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Literature Review

Motor Activity for Subjects with ADHD and ADD Disorders

Manuela Valentini[1]* and Umberto Gasparinetti[2]

[1]*Department of Humanities Studies, University of Urbino Carlo Bo, Italy*

[2]*Motor, Sport and Health Sciences, Department of Biomolecular Sciences, University of Urbino Carlo Bo, Italy*

***Corresponding Author:** Manuela Valentini, Department of Humanities Studies, University of Urbino Carlo Bo, Italy.

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Abstract

The number of subjects with ADHD and ADD is increasing; the difficult management in the family and school contexts lead to the search for increasingly effective educational, didactic and methodological strategies. In this article we present an updated Systematic Review reporting motor activity protocols for subjects with attention-deficit and hyperactive disorder which aim at positively including them-among the others-in their peer group, with attention to disciplinary knowledge. Research limiting the use of drugs and promoting new means of intervention has been chosen; some examples are: metacognitive strategies and educational planning that have proved significant, since they focus on the modification and consolidation of the skills of each individual. The search engines used are: PsycARTICLES, SPORTDiscus, Web of Science, PASCALArchive, Scopus, Springer Nature Journals, Medical Online-E, ScienceDirect and Pubmed: various intervention protocols were extrapolated and elaborated from these sources. To evaluate the effectiveness of each treatment, in addition to the argumentation, the methods were also compared.

Keywords: *ADHD; ADD; Motor Activity*

Introduction

ADHD and ADD are two disorders that lead to a lack of attention and emotional management; they are part of the deficits that most often occur in the developmental age and have repercussions on a school, sports and social level. ADHD (Attention-Deficit/Hyperactivity Disorder) manifests itself mainly with an attention deficit in all the activities that are long lasting and not very motivating for subjects with a known presence of hyperactivity; the latter determines a contrast with the peer group and with the rest of the environment, which is why greater social problems may be encountered. ADD (Attention-Deficit Disorder) is diversified, as it concerns a deficit mainly focused on attention regardless of the type of educational activity performed. Subjects with this disorder do not create problems in the management of the class for the teacher, but the frequent lack of concentration during lessons or on assigned tasks, leads to subjects' delay in learning compared to their classmates'.

Both disorders relate to another deficit concerning motor development: the DCD (Developmental Coordination Disorder). This disorder causes a deficit of attention as well as a particular hyperactivity that creates problems concerning perception and motor control, characterizing the subject for the execution of poorly coordinated clumsy movements.

Since they are "Disorders", a cure is not practicable as it is innate and resistant to change in education. An attempt has today been made to face them with medicine; unfortunately, this remedy only represents a provisional solution which, moreover, has a positive effect only on a part of subjects.

At the same time, innovations regarding the use of mental strategies and recreational and motor activities centered on a progressive improvement in the learning and relational plan are gaining the upper hand.

Subjects with ADHD/ADD are normotypical subjects that are characterized by having a disorder that makes it difficult for them to perceive environmental stimuli and inhibit negative impulses in their behavioral sphere.

Literature Review

Some intervention programs adapted to different age ranges are reported, including innovative strategies and activities aimed at improving the psycho-physical condition of subjects with ADHD/ADD disorder from early childhood to early adulthood. These strategies and activities promote greater inner awareness in subjects, helping them understand and operate on limiting sensations such as shyness, fear of failure, impulsiveness and inadequacy with respect to others and can increase the desire to test themselves, to learn, to relate and to deal with their peers and ultimately to improve their quality of life. Most inclusion criteria are based on the age range included; for example, the Bueno protocol indicates a mandatory age range between 18 - 45 years; in the case of Van den Hoofdakker's treatment on Parent Training, parents with their children aged 4 to 12 were involved; however, recruitment was not always based on age: for example in the case of Lee's program, participants were chosen based on their school grade (1^{st} - 4^{th} elementary).

