

**The Vigorous Life: Physical Activity and the Hyperactive Student**

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## Abstract

**Background:** Attention deficit hyperactivity disorder, or ADHD, is one of the most commonly diagnosed neurodevelopmental disorders in children. Children with ADHD present with inattentiveness, hyperactivity/impulsivity, or a combination of both. Given the major symptoms of ADHD, children diagnosed with the disorder often struggle with school work.

**Objective:** The purpose of this study is to examine the history of ADHD, the U.S. obesity epidemic, and the potential benefits of physical activity for children with ADHD.

**Design and Method:** The research method is based on current literature regarding ADHD and physical activity. Journal articles and studies are reviewed and reported in the Results section. The research questions are: *How can physical activity benefit children and adolescents with ADHD? How would an effective physical activity program for children and adolescents with ADHD be structured?*

**Results:** The significance of this study is that both ADHD and obesity rates in the U.S. are high and continuing to increase. The overwhelming majority of American schoolchildren do not meet the CDC's recommended physical activity guidelines. The most common treatment method for ADHD is stimulant medication, but this is a short-term solution with unknown long-term effects. A wide range of types of physical activity is effective in treating ADHD, including yoga and martial arts, which provide additional benefits by employing "mindfulness".

**Conclusions:** Despite its wide range of benefits, physical activity is underemphasized in the United States. All schoolchildren, but particularly those with ADHD, need to be provided with many opportunities throughout the day to expel excess energy.

**Keywords:** ADHD, benefits of physical activity, U.S. obesity epidemic, physical education

## Table of Contents

<b>Abstract</b> .....	2
<b>Chapter 1: Introduction</b> .....	5
<b>Chapter 2: Literature Review</b> .....	8
ADHD in the Past and Present .....	8
Cost of Obesity .....	14
JFK & Physical Education.....	17
The Importance of Exercise for Schoolchildren.....	18
Recommended Exercise Guidelines.....	19
The Current State of Physical Education in the U.S. ....	20
Treatment of ADHD with Physical Activity .....	21
<b>Chapter 3: Methods</b> .....	24
<b>Chapter 4: Results</b> .....	25
<i>Research Question 1: How can physical activity benefit children and adolescents with ADHD?</i> .....	25
<i>Research Question 2: How would an effective physical activity program for children and adolescents with ADHD be structured?</i> .....	26
<b>Chapter 5: Discussions</b> .....	30
<b>References</b> .....	33

*“All of us must consider our own responsibilities for the physical vigor of our children and of the young men and women of our community. We do not want our children to become a generation of spectators. Rather, we want each of them to be a participant in the vigorous life.”*

- John F. Kennedy, 1960

## Chapter 1: Introduction

It is a crisp, October morning. Moms and dads and little kids are walking up the long hill to the bus stop. The leaves are changing, the wind is cutting cold, and the 2003-2004 school year now has its first month in the books. Apparently, it was an especially long month for one little boy in particular, who to his mother's shock and horror, suddenly pulls away and bolts back towards their house. He knew well that this would not go unpunished; in fact, he expected this to result in the worst grounding of his 6 years on this planet. But, it could never be worse than going to school. All he wanted to do was to run around and play, and for most of the school day, all the grownups wanted him to do was the opposite of that. It was sitting at a desk or on a dirty carpet listening to incoherent ramblings and looking at strange symbols all morning and afternoon. Not long after this episode, the boy's parents brought him to a series of doctors, who ultimately concluded that this is clearly not correct behavior; this boy has attention deficit disorder.

That was my story, but millions of other Americans have one just like it. More than ten percent of schoolchildren in the U.S. have been diagnosed with attention deficit hyperactivity disorder, commonly abbreviated as ADHD (Visser & Danielson, 2014). ADHD is most frequently diagnosed during childhood and is more often found in boys than girls (Kim et al., 2011). It is characterized by inattentiveness, hyperactivity/impulsivity, or a combination of both. Though research continues, the etiology of ADHD remains unclear (Centers for Disease Control and Prevention, 2020). This means that ADHD cannot be diagnosed with neuroimaging, and only by observing the child's behavior (Cortese & Castellanos, 2012). Given this gap in our understanding, some, most notably including sociologist Peter Conrad, have argued that this is not a legitimate medical ailment, but an attempt by Big Pharma and Big Government to

“medicalize problematic but otherwise normal behaviors” (Mayes & Rafalovich, 2007). Whether or not there truly was malicious intent behind the ADHD boom, it is clear that diagnosis is determined not objectively, but subjectively by healthcare practitioners. This problem is deftly summarized by Mayes & Rafalovich:

“For virtually all the twentieth century, however, whatever was fundamentally amiss in a child’s brain (if anything) had to be ‘taken on faith.’ And we all know how inherently controversial and divisive matters of faith can be, in the arena of mental health as much as in religion” (Mayes & Rafalovich, 2007).

Nonetheless, the behaviors and academic struggles of children diagnosed with ADHD can prevent students from achieving their goals and therefore need to be addressed.

Currently, the most popular and cost-effective treatment method is medication, far exceeding behavior therapy. But medication is not without its downsides. Being a stimulant, Ritalin (methylphenidate), the most commonly prescribed ADHD medication, is known to have side effects including appetite suppression, insomnia, and anxiety, among others. The potential long-term dangers of taking stimulants throughout childhood and adolescence are not yet understood, and symptoms immediately return once treatment is discontinued. What is more important to note is that Ritalin is also ineffective for up to 30 percent of patients, of which ten percent will not have a positive reaction to any alternative ADHD medications (Meppelink, 2016).

