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Psychological Benefits of Physical Activity in Children with Mental Health Disorders

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Abstract

This review article examines the latest evidence on the effectiveness of physical activity in treating children with mental health disorders. These disorders can affect growth and development, educational attainment and the ability to lead a productive life. Children with mental health disorders often face isolation, discrimination and stigmatization. Physical activity has been found to be effective in managing emotional self-control and improving social interaction among peers. It can help reduce obesity which may reduce depression and anxiety in children. Structured physical activity can improve overall health, motor function and learning as brain-derived neurotropic factor (BDNF) is up regulated during moderate exercise activity and can encourage neuroplasticity. Moderate physical activity should be encouraged and implemented in the pre-school years and continued throughout life for maximal benefit. Research has demonstrated positive outcomes in children with mental health disorders who participate in physical activity and therefore should be considered as a viable treatment approach in the management of a variety of childhood mental health disorders.

Keywords: Behavioral management, Emotional self-control, Physical activity, Social interaction

Introduction

According to the World Health Organization (2019a), 10-20% of children and adolescents experience mental health disorders. About half of these disorders exhibit themselves by age 14, while three quarters of mental health disorders are manifested by the time an individual is in their mid-twenties. The leading cause of disability in all regions of the world are composed of neuropsychiatric conditions including both neurological and behavioral disorders (World Health Organization, 2019b). Common neuropsychiatric disorders encompass things such as autism spectrum disorders (ASD), attention deficit/hyperactivity disorders (ADHD), fetal alcohol spectrum disorders and tic disorders. It is estimated that 3% of the world's population has ASD yet the prevalence in many low and middle-income countries is

unknown and most of the research on ASD has occurred in children in countries with higher incomes (World Health Organization, 2013). In the United States, the three leading causes of mental health disorders in children and adolescents are depression, anxiety and behavioral disorders. According to the Centers for Disease Control and Prevention, approximately 6% of 12-17-year-old adolescents have been diagnosed with depression, a much higher rate than the 1.75% reported in 6-11-year-old children. Anxiety has been diagnosed in 10.5% of teens, 6.5% of 6-11-year-old children, and just over 1% of 3-5-year-old children. Most behavioral disorders are diagnosed in the 6-11-year-old age group (9%), but 7% of adolescents are afflicted and a little over 3% of 3-5-year-old children also experience behavioral disorders (Centers for Disease Control and Prevention, 2019). Many approaches can be utilized to address mental health disorders in children and adolescents, such as Cognitive Behavioral Therapy, Exposure Therapy, Peer or Support Groups, and Art Therapy (Mental Health Treatments, 2019), but this paper specifically provides an overview of the psychological benefits of physical activity as a means of managing such disorders.

Mental Health, Obesity, and Exercise Benefits

Researchers from the Karolinska Institute in Sweden reported a relationship between obesity and mental health (Sandoiu, 2019). The study, which included 12,000 children, found obesity raised the risk of anxiety and depression by 33% in boys and 43% in girls. Obesity is a major physical and mental health problem around the world. For adults, the World Health Organization (2019) defines overweight as a body mass index (BMI) greater than or equal to 25, and obesity as a BMI greater than or equal to 30. In children and teens, the Centers for Disease Control and Prevention (2018) uses BMI to define overweight (85th and 95th percentile) and obesity (BMI>95th percentile). The Organization for Economic Co-operation and Development (OECD) compiled data on obesity in its participating countries in 2017. The report states more than one in two adults (>50%), and one in six (16.6%) children are overweight or obese. Rates are highest in the United States, Mexico, New Zealand and Hungary, and lowest in Japan and Korea. However, the rates are expected to increase even further by 2030 (Organisation for Economic Co-operation and Development, 2017). When children, ages 2-17, with and without disability are compared, 22% with disability are obese, while only 16% of children without disability are obese (Centers for Disease Control and Prevention, 2010). The greatest risk for obesity affects children with mobility limitations, intellectual disabilities or those with learning disabilities (Centers for Disease Control and Prevention, 2010). In the United States, obesity rates are significantly higher among Hispanics and African Americans (Centers for Disease Control and Prevention, 2010).

