

L'EFFICACIA DELLE ATTIVITÀ FISICHE E SPORTIVE NEI BAMBINI E NEGLI ADOLESCENTI CON DISTURBI SPECIFICI DELL'APPRENDIMENTO E DISABILITÀ DELLO SVILUPPO: STATO DELL'ARTE, IMPLICAZIONI DIDATTICHE E RICERCA FUTURA.

THE EFFECTIVENESS OF PHYSICAL AND SPORT ACTIVITIES IN CHILDREN AND ADOLESCENTS WITH LEARNING AND DEVELOPMENTAL DISABILITIES: STATE OF THE ART, DIDACTIC IMPLICATIONS AND FUTURE RESEARCH.

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Abstract

I disturbi dell'apprendimento e dello sviluppo (LDD) sono associati a un ridotto sviluppo motorio. Un'attività fisica e sportiva (PSA) regolare potrebbe avere un impatto sulle funzionalità cognitive maggiore nei bambini con LDD rispetto a un bambino con sviluppo regolare. Tuttavia, la popolazione con LDD mostra scarsi livelli di PSA e non vi è consenso riguardo a quale tipo di attività abbia migliori risultati su di essa. Scopo del presente lavoro è revisionare lo stato dell'arte sugli effetti della PSA su bambini e adolescenti affetti da diversi LDD e discutere implicazioni di carattere didattico e prospettive di ricerca future.

Learning and developmental disabilities (LDD) are associated with a reduction in motor development. A regular physical and sport activity (PSA) may have a higher impact on the cognitive function of children with LDD respect to a typically developing child. However, LDD population exhibits poor PSA and there is consensus about which type of PSA has the best outcomes on it. The present work aims to review the state of the art about the effects of PSA on children and adolescents with different LDD and to discuss didactic implications and future research directions.

Keywords

Attività fisiche e sportive; disturbi specifici dell'apprendimento; ADHD; children and adolescents.
Physical and sport activities; specific learning disabilities; ADHD; bambini e adolescenti.

Valerio Bonavolontà performed the literature review and wrote the article, Stefania Cataldi performed the literature review and the meta-analysis, Gianpiero Greco reviewed the article and Francesco Fischetti reviewed the article and did the supervision.

Introduction

It has been well documented that physical activity has a multitude of health benefits for the general population of youth. The benefits of exercise in improving cognition and physical fitness in typical developing children are well established as well (Landry & Driscoll, 2012).

Learning disabilities are associated with a reduction or a slowing of the motor development. Researchers have often claimed that the positive effects of a regular physical activity on the cognitive function of a typically developing child, may have an even higher impact on those children with learning disabilities (Shepard, 1997; (Gapin & Etnier, 2010). However, epidemiological evidence reports that the learning disability population exhibits characteristics that reflect a sedentary lifestyle, and that few studies with no consensus in the literature attempted to explain the reason.

Thus, it is needed to better explore this topic and more specifically which type of exercise is more suitable and has best outcomes for those subjects with learning disabilities and also for those with Attention Deficit Hyperactivity Disorder (ADHD).

Therefore, aims of the present work are, first to review the state of the art about the effects of physical and sport activities (PSA) on children and adolescents with different learning and developmental disabilities; secondly to individuate future research perspectives about this topic.

State of the art

1. Learning Developmental Disabilities

Learning and developmental disabilities (LDD) include functional limitations that manifest in infancy or childhood as a result of disorders of or injuries to the developing nervous system (Institute of Medicine Committee on Nervous System Disorders in Developing Countries, 2001). These limitations range from mild to severe and can affect cognition, mobility, hearing, vision, speech, and behaviour. The known causes of LDD are numerous and include genetic factors, nutritional factors, infections, toxic exposures, trauma, perinatal factors, and multifactorial conditions (WHO, 2006).

Although intelligence of children with learning disabilities has been recognised as normal and above normal, they have a significant neurological disorder at the point of acquisition and application of speech skills, listening, reading, writing, reasoning, self-expression, social perception, mathematics, motor functioning, organizational skills (APA, 2013).

