the already announced third myth needs to be discussed.

2.2.6. The myth of the Randomized Control Trials

Randomized controlled trials (RCTs) are still considered the golden standard in establishing the efficacy of interventions. If individual differences are ignored in RCTs, non-significant results may overshadow the value of an intervention method for children with specific profiles. Single-Case Experimental Designs (SCEDs) are sensitive to individual variations and are increasingly considered an important addition to RCTs. It is important to realise that group studies (with its focus on interindividual variation) and SCED-studies (intraindividual variation) can lead to different conclusions about behaviour and psychological processes [76,77]. The multi-faceted dynamics of the network approach in contemporary personalised clinical psychology and psychiatry can only be grasped by a more personalised methodology. In the following section, a SCED-study will be illustrated with Braingame Brian.

2.2.7. Braingame Brian, ADHD and single-case design

A SCED-study on the effects of Braingame Brian with a 9-year-old boy A. was conducted [78]. A. met the DSM-criteria for ADHD and was not on medication. The boy had problems at home with regulating his behaviour, in particular with controlling his emotions. His teacher reported working memory and inhibition problems. With the boy and his parents, specific behaviours were

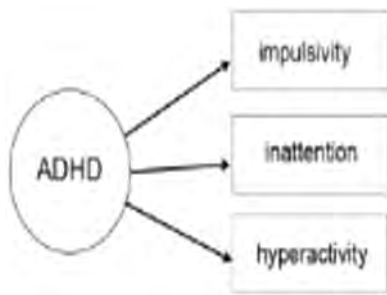


Fig. 2. The latent factor approach to ADHD.

chosen that could easily be judged by means of a Daily Report Scale (see Fig. 5). After a period of 2 weeks (the pre-treatment phase) in which the parents started to fill out the DRS, and the Parent Form and Teacher Form of the Behavior Rating Inventory of Executive Function (BRIEF) were completed, the Braingame Brian training started. The parents kept using the DRS during the training period (the treatment phase), two weeks after the training (the 1st post-treatment phase) and again for a period of 2 weeks, 3 months later (the 2nd post-treatment or follow-up phase).

Brian is a computerised training and consists of 25 training sessions of about 40 minutes. Each session contains two blocks (of about 15 minutes) of the three training tasks of working memory, inhibition, and cognitive flexibility in a fixed order [79–81]. The first training task is a working memory training task (consists of 5 variants increasing in working memory load), the second an inhibition training task, and the third a cognitive flexibility training task. Over a period of 5 weeks, the child trains and plays a total of 25 sessions. Each day of training, the child does not play more than one session of 40 minutes. After each block of training tasks, the difficulty level of the training task is automatically adjusted to the child's level of performance. The main character in the game helps the people in the village with all kinds of inventions. The game-world and the inventions get more and more interesting for the child for detailed information about Braingame Brian: [82]. A daily report scale is presented (Fig. 5).

The results on the three training tasks are displayed in Figs. 6–8. On every task, the performance is increasing, except for the 4th variant of the working memory task. The effect of the training on target behaviours of the DRS is shown in Fig. 9–10. For both behaviours, there is a significant improvement in the post-treatment phases compared to the pre-treatment phase (this is implied by the differences in the intercepts of the regression lines). The slopes of the respective regressions lines do not differ significantly (at 5% level) for both behaviours under consideration.

In Figs. 3–10, results of the BRIEF questionnaires are displayed. On the post-treatment measurements, the pre-treatment clinical scores (Parent Form: Initiate-scale, Plan/Organize scale, Organization of Materials scale and the Meta Cognition scale; Teacher Form: Inhibit scale, Working Memory scale, Organization of Materials scale and the Behavioral Regulation scale) have dropped. The improvements for the Parent Form Organization of Materials scale and the Meta Cognition scale were significant (5% level), as well as for the Teacher Form Organization of Materials scale and the Behavioral Regulation scale.

2.2.8. Conclusion

The endeavour to discuss the three myths in combination with the results of a SCED-study was maybe a bit too ambitious. Therefore, the myths could only be treated superficial, and the study only presented as an illustration of the potentials of a single-case study. The main goal however is to inspire clinical practitioners, to monitor their intervention as it is implemented in daily practice.

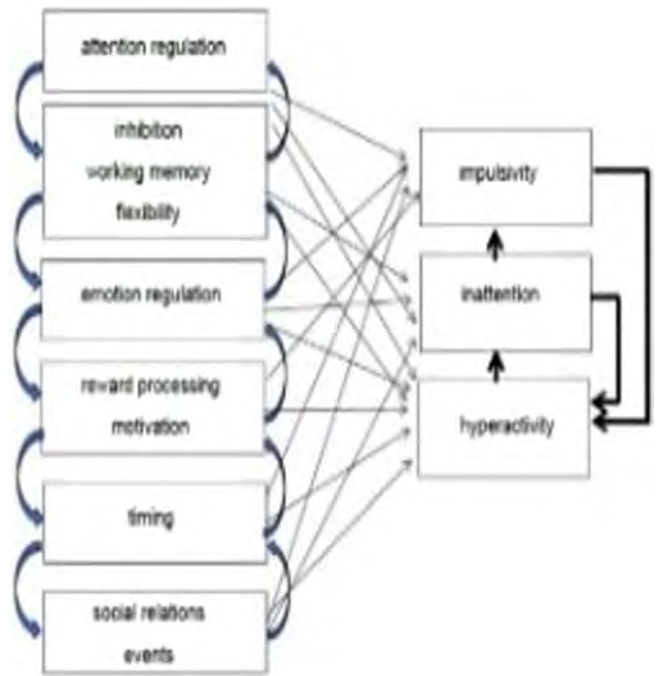


Fig. 3. The network approach with some examples of relevant factors underlying the core symptoms.

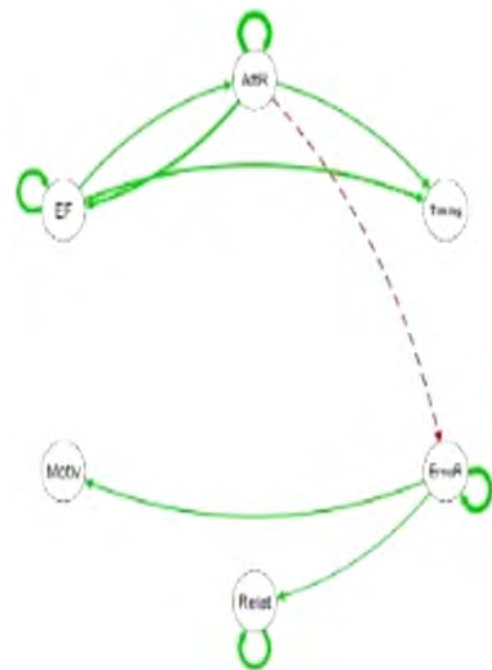


Fig. 4. Individual network of ADHD symptoms. EF: executive functions; AttR: attention regulation; EmoR: emotion regulation; Relat: social relations; Motiv: motivation.

Of course, it is always good to have some information about the strengths and weaknesses of a person compared to the average person in his or her age or clinical group. But a more personalised approach requires more than a protocolised treatment with standard questionnaires. And DSM-classifications are not sufficient to identify the aetiology of behavioural problems. The time has come to diagnose in addition to classify, to grasp the idiosyncratic caprices of everyday life of a person with dysfunctional behaviour,

How do you judge the behavior in question of A. today?
 Put the slider in the position according to your judgement.
 Then click on the button 'Send'.



Fig. 5. Daily Report Scale (DRS).

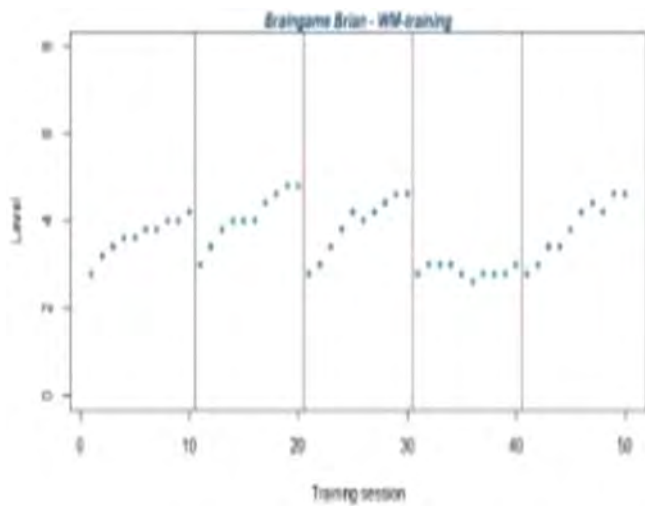


Fig. 6. Performance on the three Braingame training tasks (Work Memory training).

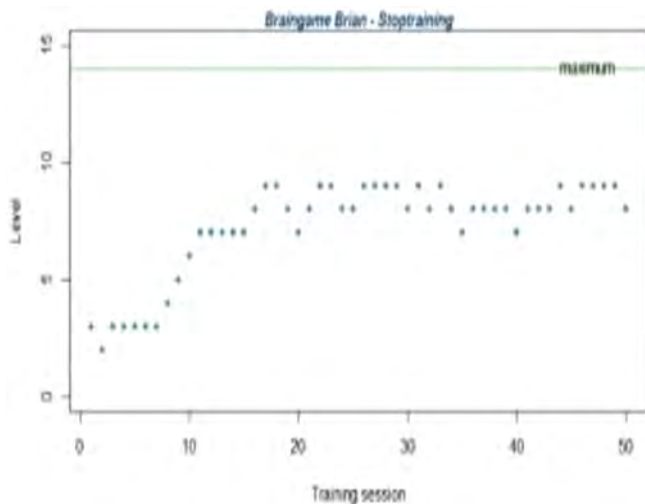


Fig. 7. Performance on the three Braingame training tasks (Stop training).

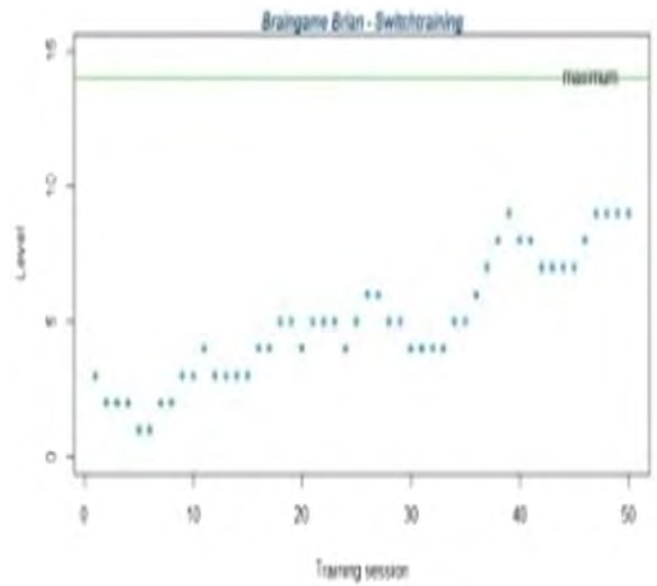


Fig. 8. Performance on the three Braingame training tasks (Switch training).

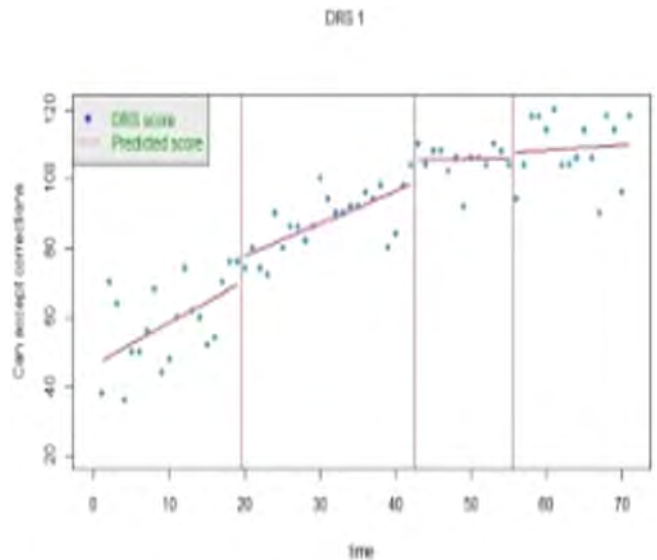


Fig. 9. Results on the Daily Report Scale DRS (DRS = "Can accept corrections").

and to use idiographic approaches to study the effects of personalized clinical interventions.

