BALNEO RESEARCH Balneo and PRM Research Journal English Edition
e ISSN 2734 - 8458 p ISSN 2734 - 844X ROMANIAN ASSOCIATION OF BALNEOLOGY

Research article

Non-pharmacological methods and techniques used in the therapy of children diagnosed with ADHD. Study of literature

Iustina Condurache [1], Iulia Crăciun [1], Mihai Ilea [1], Constantin Munteanu [1], Mariana Rotariu [1,*] and Cezar Mucileanu [1]

Citation: Condurache I., Crăciun I., Ilea M., Rotariu M. and Mucileanu C. - Non-pharmacological methods and techniques used in the therapy of children diagnosed with adhd. Study of literature
Balneo and PRM Research Journal ***2024***, *15(2): 701*

Academic Editor(s):
Constantin Munteanu

Reviewer Officer:
Viorela Bembea

Production Officer:
Camil Filimon

Received: 29.04.2024
Published: 21.06.2024

Reviewers:
Adrian Melnic
Roxana Bistriceanu

Publisher's Note: Balneo and PRM Research Journal stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1 Faculty of Medical Bioengineering, University of Medicine and Pharmacy "Grigore T. Popa" Iasi

* Correspondence: Mariana Rotariu, rotariu29@yahoo.com

Abstract: Attention deficit and hyperactivity disorder (ADHD) is seen as a long-lasting and challenging condition that affects various areas of life, such as academic and career success, relationships, and daily activities. Both the mind and the muscles jump from one task to another, failing to complete the activity, and thus difficulties arise in carrying out activities such as writing, tying shoelaces, riding a bicycle and more. Banal activities we would say, but essential for a normal lifestyle.
Medical recovery has a signifiant contribution in relieving symptoms and treating many pathologies, in both physical and mental relaxation. Moreover, it has been shown countless times that physical activity reduces stress, mainly based on muscle relaxation and improving cognitive and motor function through the development of neural functions. More and more children are diagnosed with this disorder, but, not enough attention is paid to these cases, which is one of the reasons why we chose to address this topic.
The paper aims to analyze studies carried out in recent years in different countries on motor impairments and other complications that can present children with ADHD, but also the way that balneophysiokinetotherapy has a positive effect in their therapy, being an essential form of therapy, alongside the psychological or medicinal one.
The studies analyzed confirm the benefits of physical exercise for children diagnosed with ADHD, showing visible effects on both the motor skills of the children and their lev-els of agitation and attention deficit. Although movement therapy is widely used in this condition, there are no protocols standardizing the type, duration, and intensity of exer-cise programs used. Occupational therapy, massage, and yoga have been noted for their beneficial effects on patients diagnosed with ADHD.

Keywords: ADHD, hyperactivity, therapy

1. Introduction

Attention deficit and hyperactivity disorder (ADHD) is a chronic health problem that has a significant impact on proper functioning and increases the risk of other long-term pathologies [1]. About 5.7 million children worldwide are diagnosed with ADHD. Over time, the methods of diagnosis have changed, as have those of treatment. Thus, we want to increase attention to the ways that medical recovery can be used as a treatment along with psychotherapy and drug treatment [2].

After a 10-year study conducted by the National Institute of Mental Health, researchers discovered that children and adolescents diagnosed with ADHD have brains that are 3-4% smaller compared to those without the disorder. Additionally, a decrease in gray matter was observed in the caudate nucleus, a deep brain region responsible for integrating information from various brain areas and supporting cognitive functions like memory [3].

Dr. Daniel G. Amen, brain imaging specialist, has studied for more than two decades how ADHD affects various areas of the brain and the three neurotransmitters: dopamine,

serotonin, and GABA. According to it, there are 7 types of ADHD: classic ADHD, inattention-based ADHD, hyperattention-based ADHD, ADHD-frontal lobe, ADHD-limbic, ADHD-ring of fire (ADHD plus), ADHD-based on anxiety [4]. He argued that if the treatment is applied to the type of ADHD the individual has, the results can be impressive.

Over time, it has been shown that there are notable differences between the motor performance of a person diagnosed with ADHD and that of a healthy person. Doctors also claim that there is a close connection between ADHD and anxiety. About 40-60% of ADHD patients also have an anxiety disorder [5].

Given these aspects, we believe that it is essential that these patients receive increased care and benefit from a thorough assessment of the motor deficit and, in particular, its treatment. To pinpoint potential areas for enhancing fine motor skills, it's helpful to investigate the root causes of the impairment [6].

