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Exercise as Potential Treatment Option for those with ADHD

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Senior Honors Project

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Abstract:

The purpose of this paper is to analyze and assess the need for exercise as a potential long term treatment for those suffering with ADHD. ADHD is difficult to treat long term as stimulant medication gives adverse side effects and psychosocial treatment is difficult to adhere to. This paper analyzed research in the field of exercise and psychology to identify the positive benefits of using exercise as a treatment for those with ADHD. Based on the results of the studies and the analysis of the information at hand, it can be concluded that more research is necessary to definitively prescribe exercise as an ADHD treatment, but studies in the field are promising at showing the positive benefits of exercise on those suffering from ADHD.

Key Words: ADHD, Exercise, Treatment

Introduction:

Attention-deficit/Hyperactivity Disorder (ADHD) is characterized by a pervasive pattern of developmentally inappropriate inattentive, impulsive and hyperactive behaviors that typically begin during the preschool years and often persist into adulthood. The most effective and widely used treatment options for ADHD are medication and behavior modification. These empirically-supported interventions are generally successful in reducing ADHD symptoms, but treatment effects are rarely maintained beyond the active intervention (Halperin & Healey, 2011). With empirical evidence supporting medication and behavior change, it is frequently prescribed but still struggles exist for proper long-term management of ADHD symptoms in individuals. A solution for long term effects can be found by looking at the positive effects in cognitive functioning followed by an exercise bout. With this information in mind and after analyzing current research in the psychology and exercise field, it can be argued that exercise should be part of the treatment plan for individuals affected by ADHD.

ADHD Overview:

Attention-Deficit/Hyperactivity Disorder (ADHD) is a chronic neurodevelopmental disorder affecting approximately 5% of children (American Psychiatric Association, 2013). The disorder conveys a risk for school failure, occupational problems, substance addiction, incarceration and ongoing psychiatric problems in adulthood, despite receiving treatments. Pharmacological treatments can reduce symptoms, but are often unsatisfactory due to side effects, failure to prevent or alter long-term course and discontinuance due to patient and family preferences (Rucklidge et al., 2017). ADHD typically emerges in childhood, and persists throughout adolescence and adulthood. This causes disability throughout life as it makes it difficult for a person to pay attention and control impulsive behaviors. The symptoms of ADHD can be divided into 2 categories: inattention and hyperactivity/impulsivity.

People with ADHD show a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development. To meet diagnostic criteria, individuals must show six or more symptoms of inattention for children up to age 16, or 5 or more for adolescents aged 17 and older. Symptoms must be present for at least 6 months and be inappropriate for their developmental level. Examples of symptoms of inattention include trouble holding attention on tasks or play activities, easily distracted, forgetful in daily activities, loses necessary things for tasks and activity, and difficulty with organization to name a few. (APA, 2013).

Hyperactivity and impulsivity follows the same symptom classification as listed above (six or more symptoms of hyperactivity and impulsivity before age 16 or 5 or more for people over 17). Symptoms of hyperactivity and impulsivity includes, excessive talking, trouble waiting

his/her turn, feeling of restlessness, fidgets or squirms in seat and interrupts or intrudes on others.(APA, 2013).

In addition to the criteria listed above, the following circumstances also need to be met for a DSM 5 classification. Several inattentive or hyperactive-impulsive symptoms were present before age 12, symptoms interfere with daily life, symptoms are apparent in two or more settings, and these symptoms cannot be explained better by another mental disorder (APA, 2013). A thorough psychological evaluation needs to be done by a trained professional to identify the difference between an energetic/distracted individual and someone with ADHD. The difficulty in classifying this disorder can lead to misdiagnosis and over diagnosis by healthcare providers.

The symptoms described above can occur in either a combined presentation, or be predominately inattentive or hyperactive-impulsive presentation. Symptoms can change over time, so the presentation and combination of symptoms also has the ability to change over time. (APA, 2013).An appropriate diagnosis by a healthcare professional is vital to proper control and treatment of the disorder. A common controversy in the field of psychology is the over diagnosis of ADHD. Simply showing signs of inattention and hyperactivity alone do not simply require medication or deem an individual worthy of reaching diagnostic criteria.