There is an abundance of literature indicating that physical activity can be highly effective in mitigating symptoms of ADHD, and improves mental health and cognitive functioning for all students (Ratey & Sattelmair, 2009). But unfortunately, physical activity is

grossly underemphasized in the United States. Two-thirds of American adults are considered "overweight" (Body Mass Index (BMI) between 25.0 and 29.9), and one third are so overweight that they are "obese" (BMI of 30.0 or higher) (Hammond & Levine, 2010). This has been a national concern going as far back as the mid-twentieth century, case in point John F. Kennedy's *Sports Illustrated* essay, *The Soft American* (Kennedy, 1960). But despite Kennedy's calls for fitness councils and physical education reform in the 1960s, the problem has festered considerably, as obesity rates have doubled since 1970 (Hammond & Levine, 2010). While it has been recommended by the CDC for children and adolescents to engage in at least 60 minutes of physical activity per day, less than a quarter of the demographic meet this guideline (Centers for Disease Control and Prevention, 2020). Yet, school districts continue to reduce or cut physical education, despite numerous major studies debunking the concept that less time in P.E. and more time in math and reading leads to academic improvements (Trost & van der Mars, 2009). Less time in P.E. is a great disservice to all schoolchildren, but particularly to those with ADHD, who are at a greater risk for obesity (Kim et al., 2011).

The purpose of this research was to investigate the history of ADHD, the U.S. obesity epidemic, and the potential benefits of physical activity for children and adolescents with and without ADHD. The research questions I sought to address are the following:

**RQ1:** *How can physical activity benefit children and adolescents with ADHD?*

**RQ2:** *How would an effective physical activity program for children and adolescents with ADHD be structured?*

## Chapter 2: Literature Review

### ADHD in the Past and Present

In a 1902 lecture to the Royal College of Physicians, English pediatrician Sir George Frederick Still presented his findings after studying “behaviorally disturbed” children. These children were not intellectually disabled, but constantly misbehaved and would not sit still in school. Still remarked that he had observed these traits in boys more frequently than girls. He labeled this new psychiatric phenomenon a ‘defect of moral control,’ and hypothesized (without empirical evidence) that its underlying cause was physiological (Mayes & Rafalovich, 2007).

Later on, in the 1910s and 20s, Alfred Tredgold, another English doctor, expanded upon Still’s research and claimed that such children must have had mild brain damage at some point, causing them to be inattentive and lacking self-control. To Tredgold, failure in school was a ‘symptom’ of this ‘mental deficiency’, rather than just a lack of discipline. He once commented that these ‘defective’ kids had never been noticed before the Education Act of 1876, which made public school attendance compulsory in England and Wales. In his 1922 book *Mental Deficiency (Amentia)*, Tredgold described the negative effects on behavior caused by encephalitis lethargica (also known as ‘sleepy sickness’), of which there was an epidemic in the late 1910s. Following the breakout of encephalitis lethargica, doctors began to see increased children exhibiting symptoms similar to what we now call ADHD, and thus they began to attribute hyperactivity and lack of focus in schoolchildren to ‘postencephalitic behavior disorder.’ Few child survivors actually would fit our modern description of ADHD, but because the dominant etiological conclusion (largely propagated by Tredgold) at the time was that brain damage was the underlying cause, postencephalitic behavior disorder became a popular diagnosis that medicalized misbehavior in schools (Mayes & Rafalovich, 2007).



In the 1930s, Louis Cohen and Eugene Kahn researched hyperactivity and found that contrary to Tredgold and Still, most of their hyperactive patients had not suffered any brain trauma. Kahn and Cohen had been doing much of their work at the Bradley Home, a haven for disabled children. The Bradley Home was located in Rhode Island and was donated by a wealthy, deceased couple whose daughter had severe neurological damage following the aforementioned epidemic. Doctors working at the Home in the early years believed that misbehaving children had abnormalities in the central nervous system which could be corrected via neurosurgery, specifically by performing a painful spinal tap (pneumoencephalogram). Results were not positive, and children who had received the spinal tap complained of headaches. Thus, the head of the medical staff, Dr. Charles Bradley (great-nephew of the Home's namesake) began administering a new amphetamine called Benzedrine in the hopes that it would help patients produce more spinal fluid and in turn take the pressure off their sinuses. Benzedrine failed to relieve Dr. Bradley's patients' headaches, but the drug did unexpectedly yield dramatic improvements in many of the children's classroom behavior and performance. Bradley soon after administered Benzedrine to patients who had not had the spinal tap, and he saw the same positive results. The unfortunate downside was that the children immediately reverted to their previous hyperactive state once the medication was halted (Mayes & Rafalovich, 2007).

In 1957, the diagnostic precursor to ADHD, 'hyperkinetic impulse disorder', was given its name by Bradley Home researchers Eric Denhoff, Maurice Laufer, and Gerald Solomons. Denhoff, Laufer, and Solomons noted the prevalence of hyperactivity and poor school-work among these patients, and that it was more often found in boys and first-born children. Though they originally asserted that damage to the diencephalon was the underlying cause of

hyperkinetic impulse disorder, Laufer admitted in 1975 that "so many" of the children he had worked with presented "no clear diagnostic evidence" of this (Mayes & Rafalovich, 2007).

In 1955, the Swiss pharmaceutical firm that had previously introduced Thorazine, J.R. Geigy, synthesized a new drug called methylphenidate, better known today by its brand name, Ritalin. The following year, the National Institute of Mental Health (NIMH) created the Psychopharmacological Research Branch (PRB) to encourage the development of more drugs like the widely successful antipsychotic, Thorazine (chlorpromazine). In 1958, the PRB hosted the first-ever conference 'on the use of drugs in children with psychiatric problems', which was attended by Dr. Leon Eisenberg. That same year, Eisenberg became the first person to receive a research grant from the U.S. government to study child psychopharmacology. He then brought in another top expert on pediatrics, Keith Conners. In 1963, two years after it was approved by the FDA, Eisenberg and Conners became the first to publish a scholarly article in favor of treating 'disturbed' children with Ritalin. The participants of their study had all come from one of two separate 'residential care institutions'; one was for children who were deemed unsuitable to live in foster homes, and the other was a psychiatric treatment center. Conners would later remark that he was 'struck by the size of the improvement' following the study, for his 'earlier experience treating similarly disturbed children with psychotherapy yielded virtually no improvement even after a year's worth of psychotherapy'. The only downside Conners and Eisenberg found was a loss in appetite, which had been reported by 70% of the experimental group (Mayes & Rafalovich, 2007).