2.3. ADHD-related learning difficulties and technological aids in the school environment

Previous sections have focused on ADHD subjects who present cognitive deficits that affect attentional and executive functions such as working memory, inhibition, and organisational skills. When doing work that requires sustained mental effort, they tend to work very quickly. Their speed-accuracy trade-off is focused on speed of execution, at the expense of accuracy of their responses. However, we must not neglect children with attention deficit disorder without hyperactivity or impulsivity (ADD), who have mainly cognitive deficits affecting attentional functions, working memory and speed of information processing. Thus, when they have to do work that requires sustained mental effort, they tend to work more slowly than others. They often need more time to complete a task,

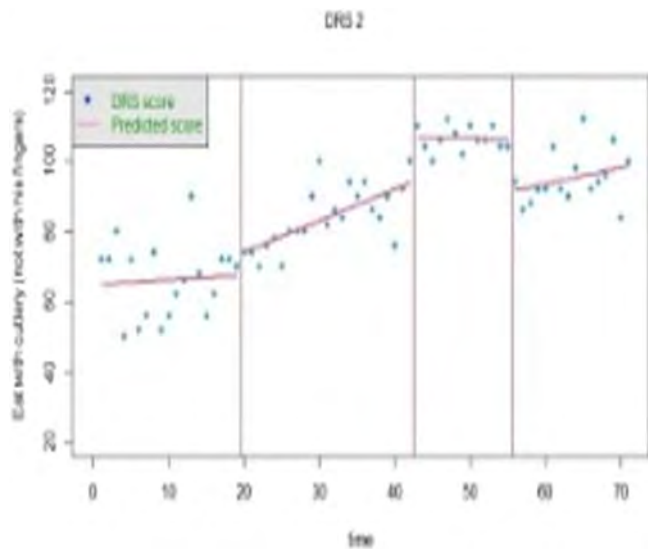


Fig. 10. Results on the Daily Report Scale DRS 2 = “Eat with cutlery not with his hands”).

but because they tend to be concerned about the accuracy of their answers, they make few mistakes. Whether for ADHD or ADD, the cognitive deficits recognised in both disorders hinder learning in reading and writing [83–85]. To better prepare these children and help them persevere in their school career, it is therefore important to better understand how their cognitive deficits affect their performance in reading and writing and how technological assistance functions are useful solutions to overcome their difficulties.

In terms reading, children with ADHD tend to read fast, skip lines, guess words and not pay attention to the text’s meaning. They are therefore good decoders and read quickly and fluently. However, they may have difficulty with reading comprehension despite good language skills. They complain that they have to read and reread to fully understand the meaning of texts. On the other hand, children with ADD tend to read slowly, lose track of things, and fall behind. They also complain about having to read and reread texts to be able to extract meaning [84].

In terms of writing, children with ADD and ADHD have lower scores than a comparison group [86]. They have more difficulties with parameters such as text adequacy, structure, grammar, and lexicon, and they produce shorter texts with more errors. However, in terms of their metacognitive knowledge (e.g., understanding the style of text to be produced, use of an outline to organise the writing, etc.), they do not differ from others [86]. Thus, they know what to do, but they have difficulty applying their knowledge when producing the text; probably because several cognitive processes that are deficient in ADD and ADHD are involved in writing a text [87]. Their regression analyses do confirm the role of working memory, information processing speed, language and reading efficiency in writing skills.

Today, schools are equipped with several technological tools that are useful for student success, particularly in reading and writing. However, for technology to help students, it is important to understand their needs. The assistive technology function must effectively address the constraints of the student’s disability or difficulty. For example, if a young person tends to be distracted, to read too quickly, to skip lines and to change or guess certain words, a technological aid such as voice synthesis can be very beneficial. Wearing a headset reduces distractions, highlighting words as they are read slows down the pace and prevents word or line skipping. In addition, speech synthesis allows the young person to hear whether the word being read makes sense in the text. Such aid therefore

facilitates a better understanding of the texts. As for writing, other tools can be fruitful in helping young people to organise their ideas, as they encourage a pause and questioning. This type of tool encourages brainstorming, but above all, it facilitates the organisation of ideas to produce an articulate, coherent and well-developed text. Also, and this is probably better known, other technological tools can help young people to correct their spelling and grammar mistakes. By visually indicating where the mistakes are, young people can spot them and then correct them to produce higher quality texts.

In conclusion, technological aids are very useful in learning to read and write. There is still some reluctance and resistance to their integration into the school environment, yet they are useful in keeping young people with difficulties in school. More effectiveness studies are needed to better implement these support functions in the student’s academic career.

2.4. Neurofeedback and ADHD

2.4.1. Background

The development of non-pharmacological strategies is a real challenge in the management of children with ADHD [18,26,32,72,88]. According to a recent systematic review of randomised controlled trials, neurofeedback may be a promising tool in this field [89]. This technique consists of measuring brain activity in a subject. The measured signal is processed by means of a technical interface to extract a parameter of interest. This parameter is presented in real time to the subject, in the form of visual or auditory information (metaphor) [90,91]. The objective of neurofeedback is to teach the participant to modify this parameter of interest, thus allowing a modulation of the subject’s cerebral and cognitive activity.

This technique, used since the 1970s in ADHD, is based on the analysis of basic electroencephalographic (EEG) rhythms. The subject’s brain activity is measured and presented to him/her to support self-regulation of ongoing brain oscillations and achieve specific behavioural and neurophysiological outcomes. Certain mental states can be correlated with EEG recordings. For example, the theta rhythm (between 4.5 and 8 Hz) is associated with a state of drowsiness and the alpha rhythm (between 8 and 13 Hz) is associated with a state of relaxation (or calm wakefulness). Faster rhythms such as the beta rhythm (between 14 and 30 Hz) are associated with a focused attentional state (or active wakefulness). The analysis of EEG rhythms in ADHD subjects shows that there is a decrease in alpha and beta activity and an increase in slow theta activity. Therefore, different neurofeedback protocols are found in the literature concerning ADHD, some focused-on EEG rhythms and others on slow cortical potential, SCP. The three main protocols used are focused on:

- regulating the Theta/Beta Ratio (TBR);
- increasing the intensity of the Sensori-Motor Rhythm (SMR);
- modulating the Slow Cortical Potential (SCP).

2.4.2. Effectiveness of neurofeedback

Over the last ten years, there has been an explosion of literature in this area [92]. While the effectiveness of neurofeedback in the management of ADHD children is a subject of research, it is also a subject of debate. In this vein, Arns and colleagues [93] summarised the published meta-analyses and systematic reviews. A significant efficacy of neurofeedback was found in pre- and post-treatment assessment by parents and teachers with a small to moderate effect size [94], and an efficacy that was maintained between 6–12 months [95]. In accordance with these studies, four multicentre randomised controlled trials have shown significant efficacy of neurofeedback versus a semi-active control group

(attentional retraining or EEG biofeedback) with a moderate to high effect size pre-post treatment [96–101]. Finally, three open-label trials showed similar or superior efficacy to the multicentre trials [102–104]. The authors conclude that neurofeedback was effective with a moderate to high effect size and remission rates of 32–47% with a persistence of efficacy ranging from 6 to 12 months.

Finally, a European protocol which is currently being published, compares the effectiveness of a neurofeedback protocol versus methylphenidate in ADHD children (NEWROFEED study; European Horizon 2020 protocol). The originality of this protocol is the development of a home neurofeedback solution with data recording transmitted to a medical portal accessible to practitioners from the Internet. The sessions were conducted at home (4/week), for 3 months. This multicentre study, carried out in 5 European countries, included 179 ADHD children (description of the protocol in [91], and the results were recently published [105]. The authors found that both treatment groups showed significant pre-post improvements in core ADHD symptoms and in a broader range of problems. Neurofeedback effects increased whereas those of methylphenidate were stable between intermediate and final visit.

2.4.3. Did you say neurofeedback effectiveness?

Research in the field of neurofeedback raises many questions; it seems interesting to consider the different types of possible effects of this technique [106]:

- specific effects (i.e., modulation of the electrophysiological marker of interest) underpinned by the relationship between clinical efficacy and learning (e.g., the ability of subjects to change the relevant EEG parameter which is not consistently studied);
- non-specific effects, including interactions with the practitioner, and the neuro-technological context;
- general non-specific effects, such as cognitive training and participating in a clinical study;
- repetition effects, i.e., the test-retest effect;
- natural effects, underpinned by brain maturation.

Because of these different effects, choosing the adequate control group is crucial: which is the best comparator group? Is it a comparison to usual treatments or to a “placebo” neurofeedback (which leads to the question what is “placebo neurofeedback?”) [107]. In addition to these data, it is also worth noting the variability in the clinical expression of ADHD (behavioural and cognitive heterogeneity) of the subjects, underpinned by the different clinical presentations and the frequent comorbidity. Finally, the issue of accessibility of neurofeedback is another obstacle, as standard protocols require intense training and high-quality equipment.

In conclusion, the research work in this field remains wide and extensive. It is important not to oppose pharmacological treatments to non-pharmacological treatments but to try to define phenotypes of responders or non-responders, according to the clinic, electrophysiological markers and also to ask the question of the temporality of the treatments (do we start with neurofeedback and/or drug treatment, or with a combined treatment). The way remains open. . .

3. Mindfulness and yoga-based approaches

3.1. Effect of mindfulness on brain function

Here, we will present the effects of mindfulness on brain activation and cognitive functions, on attention. The effects of mindfulness programs on people with ADHD will be presented in the next section.

Mindfulness can be defined as “paying attention in a particular way, deliberately, to the present moment and without any judgemental value” [108] or “focusing one’s full attention on the present experience, moment by moment” [109]. Mindfulness has its origins in the Buddhist philosophical and religious traditions. Jon Kabat-Zinn introduced mindfulness into Western clinical practice in 1979 and developed the MBSR – Mindfulness Based Stress Reduction [90,110] program which includes elements of meditation and yoga. This program, originally developed for stress management, has also been validated for the management of chronic pain, anxiety, various psychosomatic problems and is also used in the general population to reduce stress and anxiety [108,111–114]. It has been hypothesised that mindfulness has effects on the following three dimensions: emotions, cognitions and the body (especially bodily sensations) [115] and that these effects interact with each other to enable change. In order to measure these effects, several methods have been developed, such as questionnaires (e.g., Kentucky Inventory of Mindfulness Skills, KIMS [116]; Short-version [110], daily measurements [117], or experimental measurements combined or not with neurophysiological measurements).

We will focus on the latter, providing a brief review of the neurophysiological changes observed in relation to mindfulness and/or meditation and their effects on the cognitive functions potentially impacted in ADHD, specifically attention and working memory. A recent systematic review of neuroimaging findings investigating the effects of mindfulness indicate that the neurophysiological differences induced by mindfulness-based interventions mainly involve the following brain regions: the insula, the anterior cingulate cortex, the dorsolateral, dorsomedial and ventromedial prefrontal cortex, the caudate nucleus, as well as in parietal and occipital regions [118]. The authors hypothesised that these regions could be grouped according to the functions in which they are involved. They thus distinguish a system of regions associated with interoception and self-awareness, which mainly comprises the insula and the anterior cingulate cortex. The second system of regions is thought to be associated with attentional processes and meta-awareness and includes the prefrontal, parietal, occipital and subcortical regions. These findings are consistent with research investigating the effects of meditation practice on brain function. In this context, Brefczynski-Lewis et al. (2007) investigated changes in activation during meditation practice using functional magnetic resonance imaging (fMRI) in meditation novices and experts. Their results show an increase of activation in the insula, prefrontal cortex, anterior cingulate cortex and caudate nucleus, among others, which is more pronounced in the experts than in the novices. Brain activation also appears to be modulated by the number of hours of practice. The set of regions activated by meditation and its regular practice thus seem to be partly similar to the changes induced by mindfulness-based interventions.

A more recent review targeting resting-state functional magnetic resonance imaging functional connectivity of mindfulness in clinical and non-clinical contexts concluded similar results [119]. The authors found that mindfulness is related to functional connectivity in the default mode (self-referential DMN), frontoparietal (executive functions FPN), and salience (emotion, motivation and reward SN) networks. Changes following mindfulness include:

- increased connectivity between posterior cingulate cortex (DMN) and dorsolateral prefrontal cortex (FPN), which may relate to attention control;
- decreased connectivity between cuneus and SN, which may relate to self-awareness;
- increased connectivity between rostral anterior cingulate cortex region and dorsomedial prefrontal cortex (DMN) and decreased

connectivity between rostral anterior cingulate cortex region and amygdala region, both of which may relate to emotion regulation.

In the context of ADHD, however, it is particularly important to know whether these interventions also produce changes in cognitive functioning and not only in brain functioning. As the brain regions affected by mindfulness are in part like those affected by meditation practice, we will also report the results of meditation studies here. With regard to attention, results showed improvements in visual attention and alertness after an intensive meditational retreat [120]. Another study suggests that the MBSR program brings specific improvements in certain sub-components of attention, in particular in attentional orientation [121]. Notably, improvement is reported in sustained attention after an attention-focused meditational practice [122]. Thus, it can be observed that according to the studies, the results show specific effects on different components of attention, which can be explained by methodological aspects since these studies report different meditational training methods, used different measures, and investigated different groups. A systematic review suggests that MBSR/MBCT programs improve working and auto-biographical memory, cognitive flexibility and meta-awareness, but do not necessarily improve attention [123]. Their main action is at the neurocognitive level, therefore it does not seem to concern attentional processes for the most part. More recently, two meta-analyses explored the effectiveness of meditation-based therapy. The authors found moderate reductions in ADHD symptoms in both children and adolescents and adults [124,125].

In conclusion, empirical studies on the effect of mindfulness on attentional capacities show partly contradictory results, as the state of research on this subject is still rather sketchy. However, it seems that there are differences between the different forms of practice, especially between meditation and mindfulness practice. Mindfulness interventions have more of an effect on the different components of memory and on cognitive flexibility. Furthermore, at the brain level, mindfulness seems to influence interoceptive regions rather than attentional ones. However, there are indications that fronto-parietal regions are also influenced by mindfulness, which would also explain its effects on short-term memory. These findings are relevant to ADHD since recent meta-analyses suggest, among other things, reduced brain activation in fronto-parietal circuits in individuals with ADHD.

3.2. Techniques and effectiveness of mindfulness-based approaches for ADHD

Mindfulness-based interventions (MBIs) involve the development of attentional processes in combination with enhanced presence and awareness and a more integrated sense of self. They also target the development of emotional regulation [126]. The interest of these interventions with individuals with ADHD is precisely that they target processes that are deficient in this population, namely attentional control, and emotional regulation [31,127,128]. Neuroanatomical evidence also supports the link between mindfulness and ADHD, including the key role of prefrontal regions in both the etiology of ADHD and the role of mindfulness [125,129].