Other inclusion criteria are also based on cognitive functions measured through some diagnostic manuals, for example through the use of DSM-IV in the treatment of Lee and Van den Hoofdakker; furthermore, these protocols, as in Silva's case, do not include subjects having a previous history of drugs or other ADHD therapies.

In other treatments, in particular for adulthood, on the other hand, a certain level of drugs assumption was allowed if already taken before the treatment as in the case of the Mitchell protocol (in this case: combined treatment). Also in this program, the DSM-IV diagnostic criteria of ADHD were met. They included the use of the Conners ADHD self-report scale for adults (CAARS) for the inattention subscale and the subscale of symptoms of hyperactivity/impulsivity. On the other hand, in addition to the obstacles created by the use of drugs, further exclusion criteria persist, such as main neurological dysfunctions or psychoses, incorrect sensorial damage; in the case of the Mawjie protocol the motor or perceptual handicap is a problem as this treatment is based on exercises aimed at improving the working memory through an online computer program called CWMT (Cogmed Working Memory Training).

Mitchell's program excluded all those subjects who have ADHD diagnostic criteria related to the DSM-IV of Axis I, *i.e.* a manual in which clinical disorders are assessed (dementia, schizophrenia, mood disorders, substance-related disorders etc...) in which ADHD does not prevail as a primary diagnosis.

A further exclusion criterion concerns the taking of medicine for the treatment of other diseases, for example asthma, rhinitis, major depressive disorder, such as in Kang's program.

What all these treatments have in common is the comparison that is drawn between two groups in each program; a group submits to the requested intervention mode (*i.e.* the treatment group) and a group (called 'control group'), on the other hand, does not undergo it; finally, to evaluate the functionality of a given protocol, a comparison is made between the results reported by both groups.

On the other hand, the diversity lies in using distinct strategies in the sole purpose of improving the quality of life of subjects with ADHD/ADD disorder; in the articles by Hoza, Kang, Lee, Saemi, Silva and Schoenfelder, for example, the importance of physical activity (PA) has been underlined, as benefits have been reported not only from the preventive point of view in relation to chronic/degenerative diseases but also in relation to cognitive functioning; in other studies such as the research by Van de Weijer-Bergsma, Mitchell and Bueno the use of meditation techniques centered around one's own awareness is considered more effective, in order to regulate emotions and

attentional performance; such meditation can focus on one's own breathing whilst performing daily activities in addition to special sessions in the clinics as provided by the same treatments.

Saemi's protocol, in this context, turns out to be particularly significant, because contemplates both intervention methods. Two groups are structured and are asked to throw a tennis ball towards a target placed on the floor at a distance of 3 meters; a group is asked to focus externally (focus on the target during the throw), an internal focus is required by the other group (while trying to hit the target, it is required to focus on the functionality of the movement sequence).

Further treatments such as parent trainings reported by the studies of Loren, Gerdes and Van den Hoofdakker in relation to children and Van den Weijer Bergsma in relation to adolescents have proved equally effective. In this case, however, not only was the participation of subjects with ADHD/ADD disorder necessary, but also the involvement of their parents, who learned, through sessions led by competent psychologists and psychiatrists, to manage their children's difficult behavior, reduce parental stress on the part of mothers and increase family involvement on the part of fathers; in the Van den Weijer Bergsma protocol the participation of school tutors was also considered necessary.

Table: *Table with intervention protocols for childhood, adolescence and adulthood, in chronological order.*

Own source.