A 2018 systematic review of prevalence of childhood and adolescent obesity in Asian countries reported 4.8% of children and 6.2% of adolescents were found to be obese, while nearly 10.9% of children and 13.7% of adolescents were overweight. A higher percentage of boys than girls were both overweight and obese (Mazidi, Banach, & Kengne, 2018). Since obesity and mental illness are related, it is important to address these issues not only through counseling or medication but through promotion of a healthy diet and regular physical activity. Obesity and mental illness both lead to feelings of stigmatization, isolation, and discrimination, which are associated with lack of access to appropriate healthcare and education (World Health Organization, 2013; Centers for Disease Control and Prevention, 2010). In the long-term, these psychological and physiological challenges could lead to problems in proper growth and development, educational attainment and life-long productivity (World Health Organization, 2013).

Attention deficit hyperactivity disorder (ADHD) is a very common neuropsychiatric disorder affecting up to 10% of children

worldwide (Ng, Ho, Chan, Yong, & Yeo, 2017). Interestingly, it appears that children with developmental delays such as ADHD or autism are more likely to have certain medical conditions than children without these delays (Schieve et al., 2012). Children who are diagnosed with ADHD are at substantial risk of depression and anxiety, but the course and symptoms of the disorder and comorbidities may fluctuate and change over time (Franke et al., 2018). As children with known or suspected ADHD age into adulthood, their most frequently reported comorbid medical condition is obesity (Instanes, Klugsoyr, Halmoy, Fasmer, & Haavik, 2018). A review of 408 Polish children and adolescents (7-18 yrs) with ADHD revealed 14.71% and 6.37% were overweight or obese, respectively, and this prevalence was significantly greater than age matched controls (Racicka, Hanc, Giertuga, Brynska, & Wolanczyk, 2018). A study by Curtin, Bandini, Perrin, Tybor, & Must (2005) found that 29% and 17.3% of American children diagnosed with ADHD, ages 3-18, were overweight or obese, respectively, which at the time was two and three times higher than the general population, respectively. Chinese students who had ADHD symptomology (1,429), aged 13-17, were 1.4 times as likely to be obese than lean (Lam & Yang, 2007). As it relates to exercise, a meta-analysis of eight randomized controlled trials (n=249) found that aerobic exercise had a moderate to large effect on core symptoms such as attention, hyperactivity, and impulsivity and related symptoms such as anxiety, executive function and social disorders in children with ADHD (Cerrillo-Urbina et al., 2015). A systematic review by Ng, et al., (2017) of 30 studies demonstrated short and long-term intervention effects on cognition and behavior as well as reduced physical symptoms following mixed exercise programs. No adverse effects arising from physical exercise were reported so exercise appears to be a well-tolerated intervention in children and adolescents with ADHD. Archer & Kostrzewa (2012) suggest that physical exercise bestows a propensity for the eventual manifestation of "redifferentiated" developmental trajectories that may equip ADHD adults with a prognosis that is more adaptive functionally, independent of the applications of other therapeutic agents and treatments.

Autism Spectrum Disorder and Exercise Benefits

Individuals with physical and/or mental disabilities need to practice optimal health behaviors as much as individuals without a physical or mental disability. Children with ASD clearly face challenges of obesity and inactivity. This may be due to their social impairments and/or their sensory, emotional and physical regulation (Obrusnikova & Cavalier, 2011). Children with ASD face physical challenges of muscle weakness, especially with posture, poor motor control and coordination problems. They also tend to have decreased strength (Fedewa & Ahn, 2011). Importantly, previous research on utilizing physical activity in those with ASD demonstrated positive behavioral outcomes. For instance, studies utilizing jogging demonstrated reduced behavioral and disruptive problems immediately following the physical activity (Celiberti, Bobo, Kelley, Harris, & Handlemann, 1997; Petrus et al., 2008; Oriel, George, Peckus, & Semon, 2011) while 45 minutes of running in teens improved attention span, social behavior and learning (Bass, 1985) and a treadmill program reduced obesity (Pitetti, Rendoff, Grover, & Beets, 2007). Cycling was found to develop self-efficacy (Todd, Reid, & Butler-Kisber, 2010) while active video games decreased repetitive behaviors (Anderson-Hanley, Tureck, & Schneideerman, 2011). Horseback riding over 20 weeks improved motor and sensory integrative functions. (Wuang, Wang, Huang, & Su, 2010). Another study found that regular 10 min/day exercise was effective in decreasing stereotypy and improving adherence to classroom routines (Prupas & Reid, 2001). Such structured physical activity taught these individuals social behaviors such as cooperation, taking turns and fair play, and how to appropriately deal with emotional responses

(Krebs, 2005; Wright & Sugden, 1999).