To date, the few meta-analyses that have looked at the effects of MBIs in individuals with ADHD show significant post-intervention improvements in inattention and hyperactivity/impulsivity symptoms with small to large effect sizes [31,124,128,130-132]. In addition, they also show positive effects on parent-child relationships, daily executive functioning as assessed by teachers, parental stress and parent mindfulness trait [30,128]. Along these lines, Evans and co-authors, [133] suggest, in their literature review, the potential positive effects of MBIs on self-esteem, social functioning

and academic functioning. It is in this context that we developed and implemented an MBIs in a university clinic [134]. The intervention is an adaptation of the program developed by Depluis and Lahaye 2015 [135] and involves:

- the use of a group format that encourages the completion of exercises in a playful atmosphere and the sharing of experiences, which then supports motivation;
- developmentally appropriate and rehearsal-friendly language to facilitate integration;
- formal sitting meditation practices;
- links to everyday life, in particular by illustrating the usefulness of the exercises with examples from everyday life;
- home exercises to encourage practice and connections to daily life;
- sharing experience through exploratory dialogue. The young person particularly needs help to put his or her experience into words, to hear the experience of others and, on this basis, to build new knowledge;
- involving parents to promote their understanding of the intervention, support the young person's motivation and then facilitate the transposition into everyday life.

The intervention consists of seven weekly sessions lasting 1.5 hours. It is aimed at young people between the ages of 8 and 12 who have difficulties with attentional and/or emotional regulation, including those with ADHD. The following Table 1 summarises the targets and objectives of each session.

Our preliminary results on the effectiveness of this intervention show, in a sample of 8 children (including 4 with ADHD), a general improvement in mindfulness [136]. Improvements in inhibition and cognitive flexibility measured by neurocognitive tests were also observed, in addition to working memory as objectified from parents' observations [137]. Qualitatively, the young people noted that the intervention enabled them to develop their ability to observe, describe and manage their experience. They also report having had a pleasant group experience [136].

This overview therefore supports the presence of potential positive effects of MBIs with young people with ADHD. However, the current state of knowledge does not allow us to conclude definitively on the effectiveness of such interventions in ADHD, particularly because of the methodological limitations of the studies conducted to date and their great variability, for example in terms of the deployment of interventions. To this end, the use of more methodologically sound experimental designs remains necessary. More work is also needed, particularly with regard to understanding the role of parents, the characteristics of the workers, and the mechanisms of action of these interventions.

3.3. Techniques and effectiveness of yoga-based approaches for ADHD

Many children with ADHD experience difficulties in their interactions with others, whether with parents, friends or teachers. These social difficulties are partly explained by their impulsive reactions and difficulties in regulating emotions. In addition to conventional cognitive and behavioural therapies, the so-called 3rd wave therapies are useful for improving emotional regulation. These therapies add experiential, acceptance, and engagement (Hayes), and mindfulness (Kabat-Zinn's mindfulness) dimensions. They take many forms, but they all have in common the recognition and exploration of emotions and the particular focus on the here and now. Yoga is part of this new therapeutic approach. Yoga is a discipline derived from Indian philosophy and its practice aims to unify body, mind, and spirituality. It involves physical movements and postures, but it also integrates mindfulness, being in

Table 1
 Objectives of the MBLs per session.

Sessions		General objectives
1. If I were a Martian. . .	–	Introduction to mindfulness Contact between speakers participants
2. Be aware when the unknown is there. . .	–	Psychoeducation on the three components of emotion Introduction to mindfulness of the body
3. Observe unknown (emotions)	–	Psychoeducation on the adaptive functions of emotion Bringing awareness to the body dimension of emotion
4. Stop and breathe. . .	–	Bringing awareness to a particular element of the body: the breath Learn to stop: gradually increase the time of attention on the breath
5. Understanding unknown. . .	–	Introduction to automatic emotional responses (advantages and disadvantages) Distancing oneself from thoughts Recognise the behaviours and thoughts associated with the unknown being (the emotion)
6. Tame the emotion	–	Stopping: increasing attention to the breath Using a way to deal with emotion without avoiding it: breathing space
7. This is just the beginning. . .	–	Looking back at what has been achieved and how to maintain it Consolidation of what mindfulness is and how it can be used in everyday life

the present, being non-judgmental, and meditating with particular attention to breathing, physical sensations and emotions.

The effectiveness of yoga is increasingly being studied for a variety of conditions including depression, anxiety, stress and ADHD. Specifically, a recent scoping review supports the use of school-based yoga programmes for the improvement of anxiety, self-concept, resilience, depression, self-esteem, subjective and psychological well-being, executive function, inhibition, working memory, attention and academic performance in neurotypical populations was found. Findings equally support school-based yoga programmes in neurodiverse populations with improvements in self-concept, subjective well-being, executive function, academic performance and attention was also found [138]. Of particular interest to the present review, in children with ADHD, pioneering studies show improved attention, reduced hyperactivity and externalising behaviours, improved sleep, emotional well-being and parent-child relationships [139–141]. However, these early studies have methodological limitations that limit the significance of the results such as: small sample sizes, low statistical power, number of yoga sessions varying between participants, little information about the yoga programs, no control group, little information about retention. Nonetheless, two systematic reviews of the literature identify two main findings [130,131]. First, yoga interventions that included the parent show greater improvement in ADHD symptoms and well-being of the young person. For the parent, the results show a decrease in stress and psychopathology and better adaptive strategies. Secondly, studies show a moderating effect of the length of the yoga sessions; the longer they are, the larger the effect sizes.

To evaluate the effectiveness of a yoga program for youth with ADHD, our research team (Gilles Dupuis, Dominique Lanctôt, Fabienne Girard-Bériault, Marta Gunin, and Marie-Claude Guay) adapted the Bali yoga program since this program is structured and has been shown to improve quality of life for individuals with other physical health problems [142]. The aim of our first study was to evaluate the feasibility of a parent-child group yoga program with youths who have mixed-ADHD. The study also aimed to see if yoga reduces ADHD symptomatology and improves the quality of life of the participating parent and child. Group yoga sessions were held once a week for eight weeks, but the parent-child dyad was encouraged to also practice yoga at home (at least 3–5 times/week). The results show that the parent-child yoga program goes very well and that both parents and children are involved in the group sessions and practice yoga at home. The results also show that symptoms of inattention and hyperactivity-impulsivity tend to decrease and that the parents' quality of life tends to improve [143]. These promising results have led to a larger study currently underway at the University of Quebec in Montreal. In accordance with these studies, a review of randomised trials does support findings about yoga

for ADHD [144]. Notably, in 2004, Jensen and Kenny conducted a robust study on the effects of yoga, including ADHD children and a control group comprising of games incorporating talking, listening, and sharing equipment for 20 weeks. Findings post-intervention showed significant improvement in scores on the Conners' Parent Rating Scales (CPRS), namely the Oppositional (Cohen's *d* of 0.77), Global index Emotional lability (Cohen's *d* of 0.79), Global Index Total (Cohen's *d* of 0.73), Global Index Restless/Impulsive (Cohen's *d* of 0.73), ADHD index (Cohen's *d* of 0.29), and Perfectionism (Cohen's *d* of 0.58) sub-scales but not in the hyperactivity, anxious/shy, and social problems sub-scales, where the controls fared better. Interestingly, the authors noted anecdotal reports by parents, of improved homework compliance and yoga being an effective calming technique during episodes or behavioural escalation [145].

In conclusion, the results of the few pioneering studies to show the usefulness of yoga for children with ADHD are promising. However, more studies are needed, with more rigorous research designs, to confirm the effectiveness of yoga in improving emotional regulation and social adjustment in these young people.

4. Age-specific approaches

4.1. ADHD in children: specificity and family management

The presence of ADHD in a child or adolescent has a major impact on their future, but also on family dynamics. It is now established that parents have higher levels of stress [146] and depressive symptomatology than parents of ordinary children [147], and a low sense of self-efficacy [148].

On the clinical level, there are also specific characteristics to these families: low sense of help, social isolation and little time-sharing [149]. Also, as clinicians, we can observe that the main complaints of parents are related to behavioural problems (opposition, provocation) and schooling in the broadest sense (relationship with teachers and academic performance). However, it is essential to accurately assess the family situation in order to propose the best intervention by considering the brakes and levers for successful intervention [149]. In this framework, a worth noting systematic review and meta-analysis by Shephard and co-authors evaluated which early neurocognitive and behavioural precursors are associated with the development of ADHD and whether these are currently targeted in early interventions [88]. The authors concluded that children aged 0 to 5 years with current or later-emerging ADHD are likely to experience difficulties in multiple neurocognitive and behavioural functions. For example, extreme positive or negative emotional reactivity in infancy leads to weakened executive function in toddlerhood, elevated ADHD

symptoms, and irritability in the preschool years, and clinically significant ADHD at school age. Shephard and colleagues argued that early interventions show some effectiveness in reducing ADHD symptoms. In this vein, early interventions targeting emotional regulation and behavioural inhibition are pertinent taking these results into consideration: significant associations between ADHD and poorer cognitive, motor, language, development, social difficulties, early regulatory, sleep problems, sensory atypicalities, elevated activity levels and executive function difficulties. A total of 32 trials (28 randomised, 4 non-randomised, 3848 participants) testing early interventions that targeted the identified precursors met inclusion criteria for part 2. Multi-level random-effects meta-analyses on 22 studies revealed significant intervention-related improvements in ADHD symptoms (SMD=0.43 [CIs: 0.22, 0.64]) and working memory (SMD=0.37 [CIs: 0.06, 0.69]) [88].

4.1.1. Opposition Defiant Disorder in children and adolescents with ADHD

4.1.1.1. ODD-ADHD Association. A child or adolescent's behavioural problems may be of sufficient magnitude and result in significant functional difficulties, leading to a diagnosis of Opposant Defiant Disorder (ODD) [4–6]. ODD is a frequent ADHD comorbidity: as much as 23% according to a recent study [150]. More than 48% of children may exhibit certain externalised behaviours [151]. Researchers have therefore endeavoured to understand the reasons for the frequent emergence of ODD in relation to ADHD, to propose the most appropriate intervention [151]. For example, two studies consider this emergence as part of a transactional approach in which children's ADHD symptoms influence parental behaviour and adjustment, and family characteristics influence ADHD symptoms [152,153]. This does not exclude the consideration of risk factors and the developmental trajectory [154–156].

4.1.1.2. Coercive familial process. The main model about the emergence of opposant and defiant behaviours is known as the Patterson's coercion model [157]. Patterson hypothesised that aggressive behaviour develops in families when parents use coercion as the primary model for controlling their children. According to this model, the coercive family process begins when the child is reinforced for reacting inappropriately to the behaviour of their parent or sibling. The model was tested with boys, girls and older children [158].

Young children who are not yet diagnosed with ADHD present some unadapted behaviours: they don't stop their activity when asked, they are reluctant to engage in chores, they forget things necessary for their tasks and activities and have poor daily routines skills. Parents are often exasperated and misinterpret their child's behaviour [152], giving inadequate attention by shouting at their child, for example, and ignoring most of their adapted behaviours. Meanwhile, the child is telling his/her parents that they are "never satisfied with him/her". Consequently, the child's behaviours become opposant/defiant. Research confirms that parents develop inappropriate and counterproductive parenting strategies to cope with the child's behaviours [159], becoming more controlling and disapproving. Reprimands and punishments are more frequent than in families with children without ADHD [15].

After several years, diagnosis and information about the disorder are not sufficient to stop this ongoing family dynamic. The preferred intervention is to focus on the parental skills that have to be taught. The parent training programs are considered as a component in a multimodal strategy that targets the broader range of behavioural and emotional problems that frequently accompany the disorder [27].

4.1.2. Parent training programs

4.1.2.1. Goals and foundations. A parent training program is "an intervention in which parents actively develop parenting skills and which may or may not include other educational methods [160]. Parenting skills training require active parental involvement (practice during the session or assigning homework). Parenting programs for behavioural problems are generally based on three main theoretical frameworks: Skinner's theories of learning, Bandura's social learning and Patterson's coercion model (1982). They are not recent; the first ones having been developed in the 1970s [161].

As far as we are concerned, parent-training programs are designed in order to respond to oppositional and defiant behaviours; their main target is not the inattentive, hyperactive-impulsive symptomatology. These programs are most often delivered in a group setting to make it easier to obtain social support [162] and last between 8 and 12 sessions [163].

Haslam et al. [164] synthesise the usual objectives of training programs for parents. There are some primary intervention goals such as improving parent-child relationships, reducing negative, coercive or violent parenting practices, and teaching effective parenting strategies. Secondary intervention goals are to reduce parental stress, depression and anxiety, and increase feelings of parental competence. Indirect improvements should be observed in the child's behaviour.

4.1.2.2. A logic of construction. Empirically evaluated programs were found to have relatively similar content [163]. Thus, we almost systematically find content dealing with the risk factors of problematic behaviours, positive interactions, selective attention and time-out [163,165]. The training programs also follow a logic of construction: the contents are based on each other. The session(s) on understanding the disorder precede the session(s) on parent-child bonding, which in turn precede the session(s) on making demands on the child. These programs are also manualised in such a way that they are reproducible [160].