Throughout the 1960s, the link between brain damage and hyperactivity became increasingly scrutinized in the psychiatric community. By 1968, every childhood disorder was re-written into the new DSM-II as 'reactions' (i.e. hyperkinetic impulse disorder/hyperactive

child syndrome' then became hyperkinetic reaction of childhood). This move was largely inspired by the work of the pioneering child psychiatrist Leo Kanner, who argued that mental illnesses are merely reactions to events that took place as far back as one's early childhood (Mayes & Rafalovich, 2007).

While child psychiatry continued rapidly developing throughout the late 60s, Big Pharma refused to finance child psychopharmacology research. These companies feared that the general public would not be willing to administer drugs to their children, as this was widely viewed as unethical and perhaps even dangerous. Funding for such studies thus came "almost exclusively from the U.S. federal government's NIMH". In 1967, Conners was awarded the first research grant from the federal government via the NIMH to study the effects of stimulants on behaviorally disturbed children. The following year, the NIMH handed out three more grants to researchers. By the end of the decade, roughly 150,000-200,000 American children were being treated with stimulants (only about 0.002% of all kids in the U.S. at the time) (Mayes & Rafalovich, 2007).

In 1970, the *Washington Post* published a bombshell article saying that 5-10% of schoolchildren in Omaha, Nebraska were taking Ritalin. Parents were supposedly being coerced to permit their children to receive drug therapy, and adequate medical supervision was not present while dispensed, resulting in pill swapping amongst students. In reality, only 5 to 10 percent of special education students were receiving Ritalin, and there was no evidence of coercion of parents. Nevertheless, the story blew up, prompting a Congressional Committee hearing and in the following year a national conference on the topic. The story came at a time when drug use was a major concern for the American public. That same year, the Comprehensive Drug Abuse Prevention and Control Act placed Ritalin and amphetamines under

the category of Schedule III, which limited the number of refills and the length of an individual prescription. In 1971, the Drug Enforcement Administration (DEA) was created and amphetamines and Ritalin were reassigned to Schedule II, which meant that these drugs were now even more strictly regulated, with production being limited (Mayes & Rafalovich, 2007).

Four years later, three important publications were released: *The Myth of the Hyperactive Child* by Peter Schrag and Diane Divoky, *Why Your Child is Hyperactive* by Benjamin Feingold, and Peter Conrad's article 'The Discovery of Hyperkinesis.' Schrag and Divoky's book asserted that Ritalin was dangerous and being forced on parents by doctors, principals, and teachers to chemically restrain their children. Despite its popularity, *The Myth of the Hyperactive Child* was chastised by many for its fallacies and hysteria. Feingold argued in his book that hyperactivity was a consequence of food dyes and additives. Though his claims lacked evidence, Feingold Associates became a ubiquitous political/public interest group in the U.S., with chapters in every state. A trained sociologist, Conrad's thesis was that the diagnosis of ADHD is truly about social control and that the child's environment determines their behavior. He also points the finger at the pharmaceutical industry, claiming that they lobby for the 'medicalization of deviant behavior'. The anti-authoritarian message of 'The Discovery of Hyperkinesis' unsurprisingly became popular within the counter-cultural movement (Mayes & Rafalovich, 2007).

In 1978, NIMH researcher Judith Rapoport observed that stimulants produced the same improvements on behavior and academic performance in children who did not have any learning or mental disorders, a discovery that complicated the consensus on diagnosis and treatment (Mayes & Rafalovich, 2007). In the DSM-III, published in 1980, the APA again switched the name of the disorder to "Attention Deficit Disorder (ADD) (with or without hyperactivity)". This

was then changed in a revised edition of the DSM-III in 1987 to “Attention-deficit-Hyperactivity Disorder (ADHD)”, which presently remains in place (Lange et al., 2010).

Today, according to the CDC, there are three types of ADHD. The first is "inattentive", meaning the individual has difficulty with self-organization, focusing, and/or completing tasks. The second is "hyperactive/impulsive", which means that the individual may fidget, struggle to sit still, or speak out at inappropriate times. The third is a combination of the first two. Although recent research has suggested that "genetics plays an important role", the true cause of ADHD is not currently understood (Centers for Disease Control and Prevention, 2020). A review of studies investigating the efficacy of neuroimaging in diagnosing ADHD found that despite growing evidence of structural differences in the brains of individuals with the disorder, “claims of clinical utility of neuroimaging-based tools are premature and currently indefensible for the diagnosis of ADHD or for formulation of treatment plans” (Cortese & Castellanos, 2012).

As of 2014, 11 percent of school-aged children in the United States had reportedly been diagnosed with ADHD, with an approximate male to female ratio of 3:1 (Visser & Danielson, 2014). 56 percent of US children with ADHD receive medication to treat the disorder, with girls being prescribed at half the rate of boys (Kim et al., 2011). Methylphenidate is consumed in the United States more than any other country, and more children are taking the drug now than ever before. Numerous studies have shown that methylphenidate has beneficial effects for 70 percent of children with ADHD. International guidelines recommend that physicians prescribe it (assuming pharmacological treatment is indicated) first, before if necessary moving on to other options such as dextroamphetamine and atomoxetine. Methylphenidate has not only proven to be effective for treating ADHD, but also to be far more cost-effective when compared to behavioral treatment. There are possible short-term side effects however for stimulant medications,

including insomnia, loss of appetite, abdominal pain, headaches, anxiety, stress, and nervousness. It is not a long-term solution; symptoms return immediately after discontinuing the medication. Of the up to 30 percent of children with ADHD who do not respond to methylphenidate, ten percent of these children will not respond to any other medications. Nonadherence to pharmacological treatment is also common for children with ADHD, who may either forget or refuse to take their medication. Methylphenidate is short-acting, which often means that 2 to 3 daily doses will be necessary to yield effective results. Having to take the medication in front of peers can be stigmatizing and/or embarrassing for these children. Finally, the long-term efficacy and possible side effects of stimulant medications are currently not understood (Meppelink et al., 2016).