The main symptoms of ADHD are inattention, hyperactivity, and impulsivity, which are present in multiple settings and affect social, educational, and work performance throughout an individual's lifetime. (Neudecker et al., 2015). Neudecker et al., 2015 note that based on the specific symptoms, the American Psychiatric Association distinguishes between three different presentations of ADHD: the predominantly inattentive presentation (ADHD-I), the predominantly hyperactive/impulsive presentation (ADHD-H/I), and the combined presentation

(ADHD-C; American Psychiatric Association, 2013). Identifying symptom presentation helps healthcare providers create a better treatment plan focused towards the individual and their weaknesses and/or struggles.

Comorbidities of ADHD:

Like many mental health disorders, comorbidities exist with ADHD. When looking specifically at children and adolescents, a Danish study of 14,825 children and adolescents (aged 4–17 years) found that 52% of the study population had at least one comorbid psychiatric disorder, and 26.2% had two or more comorbid disorders (Jensen & Steinhausen, 2015). The researchers had a large sample size and their evidence clearly shows how common it is for children to have comorbid disorders if they have ADHD. The most frequently reported comorbid conditions the study found included: conduct disorders (16.5%), specific developmental disorders of language, learning and motor skills (15.4%), autism spectrum disorder (12.4%), and intellectual disability (7.9%). (Jensen & Steinhausen, 2015).

When looking at research done on adult populations, the research findings were similar in the fact that comorbid disorders continue to exist in adults with ADHD. The National Comorbidity Survey Replication of US adults (aged 18–44 years) identified 3199 cases of adult ADHD using a two-part diagnostic interview (Kessler et al., 2006). In this study, the most common comorbid disorders associated with ADHD included: bipolar disorder, social phobia, specific phobia, intermittent explosive disorder, generalized anxiety disorder, substance use disorder (alcohol/drugs) and major depressive disorder (Kessler et al., 2006). Throughout an individual's lifespan with ADHD, the chances of them also having another coexisting mental/mood disorder is high and should be noted when creating an individualized treatment plan.

Differences in Males and Females with ADHD:

ADHD is more common in males than females. Independent, long-term longitudinal case-controlled studies have assessed psychiatric outcomes in groups of male and female patients with ADHD. By one particular research team, in total, 110 boys with ADHD were followed-up after a 10-year study period (Biderman et al., 2006), and 140 girls with ADHD were followed-up after 11-years (Biderman et al., 2010). In both studies, males and females had high lifetime risk for comorbid antisocial, addictive, mood and anxiety disorders compared with controls. While both had disorders with some overlap, there were some comorbid condition differences between the male and female subjects.

The researchers found that for males with ADHD, the lifetime prevalence for all categories of psychopathology was significantly higher than control subjects. The major comorbid disorders found in males with ADHD included, major psychopathology (mood disorders and psychosis), anxiety disorders, antisocial disorders (conduct, oppositional-defiant and antisocial personality disorder), developmental disorders (elimination, language and tics disorder), and substance dependence disorders (alcohol, drug and nicotine dependence) (Biderman et al., 2006).

Similar to males, females with ADHD also had higher lifetime prevalence in all categories of psychopathology compared to female control subjects. The major comorbid disorders found in females with ADHD included antisocial disorders, mood disorders, anxiety disorders, developmental disorders, addictive disorders and eating disorders (Biderman et al., 2010). The only major difference between male and female comorbid disorders in this specific

study was showing that females may suffer from an eating disorder while males did not find that to be a common comorbid issue.

Typical ADHD Treatment:

With all of the above information in mind about ADHD itself, it is easy to see that treating the disorder is no simple task. The variability of treatment and concerns about overuse of stimulants has led to the writing of practice parameters, clinical guidelines, and evidence based briefings to support clinicians in achieving the best route of care in prescribing stimulants to treat ADHD (Zwi et al, 2000). Prescribing medication and over diagnosis has been a source of controversy in the treatment of ADHD. Side effects of stimulants include, mood swings and in high doses, psychosis or mania (Ross, 2006). Other side effects of stimulants include insomnia, irritability, proneness to crying, anxiousness, depression, and nightmares (Efron et. al, 1997). These side effects vary across individuals and dosages, but are fairly common amongst individuals taking it. The controversy for ADHD treatment also lies in the idea of prescribing this medication to children and the side effects they may endure.