4.1.2.2.1. Program effectiveness and main result. Several meta-analyses have shown the effectiveness of training programs [160,161,166]. Moreover, parent training programs, when combined with behavioural – pharmacological interventions, are superior to using medication alone on the measures of parenting (e.g., harsh and ineffective discipline) [167]. The meta-analysis of 125 shows that the mean effect size for parenting outcomes, which are within the primary objectives, are better than the mean effect size for children's outcomes. For parents, the mean effect size is larger for parenting knowledge, attitudes, or self-efficacy than for parenting behaviours. Moreover, study underline those changes in children's outcomes are evaluated more positively by parents than by professionals, putting the effectiveness of programs into perspective [166]. However, parent-reported outcomes in parent training programs could be increased due to the satisfaction with the treatment [161]. Among the contents, meta-analysis shows that in terms of parental behaviours and externalised parental behaviours, the most important effects are obtained in programs that require parents to create positive interactions with their child [160]. The implementation of parenting skills during the intervention, rather than at home, also results in greater effects. Finally, let us note that concerning the externalised behaviours of the child, programs that included parent training in using time-out and a consistent response to the child behaviour reported significantly greater effects.

4.1.2.2.2. Parental engagement. While the results are quite positive for those who participated, Chacko and colleagues [168] are

interested in the characteristics of parents of children with ADHD who never attended or dropped out of the parent training program. It is difficult to clearly establish the percentage of parents who never attended the program when it was offered, but clinical experience can be as high as 50 percent. Similarly, 20 percent of parents may leave the program. The authors suggest that parents who do not participate in the program have a lower sense of parental efficacy, more maladjusted attributions towards their child. Their opinion on the relevance of the program is lower overall, as is the case for parents who have dropped out of the program [168].

4.1.2.3. Parent training programs' future directions. Although much progress has been made in recent years, several avenues still need to be explored to foster engagement and retention in programs [166]. Of particular note is the involvement of single mothers, minority families and fathers. Regarding the involvement of fathers, much remains to be done to encourage their participation. Notably, Meuwissen and Carlson in 2015 demonstrated that fathers' controlling parenting was significantly inversely related to the child executive functions composite, regardless of family income and child verbal ability. Such findings approve the hypothesis that fathers are important for the development of executive functions, hence they should be included in both research and parenting interventions [169]. It is not uncommon that there is no mention of the percentage of fathers or mothers in the study samples [170] or that, despite a significant number, they are not considered separately in the results [162]. Furthermore, the absence of fathers in parenting skills training groups is often attributed by practitioners to their lesser involvement in the education of children. However, recent examples show that the same type of intervention in the same country can result in highly variable participation percentages [171].

More recently, the COVID-19 pandemic once again raises questions about the development of a thoughtful remote offering for these parents [172–175]. For the time being, there is little face-to-face parent training, while its availability remains limited in some Francophone regions. However, the few studies on this subject tend to show a high degree of acceptability [176]. As with face-to-face programs, it is important to clearly assess the elements that promote the acceptance and effectiveness of the program [172].

4.2. ADHD in adolescents – specificity and non-pharmacological management

ADHD is part of long-term care integrating different approaches that include the specificities of the developmental processes linked to the stages of the human life cycle. Adolescence is a stage that brings into play the specificities of ADHD and pubertal changes that require an understanding of the singularity of the subject and the interaction between the developmental and environmental dimensions. Interventions need to consider the difficulties linked to ADHD and comorbidities, as well as existential suffering and self-esteem disorders. The upheavals and identity crisis of adolescence mobilise psychic processes that go beyond the ADHD paradigm, with questions about the meaning, goals, and value of life, about present and future perspectives. The therapeutic framework must include genuine empathy and be flexible, striking a balance between “not trivialising and not dramatising”. Psychotherapeutic approaches adapted to pubertal processes must take into account individual profiles, introspective and control abilities as well as environmental contexts and associated disorders. Clinical experience shows the indication of different forms of psychotherapy – cognitive-behavioural, psychodynamic, and family psychotherapy – depending on the situation and the availability of therapists. In such a framework, the accompaniment of ADHD adolescents is very demanding and sometimes difficult, punctuated by disappointments and failures, but it also involves the observation

of the emergence of creative potential and the ability to find one's way in the adult world, which are also an opportunity to revisit the forces of life and destructiveness of one's own adolescence.

4.2.1. ADHD and adolescence

Current evidence suggests that ADHD persists into adolescence in 50 to 85% of cases, with significant personal, family, school, relationship and social repercussions [8,177–179]. Clinical profiles in adolescence include ADHD combined with a persistence of the classic triad inattention, hyperactivity and impulsivity which is often associated with behavioural problems and significant difficulties [180]. Hyperactive disorders tend to manifest less in a behavioural pattern and more into internal agitation, while inattention and distraction problems persist and become more clinically present [181,182]. Another profile of ADHD in adolescence has predominant inattention often associated with executive impairments which in some cases corresponds to Sluggish Cognitive Tempo [183–185].

Comorbidities are as common as in childhood: behavioural disorders (oppositional defiant disorder, legal proceedings), anxiety disorders (social phobia and/or generalised anxiety disorder), mood disorders (dysthymia or major depressive disorder). Adolescents with ADHD are more likely to use tobacco, alcohol and drugs due to their predisposition to experiment with psychoactive substances earlier and more intensively than young people in the general population [186,187], and to have early sexual experiences, sexually transmitted diseases and unwanted pregnancies [188].

On the other hand, new technologies represent sources of attraction and pitfalls for adolescents with ADHD. They are particularly attracted by these media whose reactivity corresponds to their impulsivity and hyperactivity, by being carried away by impulsive clicks and instant messages that give them access, without cognitive effort, to a multitude of websites and virtual relationships. Because of their cognitive difficulties, they are very often overwhelmed by the multitasking processes of computer operating systems that overwhelm their executive capacities. Virtual digital worlds and digital objects provide them with an escape from the constraints of everyday life and school learning. Video games are another source of fascination and escape from everyday life in which they can perform well, but also of experiences that make them feel good and allow them to share exciting moments with peers and strangers without the usual hindrances of non-virtual relationships. But screens are very often a space for testing boundaries and significant conflict with parents and carry a significant risk of withdrawal and addiction [189–191].

4.2.2. Pubertal changes in ADHD adolescents

From a clinical point of view, adolescence is a condenser and reflector of the psychological impact of ADHD from childhood. Clinical experience frequently confronts us with the following observations: low self-esteem, feelings of incompetence and failure, the impression of not being able to use one's abilities and potentials, shame and guilt for disappointing others and oneself, the impression of not being like others. Since childhood, ADHD sufferers have been confronted with identity issues related to the alienating processes of ADHD, which constitute a constraining, enigmatic inner double that overwhelms their control capacities. When medication is effective and well tolerated, children with ADHD can observe positive effects on their difficulties, but these are not directly linked to their personal abilities to act on their functioning. They are inhabited by another self and ambivalently invest this pharmacological double, an object that is both surprising and disturbingly strange. Negative remarks about their functioning destabilise their identity foundations and stigmatise them with the feeling of being less good than others, of being useless, which indelibly alters their self-esteem and their representations of inca-

capacity by making them alienated from their intrinsic values and their qualities.

On the other hand, adolescents with ADHD often have difficulties in managing the paradoxical movements between autonomy and regression and periods of psychological fragility and risky behaviour. They have to prove themselves, to show what they are capable of by having to achieve what could previously be postponed. They are confronted with their significant narcissistic fragility and difficulties in controlling and refocusing on themselves. They are searching for a sense of self and exploring psychic zones charged with excitements and fears, movements of autonomy and regression, attractions for transgressions and ambivalences. Breaking the shackles of parental figures and childish patterns of relationship is both a magnetic pole of attraction and anxiety, creating tides of emotional movement and difficulties in regulating frustrations and outbursts of desire and anger.

4.2.3. Psychotherapeutic approaches

The management of adolescents with ADHD must consider the specificities of pubertal changes while also taking into account relational and societal issues, as well as the associated disorders [192]. As in childhood, the model is based on a multidisciplinary and multidimensional approach, giving more space to the processes of autonomy and subjectivation, to questions of identity and to issues related to sexuality, while at the same time having to integrate constraints and to develop some personal projects. The challenge of therapy in adolescence is to promote an increase in reflexive and control capacities as well as a progressive and structuring transition to adulthood [163,193,194].

A central challenge in the management of adolescents with ADHD is the adherence to the therapeutic approach, for instance with medication, usually involving a psychostimulant [164,195]. It is important to regularly address the effects of medication on ADHD symptoms and executive difficulties by creating a space for discussion and reflection with adolescents with ADHD and their parents, when and where appropriate. These young people are able to subtly describe the effects of medication, such as reduced psychic energy and emotional blunting with psychostimulants.

Psychotherapeutic approaches are particularly important during puberty because of the processes of brain maturation and subjectification [165,196]. Cognitive-behavioural approaches adapted to adolescence, with a greater emphasis on cognitive processes and problem solving, can be carried out individually or in groups, possibly also including parental participation, depending on the intervention programs, with the aim of developing skills to reduce the impact of ADHD-related symptoms and executive difficulties as well as relational and motivational problems [161,166,167,192,197,198]. Psychodynamic approaches are indicated in situations involving worrying existential suffering and disorganising identity issues related to pubertal changes [167,168,198,199]. Family therapies may be appropriate in dysfunctional transition processes towards autonomy and parental resistances caused by the upheavals of family homeostasis linked to adolescence [169,200].

The establishment of a trusting relationship, the flexibility of the setting and the tactfulness of psychotherapeutic interventions are particularly important factors during adolescence. Supporting care must also strike a balance between "not trivialising and not dramatising", between patience and rapid availability (e.g. use of e-mail), between respecting the private sphere of the adolescent and the demands of parents, professionals and public authorities (e.g. school, youth protection services, juvenile justice). Based on these perspectives, a recent study used a psychotherapeutic third generation cognitive behavioural therapy (CBT) program is a combining social skills training, emotional regulation, self-esteem, cognitive remediation, and mindfulness therapies for ADHD subjects 7–15-

years-old and behavioural techniques, emotional regulation, and mindfulness for parents. The program consisted in a series of 16 simultaneous-but-separate therapy sessions for parents and for children/adolescents [201]. This multicenter randomised controlled trial yielded interesting findings: observed reductions in ADHD symptomatology and anxiety-depression scores, but also an improvement of self-esteem, emotional regulation, social integration, and school results.

4.2.4. Conclusion

Adolescents with ADHD are at high risk of academic difficulties and educational failure, substance abuse and comorbidities such as emotional and behavioural disorders. Adolescence is a condenser and reflector of the psychological impact of ADHD from childhood, including low self-esteem, feelings of shame and guilt, and the impression of not being like the others. Young people with ADHD have been confronted since childhood with questions of identity linked to the alienating processes of ADHD, which constitute a constraining, enigmatic inner double that overwhelms their capacity of self-control. The identity crisis of adolescence mobilises profound questions that go beyond the ADHD paradigm, with questions about the meaning, goals and value of life, about the perspectives of the present and the future. Difficulties related to ADHD and comorbidities need to be taken into account in the interventions by including consideration of existential suffering, self-esteem disorders, difficulties in controlling and regulating emotions. The therapeutic framework must include genuine empathy and be both flexible and affirmative by integrating the appropriate care for each situation. The accompaniment of these young people is very demanding and sometimes difficult, punctuated by disappointments and failures, but also by personal enrichment and creative potential as well as the opportunity to revisit the forces of life and destructiveness of one's own adolescence.

4.3. ADHD in adults: specificity and non-pharmacological management

ADHD prevalence in adults is estimated to be 2 to 8% in the student population [183]. Other studies suggest figures ranging from 1.4 to 8.3% [202]. Relative decrease in ADHD symptoms in adults and across the life span has been argued in recent research [11,12]. ADHD-related demands are estimated to account for 25% of the student demand on university disability and counselling services [203]. Therefore, it is important to develop programs for children as well as later for adolescents and adults to promote academic success [204,205], taking into account that psychosocial treatment is the most beneficial treatment option for most adult patients with ADHD [206].

Accordingly, specific programs including for example the taking care of adult ADHD have been proposed [196]. This is a six-month program which aims to raise awareness of the problem, of how it affects your life, associated disorders and assessment of symptoms. It offers psychoeducation and explores self-image issues, time management, goal setting and planning. Work on impaired executive functions, working memory and emotion regulation will allow better management of ADHD. Finally, this program addresses medication, routines, money management, social relationships, and other disorders such as depression, opposition, and substance use. These issues are addressed with advice on prioritising goals, a workbook, and an overall change goal. We are going to present a series of programs, firstly specific to adult ADHD and then "general" programs which can also be very interesting in the orientation and care of students but also young adults who sometimes drop out.

The second specific program is The Adult ADHD Tool Kit (learning about planning processes is an important part of this). The authors believe that the day should start with the "to do list"

(10 minutes, i.e., 600 seconds for planning and organising the day) [207]. Tasks should be described in behavioural, observable and measurable terms, always specifying “what you are going to do”, with times, places and with “concreteness” as a motto. The program consists of the following modules: modules 1 to 3 on activity planning (electronic or paper diary), a diary for all activities, but leaving space for the unexpected; module 4 focuses on prioritisation, planned activities and the reduction of distractors, while leaving time for oneself, for sleep, food, and physical activity. Module 5 deals with taking action, with the possibility of splitting up tasks and the instruction to start with an “easy” goal, a simple task to start with, to have a positive result and it is “the smallest step for a commitment to action”. Modules 6 and 7 are devoted to the implementation of the action plan and to motivation, working on automatic thoughts and cognitive distortions and moving towards a sense of values by changing the vision of oneself. Within the Adult ADHD Tool Kit, organisation, assertiveness, and the toolbox in everyday life and environmental management are covered in chapters 8 to 11. Module 12 deals with social skills, decision making and dealing with uncertainty. Module 13 deals with managing life at university, and more general modules deal with caring, coping with imperfection, assertiveness and negotiation, especially in the workplace; relationships with others, family, and health and well-being activities such as sleep, physical activity and healthy eating (modules 14 to 16). Finally, from module 17 onwards, daily life tips are covered to changing habits with screens, recognising, and overcoming procrastination.