The epidemiological evidence supports the view that a large proportion of the learning disability population exhibits characteristics proper of a sedentary lifestyle, but few studies in the literature attempted to explain this relationship and without a general consensus.

2. Specific Learning Disabilities

Specific Learning Disability (SLD) is a general term that describes specific types of learning issues. Students with specific learning disability account for a higher percentage of all special education needs than any other classification undergoing the Individuals with Disabilities Education Act (IDEA). In 2010 students with SLD amounted to 43.3% of all students with disabilities aging 6 to 21 under IDEA (Zirkel, 2010), down from the 50% average for the previous decade (Rehabilitation Research and Training Center, 2009). SLD definition (IDEA, 2004) read as follows:

“In General: Specific learning disability means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in the imperfect ability to listen, think, speak, read, write, spell, or to do mathematical calculations, including conditions such as perceptual disabilities, brain injury,

minimal brain dysfunction, dyslexia, and developmental aphasia.

Disorders not included: Specific learning disability does not include learning problems that are primarily the result of visual, hearing, or motor disabilities, of intellectual disability, of emotional disturbance, or of environmental, cultural, or economic disadvantage”.

This definition is anyway controversial as the disorders included are not clearly identified and poorly defined themselves (Kavale et al. 2009).

From a practical point of view, teachers must know that a learning disability can cause learning issues and using certain skills. The skills most often affected are reading, writing, listening, speaking, reasoning, and doing math.

Learning disabilities is not the only term used to describe these difficulties. Others include:

- dyslexia—which refers to difficulties in reading.
- dysgraphia—which refers to difficulties in writing.
- dyscalculia—which refers to difficulties in math.

Physical and sport activities and didactic implications:

Few researches on physical exercise intervention for learning disabilities have been carried out. It has been documented that people with learning difficulties exhibit poorer health compared to the general population and this should be avoided (Emerson & Baines 2010).

The physical education programs have been found highly beneficial for children with learning disabilities. Findings from a study show that significant improvement in motor skills was observed among those children who took part to all the three training programs proposed (Rintala, 1994). According to Northfield (2011), physical exercise enhanced internal muscle strength, body balance, and quality of life in children with learning disabilities.

Engagement in exercise and physical activity result in positive outcomes for children with learning difficulties (Bluehardt et 1995, a, b). According to Niemann (2002) physical activities have positive influences in learning disabled children in terms of shortening stress, anxiety and depression, and strengthening the overall academic performance. Many researchers have claimed that it is beneficial to have the children engage in regular physical activity, thereby making it a habitual daily life activity and a route to maintain good health (Rovio et al., 2005). There is empirical evidence to support the fact that physical activities may have some beneficial outcomes (Kramer et al., 2006). It may help the child to improve his academic activity and to reduce the irritability caused by the educational setting (Trudeau & Shephard, 2008). Learning ability and general health of a child may be improved with continuous engagement in physical activity (Taras, 1995). Physical activity brings positive outcomes such as enhanced feelings of social inclusion, modelling appropriate behaviours for others with similar disabilities, displaying of shared interests and rewarding experiences (Hallawell et al. 2012). Research findings showed that the overall behavioural development and academic proficiency perception of the participants increased after a physical activity training program of 10 days (Medcalf et al. 2006). Moreover, Demirci (2012) found that, there was an increase in learning abilities related to the increase of physical activity levels.

Reynolds (2003) measured the effectiveness of exercise on reading skills. The dyslexic children showed significant improvements on standardized tests of reading, writing and comprehension following intervention. The authors concluded that, the intervention showed the enhancement of cognitive skills reflecting literacy skills, such as reading process measured by standardized tests.

The same author, in a next follow-up study, indicated that the significant improvements shown on working memory, phonology, speech/language fluency, and motor skill were long-lasting (Reynolds, 2007).

The efficacy of a 20-week aerobic exercise program on cardiovascular fitness, motor proficiency, academic achievement and self-concept among boys with learning disabilities, showed

a relationship between the exercise and improvement of self-concept but no improvement on academic achievement or motor proficiency was reported (Macmahol, 1987).