Fine motor challenges in individuals with ADHD are frequently associated with brain abnormalities. Several hypotheses, such as cortical activation dysregulation, cerebellar dysfunction, and delayed white matter maturation, have been suggested to explain these motor deficits. Numerous studies have highlighted neurochemical imbalances and abnormalities in brain regions linked to motor and executive control functions, including the cerebellum, prefrontal cortex, premotor cortex, and basal ganglia, in people with ADHD [6].

Imbalances at the cerebellar level produce dysrhythmia, dysmetria as well as impairment of executive control. It seems like all these factors are connected to difficulties in coordination and motor control. Visual-motor integration and coordination of the upper extremities are crucial for legible handwriting, and children with ADHD tend to struggle more in these areas compared to their peers who develop typically [7].

So, it seems that diminished executive control is a key factor contributing to fine motor difficulties in children diagnosed with ADHD, resulting in challenges with behavioral inhibition [7].

2. Method

For the purpose of writing this paper, six virtual libraries were used: Google Academic, Science Direct, Frontiers, National Library of Medicine, Academic Physiotherapy Conference Proceeding and PubMed Central. Searches were based on specific key terms, for example: motor deficit, ADHD, children, physiotherapy in ADHD, cognitive functions, meta-analysis, hydrotherapy for children with ADHD, non-pharmaceutical treatment.

For the analysis, studies published only after 2017 were chosen, also, the selection was made based on specific criteria: after reading the abstracts, only the studies relevant to the chosen theme were selected, in addition, the age of the subjects analyzed in these studies should be between 4 - 18 years old and have been diagnosed with ADHD by specialists.

Following the applied criteria, a number of 14 studies were selected, of which 9 are analyzes of other studies carried out over time, and 5 are case studies. The focus of this paper has been on how physiotherapy and other forms of medical movement rehabilitation contribute to the treatment of symptoms of this attention disorder, particularly fine motor deficits, impulsivity and social skills.

The main objective of the paper is to identify non-pharmacological therapies used in patients diagnosed with ADHD, the benefits of these therapies on the motor skills of patients, and their effects on attention deficit and hyperactivity. Additionally, we aim to identify activities that enhance concentration, help in addressing behavioral issues, social problems, and facilitate the integration of patients into social groups.

3. Results and discussions

Most of the studies reviewed provided clear information about the results obtained through the use of physiotherapy and other forms of movement recovery, but did not disclose the protocols carried out in carrying out the studies, this detail being specified in the case of each study described below. It is important to know that the examined studies are organized in the chronological order of their development, but grouped according to the form of treatment addressed.

3.1. Physical exercises

In 2018, Jeyanthi S., summarized specialist literature works written in the period 1974-2016 that examined the function of physical exercise in the attention deficit, respectively the motor deficit present in children with ADHD. More than 34 studies were analyzed, 15 of which focused only on the effect of therapeutic physical exercise and not only on the previously mentioned deficits. Broadly, the reviewed studies reported major benefits in the correction of motor deficits of a variety of exercise programs, but, did not present enough information about the long-term effects of this treatment program based on active physical movement [8].

In 2019, Yu Zang aimed to demonstrate the advantages of physical exercise for children diagnosed with ADHD. A meta-analysis of 8 randomized trials concentrating on aerobic exercise and yoga demonstrated that both yoga and aerobic exercise effectively reduce hyperactivity, anxiety, impulsivity, and social problems in children with ADHD. Another study, spanning 6 weeks and involving 12 sessions of educational and sports therapy with 90-minute sports activities twice a week, found a significant correlation between physical activity and enhancements in attention, cognitive symptoms, and social skills among children with ADHD. Additionally, a study showcasing a 4-year-old boy with ADHD illustrated that physical activity increased his attention and calmness. Moreover, current reviews suggest that physical activities can mitigate anxiety and depression in children with ADHD. Interestingly, increasing medication dosage resulted in the emergence of depressive symptoms, as evidenced by a case study involving a 7 year old child receiving a minimal dose of methylphenidate. Therefore, improving depression through exercise in these children may reduce the need for pharmacological intervention, thereby minimizing adverse drug effects and presenting another advantage of exercise therapy [9].

Mokobane and Colab. confirmed the relationship between motor performance and executive functions through an experimental study conducted in 2019, finding that subjects who had motor coordination problems also scored poorly on tests of memory, working and planning. Therefore, there is a need for fine motor functions to be components of ADHD assessments and to be included in general intervention methods for the treatment of children who are diagnosed and also have a fine or gross motor deficit [10].