The third specific program comprises a 12-session program, in a group setting, but can be adapted for individuals [202]. It is based on the following assumptions, according to the authors: “If it's not planned, it doesn't exist”, “If you have trouble getting started, the first step is too big”; “Doing things according to priorities”, “Getting started is the hardest part” and “A place for everything”. “Doing things according to priorities”, “Getting started is the hardest part” and “A place for everything and everything in its place”.

Regarding Cognitive-Behavioural Therapy (CBT) for ADHD adolescents and adults, a psychological guide to practice a group-based program that emphasises the need to consolidate the therapeutic alliance and the need to develop supportive, informative, structuring and coaching actions was developed [208]. The program uses psychoeducation, motivational approaches, CBT and cognitive remediation. Along these lines, a French adaptation “*La maîtrise du TDAH chez l'adulte*” [209] has been proposed. It includes a manual for the therapist and another manual for the patient. The patient's book includes information about ADHD; advice on organisation and planning for multiple and demanding tasks; techniques for reducing inattention and work on cognitive restructuring. The program addresses procrastination and relapse prevention by involving a family member as a “co-therapist”. It is a progressive program with a weekly self-assessment of ADHD symptoms and exercises to be carried out in a notebook. The therapist's guide includes the same 4 modules.

We will discuss two programs that are carried out in France.

Within the same framework, the program “*Manuel de thérapie autonome : Mon programme en 16 étapes pour le TDAH de l'adulte*” was developed [210]. It is, according to the authors, a “coaching” program that includes elements of psychoeducation, self-assessment, behavioural measures and the guidance for implementation. The modules are, time management; how to do self-assessments; forgetfulness and memory; planning and prioritisation; and motivation, as well as advice on material organisation, healthy living, procrastination and impulsivity. The program is accompanied by the regular use of a diary in which the patient “assesses, informs and reviews”, with an ADHD severity and impact scale used regularly and a motivational assessment at the end of each module.

We estimate that the Vera and Gaillac program is quite interesting from a clinical point of view: “*Prendre en charge les adultes souffrant de TDAH Manuel pour le praticien*” [211]. It consists of a manual for therapists. The authors provide clinical vignettes. They address the problems of working memory, time perception, prospective memory, emotional regulation, self-activation, etc. They insist on specific situations involving young adults such as admission to university, driving and possible risky behaviours. The techniques used are psycho-education, motivational approach and CBT.

We should note that there are also “generalist” programs, not focused on ADHD, but which clinically represent interesting alternative care options for subjects with ADHD. These include CARE (Coherence Attention Relation Engagement) [212], a positive psychology program in a group setting, and mental health promotion in general; Marsha Linehan's Dialectical behaviour therapy (DBT) skills training program [213], which has 4 modules: mindfulness skills, interpersonal effectiveness skills, emotional regulation skills and distress tolerance skills, with modules consisting of 12 or 24 sessions. In the same vein, the mindfulness program [214] and “Manage your mind” approach (Butler et al., 2018) which compiles dimensions worked on in third-wave of CBT are quite interesting. The latter, addresses the following values; acceptance and kindness, this links to self-esteem and self-confidence; positive thinking, decision-making and motivation. On an organisational level, the program works on SMART (Specific, Measurable, Achievable, Realistic, and Time-bound) goals, time management and feel-good activities such as physical activity, creativity and relationships with others. Finally, the authors address stress and worries (understanding the causes and overcoming them), learning to live with uncertainty, depression, addictions, chronic pain and traumatic experiences.

In sum, despite the existence of a large number of programs that could be used for adults with ADHD, barriers exist in accessing them as well as in accessing care for young adults – stigma, not wanting to be seen as disabled and, lack of knowledge about the disorder [215]. In some cases, they will only seek medication to improve performance [216] or, conversely, they may have an outright refusal of treatment. Other problems worth mentioning are the myths about the non-existence of the disorder (an invented disorder that still persists in some circles) or the comorbidities (one does not think one has ADHD, one does not spot it although there is an associated disorder), or according to lifestyle habits (sleep, diet) in relation to the group [217]. Finally, we could mention the problem of access to care, given the precarious financial situation of students and the lack of reimbursement of psychotherapy. In view of all the above, information and awareness-raising are needed for guidance services. Work on shame and stigmatisation of students in accessing care; initiatives such as peer helpers or the development of distance care, teleconsultations, telephone, internet programs to enable access to care would be areas to develop.

5. Discussion and conclusions

The different sections proposed in this article and their corresponding symposium presentations indicate that the results of the following non-pharmacological interventions: CBT, parenting skills program, mindfulness, yoga, cognitive and metacognitive intervention, and neurofeedback are encouraging for reducing ADHD-related symptoms and improving coping skills and quality of life in children, adolescents and adults with this disorder.

However, to date, studies of non-pharmacological interventions in the ADHD population have been plagued by methodological problems. Indeed, these studies often present important biases such as the absence of a double-blind evaluation and/or a ran-

domised controlled trial. As a result, it is not currently possible to demonstrate the effectiveness of a specific non-pharmacological intervention for the treatment of ADHD. Future studies that include a rigorous scientific method and compare different non-pharmacological interventions would allow recommendations to be made.

Comparing the different programs used in psychotherapy with individuals with ADHD would also be relevant. This approach would make it possible to identify the mechanisms of action used in these programs. Indeed, it is difficult to determine the relevance of the different elements that vary from one program to another, such as: psychoeducation, behavioural measures, parenting skills, cognitive restructuring, the motivational approach, mindfulness, yoga, self-efficacy and positive psychology sessions, emotion management and social skills. It would also be relevant to examine the value of adding a module focusing on cognitive and metacognitive skills, particularly as it also seems that the integration of metacognitive interventions is the aspect that differentiates effective and ineffective cognitive training programs.

To date, the results of scientific research tend to advocate multimodal approaches. However, previous studies evaluating the effects of non-pharmacological interventions have not systematically distinguished between groups of participants with and/or without pharmacological treatment. Little is known about the influence of a pharmacological treatment on the effects of a non-pharmacological intervention. Currently, the principle of multimodal approaches is not to oppose pharmacological and non-pharmacological treatments but to examine their complementarity and to reflect on the temporality when these two types of approaches are proposed to a patient.

Overall, the articles in this symposium emphasise the importance of involving parents, family carers and the school environment to promote the generalisation of the effects of multimodal approaches in the management of patients with ADHD. Non-pharmacological approaches need to be considered in conjunction with the implementation of school or professional accommodations. The contribution of innovative technologies is part of a promising new field of research to promote accommodation of ADHD-related symptoms. However, to date, technological aids remain little studied and accessible to a French-speaking population with ADHD.

It is also important to consider the variability of clinical expression of ADHD, which remains a heterogeneous disorder. The clinical presentations and comorbidities associated with ADHD vary from one individual to another. Conducting single-case studies would allow a better understanding of the variation in the effects of non-pharmacological interventions depending on the specificity of the patient. The specificity of ADHD symptoms in adolescence is addressed in this symposium. However, it should be noted that the effects of non-pharmacological interventions are not yet known in certain age groups of individuals with ADHD, such as older children and pre-schoolers. It is therefore desirable to be able to include this age group in future studies.

In summary, this symposium recommends the implementation of multimodal programs for young people and adults with ADHD. However, this type of intervention is still not widely available for a French-speaking population, particularly in France and Switzerland, due to the lack of specific training in ADHD for professionals and the costs of these types of interventions. Intervention programs are mainly available in English and validated in North America. This symposium has raised great interest among professionals and families of patients. We hope that it will encourage the implementation and study of the effects of non-pharmacological approaches in the treatment of ADHD in a French-speaking population.

Disclosure of interest

The authors declare that they have no competing interest.

References

- [1] Polanczyk G, de Lima MS, Horta BL, et al. The worldwide prevalence of ADHD: a systematic review and meta-regression analysis. *Am J Psychiatry* 2007;164(6):942–8.
- [2] Thomas R, Sanders S, Doust J, et al. Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics* 2015;135(4):e994–1001.
- [3] Magnus W, Nazir S, Anilkumar AC, et al. Attention deficit hyperactivity disorder. Treasure Island (FL): StatPearls; 2022.
- [4] American Psychiatric Association. Desk reference to the diagnostic criteria from DSM-5-TR. Washington, DC: American Psychiatric Association Publishing; 2022.
- [5] American Psychiatric Association. Desk reference to the diagnostic criteria from DSM-5. Washington, DC: American Psychiatric Publishing; 2013, xlviii, 395 pp.
- [6] American Psychiatric Association, American Psychiatric Association. DSM-5 Task Force. Diagnostic and statistical manual of mental disorders: DSM-5. 5th ed. Washington, D.C.: American Psychiatric Association; 2013, xlv, 947 pp.
- [7] Ferguson JH. National Institutes of Health Consensus Development Conference Statement: diagnosis and treatment of attention-deficit/hyperactivity disorder (ADHD). *J Am Acad Child Adolesc Psychiatry* 2000;39(2):182–93.
- [8] Sibley MH, Swanson JM, Arnold LE, et al. Defining ADHD symptom persistence in adulthood: optimizing sensitivity and specificity. *J Child Psychol Psychiatry* 2017;58(6):655–62.
- [9] Sibley MH, Mitchell JT, Becker SP. Method of adult diagnosis influences estimated persistence of childhood ADHD: a systematic review of longitudinal studies. *Lancet Psychiatry* 2016;3(12):1157–65.
- [10] Fayyad J, Sampson NA, Hwang I, et al. The descriptive epidemiology of DSM-IV Adult ADHD in the World Health Organization World Mental Health Surveys. *Atten Defic Hyperact Disord* 2017;9(1):47–65.
- [11] Vos M, Hartman CA. The decreasing prevalence of ADHD across the adult lifespan confirmed. *J Glob Health* 2022;12:03024.
- [12] Song P, Zha M, Yang Q, et al. The prevalence of adult attention-deficit hyperactivity disorder: a global systematic review and meta-analysis. *J Glob Health* 2021;11:04009.
- [13] Ferreira S, Zeron R, Carvalho G, et al. Therapeutic aspects and diagnosis of the attention deficit hyperactivity disorder – ADHD in adults. In: Badnjevic A, Škrbić R, Gurbeta Pokvić L, editors. *CMBEBIH 2019: Proceedings of the International Conference on Medical and Biological Engineering*. Banja Luka, Bosnia and Herzegovina: Springer International Publishing; 2020, p. 769–73.
- [14] Chigome AK, Matsangaise MM, Meyer JC. Adult attention deficit hyperactivity disorder and its management: review. *SA Pharm J* 2018;85(3):31–8.
- [15] Magnin E, Maurs C. Attention-deficit/hyperactivity disorder during adulthood. *Rev Neurol (Paris)* 2017;173(7–8):506–15.
- [16] Cortese S, Asherson P, Sonuga-Barke E, et al. ADHD management during the COVID-19 pandemic: guidance from the European ADHD Guidelines Group. *Lancet Child Adolesc Health* 2020;4(6):412–4.
- [17] Hennissen L, Bakker MJ, Banaschewski T, et al. Cardiovascular effects of stimulant and non-stimulant medication for children and adolescents with ADHD: a systematic review and meta-analysis of trials of methylphenidate, amphetamines and atomoxetine. *CNS Drugs* 2017;31(3):199–215.
- [18] Mechler K, Banaschewski T, Hohmann S, et al. Evidence-based pharmacological treatment options for ADHD in children and adolescents. *Pharmacol Ther* 2022;230:107940.
- [19] Boland H, DiSalvo M, Fried R, et al. A literature review and meta-analysis on the effects of ADHD medications on functional outcomes. *J Psychiatr Res* 2020;123:21–30.
- [20] McLennan JD, Sparshu S. Returning to stimulants in children with treatment resistant ADHD: a case series. *J Can Acad Child Adolesc Psychiatry* 2018;27(1):50–6.
- [21] Perugi G, Pallucchini A, Rizzato S, et al. Pharmacotherapeutic strategies for the treatment of attention-deficit hyperactivity (ADHD) disorder with comorbid substance-use disorder (SUD). *Expert Opin Pharmacother* 2019;20(3):343–55.
- [22] Inglis SK, Carucci S, Garas P, et al. Prospective observational study protocol to investigate long-term adverse effects of methylphenidate in children and adolescents with ADHD: the Attention Deficit Hyperactivity Disorder Drugs Use Chronic Effects (ADDUCE) study. *BMJ Open* 2016;6(4):e010433.
- [23] Ramos-Quiroga JA, Montoya A, Kutzelnigg A, et al. Attention deficit hyperactivity disorder in the European adult population: prevalence, disease awareness, and treatment guidelines. *Curr Med Res Opin* 2013;29(9):1093–104.
- [24] Ahmed R, Borst J, Wei YC, et al. Parents' perspectives about factors influencing adherence to pharmacotherapy for ADHD. *J Atten Disord* 2017;21(2):91–9.
- [25] Emilsson M, Gustafsson PA, Ohnstrom G, et al. Beliefs regarding medication and side effects influence treatment adherence in adolescents with attention deficit hyperactivity disorder. *Eur Child Adolesc Psychiatry* 2017;26(5):559–71.