Literature suggests that regular physical activity promotes overall well-being and promotes academic performance and learning in children with learning disabilities. It is then crucial to remark that any intervention for children with learning disabilities would incorporate a physical activity program with the aim of promoting a long-lasting active lifestyle resulting in health and academic benefits.

There is still debate on which PSA is more suitable for SLD children and adolescents. Tafuri and Peluso Cassese (2018) indicated that, despite team sports are supposed to fit better with SLD children as they connect the subjects with the social context more directly, individual sports could be more useful as the structure of training is more customized and it stimulates the SLD subject to achieve and maintain the attentional resources for a long time.

3. Attention Deficit Hyperactivity Disorder

Attention deficit hyperactivity disorder (ADHD) is the most common neurological disorder in children with an estimated prevalence ranging between 5.3 to 20% worldwide (Moffitt & Melchior, 2007). The increase of ADHD in settings of large class sizes is a growing challenge. In addition to its major impact on school performance, ADHD also affects family relationships and social competence, with long-term consequences. Children with ADHD have significant problems in executive function as well as in controlling behaviour, cognition and attention (Jeyanthi et al. 2009). Children with ADHD are also at higher risk for injury, depression, and substance abuse. Worldwide, with the growing use in school settings of stimulants to control this chronic disorder, the impact on health care costs is potentially huge. Although there is a paucity of data on this topic, in one study, the cost of medicating children for ADHD was close to an average of US\$500 or more per child per year, and this amount could be underestimated (Chan, Zhan, and Homer 2002). Symptoms of ADHD during childhood persist into adolescence in approximately 30–50% of those affected with the condition and may even continue into adulthood (Bálint et al. 2009).

Physical and sport activities and didactic implications:

Despite a great amount of available literature on ADHD, few studies focused on the relationship between physical activities intervention and positive outcomes. Physical activity specialists should first distinguish between one child with ADHD and one child who is simply overactive as overactivity is only one indicator of this disorder. In fact, the overactivity must be excessive and inappropriate to enter the definition of ADHD (Harvey & Reid, 2003).

The ongoing development of motor skills and physical fitness is crucial in children with ADHD. Movement skills, levels of movement performance and levels of physical fitness of children with ADHD are at risk when compared to their age-matched peers (Harvey & Reid, 2003).

Poor motor coordination has been suggested as a condition experienced by many children with ADHD. It is to notice that the term motor coordination may lead to misunderstanding, as many studies are usually based on neuropsychological tests that required fine motor skill performance. Tantillo et al. (2002) proposed that running, rope jumping and similar exercised improved motor skills and therefore daily life activities in children with ADHD. Kosari (2013) suggested that exercise programmes focused on gross motor activities improved also performance on fine motor skills. Moreover, Verret et al. (2012), Mebler et al. (2016) found that moderate-to high-intensity aerobic training lasting respectively 3-weeks and 10-weeks, had positive effects on both gross motor skill and fine motor skills. Kosari et al. (2013) found that a selected physical training program based on SPARK physical education program can improve the gross

motor skills in children with ADHD.

Other authors reported that intense and aerobic exercise have major beneficial effects on children with ADHD (Berwid & Halperin, 2012). Similarly, Cornelius et al. (2017) in a large meta-analysis, found that aerobic activity was the only type of PSA that was statistically significant, supporting the hypothesis that aerobic activity would have a stronger influence than other types of PA interventions on the overall effect of PA on children with ADHD.

In a recent study by Pan and colleagues (2017), children with ADHD exhibit low motor proficiency and cardiovascular fitness levels, and a combined program with both simulated horse-riding and fitness training activities positively affected their motor proficiency, cardiovascular fitness, and flexibility levels. Zang (2019) conducted a thorough meta-analysis of physical exercise effects on ADHD people: the author reports that physical activities could reduce and improve anxiety and depression among children with ADHD. In another study, Lufi & Parish-Plass (2011) proposed a 1 school year therapy program made up of 20 sessions lasting 90 minutes: each session proposed a mixed PSA program made up by 20-30 minutes of individual activities and 30-40 minutes of team games. The authors reported improvements in two behavioural domains especially in the reduction of anxiety.