In addition to medication/stimulants, psychosocial treatment is a critical part of treatment for attention-deficit/hyperactivity disorder (ADHD) in children and adolescents. The scientific community can agree that behaviorally oriented psychosocial treatments—also called behavior therapy or behavior modification—and stimulant medication have a solid base of scientific evidence demonstrating their effectiveness. Behavior modification is the only nonmedical treatment for ADHD with a large scientific evidence base. Treating ADHD in children with behavior modification, parents, teachers and children learn specific techniques and skills from a therapist, or an educator experienced in the approach, that will help improve children's behavior. Parents and teachers then use the skills in their daily interactions with their children with ADHD,

resulting in improvement in the children's functioning in the key areas noted above. In addition, the children with ADHD use the skills they learn in their interactions with other children.

(National Resource Center on ADHD, 2017).

ADHD is one of the leading childhood psychiatric disorders in America, and this disability has symptoms that persist into adulthood and cause impairment in school, the work force, and daily life. Treatment and medication to treat ADHD over the lifespan of the disorder can become very expensive and time consuming. Once treatment and intervention ends, the results are not usually sustained; creating the need for a long term solution for ADHD treatment.

Exercise Overview:

According to the American College of Sport Science (ACSM) guidelines, 2016, physical activity (PA) and exercise are often used interchangeably, but these terms are not synonymous. Physical activity is defined as any bodily movement produced by the contraction of skeletal muscles that results in a substantial increase in caloric requirements over resting energy expenditure. But ACSM defines exercise as a type of physical activity consisting of a planned, structured, and repetitive bodily movement done to improve and/or maintain one or more components of physical fitness. So overall, all exercise consists of physical activity, but not all physical activity constitutes as exercise. Exercise needs to be planned and structured with intent of improving health or fitness goals. ACSM guidelines for 2016, breaks the components of an individual's physical fitness into health-related and skill-related physical fitness components. Health-related physical fitness components involve cardiorespiratory endurance, body composition, muscular strength, muscular endurance and flexibility while skill-related physical fitness components include agility, coordination, balance, power, reaction time and speed.

For the focus of this paper and research on cognitive benefits of exercise, cardiorespiratory fitness is used. ACSM guidelines 2016 defines cardiorespiratory endurance as the ability of the circulatory and respiratory system to supply oxygen during sustained physical activity. Such activities include but are not limited to, walking, running, swimming, biking, and elliptical/stairclimbing, etc. Cardiorespiratory exercises can be classified as light, moderate, or vigorous based on effort and calories burned while exercising.

Besides better overall health and reduced risk of disease, exercise has many other benefits. Other benefits of exercise described in ACSM guidelines 2016 include decreased anxiety and depression, improved cognitive function, enhanced physical function and independent living in older individuals, enhanced feelings of well-being, enhanced performance of work, recreational, and sport activities, reduced risk of falls and injuries from falls in older individuals, prevention or mitigation of functional limitations in older adults, and effective therapy for many older adults. These “other benefits” are in addition to benefits in the categories of improved cardiovascular and respiratory function, reduction in cardiovascular disease risk factors and decreased morbidity and mortality. These guidelines set and the research gathered to make fitness guidelines give all the evidence necessary to prove that exercise is medicine and a functional tool and treatment plan for many diseases. With this knowledge in mind, with benefits such as improved cognitive function, decreased anxiety and depression, enhanced feelings of well-being and enhanced performance of work, recreational, and sport activities, why would these benefits not be applicable to people suffering from ADHD?

Exercise Guidelines for Children:

Exercise guidelines for children and adolescents differ and need to be taken into account by healthcare providers when making an exercise prescription for this specific population.

Looking specifically at guidelines for aerobic/cardiorespiratory training, ACSM 2016 states that children and adolescents should get daily aerobic exercise. In addition, most exercise should be moderate (noticeable increase in heart rate and breathing) to vigorous intensity (substantial increase in HR and breathing). Vigorous intensity should occur at least 3 days a week. ACSM guidelines 2016 also states that exercise should occur greater than or equal to 60 minutes a day and consists of enjoyable developmentally appropriate activities including, running, brisk walking, swimming, dancing, bicycling, and sports such as soccer, basketball, or tennis. These guidelines differ from the adult, older adult and diseased population recommendations and are tailored for the specific age group at hand.