- [26] Pliszka SR, Pereira-Sanchez V, Robles-Ramamurthy B. A review of clinical practice guidelines in the diagnosis and treatment of attention-deficit/hyperactivity disorder. *Child Adolesc Psychiatr Clin N Am* 2022;31(3):569–81.
- [27] Sonuga-Barke EJ, Brandeis D, Cortese S, et al. Nonpharmacological interventions for ADHD: systematic review and meta-analyses of randomized controlled trials of dietary and psychological treatments. *Am J Psychiatry* 2013;170(3):275–89.
- [28] Lee S, Hill TR, Johnson B, et al. Can neurocognitive outcomes assist measurement-based care for children with attention-deficit/hyperactivity disorder? A systematic review and meta-analyses of the relationships among the changes in neurocognitive functions and clinical outcomes of attention-deficit/hyperactivity disorder in pharmacological and cognitive training interventions. *J Child Adolesc Psychopharmacol* 2022;32(5):250–77.
- [29] Haugan ALJ, Sund AM, Young S, et al. Cognitive behavioural group therapy as addition to psychoeducation and pharmacological treatment for adolescents with ADHD symptoms and related impairments: a randomised controlled trial. *BMC Psychiatry* 2022;22(1).
- [30] Siebelink NM, Bogels SM, Speckens AEM, et al. A randomised controlled trial (MindChamp) of a mindfulness-based intervention for children with ADHD and their parents. *J Child Psychol Psychiatry* 2022;63(2):165–77.
- [31] Zhang L, Lopes S, Lavelle T, et al. Economic evaluations of mindfulness-based interventions: a systematic review. *Mindfulness (N Y)* 2022;13(10):2359–78.
- [32] Cibrian FL, Monteiro E, Schuck SEB, et al. Interdisciplinary tensions when developing digital interventions supporting individuals with ADHD. *Front Digit Health* 2022;4:876039.
- [33] Lambez B, Harwood-Gross A, Golumbic EZ, et al. Non-pharmacological interventions for cognitive difficulties in ADHD: a systematic review and meta-analysis. *J Psychiatr Res* 2020;120:40–55.
- [34] Cortese S, Ferrin M, Brandeis D, et al. Cognitive training for attention-deficit/hyperactivity disorder: meta-analysis of clinical and neuropsychological outcomes from randomized controlled trials. *J Am Acad Child Adolesc Psychiatry* 2015;54(3):164–74.
- [35] Rabipour S, Raz A. Training the brain: fact and fad in cognitive and behavioral remediation. *Brain Cogn* 2012;79(2):159–79.
- [36] Rutledge KJ, van den Bos W, McClure SM, et al. Training cognition in ADHD: current findings, borrowed concepts, and future directions. *Neurotherapeutics* 2012;9(3):542–58.
- [37] Superbia-Guimaraes LM-E, Camos SV. Effects of cognitive training upon working memory in individuals with ADHD: an overview of the literature. *J Educ Dev Psychol* 2022;12(1):21–30.
- [38] Dentz A, Guay M-C, Gauthier B, et al. Is the Cogmed program effective for youths with attention deficit/hyperactivity disorder under pharmacological treatment? *Appl Cogn Psychol* 2020;34(3):577–89.
- [39] Stern A, Malik E, Pollak Y, et al. The efficacy of computerized cognitive training in adults with ADHD: a randomized controlled trial. *J Atten Disord* 2016;20(12):991–1003.
- [40] Veloso A, Vicente SG, Filipe MG. Effectiveness of cognitive training for school-aged children and adolescents with attention deficit/hyperactivity disorder: a systematic review. *Front Psychol* 2019;10:2983.
- [41] Villemonteix T. L'entraînement de la mémoire de travail est-il bénéfique pour les enfants présentant un trouble déficit de l'attention/hyperactivité ? *Neuropsychiatr Enfance Adolesc* 2018;66(1):3–12.
- [42] Kofler MJ, Sarver DE, Austin KE, et al. Can working memory training work for ADHD? Development of central executive training and comparison with behavioral parent training. *J Consult Clin Psychol* 2018;86(12):964–79.
- [43] Sol Sandberg S, McAuley T. Hospital-based modified cogmed working memory training for youth with ADHD. *J Atten Disord* 2022;26(10):1283–92.
- [44] Roberts BA, Martel MM, Nigg JT. Are there executive dysfunction subtypes within ADHD? *J Atten Disord* 2017;21(4):284–93.
- [45] Deforme H. Prise en charge des troubles attentionnels et exécutifs chez l'enfant. La remédiation cognitive : pratiques et perspectives. *Developpements* 2011;8(2):5–20.
- [46] Butzbach M, Fuermaier ABM, Aschenbrenner S, et al. Metacognition in adult ADHD: subjective and objective perspectives on self-awareness of cognitive functioning. *J Neural Transm (Vienna)* 2021;128(7):939–55.
- [47] Giroux S, Parent V, Guay M-C. La remédiation cognitive et la remédiation métacognitive pour les personnes ayant un TDAH : deux stratégies d'intervention novatrices et pourquoi pas complémentaires ? *J Ther Comput Cogn* 2010;20(3):87–92.
- [48] Fonagy P, Moran GS, Edgcombe R, et al. The roles of mental representations and mental processes in therapeutic action. *Psychoanal Study Child* 1993;48:9–48.
- [49] Cella M, Edwards C, Swan S, et al. Exploring the effects of cognitive remediation on metacognition in people with schizophrenia. *J Exp Psychopathol* 2019;10(2).
- [50] Renou S, Doyen C. Programme de remédiation cognitive NEAR (Neuropsychologique Educational Approach to Cognitive Remediation) chez des adolescents présentant un trouble déficit de l'attention/hyperactivité et/ou un trouble du spectre autistique. *Ann Med Psychol* 2019;177(8):758–64.
- [51] Pezzica S, Vezzani C, Pinto G. Metacognitive knowledge of attention in children with and without ADHD symptoms. *Res Dev Disabil* 2018;83:142–52.
- [52] Lussier F, CENOP (Canada), CRAN (Canada). PIFAM : programme d'intervention sur les fonctions attentionnelles et métacognitives. IRP; 2013.
- [53] Caron Asd. Aider son enfant à gérer l'impulsivité et l'attention. *Attentix à la maison* 2015:13.
- [54] Gagné PP, Longpré LP. Apprendre avec réfléchto. Canada: Chenelière Éducation; 2004.
- [55] Rigard C, Peyroux E, Morel A, et al. Remédiation cognitive en psychiatrie de l'enfant. Approche neuropsychologique des apprentissages chez l'enfant 2016;28:233–40.
- [56] Unver H, Rodopman Arman A, Nur Akpunar S. Metacognitive awareness and emotional resilience in children with attention deficit hyperactivity disorder. *Scand J Child Adolesc Psychiatr Psychol* 2022;10(1):33–9.
- [57] Macoun SJ, Pyne S, MacSween J, et al. Feasibility and potential benefits of an attention and executive function intervention on metacognition in a mixed pediatric sample. *Appl Neuropsychol Child* 2022;11(3):240–52.
- [58] Aydin O, Balikli K, Sonmez I, et al. Examining the roles of cognitive flexibility, emotion recognition, and metacognitions in adult attention deficit and hyperactivity disorder with predominantly inattentive presentation. *Clin Psychol Psychother* 2022;29(2):542–53.
- [59] Hahn-Markowitz J, Berger I, Manor I, et al. Cognitive-Functional (Cog-Fun) dyadic intervention for children with ADHD and their parents: impact on parenting self-efficacy. *Phys Occup Ther Pediatr* 2018;38(4):444–56.
- [60] Pisacco NMT, Sperafoico YLS, Enricone JRB, et al. Metacognitive interventions in text production and working memory in students with ADHD. *Psicol Reflex Crit* 2018;31(1):5.
- [61] Qian Y, Chen M, Shuai L, et al. Effect of an ecological executive skill training program for school-aged children with attention deficit hyperactivity disorder: a randomized controlled clinical trial. *Chin Med J (Engl)* 2017;130(13):1513–20.
- [62] Tamm L, Nakonezny PA. Metacognitive executive function training for young children with ADHD: a proof-of-concept study. *Atten Defic Hyperact Disord* 2015;7(3):183–90.
- [63] Tamm L, Epstein JN, Peugh JL, et al. Preliminary data suggesting the efficacy of attention training for school-aged children with ADHD. *Dev Cogn Neurosci* 2013;4:16–28.
- [64] Moritz S, Lysaker PH, Hofmann SG, et al. Going meta on metacognitive interventions. *Expert Rev Neurother* 2018;18(10):739–41.
- [65] Solanto MV, Marks DJ, Wasserstein J, et al. Efficacy of meta-cognitive therapy for adult ADHD. *Am J Psychiatry* 2010;167(8):958–68.
- [66] Solanto MV. Cognitive-behavioral therapy for adult ADHD: targeting executive dysfunction. New-York: Guilford Press; 2011, x, 214.
- [67] Borsboom D. A network theory of mental disorders. *World Psychiatry* 2017;16(1):5–13.
- [68] Borsboom D, Cramer AO. Network analysis: an integrative approach to the structure of psychopathology. *Annu Rev Clin Psychol* 2013;9:91–121.
- [69] Perez-Alvarez M. The four causes of ADHD: aristotle in the classroom. *Front Psychol* 2017;8:928.
- [70] Jensen CM, Steinhausen HC. Comorbid mental disorders in children and adolescents with attention-deficit/hyperactivity disorder in a large nationwide study. *Atten Defic Hyperact Disord* 2015;7(1):27–38.
- [71] Kofler MJ, Raiker JS, Sarver DE, et al. Is hyperactivity ubiquitous in ADHD or dependent on environmental demands? Evidence from meta-analysis. *Clin Psychol Rev* 2016;46:12–24.
- [72] Cortese S, Sabe M, Chen C, et al. Half a century of research on attention-deficit/hyperactivity disorder: a scientometric study. *Neurosci Biobehav Rev* 2022;140:104769.
- [73] Chen SX, Yu JL, Zhang Q, et al. Which factor is more relevant to the effectiveness of the cognitive intervention? A meta-analysis of randomized controlled trials of cognitive training on symptoms and executive function behaviors of children with attention deficit hyperactivity disorder. *Front Psychol* 2022;12.
- [74] Dovis S, van der Oord S, Wiers R, et al. Een nieuwe kijk op ADHD: De rol van executief functioneren en motivatie. *Psycholoog* 2016;51.
- [75] Willcutt EG, Doyle AE, Nigg JT, et al. Validity of the executive function theory of attention-deficit/hyperactivity disorder: a meta-analytic review. *Biol Psychiatry* 2005;57(11):1336–46.
- [76] Peter CM, Molenaar, Cynthia G (sd), et al. The new person-specific paradigm in psychology. United States: Current Directions in Psychological Science; 2009.
- [77] Hamaker EL. Why researchers should think “within-person”: a paradigmatic rationale. In: Mehl MR, Conner TS, editors. Handbook of research methods for studying daily life. Netherland: Guilford Publications; 2012. p. 43–61.
- [78] Ponsioen AJGB, Vliet FV, Blijderveen R, et al. Braingame Brian: N = 1 in de praktijk. Wat doet deze interventie bij deze cliënt? *Psycholoog* 2016;51(5):44–57.
- [79] Prins PJ, Brink ET, Dovis S, et al. “Braingame Brian”: toward an executive function training program with game elements for children with ADHD and cognitive control problems. *Games Health J* 2013;2(1):44–9.
- [80] Prins PJ, Dovis S, Ponsioen A, et al. Does computerized working memory training with game elements enhance motivation and training efficacy in children with ADHD? *Cyberpsychol Behav Soc Netw* 2011;14(3):115–22.
- [81] van der Oord S, Ponsioen AJ, Geurts HM, et al. A pilot study of the efficacy of a computerized executive functioning remediation training with game elements for children with ADHD in an outpatient setting: outcome on parent- and teacher-rated executive functioning and ADHD behavior. *J Atten Disord* 2014;18(8):699–712.
- [82] van der Oord S, Bogels SM, Peijnenburg D. The effectiveness of mindfulness training for children with ADHD and mindful parenting for their parents. *J Child Fam Stud* 2012;21(1):139–47.
- [83] Guay MC. Ces enfants qui apprennent autrement. In: Broché. Canada; 2019.