In a cross-sectional analysis of nearly 67,000 children aged 6-17, Kim et al. (2011) found that children with ADHD were generally less likely to engage in physical activity and organized sports than those without ADHD, regardless of medication status. Obesity is overall more prevalent among children with ADHD, especially among non-medicated children, and even more so among girls, who tend to be less active than boys. Medication was found to a “protective factor for obesity”, likely because stimulants suppress appetite. Boys with ADHD not on medication were found to be 42 percent more likely than boys without ADHD to be obese, and girls with ADHD not on medication were found to be 85 percent more likely to be obese than girls without ADHD (Kim et al., 2011).

### **Cost of Obesity**

It is quite clear that there is an obesity epidemic in the United States. Hammond & Levine (2010) wrote a comprehensive research article that estimates the total cost of American obesity across four categories: direct medical costs, productivity costs, transportation costs, and

human capital costs. In the U.S., more than 2/3 adults are considered overweight and 1/3 adults are considered obese. “Overweight” means to have a body mass index (BMI) of 25.0-29.9, while “obese” means to have a BMI of 30.0 or higher. By 2002, nearly a half-billion people were overweight worldwide. Since 1970, American obesity rates have doubled. Obesity has been known to cause type 2 diabetes, hypercholesterolemia, coronary heart disease, stroke, asthma, osteoarthritis, and many other diseases and ailments. In their article, Hammond & Levine (2010) cite a study of healthcare expenses of a sample of adults ages 35-69 by Kaiser Permanente that took place spanning 9 years. All of the participants were non-smokers and had no history of heart disease. What Kaiser Permanente found was that in comparison to participants at a healthy weight, the obese participants’ overall healthcare costs were 36% higher, prescription costs were 105% higher and primary care costs were 39% higher. Overweight participants had prescription costs which were 37% higher and primary care costs which were 13% higher when compared to healthy weight participants.

Hammond & Levine also cited a study estimating healthcare expenses that took place in Minnesota and consisted of adults over the age of 40. Controlling for disease and demographics, the researchers found that for every one unit (1.0) increase in BMI, participants paid 1.9% more in healthcare costs. Citing a regression analysis based on nationally representative surveys from 1998-2006, Hammond & Levine (2010) estimated annual direct medical costs relative to obesity to be as high as \$147 billion annually. This would equate to ten percent of all federal government spending in 2008. They go on to state that between the years of 1987 to 2001, per-capita healthcare spending increased by 12% due to obesity alone. The increased early mortality rate may however offset some of these costs. Direct annual costs of childhood obesity according to Hammond & Levine’s article are as high as \$14.3 billion. A regression analysis cited in their

article insists that many of the costs associated with obesity are passed on with employer-sponsored insurance in the form of lower wages, which may explain much of the wage gap that is often attributed to discrimination. The authors go on to explain the obesity costs that come in the form of absenteeism and presenteeism. Absenteeism is the loss of money due to being absent for health issues, whereas presenteeism is decreased productivity due to health issues.

According to data from Shell Oil Company's North American Division, 3.73 additional days of work were lost for each obese employee relative to normal-weight employees. The company lost \$11.2 million per year due to absenteeism, not including the potential effects of obesity on training, company morale, and etcetera. Nationwide estimates of the costs of absenteeism in Hammond & Levine's article are anywhere from \$3.38-6.38 billion per year. The costs of lost productive time (LPT) per year are estimated at \$11.7 billion annually, controlling for co-occurring health conditions. Being obese also raises the probability of receiving disability compensation by approximately 7% for men and 5% for women. Hammond & Levine (2010) cite a study that showed that a twenty-year-old white male with a BMI over 45.0 could be expected to have as much as thirteen YLLs (years of life lost), which would be a 22% reduction in typical remaining years for his demographic. Hammond & Levine (2010) also point out that pooled insurance may incentivize obesity by transferring costs to healthy people. Authors of one study cited by Hammond & Levine (2010) find that there is a welfare loss in pooled insurances when compared to risk-adjusted premiums. This loss is estimated to be \$150 per capita in the United States. Another study cited shows 5 billion dollars in non-medical costs for businesses in 1994. Hammond & Levine reported that weight gain in the 90s required 350 million extra gallons of jet fuel in the year 2000, costing an additional \$275 million. Another study cited declares that reduction of an average of 5 kilograms for all Americans could reduce CO<sub>2</sub>



emissions by 10 million T annually. Adding up total costs, Hammond & Levine (2010) estimate that \$215 billion or more is accrued in costs related to obesity each year.