Later, in 2021, after examining several studies conducted between 1997-2020, Seiffer B. et al. performed a systematic analysis of several randomized controlled trials that were based on moderate, physical activity and thus compared the differences in the symptomatology of children diagnosed with ADHD who performed this type of physical activity and those in the reference groups. The authors concluded that moderate to vigorous physical activity could represent an alternative method of treatment for ADHD, improving the concentration, motivation and social skills of these children, especially in cases where this type of physical activity was carried out under the guidance of a physiotherapist or specialized trainer. However, more studies are necessary to understand exactly the effect of frequency, intensity and time allocated to physical activity and the diversity of effects that may occur in relation to the subject's age [11].

In 2021, Amir Sabrizi conducted an experimental study involving 46 middle-aged children selected based on two-stage diagnostic criteria. The participants were divided into control (CG) and experimental groups (EG) using random assignment. EG participated in Water treadmill sessions for 30 minutes, 3-4 times per week for eight weeks. Each session began with warm-up, soft aerobic activity, dynamic and static stretching, and cool-down. The study concluded that the EG exhibited significantly lower levels of behavioral problems, social issues, anxiety-shyness, psychosomatic symptoms, and overall ADHD scores compared to the CG at the finish of the study [12].

In 2021, several authors, including Lelong M. have built a clear scheme of studies carried out until 2021 in accordance with the fine motor deficit and the training for its reduction through various forms. 12 studies were analysed, most specific training for fine motor deficits was carried out over a period of 8-12 weeks, only one of the 12 included training over a period of 10 months. Only 3 studies included a check-up at some time after treatment, noting that the positive effects were still present, especially on muscle control. In addition to occupational therapy and other treatment and training methods evaluated by the authors, there was also a form of complementary therapy based on applied kinesiology and breathing exercises that made a major contribution to improving muscle function, sleep, and writing. All included studies reported significant improvement in motor skills, writing, aggression control and academic performance [13].

In 2022, Yuan-Shuo Chan conducted a much more detailed study focusing only on the effect of physical exercise on the specific symptoms of a child with ADHD and on the brain of a child with ADHD in general. Around 314 studies were collected, after filtering them the author focused on a number of 34 experimental studies, as well as literature studies that proved that physical exercise effectively increases the executive function of children with ADHD. Moreover, Professor Yuan described in detail the effects of two different exercise patterns and their effect. First, aerobic exercise, 20 minutes of high-intensity aerobic exercise improved cognitive function and stabilized attention in the children tested. These effects are based on the following processes: when exercise intensity is moderate to high, the body activates neurophysiological responses to induce the synthesis of neurotransmitters, increases blood flow to the brain which improves neuroplasticity and increases the ability to process information. Thus, aerobic exercises have a much faster and long-term effect. Also, another training model analyzed in the study was the motor perceptual one, which aims to train the coordination between the perception of information and motor control, the training of vestibular sensation, proprioception and visual-motor coordination. Motor development appears to be abnormal in children with ADHD, with a delay of nearly two years compared to neurotypical children. For this reason, multiple studies have been carried out related to fine and gross motor deficits in children with ADHD [14].

In 2023, Yue Ye and colab, study the effects of exercise on both fine and gross motor skills in children with ADHD were analyzed. Among the included studies, only four focused on exercise interventions for fine motor skills. Table tennis exercises and horse riding programs were highlighted as significant interventions for improving fine motor skills, each with distinct exercise patterns. Table tennis exercises, based on constraint-induced exercise therapy principles, involved repetitive exercises aimed at harnessing motor potential through various strategies and tasks, enhancing hand-eye coordination, fine manual control, and executive function. On the other hand, the horse riding program emphasized the coordination between vision and limbs, requiring children with ADHD to adjust upper limb posture and speed based on visual information and trunk movement, thereby enhancing coordination, fine manual control, and hand-eye coordination. Additionally, a meta-analysis of 12 studies revealed that exercise interventions could enhance gross motor skills in children with ADHD. Among these interventions, fundamental movement skills (FMS) and table tennis exercises showed promise in improving both locomotor and object control skills, with FMS interventions

demonstrating superior efficacy. Further analysis suggested that FMS interventions not only provided goal-oriented guidance but also impacted neurogenesis, brain adaptation, and protection, fostering a stimulating learning environment to promote positive self-perception and experiences in children with ADHD. Furthermore, hydrotherapy, or physical exercise in water, yielded the most significant improvement effect, leveraging hydrodynamics principles to provide multisensory stimulation through factors like water temperature, weight reduction, and vestibular input, thereby enhancing the execution of gross motor skills [15].