ACSM guidelines 2016 note special considerations that need to be taken into account when working with this population. “The special considerations are as follows:

- Children and adolescents may safely participate in strength training activities provided they receive proper instruction and supervision. Generally, adult’s guidelines for resistance training may be applied.
- Because of immature thermoregulatory systems, youth should avoid sustained, heavy exercise in exceptionally hot humid environments, be properly hydrated, and appropriately modify activities.

- Children and adolescents who are overweight or physically inactive may not be able to achieve the 60 minutes per day guidelines to achieve moderate-to-vigorous intensity physical activity. These individuals should start out with moderate intensity physical activity as tolerated and gradually increase the frequency and time of PA to achieve the 60 minute a day goal. Vigorous intensity physical activity can then be gradually added at least 3 days per week.

- Children and adolescents with disease or disabilities such as asthma, diabetes mellitus, obesity, cystic fibrosis, and cerebral palsy should have their exercise prescription tailored to their condition, symptoms and physical fitness level.

- Efforts should be made to decrease sedentary activities (i.e., television watching, Web surfing, and playing video games) and increase activities that promote lifelong activity and fitness (i.e., walking and cycling).”

*Quotations above taken from ACSM’s Guidelines for Exercise Testing and Prescription, 2016 (10th edition). Pages 183-184.

Exercise Guidelines for Adults:

In healthy adults, the guidelines for exercise are broken down by exercise type. For cardiorespiratory endurance (the focus of exercise treatment for the majority of the ADHD and exercise research) ACSM guidelines, 2016 state that moderate intensity aerobic exercise should be done at least 5 days a week or vigorous intensity aerobic exercise done at least 3 days a week, or a weekly combination of 3-5 days a week of moderate and vigorous intensity exercise is recommended for most adults to achieve and maintain health/fitness benefits (ACSM Guidelines, 2016). It is recommended that most adults should accumulate 30-60 minutes a day (150 minutes a week) of moderate intensity exercise 20-60 minutes a day (75 minutes a week) of vigorous intensity exercise or a combination of the two. This recommended exercise time may be

accumulated in one continuous session or in 10 minute (or greater) exercise bouts (ACSM Guidelines, 2016). Exercises to meet this guidelines include (but are not limited to) walking, running, cycling, swimming, dancing, sports etc. If the exercise meets the criteria for being aerobic and involving large muscle groups, then it can be considered to help improve health and cardiorespiratory fitness.

ACSM guidelines 2016 recommend that resistance training of each major muscle group should occur 2-3 days per week with at least forty-eight hours separating the training sessions occurring in the same muscle group. Many types of resistance training equipment can effectively be used to improve muscular fitness. Multi-joint and single-joint exercises are recommended (ACSM Guidelines, 2016). Further research in resistance training and its effects of people with ADHD needs to be done.

In a study discussed later in this paper, yoga was proposed as a potential treatment option for people with ADHD. With this specific type of exercise in mind, the exercise guidelines for flexibility and neuromotor exercises are as follows: Flexibility exercises should be done 2-3 days per week, with daily being the most effective. A stretch should be held for 10-30 seconds and held to the point of tightness or slight discomfort (no pain). Different stretching techniques can be used to achieve this goal (ACSM Guidelines, 2016). The recommendations for neuromotor exercises are 2-3 days per week, with 20-30 minutes per day being ideal .Neuromotor exercises include exercises such as yoga or tai chi, or any exercise involving motor skills such as balance, agility or coordination (ACSM Guidelines, 2016). I list these guidelines to demonstrate that neuromotor and flexibility exercises can be done daily to show positive benefits and are recommended for an individual to meet their exercise goals.

In any exercise session for a healthy individual, a warm up and cool down before and after exercise is necessary. When making an exercise prescription, individual health needs to be taken into account. The above are the guidelines for cardiorespiratory endurance in healthy individuals.