### **JFK & Physical Education**

The issue of an increasingly sedentary America has long been a national concern. John F. Kennedy wrote a *Sports Illustrated* article on the topic in 1960 entitled *The Soft American*. He begins the article by discussing some of the histories of sport and exercise in Western civilization, beginning with the Ancient Olympic Games. JFK argues that fitness should always be a priority for individuals and societies. The Greeks believed that it was one of the prime foundations of a vigorous state. He goes on to say that fitness goes hand in hand with culture and intellectual achievement. Kennedy points to the Korean War as an example of how we are losing this value, when half of the men in the selective service system were deemed “mentally, physically or morally unfit”. He mentions a study by Kraus & Weber in which six different fitness tests were given to children. They found that 57.9% of U.S. students failed one or more tests, while only 8.7% of Europeans failed. 35.7% of the Americans failed the strength test, compared to only 1.1% of the Europeans. JFK then explains that President Eisenhower was very troubled by this growing trend, so much so that he established the Council on Youth Fitness and appointed a Citizens Advisory Committee. By the time Kennedy wrote this article, he claimed that no improvement was noticed. Kennedy writes about Yale’s freshman fitness test to show that this is a growing problem: in 1951, 51% passed, in 1956, 43% passed, and in 1960, only 38% percent passed. He yearns for an American revival of the Ancient philosophy of “sound mind and sound body”. A root cause Kennedy singles out is that people in the U.S. work with their hands less and less and are no longer moving around as much. To combat this, JFK calls for a committee on fitness and for the U.S. government to tackle obesity. Though he says that we

should not establish an authoritarian state where people are forced to exercise, he believes we shouldn't encourage children to be "spectators" but instead "participants in the vigorous life" (Kennedy, 1960).

### **The Importance of Exercise for Schoolchildren**

Since Kennedy wrote *The Soft American*, much more scientific literature has been released which supports his claim that fitness and cognitive ability are related. According to Ratey & Sattelmair (2009), exercise may improve cognitive development and academic performance. Physical activity promotes brain adaptation and growth, preserves function, and enables response to future challenges. Ratey & Sattelmair (2009) also explain that physical activity enhances learning & memory in animals, delays and prevents decline in the elderly, and encourages gross structural and vascular plasticity in the brain. Physical activity enhances brain activity and modulates important neurotransmitter systems. Aerobics stimulate the release of neuronal growth factors, which are molecules that help neurons survive and thrive. Exercise stimulates the growth of new neurons in the hippocampus, the part of the brain responsible for learning and memory. Play facilitates healthy cognitive development by stimulating frontal lobe maturation. Exercise also alleviates ADHD by encouraging social behavior through the maturation of behavioral inhibition. Ratey & Sattelmair (2009) cite a meta-analysis that showed a positive correlation between Physical Activity and 7 categories of cognitive performance among schoolchildren (perceptual skills, IQ, achievement, verbal tests, mathematical tests, developmental level/academic readiness, other). Physical fitness is also positively correlated to executive control in pre-teens. They also cite a study from Iceland which said that BMI and Physical Activity can account for up to 24% of the variance in academic success. Ratey & Sattelmair (2009) cite a study of 5<sup>th</sup>, 7<sup>th</sup>, and 9<sup>th</sup> graders which showed that students with higher

fitness levels scored higher on the SAT-9, especially in math. Finally, they cited a middle school intervention study that exhibited that physical education does not affect classroom performance, but vigorous activity outside of school has a very positive effect. The classes involved only included 19 minutes of vigorous activity per 55 minutes of PE class (Ratey & Sattelmair, 2009).

### Recommended Exercise Guidelines

According to the Center for Disease Control, children and adolescents older than 6 and younger than 18 should exercise at a moderate to vigorous level for at least 60 minutes per day. Their chosen exercises should include aerobic activities, bone-strengthening activities, and muscle-strengthening activities. The majority of the daily 60 minutes of physical activity should be aerobic, which bolsters one's cardiovascular health. On at least three days of the week, vigorous aerobics should be included. The intensity of exercise can be determined by either "absolute intensity", which is an objective measure (calories burnt), or by "relative intensity", which is a subjective measure (rate of perceived exertion). Relative intensity can be measured with a simple 0 to 10 scale of perceived difficulty. The moderate activity would fall in the middle of the scale around 5 or 6, whereas vigorous activity begins at 7 or 8. Examples of moderate aerobic activity for children and adolescents could include brisk walking or bike riding. Examples of vigorous aerobic activity for children and adolescents could be vigorous dancing or martial arts. Along with aerobic activity, muscle-strengthening activities should be performed at least 3 days per week. These are very important because "the greatest gains in bone mass occur during the years just before and during puberty. Also, the majority of peak bone mass is obtained by the end of adolescence" (Centers for Disease Control and Prevention, 2020). Bone strengthening activities involve "a force on the bones of the body that promotes bone growth and strength" (Centers for Disease Control and Prevention, 2020). Examples would include jumping

rope and running, because of the impact of the ground. Lastly, muscle-strengthening activities should also be performed 3 or more days per week. Resistance exercises of any kind (body weight, resistance bands, weights, etc.) and yoga (depending on the intensity/type) are both great options. Resistance training, when properly prescribed and supervised, are perfectly suitable for not only adolescents but children. However, children can build strength just as well during unstructured activities such as climbing on a jungle gym or a tree. Children can also meet aerobic, muscle-strengthening, and bone-strengthening guidelines just by playing, assuming they alternate between moderate and vigorous-intensity, like a game of tag or hide-and-go-seek would entail. There is also overlap in certain structured activities like running, which would cover aerobic activity and bone-strengthening. The CDC recommends substituting sedentary activities for more active ones, like taking the stairs rather than an elevator or escalator. Those children and adolescents who do not meet guidelines should gradually increase physical activity, choosing ones they prefer that match the recommendations. Those that meet the guidelines should consider increasing activity, as the current literature indicates that there may be additional health benefits. Those that exceed guidelines should vary their activities to prevent physical imbalances and overtraining (Centers for Disease Control and Prevention, 2020).