Authors, Year, Country	Number of subjects	Age of subjects	Type of intervention	Frequency and duration of intervention	Results and variables of results	Setting	Motor of research and Review
Van den Hoofdakker, 2010, The Netherlands	94 children with ADHD and their parents	4 - 12 years old	Parent training, efficacy of BPT + RCC compared only to the use of RCC for improvement of the behavioral sphere of children and management by parents	12 sessions, 2 hours per session, total duration of 20 weeks	More positives results in the group BPT + RCC in relation to RCC in the behavioral sphere of children and management by parents	Centre of pediatric hospital, Home	PASCAL Archive Journal of Pediatric Psychology
Kang et al., 2011, USA	32 ADHD children, casually assigned to 2 groups	8.4 years old	Sports group - running, aiming exercises, skip exercises vs educational group. Attention measured according to the Scale of DuPaul's evaluation and the executive functions evaluated using the KEDI-WISC and the TMT B	90 minutes, 2 times per week for a total of 6 weeks	Improvement in attentional symptoms, of social skills and of aerobic capacity	Psychiatry Department of the medical Centre of the Chung Ang's Hospital	SPORTDiscus Clinical sciences

Van de Weijer-Bergsma et al., 2011, The Netherlands	10 ADHD adolescents, 19 parents and 7 tutors	11 -15 years old	Activity - exercises about mindfulness that involve sitting meditation, body scan and respiratory space. Learn to self-manage in stressful environments, exercises in environments without stimuli. Computer test to evaluate reactivity and support for attention in the medium-long time	Training - 8 weeks 8 weeks and 16 weeks follow ups	Greaterintentionality and mindfulness in adolescents, parents and tutors. Improvement in the reactivity and attentional capacity in adolescents	Centre of academic treatment for parents and children	Springer Nature Journals Journals of Child and Family Studies
Gerdes et al., 2012, USA	20 ADHD children of who 7 ADD, 5 hyperactive/ impulsive, 8 combined ADHD	5 - 12 years old	Parent training, BPT for the dysfunctional parent-child interactions, child difficult to manage, parental stress, inconsistent discipline and corporal punishment	10 sessions, 50 minutes per session	Improvement in parental behavioral	Clinic, Home	Scopus Journal of Attentional Disorders
Mitchell, 2013, USA	20 ADHD participants	Intervention group:/, 40.55 Control group:/, 36.22	MAP for ADHD, exercises of meditation to mindfulness and daily practices at home. Evaluation of the group's effects based on training through meditation for adults with ADHD in comparison with a control group on a waiting list	Total duration - 8 weeks Duration of session - 2.5 hours and daily practices at home	Significant reduction of inattentive symptom	Clinic, Home	ScienceDirect Cognitive and Behavioral Practice

Saemi et al., 2013, Iran	20 ADHD children, divided in 2 groups of 10 children	8 - 11 years old	Motor abilities' evaluation of learning with instructions to be taken in focus of external attention and in focus of internal attention. Tasks to be done: center a 3m distant target placed on the floor with a tennis ball	180 trials (6 blocks of 30 trials each)	Better results using the external focus attention	Controlled research laboratory	SPORTDiscus Kinesiology
Bueno et al., 2014, Brazil	60 ADHD participants	Intervention group:/, 31.2 Control group:/, 31.7	MAP for ADHD, evaluation of effects interaction between the group with subjects ADHD and the control group that have performed the MAP and the group with subjects ADHD and the control group that haven't participated in the MAP	Total duration - 8 weeks. Duration of the session - 2.5 hours and daily practices at home	Significant improvement in sustained attention (ANT) and in detectability (CPT II)	Clinic, Home	Pubmed Hindawi Publishing Corporation
Hoza et al., 2015, USA	202 students (94 ADHD, 108 in normal development)	4 - 9 years old	Program: 1 group for physical activity - steeplechase for 3 stations etc. 1 group for sedentary classroom - tracing and cutting a frog, assembling a frog etc.	31 minutes per day for 2 weeks	Improvement in aerobic capacity	School	Springer Nature Journals J Abnorm Child Psychol