Contraindications of exercise:

When initiating a new exercise program, exercise recommendations should be given in conjunction with other health maintenance advice such as smoking cessation, weight loss, and moderation of alcohol use (Metkus et al, 2010). When creating a new exercise plan for an ADHD patient, other contraindications and health history factors need to be taken into account. Major signs and symptoms suggestive of cardiovascular, metabolic, or renal disease that need to be monitored during exercise include, pain; discomfort (or other anginal equivalent) in the chest, neck, jaw, arms, or other areas that may result from myocardial ischemia, shortness of breath at rest or with mild exertion, dizziness or syncope, orthopnea or paroxysmal nocturnal dyspnea, ankle edema, palpitations or tachycardia, intermittent claudication, known heart murmur, and/or unusual fatigue or shortness of breath with usual activities (ACSM Guidelines, 2016).

Appropriate sign and symptom interpretation during exercise screens for potential disease and monitors the safety of the subject exercising.

Known disease status (metabolic, cardiovascular or renal disease) yields the need for medical clearance from a physician before beginning an exercise program. When working with healthy populations, regular exercise assessment needs to be taken into account, but medical clearance is not necessary. Guidelines and exercise prescriptions exist for diseased populations, showing that even in unhealthy populations, exercise is necessary in improving health. When analyzing contraindications of exercise, it is noted that in general, the benefits of appropriate

exercise outweigh the risk, making it a major component of individual health. Physical activity continues to take on an increasingly important role in the prevention and treatment of multiple chronic diseases, health conditions, and their associated risk factors (ACSM Guidelines, 2016).

ADHD and Exercise: The Research

ADHD treatment requires research to find a long term solution with limited side effects in individuals. In recent years, exercise has been theorized to provide positive effects in executive functioning and cognitive functioning. Below is research outlining and supporting research done in the field of ADHD and exercise. While thinking of this information, it can be argued that exercise should be a part of, if not at least mentioned, by medical professionals in ADHD treatment.

Exercise is hypothesized to be an effective additional therapeutic option because of its positive effects on cognition in general and, in particular, on the neurobiological pathologies associated with ADHD. Acute and chronic effects on brain structure and activity, neurotransmitter and neurotrophic levels, neuroendocrinology, angiogenesis, and cerebral blood flow are possible neurobiological mediators of health effects of exercise (Neudeckar et al., 2015). Neurobiological research has already proven the effects on brain changes during exercise and in the case of ADHD, increasing levels of serotonin, dopamine, and norepinephrine within the front striatal lobes of the brain were highlighted when discussing the effects on this neurodevelopmental disorder (Neudeckar et al., 2015).

Because positive, especially acute, effects of aerobic running or cycling exercises on cognition in children with ADHD have been reported by several studies, endurance training should be part of ADHD and exercise treatment programs. In addition to the direct effects on executive function and attention, improvements in aerobic fitness lead to further physiologic

health benefits, which are particularly important because obesity is a common problem in children with ADHD (Cortese et al., 2008). Compared with simple running or cycling exercises, sport-specific training (for instance, ball games) offers the opportunity of improving physical fitness in combination with social behavior and sports skills. Another positive effect of the latter might be the facilitated integration of children and adolescents with ADHD into physical education and sport clubs in non-therapeutic settings. Moreover, improvements in the sports context, such as rule adherence and cooperation, may positively influence behavior in daily life (Neudecker et al., 2015). Especially when working with children, early exercise intervention as a part of ADHD treatment program can lead to positive future benefits as they adhere to positive lifestyle changes throughout life.

Exercise has been proven to show a positive correlation in multiple aspects of overall health. Improved quality of life, decreased risk for disease, and improved mood and mental functioning have been studied to show the benefits of exercise. While knowing the idea that “exercise is medicine” we can apply this further information to mental disorders. Mental disorders are of major public health significance. It has been claimed that vigorous physical activity has positive effects on mental health in both clinical and nonclinical populations. (Taylor et. al, 1985). This knowledge can be further divided into the effects of exercise on specific mental disorders. Evidence looking at mental health benefits on mental disorders correlated with exercise have been shown to improve self-image, social skills, reduce anxiety, and cognitive functioning.