Similarly, another meta-analysis involving aerobic and yoga exercises showed that these activities could effectively improve hyperactivity, anxiety, impulsive disorders and social problems in children with ADHD with major effects of aerobic than yoga (Cerrillo-Urbina et al., 2015). A significant improvement in cognitive functions and social competency was noted in another study suggesting a major impact of physical exercises in children with ADHD (Kang et al. 2011).

In addition, Taylor and Kuo (2009) found that walking in park improved level of attention in ADHD children; similarly, Silva et al. (2015) proposed that aerobic exercises such as walking, running, showed improvements on selective attention.

Furthermore, the creative use of directed play, which incorporates cognitive challenges and physical exercise, may have the potential to serve as a vehicle for treatment of children with ADHD.

Beyond directed play and exercises with parents, it is possible that engaging children in sports, nature (Kuo and Taylor, 2004), and other group-based cognitively and physically challenging activities may provide an avenue for neural and cognitive growth that would serve to facilitate the diminution of ADHD severity across development. Such activities could be provided in schools (Diamond et al., 2007), after school programs, or in summer camps, although it would be important that the activities continue over an extended period of time (Halperin and Healey, 2011). Another analysis concluded that exercise administered over a long period of time would be more likely to enhance cognitive abilities compared to short bouts of activity (Taras, 2005).

Another key element was reported by Hodge et al. (1999) who found that visual imagery training as preparatory condition had significant effects on the accuracy of a throwing task. Therefore, visual imagery could represent an effective strategy to compensate cognition deficits and delay that occur in ADHD subjects.

4. Developmental Coordination Disorder

Developmental coordination disorder (DCD) is a neurodevelopmental condition characterized by poor motor proficiency that interferes with a child's activities of daily living.

DCD is a disorder of motor coordination that is not explainable by intellectual disability or any specific congenital or acquired neurologic condition, the which updated diagnostic criteria are described in the DSM-5 (American Psychiatric Association (APA), 2013). Approximately 5% of children have DCD, a disorder of praxis.

DCD affects the process involved in acquiring and executing age-appropriate motor skills interfering significantly with academic achievement and daily life activities, in the absence of

underlying medical conditions such as cerebral palsy or mental retardation (APA, 2013).

Moreover, there is growing evidence that ADHD and DCD might be comorbid conditions (Harvey & Reid, 2003). In fact, up to 50% of children with DCD have been shown to meet criteria for ADHD (Waternberg et al., 2007) with evidence suggesting a genetic link between these two disorders (Fliers et al., 2009). Gillberg (2003) also described the DAMP model (deficits in attention, motor, and perception) in which there is a 40% overlap of ADHD and DCD. Despite average or above average intelligence, children with DCD have lower school achievement than peers, and they often develop learning disabilities, especially dyslexia.

Physical and sport activities and didactic implications:

Children with DCD enjoy Physical Education (PE) class less than their peers (Carney et al. 2007). Results from the above-mentioned study show that differences in body fat, cardiorespiratory fitness and particularly perceived adequacy account for more than two-thirds of the difference in enjoyment of PE between children with DCD and their peers.

A study conducted in 2009 of children with DCD found that regularly playing table tennis was beneficial for both coordination and ability to sustain focus. Exercise conducted outdoors in natural environment is even better than exercise in a gym or urban setting. Several studies argued that PE class remains one of the best settings to try to encourage greater physical activity in this population, as they are mandatory and in many cases they represent the only opportunity to engage in PSA. Nevertheless, Losse et al. (1991), concluded that the structure of PE classes needs to meet the different needs of all children, including recognizing those with DCD.