A well-designed eight-week structured physical activity program conducted by Hong Kong Baptist University investigators compared a training group of 18 children to a control group of 12 children (Choi & Cheung, 2016). Their sample consisted of 22 boys and 8 girls, seven and eight years of age who had mild intellectual disabilities. ASD was diagnosed in 60% of the children. A "Checklist of Behaviors" was recorded at weeks 1, 4 and 8. The structured program focused on physical activities specifically designed to address emotional self-control and social interaction, and each activity has a structured and specific delivery approach. Targeted behaviors included such things as controlling frustration, following directions, and accepting criticism. Social interactions targeted included assisting and cooperating with classmates, being happy and waiting for one's turn. The results demonstrated significant improvements in emotional control between the two groups at both the 4-week and 8-week time frames. There was a positive linear trend in improvement with a large effect size. The self-control scores explained 23% of the variance in the training group. No difference in social interaction was found between the two groups, although there was a positive linear trend, suggesting 8-weeks may not be long enough to effect social interaction. In summary, structured physical activity in children and adolescents with Autism Spectrum Disorder can improve health, wellness, behavior, and learning.

Procedure

Duplanty, Vingren, & Keller (2014) published exercise recommendations for individuals with intellectual disabilities. Since each person is unique, it is important to know their health history so physical activity programs can be tailored to individual needs. Children enjoy activity which includes rewards, games and aerobic routines. The benefits are numerous and include reducing risk factors for coronary artery disease, improving strength, balance, agility, coordination, functional capacity and quality of life. Cardiorespiratory (aerobic) recommendations include 30-60 minutes per session of moderate activity a minimum of 5 days/week. Resistance training should include a slow progression targeting major muscles groups 3 days/week. One to four sets of 10-15 repetitions should be the followed. Agility, balance, coordination and gait activities should be completed 2-3 days/week for 20-30 minutes to target the neuromotor system. Finally, flexibility activities 2-3 days/week focusing on major tendon-units should held for 10-30 seconds and repeated 2-4 times. Furthermore, the United States Department of Health and Human Services (2018) suggest preschool children be encouraged to be active throughout the day to enhance growth and development. Active play can meet the recommendations listed above. School-aged children should participate in moderate to vigorous intensity and include aerobics, muscle-strengthening and bone-strengthening activities. Moderate intensity aerobic activities for children and adolescents could include games such as tag, skipping, jumping, bicycling, scooter, throwing & catching games and even vigorous video games. Muscle-strengthening activities could include gymnastics, climbing on playground equipment, tug of war, rope climbing, yoga, or resistance body weight activities. Good bone-strengthening activities are running, jumping rope, hopping, skipping, and games that involve jumping or rapid change in direction.

A study by Pastula, Stopka, Delisle, & Hass (2012) focused on utilizing aerobic (60-70% max HR) and resistance training in 16 adolescent volunteers (mean age = 19.4 ± 1.3 yrs.) with various intellectual disorders. Participants were given the choice to exercise or remain in the classroom. Those participating in the physical activity met 3x/week for 45-60 minutes. Participants completed 20 minutes of total body circuit training for muscular strength, followed by 30-45 minutes of aerobic sport such as soccer, tee ball, relays, basketball, etc. Following 8 weeks with 100% adherence of 14 participants, fitness, which was assessed by a step test, improved 17.5%. Cognitive abilities, assessed

by 3 validated subtests of cognitive processing, demonstrated a 103% improvement. The authors postulated the changes resulted from improved neuroplasticity secondary to upregulation of brain-derived neurotrophic factor (BDNF). A systematic review of nine papers published on BDNF and physical activity found 86% of human studies in persons with disease or disability showed a transient increase in BDNF following acute aerobic exercise, while 30% of the studies showed a training induced increase in basal BDNF (Knaepen, Goekint, Hyman, & Meeusen, 2010).