Moderate intensity exercise has been shown to improve behavioral, neurocognitive, and scholastic performance in children with ADHD. In a study conducted by Pontifex et al. in 2012, children in control groups and experimental groups showed greater response accuracy and

stimulus-related processing after a 20 minute moderate intensity exercise bout. In addition, both groups showed greater performance in reading and arithmetic following exercise. The ADHD group specifically also exhibited selective enhancements in regulatory processes and could remain seated for quiet reading longer. The research team aimed to learn about the effect of single moderate intensity aerobic exercise bouts on preadolescents children with ADHD. They used objective measures of attention, brain neurophysiology and academic performance (Pontifex et al., 2012). This study specifically demonstrated the fact that exercise improves cognitive functioning in those with and without ADHD. With this in mind, we can safely assume that supervised, appropriate exercise prescription can show positive benefits in treating symptoms of ADHD in short term. These findings also indicate that single bouts of moderately intense aerobic exercise may have positive implications for aspects of neurocognitive function and inhibitory control in children with ADHD.

Chuang et al. reported similar findings in children with ADHD during a study they conducted in 2015. This research team analyzed the impact of acute aerobic exercise on response preparation in a go/no go task in children with ADHD. The researchers tested this under the hypothesis that acute exercise may exert similar impacts as that of medication on inhibitory control in individuals with ADHD. With this in mind, the researchers recruited 19 children with ADHD between the ages of 8-12 to participate in the study. The experimental sessions alternated between watching videos or moderate intensity exercise before completing stop/go task on the computer. The task consisted of hitting a button for one shape that appeared on the screen, and to withhold when a different shape flashed on the screen. Using this test requires inhibition in children with ADHD to hold their response to particular questions. At the end of their study, the research team found evidence to support the effect of acute exercise on the attentional and

preparatory processes in their task that required inhibition. This evidence shows how exercise can improve performance in specific instances short term (Chuang et al., 2015).

In 2015, Piepmeier et al., confirmed the findings of positive cognitive benefits after acute exercise in children as found by Chang and Pontifex et al. This study analyzed 32 adolescent teens with and without ADHD. Children with and without ADHD were asked to perform cognitive tasks on 2 days following treatment conditions that were assigned in a random, counterbalanced order. The treatment conditions consisted of a 30-min control condition on 1 day and a moderate intensity exercise condition on the other day. Their results found that exercise significantly benefited performance on all three conditions of the Stroop Task, but did not significantly affect performance on the Tower of London or the Trail Making Test and children with and without ADHD realize benefits in speed of processing and inhibitory control in response to a session of acute exercise, but do not experience benefits in planning or set shifting. (Piepmeier et al, 2015).

The studies described previously demonstrate the positive effects children see short term in cognitive performance after aerobic exercise. These positive benefits are overlooked as healthcare providers quickly look to medicate or prescribe treatment when exercise can be beneficial. Especially in children, including physical activity as part of their daily routine or during specific instances (i.e. exercise break/recess before a test) can improve academic performance and cognitive functioning short term. Exercise in addition to other interventions can result in positive benefits for ADHD symptom management.

The positive benefits of ADHD and exercise have been proven in children and demonstrate the need for exercise as a prescription and form of supplemental treatment for the disease. But does the same benefits apply to adolescents and adults? Gapin et al. in 2015

performed a preliminary study on the effects of exercise on college students with ADHD. There has yet to be a clearly established relationship between the two; but studies are currently aimed to identify and give empirical evidence to the correlation between the two. The researchers had a group of ADHD and control subjects that performed the Stroop Test, Trail Making Test, and Digit Span test prior to and after an acute exercise intervention. At the end of the test, the results showed that the subjects with and without ADHD had improved executive functions and subjects with ADHD additionally had improved inhibitory performance. The researchers concluded that these results provide preliminary evidence for exercise as a potential adjunct treatment for benefiting inhibition in college students with ADHD (Gapin et al. 2015).

In a study performed by Fritz and O' Connor (2016), the two researchers analyzed the acute exercise effects on adult men with ADHD. Their participants were men between the ages of 18 and 33. Their experiment wanted to determine the effects of a single moderate-intensity leg cycling exercise bout and the measured effects afterward on attention, hyperactivity, mood and motivation. The results of their study found that in young men reporting elevated symptoms of ADHD, a 20-min bout of moderate-intensity cycle exercise transiently enhances motivation for cognitive tasks, increases feelings of energy, and reduces feelings of confusion, fatigue, and depression, but this has no effect on the behavioral measures of attention or hyperactivity used (Frtiz & O'Connor, 2016). Their small sample size and limited assessments may explain future use for analyzing symptom effects after exercise. Even with no statistically significant changes in symptom management, the research team still showed the positive benefits of exercise on mental health.