- [84] Guay M-C. Les difficultés d'apprentissage chez les jeunes qui ont un TDA ou un TDAH. *Approche Neuropsychol Apprentiss Enfant (Revue ANAE)* 2016;28(1):140.
- [85] Mahone EM. The effects of ADHD (beyond decoding accuracy) on reading fluency and comprehension. *New Horiz Learn* 2011;9(1).
- [86] Re AM, Pedron M, Cornoldi C. Expressive writing difficulties in children described as exhibiting ADHD symptoms. *Learn Disabil* 2007;3:244–55.
- [87] DeBono T, Hosseini A, Cairo C, et al. Written expression performance in adolescents with attention-deficit/hyperactivity disorder (ADHD). *Read Writ* 2012;25:1403–26.
- [88] Shephard E, Zuccolo PF, Idrees I, et al. Systematic review and meta-analysis: the science of early-life precursors and interventions for attention-deficit/hyperactivity disorder. *J Am Acad Child Adolesc Psychiatry* 2022;61(2):187–226.
- [89] Moreno-Garcia I, Cano-Crespo A, Rivera F. Results of neurofeedback in treatment of children with ADHD: a systematic review of randomized controlled trials. *Appl Psychophysiol Biofeedback* 2022;47(3):145–81.
- [90] Micolaud-Franchi JA, Geoffroy PA, Fond G, et al. EEG neurofeedback treatments in children with ADHD: an updated meta-analysis of randomized controlled trials. *Front Hum Neurosci* 2014;8:906.
- [91] Bioulac S, Purper-Ouakil D, Ros T, et al. Personalized at-home neurofeedback compared with long-acting methylphenidate in an european non-inferiority randomized trial in children with ADHD. *BMC Psychiatry* 2019;19(1):237.
- [92] Patil AU, Madathil D, Fan YT, et al. Neurofeedback for the education of children with ADHD and specific learning disorders: a review. *Brain Sci* 2022;12(9).
- [93] Arns M, Clark CR, Trullinger M, et al. Neurofeedback and Attention-Deficit/Hyperactivity-Disorder (ADHD) in children: rating the evidence and proposed guidelines. *Appl Psychophysiol Biofeedback* 2020;45(2):39–48.
- [94] Cortese S, Ferrin M, Brandeis D, et al. Neurofeedback for Attention-Deficit/Hyperactivity Disorder: meta-analysis of clinical and neuropsychological outcomes from randomized controlled trials. *J Am Acad Child Adolesc Psychiatry* 2016;55(6):444–55.
- [95] Van Doren J, Arns M, Heinrich H, et al. Sustained effects of neurofeedback in ADHD: a systematic review and meta-analysis. *Eur Child Adolesc Psychiatry* 2019;28(3):293–305.
- [96] Gelade K, Janssen TW, Bink M, et al. Behavioral effects of neurofeedback compared to stimulants and physical activity in attention-deficit/hyperactivity disorder: a randomized controlled trial. *J Clin Psychiatry* 2016;77(10):e1270–7.
- [97] Gelade K, Janssen TWP, Bink M, et al. A 6-month follow-up of an RCT on behavioral and neurocognitive effects of neurofeedback in children with ADHD. *Eur Child Adolesc Psychiatry* 2018;27(5):581–93.
- [98] Gevensleben H, Holl B, Albrecht B, et al. Neurofeedback training in children with ADHD: 6-month follow-up of a randomised controlled trial. *Eur Child Adolesc Psychiatry* 2010;19(9):715–24.
- [99] Gevensleben H, Holl B, Albrecht B, et al. Is neurofeedback an efficacious treatment for ADHD? A randomised controlled clinical trial. *J Child Psychol Psychiatry* 2009;50(7):780–9.
- [100] Steiner NJ, Frenette EC, Rene KM, et al. In-school neurofeedback training for ADHD: sustained improvements from a randomized control trial. *Pediatrics* 2014;133(3):483–92.
- [101] Strehl U, Aggensteiner P, Wachtlin D, et al. Neurofeedback of slow cortical potentials in children with Attention-Deficit/Hyperactivity Disorder: a multicenter randomized trial controlling for unspecific effects. *Front Hum Neurosci* 2017;11:135.
- [102] Arns M, Drinkenburg W, Leon Kenemans J. The effects of QEEG-informed neurofeedback in ADHD: an open-label pilot study. *Appl Psychophysiol Biofeedback* 2012;37(3):171–80.
- [103] Kropotov JD, Grin-Yatsenko VA, Ponomarev VA, et al. ERPs correlates of EEG relative beta training in ADHD children. *Int J Psychophysiol* 2005;55(1):23–34.
- [104] Monastra VJ, Monastra DM, George S. The effects of stimulant therapy, EEG biofeedback, and parenting style on the primary symptoms of attention-deficit/hyperactivity disorder. *Appl Psychophysiol Biofeedback* 2002;27(4):231–49.
- [105] Purper-Ouakil D, Blasco-Fontecilla H, Ros T, et al. Personalized at-home neurofeedback compared to long-acting methylphenidate in children with ADHD: NEWROFEED, a European randomized noninferiority trial. *J Child Psychol Psychiatry* 2022;63(2):187–98.
- [106] Fouillen M. Interface Cerveau-Machine de type P300 pour l'entraînement de l'attention chez les enfants avec TDAH. Lyon : université Claude Bernard Lyon 1 ; soutenue publiquement le 17/12/2019.
- [107] Thibault RT, Veissiere S, Olson JA, et al. Treating ADHD with suggestion: neurofeedback and placebo therapeutics. *J Atten Disord* 2018;22(8):707–11.
- [108] Kabat-Zinn J. *Wherever you go, there you are: mindfulness meditation in everyday life*. UK: Hachette Books; 1994.
- [109] Marlatt GA, Kristeller JL. In: *Mindfulness and meditation*. American Psychological Association United States; 1999. p. 67–84.
- [110] Hofling V, Strohle G, Michalak J, et al. A short version of the Kentucky Inventory of Mindfulness Skills. *J Clin Psychol* 2011;67(6):639–45.
- [111] Kabat-Zinn J, Massion AO, Kristeller J, et al. Effectiveness of a meditation-based stress reduction program in the treatment of anxiety disorders. *Am J Psychiatry* 1992;149(7):936–43.
- [112] Kristeller JL, Hallett CB. An exploratory study of a meditation-based intervention for binge eating disorder. *J Health Psychol* 1999;4(3):357–63.
- [113] Shapiro SL, Schwartz GE, Bonner G. Effects of mindfulness-based stress reduction on medical and premedical students. *J Behav Med* 1998;21(6):581–99.
- [114] Teasdale JD, Segal ZV, Williams JMG. *Mindfulness training and problem formulation*. *Clinical Psychology: Science and Practice* 2003;10(2):157–60.
- [115] Bulzacka E, Lavault S, Pelissolo A, et al. [Mindful neuropsychology: mindfulness-based cognitive remediation]. *Encephale* 2018;44(1):75–82.
- [116] Baer RA, Smith GT, Allen KB. Assessment of mindfulness by self-report: the Kentucky inventory of mindfulness skills. *Assessment* 2004;11(3):191–206.
- [117] Geschwind N, Peeters F, Drukker M, et al. Mindfulness training increases momentary positive emotions and reward experience in adults vulnerable to depression: a randomized controlled trial. *J Consult Clin Psychol* 2011;79(5):618–28.
- [118] Young KS, van der Velden AM, Craske MG, et al. The impact of mindfulness-based interventions on brain activity: a systematic review of functional magnetic resonance imaging studies. *Neurosci Biobehav Rev* 2018;84:424–33.
- [119] Sezer I, Pizzagalli DA, Sacchet MD. Resting-state fMRI functional connectivity and mindfulness in clinical and non-clinical contexts: a review and synthesis. *Neurosci Biobehav Rev* 2022;135:104583.
- [120] MacLean KA, Ferrer E, Aichele SR, et al. Intensive meditation training improves perceptual discrimination and sustained attention. *Psychol Sci* 2010;21(6):829–39.
- [121] Jha AP, Krompinger J, Baime MJ. Mindfulness training modifies subsystems of attention. *Cogn Affect Behav Neurosci* 2007;7(2):109–19.
- [122] Carter OL, Presti DE, Callistemon C, et al. Meditation alters perceptual rivalry in Tibetan Buddhist monks. *Curr Biol* 2005;15(11):R412–3.
- [123] Lao SA, Kissane D, Meadows G. Cognitive effects of MBSR/MBCT: a systematic review of neuropsychological outcomes. *Conscious Cogn* 2016;45:109–23.
- [124] Zhang J, Diaz-Roman A, Cortese S. Meditation-based therapies for attention-deficit/hyperactivity disorder in children, adolescents and adults: a systematic review and meta-analysis. *Evid Based Ment Health* 2018;21(3):87–94.
- [125] Faraone SV, Banaschewski T, Coghill D, et al. The World Federation of ADHD International Consensus Statement: 208 Evidence-based conclusions about the disorder. *Neurosci Biobehav Rev* 2021;128:789–818.
- [126] Krisanaprakornkit T, Ngamjarus C, Witoonchart C, et al. Meditation therapies for attention-deficit/hyperactivity disorder (ADHD). *Cochrane Database Syst Rev* 2010;(6). CD006507.
- [127] Lenzi F, Cortese S, Harris J, et al. Pharmacotherapy of emotional dysregulation in adults with ADHD: a systematic review and meta-analysis. *Neurosci Biobehav Rev* 2018;84:359–67.
- [128] Phan ML, Renshaw TL, Caramanico J, et al. Mindfulness-based school interventions: a systematic review of outcome evidence quality by study design. *Mindfulness (N Y)* 2022;13(7):1591–613.
- [129] Tang YY, Lu Q, Geng X, et al. Short-term meditation induces white matter changes in the anterior cingulate. *Proc Natl Acad Sci U S A* 2010;107(35):1564–652.
- [130] Chimiklis AL, Dahl V, Spears AP, et al. Yoga, mindfulness, and meditation interventions for youth with ADHD: systematic review and meta-analysis. *J Child Fam Stud* 2018;27(10):3155–68.
- [131] Chimiklis AL, Dahl V, Spears AP, et al. Yoga, mindfulness, and meditation interventions for youth with ADHD: systematic review and meta-analysis. *J Child Fam Stud* 2018;27(10):3155–68.
- [132] Cairncross M, Miller CJ. The effectiveness of mindfulness-based therapies for ADHD: a meta-analytic review. *J Atten Disord* 2020;24(5):627–43.
- [133] Evans S, Ling M, Hill B, et al. Systematic review of meditation-based interventions for children with ADHD. *Eur Child Adolesc Psychiatry* 2018;27(1):9–27.
- [134] Parent V, Lagueux F. Évaluation de l'implantation et de l'efficacité d'une intervention basée sur la pleine conscience pour des enfants âgés de 8 à 12 ans et leurs parents. Thèse 2017.
- [135] Deplus S, Lahaye M. La pleine conscience chez l'enfant et l'adolescent: programmes d'initiation et d'entraînement. *Mardaga*; 2015. p. 249.
- [136] Beauregard-Lacroix R. Efficacité d'une intervention basée sur la pleine conscience sur le développement de la pleine conscience d'enfants d'âge scolaire. Thèse 2019.
- [137] Gaudreault K. Effets d'une intervention basée sur la pleine conscience sur les fonctions exécutives chez des enfants d'âge scolaire. Thèse 2020.
- [138] Hart N, Fawkner S, Niven A, et al. Scoping Review of yoga in schools: mental health and cognitive outcomes in both neurotypical and neurodiverse youth populations. *Children (Basel)* 2022;9(6).
- [139] Hariprasad VR, Arasappa R, Varambally S, et al. Feasibility and efficacy of yoga as an add-on intervention in attention deficit-hyperactivity disorder: an exploratory study. *Indian J Psychiatry* 2013;55(Suppl. 3):S379–84.
- [140] Harrison LJ, Manocha R, Rubia K. Sahaja yoga meditation as a family treatment programme for children with attention deficit-hyperactivity disorder. *Clin Child Psychol Psychiatry* 2004;9(4):479–97.
- [141] Stueck M, Gloeckner N. Yoga for children in the mirror of the science: working spectrum and practice fields of the training of relaxation with elements of yoga for children. *Early Child Dev Care* 2005;175(4):371–7.
- [142] Anestini AS, Dupuis G, Lanctot D, et al. The effects of the Bali yoga program for breast cancer patients on chemotherapy-induced nausea and vomiting: results of a partially randomized and blinded controlled trial. *J Evid Based Complementary Altern Med* 2017;22(4):721–30.
- [143] Girard-Bériault F. Étude de faisabilité sur l'utilisation de la méthode de yoga Bali et ses effets auprès des enfants ayant un trouble du déficit de l'attention avec hyperactivité. Thèse 2019.

[144] Balasubramaniam M, Telles S, Doraiswamy PM. Yoga on our minds: a systematic review of yoga for neuropsychiatric disorders. *Front Psychiatry* 2012;3:117.

[145] Jensen PS, Kenny DT. The effects of yoga on the attention and behavior of boys with Attention-Deficit/hyperactivity Disorder (ADHD). *J Atten Disord* 2004;7(4):205–16.

[146] Theule J, Wiener J, Tannock R, et al. Parenting stress in families of children with ADHD: a meta-analysis. *J Emot Behav Disord* 2013;21(1):3–17 [1063–4266].

[147] Margari F, Craig F, Petruzzelli MG, et al. Parents psychopathology of children with Attention Deficit Hyperactivity Disorder. *Res Dev Disabil* 2013;34(3):1036–43.

[148] Chadwick O, Momcilovic N, Rossiter R, et al. A randomized trial of brief individual versus group parent training for behavior problems in children with severe learning disabilities. *Behav Cogn Psychother* 2001;29(2):151–67.

[149] Barkley RA. *Defiant children: a clinician's manual for assessment and parent training* 2013.

[150] Reale L, Bartoli B, Cartabia M, et al. Comorbidity prevalence and treatment outcome in children and adolescents with ADHD. *Eur Child Adolesc Psychiatry* 2017;26(12):1443–57.

[151] Efron D, Bryson H, Lycett K, et al. Children referred for evaluation for ADHD: comorbidity profiles and characteristics associated with a positive diagnosis. *Child Care Health Dev* 2016;42(5):718–24.

[152] Johnston C, Chen M, Ohan J. Mothers' attributions for behavior in nonproblem boys, boys with attention deficit hyperactivity disorder, and boys with attention deficit hyperactivity disorder and oppositional defiant behavior. *J Clin Child Adolesc Psychol* 2006;35(1):60–71.