Silva et al., 2015, Mexico	28 ADHD participants and 28 without ADHD	10 - 16 years old	Evaluation of attention level with a computer game (The predators of the lost treasure) after running a relay race	Before - after (immediately after 5 minutes relay race)	Attention improvement measured by means of a computer game (The predators of the lost treasure)	City College in São Simao-Goiás	Web of Science PLoS One
Mawjie et al., 2015, Canada	97 subjects ADHD post secondary school divided in 2 groups	18 - 35 years old	Activity focused on working memory thanks to the use of the CWMT online program	2 groups - 1 standard length training group (25 sessions by 45 minutes - 5 times per week) short training group (25 sessions by 15 minutes - 5 times per week) Total duration of the program - 5/6 weeks	Improvement in memory capacity without significant transfer results in the cognitive and behavioral sphere	Home	Web of Science PLoS One
Lee et al., 2015, Republik of Korea	12 ADHD children	1° - 4° primary school	Rope skipping and ball exercises	60 minutes, 3 times per week for a total of 12 weeks	Improvement in cardiorespiratory resistance, muscle strength, flexibility and muscular endurance	Department university hospital of pediatric psychiatry	Medical Online - E J.Phys. Ther. Sci
Schoenfelder et al., 2017, USA	11 ADHD adolescents	14 - 18 years old	Weekly goals on step counting using social support through a Facebook group where coaches give daily messages on physical activity (goals to be achieved and encouragement)	4 weeks	Improvement in inattention symptoms	Home, specialized clinics in medicine for adolescents and psychiatry	ScienceDirect Preventive Medicine Reports
Loren et al., 2017, USA	241 parents with their children	6 - 12 years old	Parent training, sessions that provide for cooperation between parents and children in the expenditure of attention, organizational skills, time management, strategies concerning tasks, communication skills, mood management and children's anger. Comparison between BPT and BPT + CCG	8 - 12 sessions	Improvement in the parents' confidence in the management of their children's problematic behaviors and of their own behavioral sphere	Medical Centre of pediatric hospital, Home	-PsycARTICLES Clinical Practice in Pediatric Psychology

Incidence of ADHD and ADD in society

ADHD is an acronym standing for Attention Deficit/Hyperactivity Disorder, while ADD (a component of ADHD) stands for Attention Deficit Disorder.

This disorder represents one of the biggest problems that can occur during childhood; the incidence rate is increasing; the subjects affected by it, are characterized by catecholaminergic alterations in the brain's prefrontal area.

Several issues relative to the behavioral sphere are reported: 1. low self-esteem; 2. inferiority complex; 3. difficulty in making decisions; 4. difficulty in impulse management; all these elements cause long-term chronic conditions such as depression, anger and low motivation.

The ADHD/ADD disorder presents three main aspects: 1. risk of becoming chronic; 2. high frequency, especially during school years; 3. heterogeneity of the symptom panel.

The symptom panel presents three characteristics: 1. hyperactivity; 2. impulsiveness; 3. Inattention. Instead, referring to the risk of chronicity, there are distinct causes of ADHD and ADD disorders. The most known cause is of genetic nature and is called hereditary responsibility [1].

Other causes comprises pre- and peri-natal factors such as the smoke and alcohol assumption, maternal stress during pregnancy, advanced age of the mother and inhalation of toxins in the air [2-4]; post-natal factors, such as Parent-Child hostility, abuse, poverty and inhalation of toxins air [5,6].

ADHD/ADD disorder is also characterized by having different co-morbidities, that is, it influences the subject's cognitive sphere, associating with other disorders such as DCD (Developmental Coordination Disorder) [7], which causes problems at the level of the verbal intelligence quotient and processing speed; there is also a connection with a subgroup called DAMP (Deficit in Attention, Motor Control and Perception) [8], which affects the subject with ADHD/ADD in two ways: on one side there is a physiological hyper-excitation represented by breathing, heart rate alteration and high sweating; on the other, inter-situational inattention, causing problems in the gross and fine motor areas, in perception and language.