The literature on the effects of physical exercise in adults with ADHD remains relatively scarce. In the available studies, beneficial effects (of medium size) of both active (leisure time

sports activities with a strong aerobic component) and passive physical activity (WBV) were described to be related to improved cognitive and behavioral functions including attention, inhibition, motivation and impulsivity. Not all assessed functions improved and the duration of the effects of passive physical remains to be elucidated, but the fact that positive findings were shown in these studies is promising when considering physical exercise interventions for adults with ADHD (Heijer et al., 2015). More research needs to be done on ADHD and exercise effects on adults, but this topic is of particular interest and I predict future studies will exist on this particular area.

While many studies (such as the ones discussed above) focus on aerobic exercise, yoga has been a popular alternative solution to improve one's ability to focus and concentrate. Yoga is a popular exercise trend used for stress reduction, improved focus, meditation and core strength in addition to other positive physical benefits from performing the exercise itself. Yoga requires long periods of concentration and that is why it has been hypothesized to reduce attention deficits in people suffering from ADHD. In recent years, meditation has become increasingly popular as a treatment for psychological conditions. There is emerging evidence from randomized trials to support popular beliefs concerning beneficial effects of yoga in the treatment of neuropsychiatric disorders such as depression, sleep disorders, and ADHD (Lange et al., 2014).

In recent years, meditation has become increasingly popular as a treatment for psychological conditions. The long periods of concentration required by yoga are thought to potentially help reduce attention deficits. In addition, yoga may produce a state of calmness and contentment which is lacking in patients with ADHD (Lange et al., 2014). To further investigate the idea of yoga in benefitting children with ADHD, Jensen and Kenny (2004) conducted a study

to test this hypothesis. The two researchers took a small sample of boys diagnosed with ADHD and divided them into two groups. One group was assigned to a 20 session yoga group and the other was a control. The boys were assessed before and after each session with multiple attention and cognitive tests. The researchers used a very small sample (20 subject's total) but they found that the ADHD subjects that also did yoga at home showed greater improvements in multiple tests. The data does not show strong support for the use of yoga for ADHD due to the small sample size and only have boys in the sample. Further research needs to be done to draw conclusive results to prescribe yoga as a potential treatment for ADHD.

Yoga and aerobic exercise dominate the studies on different exercise treatment options for individuals with ADHD. Interesting research ideas would be to look at the effects of resistance training and long term benefits of exercise on symptoms compared to acute effects. Based on the information and current research on the study, we know that exercise has positive benefits on physical and mental health (making it a generally safe and viable treatment option) and it benefits hyperactivity and inattention symptoms in people with ADHD. Future research in the topic of exercise and ADHD has many different topics/ modes of assessment available to further identify effects of specific exercise on ADHD and symptom alleviation.

Multiple studies have looked at the benefits of exercise over periods of time. Joyce et al. 2009, analyzed the time course effect on exercise intensity and response execution and inhibition. A major topic in this field is how long do these positive effects happen after exercise has occurred? Joyce et al. (2009) found positive benefits on response execution and inhibition for up to 52 minutes after exercise cessation. Long term benefits of exercise on ADHD symptoms management still need research but this specific study shows that an individual can exhibit cognitive benefits almost an hour after exercise cessation.

More research needs to be done in the topic of long term cognitive effects after exercise. Current studies have found and analyzed the positive benefits of acute exercise performance on cognitive tasks. Knowing these benefits is helpful in understanding appropriate treatment and benefits of performing exercise short term. When working with children, this research can be used to better classroom performance. Knowing these positive benefits, this knowledge can be applied by having kids exercise (aka an active recess or gym class) before a test or quiet time in a classroom, their inhibition will be lower and hyperactivity. The same basic principle can be applied across age groups knowing that exercise can give short term benefits before major times of stress and times that require quiet and more focus. Knowing these benefits and consistently applying them across an individual's treatment plan can help better their overall symptoms and adherence to treatment.