3.2. Masotherapy

In 2019, Shu-Cheng C. and Branda Y. conducted an analysis to examine the impact of masotherapy on children and adolescents diagnosed with ADHD, ADD, or HKD. Among the 23 studies they reviewed, 11 focused on massage therapy for ADHD in this age group, while the remaining 12 were excluded. Their meta-analysis of randomized controlled trials revealed that massage therapy was more effective than methylphenidate in improving ADHD symptoms. Additionally, combining massage with sensory integration traaining showed superior results compared to sensory integration training alone. Some individual studies even demonstrated that massage therapy outperformed exercise therapy and relaxation therapy [16].

The aim of the study conducted by Zahra Asadi in 2020 was to assess how foot massage administered by a mother affects the severity of ADHD symptoms in children. The study was conducted on 56 children. The children were split into two groups, experimental (EG) and control group (CG). In the EG, after the mother was given masotherapy training, the mother massaged the child's foot three times a week for one month. Comparison of mean ADHD symptom scores after the intervention revealed a important difference between the two groups on the dimensions of memory and attention deficits, lack of responsibility and organization, lack of cooperation with others, and the total symptom severity score [17].

3.3.Hidrotherapy and ludotherapy

In 2021, Devi Chithra explored alternative therapies for children with ADHD. The study aimed to assess the effectiveness of hydrotherapy and ludotherapy in the recovery of children aged 7 to 10 years with ADHD. The experimental group received eight sessions of hydrotherapy and ludotherapy. Following these sessions, the authors concluded that both hydrotherapy and ludotherapy are beneficial for children with ADHD, helping them reduce hyperactivity and rash behavior [18].

3.4. Yoga

Gunasselan L. produced a paper (2021) that examined several studies of this form of therapy, including one by Beart and Lessing in 2019 that studied the impact of yoga therapy on the concentration and behavior of 10 patients, all children with age between 7-9 years, with ADHD, demonstrating in an orderly manner that there is a positive feed-back on the behavior of the majority of patients. They improved their concentration and physical coordination thanks to postures that optimized balance, flexibility, coordination, helped release accumulated energy, thus reducing hyperactivity. Yoga helps children with ADHD become more aware of their thoughts, emotions and physical sensations by controlling these feelings [19].

3.5. Sensory integration therapy

A 2021 case study by Yusiansari brings to the fore the recovery of children with ADHD through sensory integration therapy, a type of movement therapy that uses sensory

experiences to improve the child's ability to process and respond to sensory input. Head massage has also been shown to be useful for sensory stimulation, reducing children's overwhelming emotions and providing a sense of comfort, thus helping them manage their hyperactivity. Paravertebral release with the myofascial relaxation technique has been used to reduce spasm in the paravertebral area as this technique elongates the muscle fascia and can restore joint mobility, reducing pain and pressure on the fibrous connective tissue or fascia by breaking down adhesions. These techniques have been shown to be beneficial in children with ADHD, as in most cases they have muscle spasms and various other muscle problems [20].

5. Conclusions

The purpose of this paper was to draw attention to the positive effects that medical rehabilitation based on physical activity and other forms of non-pharmacological therapy have on patients diagnosed with ADHD and potential associated pathologies. Although it can be difficult at times, it is important to know that a child with ADHD cannot manage their behavior.

Children with ADHD may have difficulty suppressing their impulses, which means they may not analyze a situation or its consequences before acting. Therefore, a more in-depth study of these types of therapy methods is necessary, as well as the implementation of a more efficient system for evaluating the motor deficit present in these children in order to create a favorable environment for them and a life free from the obstacles posed by this pathology.

Physical activity can be a great ally for hyperactive children who struggle with concentration and restlessness. The positive effects are numerous, including significant improvements in motor skills, neuropsychological parameters and social behavior. Moreover, engaging in a regular exercise program can lead to noticeable enhancements in anxiety, depression, and aggressive behavior in a relatively short period, as observed in various studies.

Also beneficial are occupational therapy and specific physical therapy techniques that can improve writing and other fine motor skills previously presented, hydrotherapy which is an easy and fun way to exercise, where the child can use up energy and helps reduce impulsivity. Yoga, which, in addition to some of the previously mentioned benefits, can involve breathing exercises and relaxation techniques, thus inducing a state of calm and thus reducing hyperactivity. So, if these practices are studied more, son we will be able to talk about a complex, effective, standardized and well-staged alternative treatment.

We started this work from the idea of identifying non-pharmacological recovery methods used in ADHD patients. The continuously increasing number of cases requires the identification and implementation of standardized protocols used in patients with this diagnosis. The type of exercises used, the frequency of sessions and the type of combined therapies used require standardization in this way, making the recovery process easier. Occupational therapy comes with promising tools in the therapy of ADHD patients, being a research direction worthy of consideration.