Physical Disabilities and Exercise Benefits

Much like children with intellectual disabilities, children with physical disabilities also need to be encouraged to participate in physical activity and/or sport. Even children in wheelchairs can be active participants. A systematic review by Johnson (2009) found aquatic therapy improved vital capacity in children with developmental disabilities and Fragala-Pinkham, Haley, & O'Neil, (2008) reported similar findings in a child with Duchenne muscular dystrophy. Johnson (2009) also reported hippotherapy and therapeutic riding improved balance, posture, fine and gross motor skills, and overall daily functioning at home and in the community. Children with cerebral palsy who participated in aerobic activity significantly decreased their resting heart rates (Schlough, Nawoczenski, Case, Nolan, & Wigglesworth, 2005; Howcroft et al., 2012) and similar studies found physical activity and exercise to enhance fitness and functionality (Martin, 2011). Nearly all participants with a physical disability who participate in physical activity reported some level of enjoyment, satisfaction and/or physical benefits (Arbour-Nicitopoulos et al., 2018; Johnson, 2009; Howcroft et al., 2012; Martin, 2011). Finally, youth sports participation for those with disability has also been found to have beneficial effects. A literature review by Martin in 2011 reported adolescent swimmers with varied physical disabilities reported self-esteem scores comparable to elite soccer players, gymnasts and figure skaters. Swedish children participating in sport reported enhanced self-confidence, self-control and group acceptance. While youth athletes with disability reported stronger personal athletic identity than children in sport without disability, they did not feel the public perceived them as "real" athletes. Girls with physical disability participating in sport reported feeling more "normal" and "free" and found sport minimized their disability. Other findings included perceived competence if allowed to set personal goals, overall enjoyment of physical activities, enhanced friendships, connectedness and quality of life and positive social support from family, coaches and teammates. Table 1 summarizes the negative psychological and physical health impact from lack of participation in physical activity by those with intellectual and physical disabilities. (Johnson, 2009; Lin, Lin, & Lin, 2010; Kurtz, 2008; Martin, 2011; Lutz & Bowers, 2005). Table 2 summarizes some of the positive psychological and physical benefits from participation in physical activity in the those with intellectual and physical disabilities. (Srinivasan, Pescatello, & Bhat, 2014; Weber & French, 1988; Bartlo & Klein, 2011; Sandoiu, 2019; Pitchford, Siebert, Hamm, & Yun, 2016).

Table 1 : Negative Impact of physical inactivity in those with intellectual and physical disabilities

Feelings of:	Health Problems:
• Being less valued • Being less capable • Being less confident • Being more frustrated • Being inadequate	• Decreased energy • Increased muscle weakness • Increased fatigue • Decreased circulation • Increased osteoporosis • Increased obesity • Increased joint pain • Increased Type 2 diabetes

Table 2 : Positive Outcomes of physical activity in those with intellectual and physical disabilities

Feelings of:	Health Problems:
• Health /Wellness • Perceived increased quality of life • Reduced anxiety, depression, stress • Enhanced self-perception • Enhanced self-respect • Improved socialization	• Increased cardiovascular fitness • Improved energy level • Reduced fatigue • Increased muscle strength • Enhanced fine and gross motor skill • Improved posture • Increased functionality

Summary

In summary, all children and adolescents are encouraged to participate in regular daily physical activity. Various daily physical activities have been shown to enhance growth and development in children under age 5 years. Children and adolescents should participate in moderate-to-vigorous activities for 60-minutes throughout the day. These activities should include aerobics three days per week, as well as muscle strengthening and bone-strengthening activities three days per week. (United States Department of Health and Human Services, 2018). Children with mental health disorders, like other children, face increased risk of pathophysiological long-term systemic diseases (heart, blood vessel disease, cancer) due to inactivity. Beyond this, children with disabilities have a greater prevalence of obesity vs. non-disabled children (Centers for Disease Control and Prevention, 2010). Obesity and related mental illness can both be addressed through a healthy diet and regular physical activity (World Health Organization, 2013); Centers for Disease Control and Prevention, 2010). From a behavioral perspective, exercise has been shown to improve cognition (Tan, Pooley, & Speelman, 2016) quality of life (Duplanty et al., 2014), attention, anxiety, hyperactivity, impulsivity, and executive function (Cerrillo-Urbina et al., 2015) in those with ADHD. In children and adolescents with ASD, various forms of exercise have demonstrated improved attention span, social behavior and learning (Bass, 1985), self-efficacy, (Todd et al., 2010) motor and sensory integrative functions (Wuang et al., 2010), cooperation, taking turns and fair play, and how to appropriately deal with emotional responses (Krebs, 2005; Wright & Sugden, 1999). Additionally, reduced behavioral and disruptive problems have been seen immediately following the physical activity (Celiberti et al., 1997; Petrus et al., 2008; Oriel et al., 2011). Exercise is a well-tolerated intervention in children with neuropsychiatric disorders, with no adverse effects (Ng, et al.,

2017). It has been found to decrease body fat (Pitetti et al., 2007). While larger randomized control trials are needed to support exercise benefits and/or differentiate exercise benefits with or without other treatments, i.e., medications, there is substantial evidence from randomized control trials, systematic reviews and meta-analyses to support the use of exercise, in addition to standard medical treatment, for children and adolescents with intellectual disabilities. Physicians should be encouraged to work with exercise professionals to garner the many exercise benefits available to their pediatric patients.

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