Exercise as ADHD Treatment:

How well will parents and individuals react to different treatment alternatives? A study done by Corkum et al. in 1999 analyzed the opinion of parents towards different ADHD treatments. By having parents of children with ADHD fill out an ADHD knowledge and opinion scale, the participants were treated and adhered to a 12 month experimental trial (medication or placebo) and parent group (training or support). If the families and children adhered to the trial for 12 months, they completed another survey the results of this study found that parents would rather adhere to non pharmacological treatments. Thinking practically, it makes sense that parents would rather not medicate their children for mental disorders if they don't have to. Based on stigmas around mental health and controversy about medicating children, parents would prefer not to medicate their school aged children. This further argues that parents and children may adhere to an exercise prescription for symptom management because of this research study.

Finding appropriate treatments that people will adhere to is vital to finding the best care of treatment for the population suffering from this disorder.

Long term outcome for children with ADHD appears to be correlated with the length of adherence to treatment; however, many families do not enroll or adhere to recommended treatments for the entire duration (Corkum et al. 1999). When thinking about ADHD treatment, one main problem is getting children, adolescents, adults and parents to adhere to treatment plans. Socioeconomic status, family stress, knowledge of ADHD and parenting styles can all be hypothesized reasons for lack of adherence to treatment but there is no evidence available to conclusively explain why some families adhere to treatment and others do not. A study conducted by Corkum et al. (1999), evaluated the correlation between parent's knowledge of ADHD and their opinions on treatment options. One major finding of their study was that parents of ADHD children provided more favorable ratings for nonpharmacological interventions compared with pharmacological interventions. One can argue that the research study in discussion is dated, but the logic that families prefer to avoid medication for children can still be argued and validated today. Corkum et al. 1999 also found that higher knowledge of ADHD was associated with more favorable opinions of non-pharmacological interventions but not pharmacological interventions.

With this knowledge of preferred treatment and opinions by parents, we can argue that parents would prefer their children to find alternative ADHD treatments such as exercise, to help their children. By educating, finding evidence, and demonstrating the positive benefits of exercise on ADHD symptoms, adherence to treatment plans may be greater and more beneficial long term. Long term solutions and adhering to treatment is difficult for many factors (time

consuming, expensive, draining etc.) but showing results and incorporating healthy solutions into a lifestyle change may prove to be a more adhered to- long term solution for ADHD.

In a 2014 study done by Jennifer Gapa and Jennifer Etnier, their findings suggested that that most parents (85%) reported that physical activity (PA) provided benefits beyond the benefits provided by the medications alone. With this in mind, their findings support arguments that PA may be a viable strategy for reducing symptom severity. An addition point of interest in this study is that chronic exercise in addition to medication results in positive changes in a result of symptoms.

Conclusions:

With current research in mind about the proven effects of exercise on cognitive performance, it can easily be asked why is exercise not a regular part of ADHD treatment? In current treatment plans, health care providers have yet to acknowledge the importance of prescribing exercise to patients with ADHD. Based on the research stated within this paper, and the known positive benefits of exercise on physical and mental health, it can be argued that exercise should be regularly prescribed as a part of treatment plans. In supervised settings with no contraindications, exercise can be safe and beneficial to patients of all ages.

The current status of the American health care system revolves around the idea of giving everyone a “quick fix”. Instead of recommending lifestyle changes that take a lot of time and effort to make a positive effect on health, people prefer a prescription for medicine that begin working immediately. Changing the healthcare system from an organization that gives individuals quick fixes to their problems to an organization that tries to create long term changes is no easy task. But, long-term solutions benefit individual health and outcomes more than short term solutions ever will.

In order to better treat mental health problems, health professionals need to involve more aspects of treatment. While research cannot prove that we can completely get rid of other treatments like medication and interventions, but we know that exercise has positive benefits and can be applied in combination. The mindset of health professionals needs to change with the idea that exercise is medicine. The research and mindset that long term treatments not involving medicine and continual treatment can be used will benefit healthcare professionals in many ways. Parents, children and adults will be more likely to adhere to a treatment plan that involves healthy lifestyle changes. Exercise can prove beneficial in all aspects of health and help with comorbidities in people with ADHD.

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