Intervention protocols in childhood

The reported protocols are not all directed exclusively to subjects with ADHD/ADD, but also to the most intimate circle in which they grow, that is the family. A doubt may arise: what does the family have to do with the ADHD subject's sporting performance? It can be addressed through simple reasoning: if inside a family, a climate of agitation and distrust is established towards a child, is there not a possibility that he or she can be influenced by negative thoughts when she or he has to confront herself or himself with the external environment? Therefore we are going to talk about BPT (Behavioral Parent Training) that is an intervention measure which goes to work on parenting skills in order to balance the parent-child relationship. The competences worked on are: 1. parents' trust in their child in order to make her or him grow up more independently and raise his or her level of self-esteem; 2. management of the child's behavioral problem through praise and rewards for positive behaviors ignoring negative behaviors; 3. help the child with communication skills; 4. set out strategies concerning the loss of attention and the inability to follow given directions; 5. organization skills; 6. time management; 7. problem solving.

In the Loren protocol, two groups were compared to evaluate their functionality within these competences: a group of parents only (BPT) and a group composed of parents and children (BPT-CCG) [9]. In both groups, the majority of children improved under a behavioral point of view.

In the second case, a group of parents (BPT) in addition to a professional figure such as the child psychiatrist (RCC = Routine Community Care) was compared with a group of only RCC personnel [10].

"The Gerdes study, on the other hand, investigates whether the BPT offered in an ADHD clinic based in a University has produced clinically significant changes for parents of children with ADHD; he highlights significant improvements for both mothers and fathers in terms of reducing parental stress, increasing the use of positive parenting techniques and reducing inconsistent discipline" [11]. From several results referring to different measuring scales, it was reported that the mother was too involved in the family and was responsible of corporal punishment and inconsistent discipline towards her child due to a high level of stress, while the father needed more involvement.

At the end of the session, the measurement scales reported a greater balance between the two parents within the family. Subsequent protocols focus exclusively on subjects with ADHD/ADD; in some of these, such as in the Hoza and Kang protocol, a group having a program of physical activity and an educational group purely directed to the development of interactive abilities through ludic and creative experiences were compared [12,13]. The intervention protocols by Lee and Saemi allow the subjects with ADHD/ADD to carry out sports activity programs capable of bringing them to an improvement in the execution of movements and of their physical abilities (for example aerobic capacity, cardiorespiratory resistance, muscular strength, flexibility etc.) [14,15].

The Saemi protocol is particularly interesting and it affirms that: "The purpose of the present study is to investigate if children with deficit hyperactivity disorder (ADHD) would show enhanced motor skill learning with instructions for adopting an external focus of attention (i.e. on the effect of movement) rather than an internal focus (i.e. on the movements themselves)".

Two groups of ten children each are structured. The test consists in throwing a tennis ball and centering a target located three meters away on the floor; a group uses the focus of external attention, so it has to focus on centering the objective, while the other group focuses internally, *i.e.* has to focus on controlling its motor gesture, always keeping in mind that the target must still be centered.

In the intervention protocols in which two groups are used to compare different treatment methods aimed at the cognitive and motor spheres, ANOVA (Variance Analysis) measurement was used to evaluate where there were more significant results at the end of the sessions.

Intervention protocols in adolescence

The first intervention protocol focuses on the completion of a computer game level called "The Predators of Lost Treasure" [16]; Silva, who is the author, believes that motor activity determines an improvement in cognitive abilities. 28 subjects with ADHD and 28 without ADHD were considered; these groups were in turn divided into two other groups, reaching a total of four groups, each composed of 14 subjects. The ADHD group that did the motor activity program, reported better performance in computer game completion in relation to the ADHD group that didn't perform the motor activity program and the group without ADHD involved in the motor activity; while the group without ADHD not involved in the proposed physical activity, reached the goal proposed by the evaluation game in less time.

The activity includes a relay race on an athletics track; the exercise consists in recovering as many inflatable balls as possible and placing them in a basket at the starting point; everything is done within 5 minutes.

The following intervention method, purposed by Schoenfelder, highlights the importance of Social Media as an interaction platform for subjects with ADHD [17].