### **The Current State of Physical Education in the U.S.**

While only 24 percent of American schoolchildren ages 6 to 17 meet the CDC's recommended 60 minutes of physical activity per day (Centers for Disease Control and Prevention, 2020), most elementary schools in the U.S. only have physical education class one to 3 times per week for 30 minutes (Nye, 2008). In 2006, only 3.8 percent of elementary schools, 7.9 percent of middle schools, and 2.1 percent of high schools in the U.S. offered daily physical education classes for the whole year (Trost & van der Mars, 2009). Also, only 59% of American

school districts have mandated that elementary schools provide a regularly programmed recess. In 2008, the U.S Department of Health and Human Services gave American schoolchildren a “D-” grade for their widespread failure to meet national physical activity guidelines. Most public schools in the U.S. are not allotting enough time to meet the nationally recommended 60 minutes or more of daily physical activity (U.S. Department of Health and Human Services, 2008). Following the passing of No Child Left Behind in 2002, federal funding for public schools became linked to progress in reading and math scores. By 2007, 62 percent of elementary school and 20 percent of middle schools increased the time spent on reading/language arts and math. 44 percent of districts reported time cuts for art, music, physical education, recess, and social studies, with the average reduction being 30 minutes per day (Trost & van der Mars, 2009). Trost & van der Mars (2009) cited five studies that found that devoting additional time to physical education and other subjects besides reading/math does not reduce grades. They also cited three major studies that indicated that additional time in physical education class leads to academic improvement. Trost & van der Mars (2009) conclude that “...the policy of reducing or eliminating school-based physical activity programs cannot be justified”.

### **Treatment of ADHD with Physical Activity**

Physical activity habits play a key role in the mental health and functioning of all children and adolescents, but especially for those with ADHD. In a review of several studies of physical activity interventions, Kamp et al. (2014) found numerous forms of exercise that may improve symptoms of ADHD in children including, but not limited to, jump-rope, athletic training, walking, dancing, jogging, and swimming. This review also included a yoga intervention, which proved to be successful in mitigating symptoms, especially in combination with pharmaceutical treatment. The authors attributed this result to the “mindful” component of

it. This is consistent with another yoga ADHD intervention study published by Meppelink et al. (2016), who found that practicing mindfulness improves attentiveness in children with ADHD. In another study, children with ADHD received 2 weekly 50-minute Taekwondo sessions for 18 months. The authors found that the martial art “may increase selective attention of adolescents with ADHD”. They describe taekwondo as "a very sophisticated activity, which meshes both physical and mental components and leads to the balance and harmony of the body, mind, and spirit" (Kadri et al., 2019).

In a study by Hoza et al. (2014), the effects of sedentary activities versus physical activities for elementary school students with ADHD were compared after a 12-week trial. The participants were divided into two groups. One group participated in sedentary activities such as arts and crafts, while the other participated in a multitude of physical activities with varying intensities and durations, including yoga, basketball, soccer, cycling, and jump rope. The results showed that school performance and attention had improved significantly more for the physical activity group, with the parents and teachers of these students reporting improved ADHD symptoms and behavior. Mulrine & Prater (2008) concluded that as little as 30 minutes of physical activity for 3 to 5 days per week is sufficient to improve behavior and academic performance for children with ADHD. Silva & Prado (2015) found that physical activity can effectively reduce symptoms and improve functions such as cognition even in interventions as brief as a 5-minute run. In a study by Schoenfelder et al. (2017), a group of 11 adolescents with ADHD were given a "Fitbit" watch to track their physical activity for 4 weeks. A private Facebook group was also set up for the participants to encourage social support. The Fitbit watch incentivizes steady weekly increases in physical activity by counting steps and rewarding users with digital badges for reaching personal goals. Adherence to the program was high, and the

authors concluded that the use of mHealth devices such as Fitbit is "engaging and promising for increasing physical activity among adolescents with ADHD" (Schoenfelder et al., 2017).

### **Chapter 3: Methods**

The purpose of this paper was to explore the intersection of physical activity and attention deficit hyperactivity disorder. Readers will gain a more complete understanding of the origins of the ADHD diagnosis and how physical activity can help children and adolescents with it. It should be noted however that I am personally biased on this topic. I've always felt that unlike other classes where one is expected to have a better understanding of the subject matter by the end of the year, I never felt challenged or better informed by public school physical education class. Independent of school, I became enthusiastic about fitness, learning most of what I know for free from reputable sources on the internet. I have a very positive view of exercise; it has been a highly constructive hobby, and one that I encourage my friends and family members to take up themselves. Additionally, I was diagnosed with ADD and was put on stimulant medication beginning in elementary school until the 11<sup>th</sup> grade. The reason I stopped was that a neurologist determined that I in fact did not have ADD but auditory processing disorder. Since then, I have found that I perform better in school while maintaining an active lifestyle, and I have grown somewhat skeptical of medication for children.

To compile research, I spent all of my time online. The two search engines I used were Google Scholar and the Purchase College Library online database. In addition to peer-reviewed articles, I also used at least one historical document. Articles cited discuss topics such as the obesity epidemic, the history and treatment of ADHD, the history of physical education in the United States, and the benefits of physical activity. Given the vast number of articles available through the Purchase College Library and Google Scholar, I was able to find a plethora of valuable sources, all free of charge. I would advise anyone doing research to begin with a simple Google search as at least a starting point, if not using Google for the entirety of research.



## Chapter 4: Results

The purpose of this research paper was to examine the history of ADHD, the rise of the obesity epidemic, and the benefits of physical activity for children and adolescents with ADHD. The literature review revealed that physical activity does in fact reduce ADHD symptoms. The studies cited included various types of physical activity for schoolchildren diagnosed with the disorder. The results of these exercise interventions, along with CDC guidelines, were then reviewed to determine what an appropriate fitness program for the treatment of ADHD would look like.

**RQ 1:** *How can physical activity benefit children and adolescents with ADHD?*

As indicated by the literature review, physical activity can benefit all children and adolescents, but particularly those with ADHD. Ratey & Sattelmair (2009) explained that physical activity can improve both academic performance and brain functions for schoolchildren. Several exercise intervention studies presented a positive correlation between physical activity and reduced ADHD symptoms. Even a short duration of exercise, such as a five-minute run, is enough to yield positive results (Silva et al., 2015).