Exercise increases brain-derived neurotrophic factor levels and enhances neurogenesis, thereby promoting overall cognitive function, including attention and memory, which are both required for academic achievement. Thus, activities that build balance and coordination such as yoga, juggling, crossing-midline exercises might be effective for this population. Relaxing and mindful exercises, such as tai chi and yoga, encourage focus on body movements and can thereby improve ability to focus and allow individuals to be more deliberate and less impulsive.

5. Autism Spectrum Disorders

All autism spectrum disorders (ASDs) are characterized by varying degrees of impairment in communication skills and social interactions and in restricted, repetitive patterns of behaviour or interests. Although only 50 percent of children in the United States with ASDs are diagnosed before six years of age, this group of disorders can reliably be diagnosed by three years of age and in some cases by as early as 18 months. ASDs range from a severe form called autistic disorder to a milder form known as Asperger syndrome. Prevalence studies of ASDs in Asia, Europe, and North America estimate that 2 to 6 out of every 1,000 children have an ASD. Screening instruments using responses from children and parents are available. Evidence indicates that early intervention (ideally in optimal educational settings for at least two years during preschool) results in improved outcomes. Individuals with ASDs generally respond well to highly structured, specialized programs. A variety of medications is used to treat associated depression, anxiety, ADHD, seizures, and other behavioural symptoms. Adults with severe ASDs require intensive and constant supervision.

Physical and sport activities and didactic implications:

Several studies suggest that moderate to vigorous physical activity (MVPA) may be beneficial especially for children with autism spectrum disorders. Evidence from a review by So-

rensen and Zarrett (2014) supports benefits related to motor development and physical fitness and decreases in repetitive, stereotyped, and self-injurious behaviours in adolescents with ASD. Moreover, the same study revealed minimal evidence of increases in cognitive performance for adolescents, but some evidence for improvements in executive function specifically, as well as some evidence for benefits related to decreases in aggression and disruptive behaviours.

Agrati & Fischetti (2017) stated that verbal prompts need to be integrated with images in physical activity for ASD students. However, the authors recommend analysing in detail the iconic mediators because their features may have an effect on the learning and performance of ASD students.

It has also been proposed that a child-centered approach, that allows the child to initially decide which activity to participate in, may be more successful (Crollick et al. 2006).

Conclusion and future research

Regardless of the type of disability, more research is needed to examine dose–response effects for differing levels of PSA. In fact, most of studies fails to include any measurement of PSA intensity or measure variations in outcomes by PA intensity (e.g., MVPA vs. light PA).

In addition, it is also necessary a thorough qualitative description of the PSA interventions to guarantee all the professionals involved, an effective teaching process for LDD subjects.

However, to date, this qualitative approach fails to be recognizable or it is at least unclear in most of studies reviewed for the present work.

Further research must address the improvement of motor skills in children with ADHD to facilitate participation in PSA among this population. Future studies will also better clarify the mechanisms by which PSA might mediate symptoms of ADHD, even if evidence has already suggested that improvements are multi-dimensional and affect a wide range of aspects of the individual.

PSA could then represent a valid alternative to medical approach which has proven to have side-effects on some ADHD individuals (Reeves and Bailey, 2016).

Schools, parents and policy makers should maximize their efforts to encourage the participation of children with ADHD to structured group programs and individual physical activities. As suggested by Zang (2019), therefore, physical exercise should be incorporated in the daily life of children with ADHD.

Regarding ASD management in children and adolescents, further research is needed regarding the effects of physical activity on specific elements of cognitive ability and executive function to better clarify this relationship.

Moreover, independently from the disorder/disability, multilateral training could represent an effective approach when designing intervention in LDD population as, it is focused on the development of the conditional and coordinative motor abilities respecting the physiologic age and psychological maturation (Greco et al. 2019).

It will also be crucial to develop collaborative research projects including professionals in psychology, psychiatry, special education and physical education teachers. Last but not least, studies which identify optimal settings for the implementation of PSA activities for children and adolescents with LDD are needed and may be useful tools for researchers and practitioners.

It finally appears that an education setting together with well-designed qualitative studies, with a PSA intervention with large sample sizes, would be an ideal research perspective.

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