In this group there are special instructors who assign different daily activities that participants have to perform, such as a minimum count of daily steps; moreover praises are given for the results achieved and encouragement in relation to following steps and in case of failures for the recruited subjects with ADHD.

With the third intervention protocol, we are looking towards a cult still little known in the West; Wan de Weijer-Bergsma argues that "Mindfullness is a form of attention or meditation training, based on the Buddhist tradition and Western knowledge of psychology, in which awareness of the present moment and non-judgmental observation is increased, whereas automatic responding is reduced".

In this case in addition to participation of adolescents, their parents and tutors are also recruited. The exercises consist of sitting meditation, breathing space and body scan so that the subjects to be able to manage themselves in stressful environments (for example, while a parent scolds a teenager with ADHD). It is strongly recommended to carry out these exercises in environments without stimuli. A second required activity, this time directed exclusively to ADHD subjects concerned the carrying out of a computer test to evaluate the reactivity and the support of attention in the medium-long term (an example of a test to be performed concerning the reactivity is reported: the subject is in front of a monitor and looks at a red cross located in the center; as soon as it becomes a square, he or she must press the right mouse button so that it becomes a cross again; another test that, instead, consists in the development of sustained attention, spans out in the following way: three sounds are played and the mouse button must be pressed when the most acute sound is heard between all three) [18].

Intervention protocols in adulthood

The first protocol, purposed by Mawije, is based on exercises in working memory through an online program called CWMT (Cogmed Working Memory Training) [19]. The recruited patients worked at home. This activity is focused on audio-verbal and visual-spatial working memory tasks in order to preserve and manipulate specific sequences of stimuli. Difficulties differed according to the structure of the test in such a way that each subject could fully express his or her working memory skills.

The last two protocols are based on a practice called MAP (Mindfulness Awareness Practice) used by Bueno and Mitchell, who claims that "mindful meditation training is gathering growing empirical interest as an intervention for adult ADHD" [20]. These two intervention protocols take place in two distinct places, namely a clinic where, thanks to qualified instructors, multiple self-awareness techniques are taught and at home where these same techniques are put into practice. Inside the clinics, short breathing exercises are performed on the reflection of one's symptoms in a curious and non-judgmental way to identify strengths and weaknesses; these exercises become more and more prolonged with the passaging of time (5 minutes in the 1^{st} - 2^{nd} session; 10 minutes in the 3^{rd} - 4^{th} session). At home simple exercises are required such as noticing one's breath several times during daily tasks (ex. while setting the table) or, as reported in the Bueno protocol, 3 CDs were distributed by the instructors with the aim of acting as a guide at home for meditation in which the time spent in training varies with the passing of weeks (for example, 1^{st} - 2^{nd} week - 5 minutes; 3^{rd} - 5^{th} week - 10 minutes; 6^{th} - 8^{th} week - 15 minutes) [21].

Conclusion

The set of these protocols show two very specific objectives: the first concerning the development of cognitive-behavioral skills starting from a greater awareness of oneself, affecting the reduction of inattention symptoms, the improvement in the parent-child relationship and therefore increasing one's self-esteem and encouraging interaction with others; the second objective, concerning the comorbidities of ADHD, refers to the cognitive-motor sphere, reporting significant improvements in the execution of movements and physical abilities.

The moral duty of professional figures in the educational-sports field is to be more elastic, recognizing the diversity of the characters which they interacts with, trying to be more understanding, sensitive and encouraging towards subjects with ADHD, that is with people who demonstrate difficulties in basic skills such as memory, attention and responsiveness, in such a way as to favor a serene and more

satisfying growth.

With this bibliographic research, we wanted to reflect upon the importance of working on ourselves, since this involves modifications but also consolidations of new cognitive networks that characterize our competences, in contrast with the use of drugs that determine a temporary improvement in the symptoms of inattention without bringing, however, the aforementioned benefits on the totality of the

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