Author Contributions: All the authors had the same contribution.
Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.

References

1. Drechsler R, Brem S, Brandeis D et all. ADHD: Current Concepts and Treatments in Children and Adolescents. *Neuropediatrics.* 2020; 51(5): 315–335.
2. Posner J, Polanczyk G, Sonuga-Barke E. Attention-deficit hyperactivity disorder. *Lancet.* 2020; 395(10222): 450–462.
3. Samea F, Soluki S, Nejati V et all. Brain alterations in children/adolescents with ADHD revisited: A neuroimaging meta-analysis of 96 structural and functional studies. *Neurosci Biobehav Rev.* 2019; 100: 1–8.
4. Anem D.G. Heaking Add. Editura Penguin Putman Inc, 2013.
5. Wolraich M.L, Hagan Jr. J.F., Allan C et all. Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents. *Pediatrics.* 2019; 144(4): e20192528.
6. Lelong M, Zysset A, Nievergelt M et all. How effective is fine motor training in children with ADHD? A scoping review. *BMC Pediatr.* 2021; 21: 490.
7. Caldani S, Acquaviva E, Moscoso A et all. Motor Capabilities in Children with ADHD Are Improved after Brief Visuopostural Training. *Neurol Int.* 2023; 28;15(3): 792-803.
8. Jeyanthi S, Arumugam N, Parasher R.K. Effect of physical exercises on attention, motor skill and physical fitness in children with attention deficit hyperactivity disorder: a systematic review. Atten Defic Hyperact *Disord.* 2019; 11(2): 125-137.
9. Zang Y. Impact of physical exercise on children with attention deficit hyperactivity disorders. *Medicine (Baltimore).* 2019; 98(46): e17980.
10. Mokobane M, Pillay B.J, Meyer A. Fine motor deficits and attention deficit hyperactivity disorder in primary school children. *S Afr J Psychiatr.* 2019; 25: 1232.
11. Seiffer B, Hautzinger M, Ulrich R, Wolf S. The Efficacy of Physical Activity for Children with Attention Deficit Hyperactivity Disorder: A Meta-Analysis of Randomized Controlled Trials. *J Atten Disord.* 2022; 26(5): 656-673.
12. Sabzi A.H, Dan A, Salehian M.H, Yekta S. The Effect of Water Treadmill Exercise on Children with Attention Deficit Hyperactivity Disorder. *Int J Pediatr*. 2021; 9:6.
13. Lelong M, Zysset A, Mirjam Nievergelt M et all. How effective is fine motor training in children with ADHD? A scoping review. *BMC Pediatr.* 2021; 21: 490.
14. Chan Y-S, Jang J-T, Ho C-S. Effects of physical exercise on children with attention deficit hyperactivity disorder. *Biomedical Journal.* 2022; 45:2, 265-270.
15. Ye Y, Ning K, Wan B, Shangguan C. The Effects of the Exercise Intervention on Fundamental Movement Skills in Children with Attention Deficit Hyperactivity Disorder and/or Autism Spectrum Disorder: A Meta-Analysis. *Sustainability* 2023, 15(6), 5206.
16. Chen S, Yee-Man Yu B, Kwai-Ping Suen L et all. Massage therapy for the treatment of attention deficit/hyperactivity disorder (ADHD) in children and adolescents: A systematic review and meta-analysis. *Complementary Therapieus in Medicine*. 2019; 42: 389-399.
17. Asadi Z, Shakibaei F, Mazaheri M, Jafari-Mianaei S. The Effect of Foot Massage by Mother on the Severity of Attention-Deficit Hyperactivity Disorder Symptoms in Children Aged 6-12. *Iran J Nurs Midwifery Res*. 2020 18;25(3): 189-194.
18. Devi Chithra R, Janani M, Struhi B et all. Study to Find the Effect in Combined Protocol of Aquatic Therapy and Play Therapy in Attention Deficit Hyperactive Disorder in School Going Children from 7 – 10 Years to Improve the Quality of Life. *Journal of Pharmaceutical Research International.* 2021; 33(60A): 342-351.
19. Gunaseelan L, Vanama M.S, Abdi F et all. Yoga for the Management of Attention-Deficit/Hyperactivity Disorder. *Cureus.* 2021; 13(12): e20466.
20. Yustiansari R.A, Wijianto W, Trisnaningrum D.A. Management of physiotherapy in child with attention deficit hyperactivity disorders (ADHD). A case study. "Innovation of Physiotherapy Community on Increasing Physical Activity during Pandemic Covid-19". 2021; O-10, 243-253.