With the obesity rate continuing to skyrocket, physical activity will play a key role in fighting this epidemic. Because children with ADHD are statistically less active than the average U.S. child and are at a heightened risk of obesity, it is especially important to encourage them to meet CDC physical activity guidelines. Children with ADHD are most at risk for obesity if they are not on medication. The most common ADHD drugs are stimulants, which have been known to suppress appetite. These drugs, such as Ritalin (methylphenidate), do not provide lasting benefits; ADHD symptoms return once the child stops taking the medication. The long-term

harms of taking stimulants throughout childhood are not fully known (Kim et al., 2011).

Therefore, there is currently a demand for alternative treatment options. Physical activity does not produce the side effects and potential hazards that medications have been known to. On the contrary, exercise can be a life-long option which not only improves ADHD symptoms but also emotional and physical health (Ratey & Sattelmair, 2009). It should be noted that the participants in the studies cited in the literature review were taking medication for ADHD. But regardless of medication status, the results consistently showed behavioral or cognitive improvements.

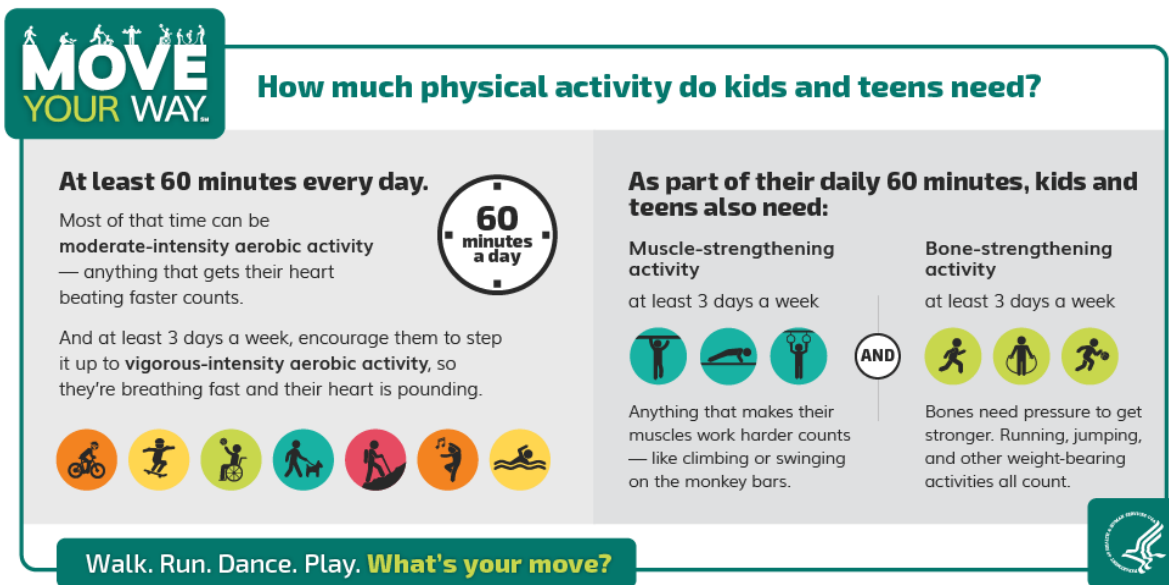
**RQ 2:** *How would an effective physical activity program for children and adolescents with ADHD be structured?*

Though the literature review exhibited that participation in any form of physical activity relieves symptoms of ADHD, none have been deemed "the best". The review by Kamp et al. (2014) included many different types of exercises and active games, including yoga. Yoga was found to be highly effective in reducing symptoms, particularly when prescribed in tandem with medication. This is because yoga synergizes mindfulness and physical activity. Meppelink et al. (2016) defined mindfulness training as "an intervention based on Eastern meditation techniques, that aims to increase awareness by paying attention on purpose in the present moment, enhance non-judgmental observation, and reduce automatic responding". Based on this definition, yoga is quite similar to another physical activity from the Orient, taekwondo, which engages both mind and body. In a study by Kadri et al. (2019), bi-weekly taekwondo sessions yielded promising results in improving behavior and focus among schoolchildren with ADHD. The authors recommend that martial arts should be implemented into physical education programs to treat ADHD and reduce inattentiveness. The mindful component of yoga and martial arts provides a unique advantage over the typical Western forms of physical activity. When practicing yoga or

martial arts, one is honing in on their focus, training their mind rather than just simply burning calories. But unfortunately, this one advantage is not enough to conclude that yoga and martial arts alone would provide students with ADHD with the perfect exercise program.

A proper physical activity program for children and adolescents should also fulfill CDC guidelines. The mindful component of yoga and martial arts make them both great options, but it is also necessary to include a balance of aerobic, bone-strengthening and muscle-strengthening activities, as well as an appropriate volume of moderate/vigorous activity (Centers for Disease Control and Prevention, 2020). Figure 1 below, from the Office of Disease Prevention and Health Promotion (ODPHP) website (2020), explains these recommendations.

Figure 1: *Staying Active While Social Distancing: Questions and Answers.* (health.gov, 2020)



If these guidelines were met in an exercise program for school children with ADHD, it would be more than enough to reduce symptoms. Mulrine et al. (2008) found that merely a 30 minute per day, 3 to 5 day per week program was sufficient to improve behavior and grades in diagnosed

children, and Silva et al. (2015) saw positive results in even shorter interventions. Kamp et al. (2014) reported reduced core symptoms in all interventions reviewed, so any combination of activities that meets CDC guidelines could make for an optimal program. This doesn't necessarily mean that children have to complete their entire daily 60 minutes in one session. Physical activities can be divided into multiple, shorter sessions. Assuming children have the opportunity throughout the school day via stretching/movement breaks in the classroom, physical education class, and/or recess, physical activity requirements can even be met by the time they go home.