[153] Johnston C, Mash EJ. Families of children with attention-deficit/hyperactivity disorder: review and recommendations for future research. *Clin Child Fam Psychol Rev* 2001;4(3):183–207.

[154] Noordermeer SDS, Luman M, Weeda WD, et al. Risk factors for comorbid oppositional defiant disorder in attention-deficit/hyperactivity disorder. *Eur Child Adolesc Psychiatry* 2017;26(10):1155–64.

[155] Harvey EA, Breaux RP, Lugo-Candelas CI. Early development of comorbidity between symptoms of attention-deficit/hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD). *J Abnorm Psychol* 2016;125(2):154–67.

[156] Ging-Jehli NR, Arnold LE, Roley-Roberts ME, et al. Characterizing underlying cognitive components of ADHD presentations and co-morbid diagnoses: a diffusion decision model analysis. *J Atten Disord* 2022;26(5):706–22.

[157] Patterson GR. In: *Coercive family process*. Castalia, [SS](2002) The early development of coercive family process. A developmental analysis and model for intervention. *Antisocial behavior in children and adolescents*. USA: American Psychological Association, [aTS]; 1982.

[158] Eddy JM, Leve LD, Fagot BI. Coercive family processes: A replication and extension of Patterson's coercion model. *Aggressive Behavior: Official Journal of the International Society for Research on Aggression* 2001;27(1):14–25.

[159] Patterson GR, DeBaryshe BD, Ramsey E. A developmental perspective on antisocial behavior. *Am Psychol* 1989;44(2):329–35.

[160] Kaminski JW, Valle LA, Filene JH, et al. A meta-analytic review of components associated with parent training program effectiveness. *J Abnorm Child Psychol* 2008;36(4):567–89.

[161] Rimestad ML, Lambek R, Zacher Christiansen H, et al. Short- and long-term effects of parent training for preschool children with or at risk of ADHD: a systematic review and meta-analysis. *J Atten Disord* 2019;23(5):423–34.

[162] Hauth-Charlier S, Clément C. Abord développemental du TDAH : efficacité d'un programme d'entraînement aux habiletés parentales. [Development of ADHD: Efficacy of a parenting skills training program]. *Can J Behav Sci* 2014;46(2):107–16.

[163] Hauth-Charlier S, Clément C. Programmes de formation aux habiletés parentales pour les parents d'enfant avec un TDA/H : considérations pratiques et implications cliniques. *Prat Psychol* 2009;15(4):457–72.

[164] Haslam DM, Sanders MR, de Vries PJ. IACAPAP e-textbook of child and adolescent mental health. In: *International Association for Child and Adolescent Psychiatry and Allied Parenting programs*. Australia; 2016.

[165] Massé L, Lanaris C, Couture C. Interventions auprès des parents de jeunes présentant un TDAH. In: *Chevalier N, Guay MC, Achim A, Lageix P, Poissant H, editors. Trouble déficitaire de l'attention avec hyperactivité. Soigner, éduquer, surtout valoriser*. Quebec: Presse de l'université du Quebec; 2006. p. 255–80.

[166] Chronis AM, Chacko A, Fabiano GA, et al. Enhancements to the behavioral parent training paradigm for families of children with ADHD: review and future directions. *Clin Child Fam Psychol Rev* 2004;7(1):1–27.

[167] Hinshaw SP, Owens EB, Wells KC, et al. Family processes and treatment outcome in the MTA: negative/ineffective parenting practices in relation to multimodal treatment. *J Abnorm Child Psychol* 2000;28(6):555–68.

[168] Chacko A, Wymbs BT, Rajwan E, et al. Characteristics of parents of children with ADHD who never attend, drop out, and complete behavioral parent training. *J Child Fam Stud* 2017;26(3):555–68.

[169] Meuwissen AS, Carlson SM. Fathers matter: the role of father parenting in preschoolers' executive function development. *J Exp Child Psychol* 2015;140:1–15.

[170] Forehand R, Parent J, Sonuga-Barke E, et al. Which type of parent training works best for preschoolers with comorbid ADHD and ODD? A secondary analysis of a randomized controlled trial comparing generic and specialized programs. *J Abnorm Child Psychol* 2016;44(8):1503–13.

[171] Sankey C, Derguy C, Clement C, et al. Supporting parents of a child with autism spectrum disorder: the French awakening. *J Autism Dev Disord* 2019;49(3):1142–53.

[172] DuPaul GJ, Kern L, Belk G, et al. Face-to-face versus online behavioral parent training for young children at risk for ADHD: treatment engagement and outcomes. *J Clin Child Adolesc Psychol* 2018;47(supp. 1):S369–83.

[173] Claussen AH, Holbrook JR, Hutchins HJ, et al. All in the family? A systematic review and meta-analysis of parenting and family environment as risk factors for Attention-Deficit/Hyperactivity Disorder (ADHD) in Children. *Prev Sci* 2022;19:1–23.

[174] Ros-DeMarize R, Chung P, Stewart R. Pediatric behavioral telehealth in the age of COVID-19: Brief evidence review and practice considerations. *Curr Probl Pediatr Adolesc Health Care* 2021;51(1):100949.

[175] Valentine AZ, Hall SS, Young E, et al. Implementation of telehealth services to assess, monitor, and treat neurodevelopmental disorders: systematic review. *J Med Internet Res* 2021;23(1):e22619.

[176] Myers K, Vander Stoep A, Zhou C, et al. Effectiveness of a telehealth service delivery model for treating attention-deficit/hyperactivity disorder: a community-based randomized controlled trial. *J Am Acad Child Adolesc Psychiatry* 2015;54(4):263–74.

[177] Barkley RA. *Attention-deficit hyperactivity disorder. A handbook for diagnosis & treatment*. USA: The Guilford Press; 2015.

[178] Cheung C, Rijdsdijk F, McLoughlin G, et al. Childhood predictors of adolescents and young adults outcome in ADHD. *J Psychiatr Res* 2015;62:92–100.

[179] Sibley MH, Pelham WE, Molina BSG, et al. Diagnosing ADHD in adolescence. *J Consult Clin Psychol* 2012;80(1):139–50.

[180] Wolraich ML, Bickman L, Lambert EW, et al. Intervening to improve communication between parents, teachers, and primary care providers of children with ADHD or at high risk for ADHD. *J Atten Disord* 2005;9(1):354–68.

[181] Biederman J, Mick E, Faraone SV. Age-dependent decline of symptoms of attention deficit hyperactivity disorder: impact of remission definition and symptom type. *Am J Psychiatry* 2000;157(5):816–8.

[182] van Lier P, van der Ende J, Koot HM, et al. Which better predicts conduct problems? The relationship of trajectories of conduct problems with ODD and ADHD symptoms from childhood into adolescence. *J Child Psychol Psychiatry* 2007;48(6):601–8.

[183] Barkley RA. Sluggish cognitive tempo (concentration deficit disorder?): current status, future directions, and a plea to change the name. *J Abnorm Child Psychol* 2014;42:117–25.

[184] Becker SP, Marshall SA, McBurnett K. Sluggish cognitive tempo in abnormal child psychology: an historical overview and introduction to the special section. *J Abnorm Child Psychol* 2014;42(1):1–6.

[185] Becker SP. Systematic review: assessment of sluggish cognitive tempo over the past decade. *J Am Acad Child Adolesc Psychiatry* 2021;60(6):690–709.

[186] Wilens TE, Adamson J, Sgambati S, et al. Do individuals with ADHD self-medicate with cigarettes and substances of abuse? Results from a controlled family study of ADHD. *Am J Addict* 2007;16(Suppl. 1):14–21 [quiz 2–3].

[187] Gudjonsson GH, Sigurdsson JF, Sigfusdottir ID, et al. An epidemiological study of ADHD symptoms among young persons and the relationship with cigarette smoking, alcohol consumption and illicit drug use. *J Child Psychol Psychiatry* 2012;53(3):304–12.

[188] Antshel K, Barkley RA. Attention deficit/hyperactivity. In: *Bradford B, Prinstein MJ, editors. Encyclopedia of Adolescence*, 3. 2011. p. 56–61.

[189] Chou WJ, Huang MF, Chang YP, et al. Social skills deficits and their association with Internet addiction and activities in adolescents with attention-deficit/hyperactivity disorder. *J Behav Addict* 2017;6(1):42–50.

[190] Evren C, Evren B, Dalbudak E, et al. Relationships of Internet addiction and Internet gaming disorder symptom severities with probable attention deficit/hyperactivity disorder, aggression and negative affect among university students. *Atten Defic Hyperact Disord* 2019;11(4):413–21.

[191] Tourjman V, Louis-Nascan G, Ahmed G, et al. Psychosocial interventions for attention deficit/hyperactivity disorder: a systematic review and meta-analysis by the CADDRA Guidelines Work group. *Brain Sci* 2022;12(8).

[192] Sibley MH, Graziano PA, Kuriyan AB, et al. Parent-teen behavior therapy-motivational interviewing for adolescents with ADHD. *J Consult Clin Psychol* 2016;84(8):699–712.

[193] Sprich SE, Safren SA, Finkelstein D, et al. A randomized controlled trial of cognitive behavioral therapy for ADHD in medication-treated adolescents. *J Child Psychol Psychiatry* 2016;57(11):1218–26.

[194] McClain EK, Burks EJ. Managing attention-deficit/hyperactivity disorder in children and adolescents. *Prim Care* 2015;42(1):99–112.

[195] Bussings R, Zima BT, Mason DM, et al. Receiving treatment for attention-deficit hyperactivity disorder: do the perspectives of adolescents matter? *J Adolesc Health* 2011;49:7–14.

[196] Jeamment P. *Innovations en clinique et psychopathologie de l'adolescence*. *Ann Med Psychol* 2001;159:672–8.

[197] Evans SW, Owens JS, Bunford N. Evidence-based psychosocial treatments for children and adolescents with attention-deficit/hyperactivity disorder. *J Clin Child Adolesc Psychol* 2014;43(4):527–51.

[198] Bader M., Knauer K. *Perspectives psychanalytiques chez les enfants ayant un TDAH.2015 (conférence)*.

[199] Gunter M. Attention deficit hyperactivity disorder (ADHD): an affect-processing and thought disorder? *Int J Psychoanal* 2014;95(1):43–66.

[200] Robin AL. Family therapy for adolescents with ADHD. *Child Adolesc Psychiatr Clin N Am* 2014;23(4):747–56.

[201] Crouzet L, Gramond A, Suehs C, et al. Third-generation cognitive behavioral therapy versus treatment-as-usual for attention deficit and hyperactivity disorder: a multicenter randomized controlled trial. *Trials* 2022;23(1):83.

- [202] Mortier P, Demyttenaere K, Nock MK, et al. [The epidemiology of ADHD in first-year university students]. *Tijdschr Psychiatr* 2015;57(9):635-44.
- [203] Wolf LE. College students with ADHD and other hidden disabilities. Outcomes and interventions. *Ann N Y Acad Sci* 2001;931:385-95.
- [204] Brassard J, Moreault B. Trajectoire optimale de services pour les enfants, adolescents et jeunes adultes ayant un trouble de déficit de l'attention avec ou sans hyperactivité (TDAH) ou des difficultés apparentées. Institut national d'excellence en santé et en services sociaux. France: INESSS; 2018.
- [205] Zendarski N, Sciberras E, Mensah F, et al. A longitudinal study of risk and protective factors associated with successful transition to secondary school in youth with ADHD: prospective cohort study protocol. *BMC Pediatr* 2016;16:20.
- [206] Kolar D, Keller A, Golfinopoulos M, et al. Treatment of adults with attention-deficit/hyperactivity disorder. *Neuropsychiatr Dis Treat* 2008;4(1):107-21.
- [207] Ramsay JR, Rostain AL. The adult ADHD tool kit. United States: Routeledge; 2014.
- [208] Young S, Bramhan J. In: *Cognitive-Behavioral therapy for ADHD in adolescents and adults: a psychological guide to practice*. United States: Wiley-Blackwell; 2012.
- [209] Safren SA, Sprich S, Perlman CA (sd), et al. *Mastering your adult ADHD*. Oxford, UK: Oxford University Press; 2020.
- [210] Lopez R, Roques A. *Surmonter le TDAH de l'adulte : le premier manuel de coaching autonome pour le TDAH de l'adulte*. France: Broché; 2018.
- [211] Vera L, Gaillac V. *Prendre en charge les adultes souffrant de TDAH manuel pour le praticien*. France: Dunod; 2016.
- [212] Shankland R, Durand J, Pancsik M, et al. *Mettre en oeuvre un programme de psychologie positive*. France: Dunod; 2018.
- [213] Linehan MM. *Dialectical behavior therapy in clinical practice*. USA: Guilford Press; 2020.
- [214] Zylowska L. *The mindfulness prescription for adult ADHD: An 8-step program for strengthening attention, managing emotions, and achieving your goals*. United States: Shambhala Publications; 2012.
- [215] Schoeman R, Liebenberg R. The South African Society of Psychiatrists/Psychiatry Management Group management guidelines for adult attention-deficit/hyperactivity disorder. *S Afr J Psychiatr* 2017;23:1060.
- [216] Culpepper L, Fried R. Attention-deficit/hyperactivity disorder in a chronic care paradigm. *Postgrad Med* 2013;125(4):78-86.
- [217] Corkum P, Elik N, Blotnicky-Gallant PAC, et al. Web-based intervention for teachers of elementary students with ADHD: randomized controlled trial. *J Atten Disord* 2019;23(3):257-69.