But, perhaps the child attends a school district that refuses to implement stretching/movement breaks, does not offer recess, and/or has limited time devoted to physical education. One possible alternative to devoting time in school to physical activity could be one such as the intervention described by Schoenfelder et al. (2017). The use of mHealth products like the Fitbit could allow educators and clinical professionals to measure children's activity habits both during and after school hours. This data could be used to determine whether a child needs to make adjustments to their physical activity program. What is more, the Fitbit incentivizes increased activity with its system of digital achievement badges and by archiving personal records (most steps in a day, calories burnt in a week, etc.). Devices like Fitbits are perfect for children because they add a "video game" aspect to exercise. Children would ideally be excited and motivated to beat their personal best or "level up". Ideally, all public school students in the U.S. would graduate high school with at least a rudimentary understanding of how to structure a fitness regimen. The mHealth products could teach students, particularly older children and adolescents, self-discipline by allowing them to work out on their own time rather than during a set physical education period. The role of the physical education teacher would then elevate to providing

students with fitness skills for life, rather than simply blowing a whistle while the kids play handball.

In summary, regular physical activity is imperative for children and adolescents with ADHD. There is a high degree of flexibility when it comes to prescribing exercise for these schoolchildren. Therefore, it would be optimal to choose a program that involves whichever exercises and/or games that the child prefers, so long as CDC guidelines are met. Logically, the child is most likely to adhere to a program that they enjoy to at least some extent. Exercise should ideally be a recreational activity that one looks forward to. Regardless of the ADHD diagnosis, it is unreasonable to expect any schoolchildren that lack self-discipline to voluntarily continue a program that feels like a chore.

## Chapter 5: Discussion

The purpose of this study was to examine the roots of the ADHD boom, America's obesity epidemic, and whether physical activity can be used to treat children and adolescents with ADHD. ADHD is a relatively new phenomenon in medical history. Clinical research of hyperactive and inattentive children was essentially virtually until the twentieth century, and the current ADHD diagnosis came about in 1987 (Lange et al., 2010). While many leading experts in the field have claimed that brain damage causes hyperactivity (Mayes & Rafalovich, 2007), modern neuroimaging still cannot be used to detect ADHD in the brain (Cortese & Castellanos, 2012). The subjectivity of the ADHD diagnosis raises questions about its legitimacy as a medical disorder, as Peter Conrad discussed in his article *The Discovery of Hyperkinesis* (Conrad, 1975).

As I had been incorrectly diagnosed as a child, I am sympathetic to the notion that ADHD is not a legitimate disorder but a construct of the psychiatric community. And as someone who mostly disliked school, I am even more sympathetic to this argument. But Conrad's view is quite radical, that the misbehavior of hyperactive children should be blamed solely on their environment.

Perhaps we will gain more insight into the etiology of ADHD as research continues. But as of now, we can only determine whether or not a child has the disorder through observed behavior (Cortese & Castellanos, 2012). As I can attest, clinicians are not always correct in their analysis, and many children are erroneously prescribed potentially harmful medications. It is also true that the psychiatric community has medicalized deviance in the past, as exemplified by the diagnosis of "drapedomia" in runaway slaves (Conrad, 1975). Given that medical professionals hold a monopoly on what can be considered a genuine ailment, we should always maintain a healthy skepticism regarding any subjectively-diagnosed disease such as ADHD.

As indicated in the literature review, a correlation exists between obesity and ADHD, particularly among non-medicated children (Kim et al., 2011). Perhaps many of these children have been incorrectly diagnosed with ADHD simply because they are too sedentary and are not expelling excess energy, making it difficult to focus. Then these same kids are forced to sit in a classroom and learn about subjects that they may see as boring and irrelevant (perhaps justifiably so). I do not believe it is a coincidence that school children's hyperactivity became increasingly common in the UK after they passed compulsory school attendance laws (Mayes & Rafalovich, 2007). Despite the presence of physical education programming in the majority of American public schools, our obesity rate continues to soar. The unfortunate reality is that the costs of this epidemic are levied onto the U.S. taxpayer, to the tune of 215 billion dollars annually (Hammond & Levine, 2010). It is in the best interest of every American to address this crisis, and I believe this begins with the youth. More than three quarters of U.S. children and adolescents are failing to meet the CDC's recommended 60 minutes of daily exercise (Centers for Disease Control and Prevention, 2020). We have lost our "belief in the importance of physical soundness which has become a part of Western tradition," as John F. Kennedy would say (Kennedy, 1960).

When I was 18, I worked as a cashier at a grocery store, where I occasionally worked the early morning shift. I used to see the same older man seemingly every time I had that shift, and I wondered to myself, why is he waking up at the crack of dawn to go grocery shopping? He was at least in his 80s, so I assumed he must have been retired and probably had plenty of time to shop later. At that point in my life, I had been going through a difficult time and experiencing some depression. Since then, I have overcome that adversity, mostly thanks to exercising. There is an immediate sense of accomplishment that comes with completing a challenging work-out, and a lingering sense of accomplishment when one sees progress in their strength and/or

physique. I always feel better after a work-out, and my general mood improves when I exercise consistently. The change in mood is because I know; that no matter what else is going on, I have complete control over my fitness and can become better than I was yesterday. Now, when I think back about that older man, I understand why he was such a devoted early-riser. Just as my workouts give my life meaning, so did those morning errands for the older man. This concept is perhaps best encapsulated by the Canadian psychologist Jordan B. Peterson:

Responsibility, that's what gives life meaning. Lift a load, so that then you can tolerate yourself. Because look at yourself; you're useless, easily hurt, easily killed. Why should you have any self-respect? ... Pick something up and carry it. Make it heavy enough so that you can think, 'yea well, useless as I am, at least I can move that from there to there' (Peterson, 2017).

Trivial though it may seem, having that task to conquer gave that older man's day a purpose. As far as I can tell, when John F. Kennedy beckoned America's youth to each become "a participant in the vigorous life," this is what he meant (Kennedy, 1960). For life is to be spent living, not twiddling thumbs waiting for the school bell!



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