Attention Deficit Hyperactivity Disorder (ADHD) and Sports – What Causes ADHD and How does Sport Help deal with it?

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Abstract

Background: Attention Deficit Hyperactivity Disorder (ADHD) is a complex multidimensional syndrome where it results in restlessness, hyperactivity, and inattention. The purpose of this analysis was intended towards determining the scientific causes that result in ADHD and examine its various ways of inheritance and factors. Certain diet and hereditary factors have also been identified that trigger ADHD where the intake of protein in the diet of an athlete increases the neurotransmitters in the brain which reduces the symptoms of ADHD. Along with this, the cerebellum region of the brain is responsible for generating hereditary abnormalities which cause ADHD.

Methods: To witness how practising sports, assist in subsiding the symptoms of ADHD, the methodology of systematic literature reviews were conducted which involved numerous facts that supported the hypothesis. It also involved a detailed study of the infamous American competitive swimmer Michael Fred Phelps and his past experiences related to ADHD provided an insight into the importance of sports to a person with this syndrome.

Conclusion: The results suggested that participating in sports builds a kind of neurotransmitter called norepinephrine which is derived from dopamine, the lack of which results in ADHD. There are also a few behavioural therapies that can be practised that minimize the symptoms in the children.

Keywords: ADHD, Dopamine, Neurotransmitter, Norepinephrine, Sports

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1. Introduction:

ADHD (Attention Deficit Hyperactivity Disorder) a type of mental disorder in which a person suffers from a lack of attention towards routine activities, especially the ones that are long or difficult to focus on. In ADHD, the person is often excessively active and faces problems in controlling their emotions. This disease occurs due to a deficiency of a specific neurotransmitter called norepinephrine. The tiny molecule dopa is the basic building block of all neurotransmitters which is converted into dopamine, which, in turn, is converted into norepinephrine (3). Attention-Deficit Hyperactivity Disorder is a kind of syndrome which creates a network of multiple dimensions which are responsible for the occurrence of this disease. It is characterized by its diagnosis, causes, biological traits, and effects on individuals and society. There is a peculiar framework behind the occurrence of this mental condition. This framework is arranged according to an organized system including the nosology (a branch of medical science dealing with the classification of diseases), biology, psychology, and evolutionary pressures that cause ADHD (1). Vaidya’s suggested that brain maturation is delayed by a few years in ADHD. There are three subtypes of ADHD: combined type, predominantly inattentive type, and predominantly hyperactive-impulsive type (4). Combined type generally includes both inattention and impulsivity whereas predominantly inattentive is wholly categorized by problems regulating attention and predominantly hyperactive is wholly categorized by impulsive and hyperactive behaviour. Attention-Deficit/Hyperactivity Disorder may also be hereditary. Symptoms of ADHD are often found in kids and adolescents and usually become more obvious from age 7 to 9 but can sometimes
appear as late as age 13 to 15\(^{(7)}\). One or two symptoms of ADHD in children are not unusual so it is important to know the difference between ADHD and normal inattention or high energy in children. For a child to be diagnosed with ADHD, the symptoms must cause a problem for the child at home, play and school and must be excessive, persistent, or pervasive. These symptoms also affect several other areas of a person’s mental well-being such as difficulty attending school, excessive exhaustion and the urge to sleep more than the required hours, getting irritated easily, feeling different from others and having less confidence in general. Many adolescents also indicate feelings of extreme uneasiness and insecurity when being untruthful to and protest submitting to coercion\(^{(21)}\). The symptoms become excessive when a child experiences it very frequently as compared to other children of the same age. They become persistent when it continues for many months and they become pervasive when they occur in several different settings such as at school, at home, and after-school activities.

After observation for many years, it has been concluded that an active sportsperson carries an increased level of attention span while performing mundane tasks and other activities that require a decent amount of concentration like academics. Recent studies have shown that sportspersons are often being diagnosed with a mental condition known as ADHD and it is becoming increasingly common among sportspersons around the world. Unlike a normal person, a sportsperson tends to indulge in multiple activities throughout the day. For instance, a teenager who participates in physical activity or plays a sport has a responsibility to both train for the tournaments as well as study for their academics. As the number of activities increases on an average, the chances of an athlete suffering from ADHD also increases since ADHD is categorized under neurodevelopmental disorder where it is characterized by difficulty paying attention and excessive activity. This study is particularly targeted towards identifying the causes of ADHD in them at an early stage and determining how sports help with ADHD so that it can be managed as soon as possible with limited medication.

**Factors triggering symptoms of ADHD and ways of inheritance**

There are certain diet factors which affect the symptoms of ADHD to some extent. The diet of an athlete should consist of balanced meals including an adequate amount of protein, carbohydrates, fats, vitamins, and minerals. The same applies to maintain ADHD symptoms under control too. Meals that are rich in protein helps the body to make neurotransmitters which are chemicals released by the brain cells to communicate with each other. These include beans, fish, eggs, nuts, and low-fat dairy products\(^{(10)}\). The body generates brain-awakening neurotransmitters after consuming protein so it should be eaten as a part of breakfast. This will ensure in controlling the symptoms within a child along with indulging in sports and other physical activities. On the other hand, foods which contain high sugar levels and preservatives should be avoided to control ADHD symptoms. A survey conducted by Faber Taylor and Kuo\(^{(19)}\) indicates that the children who practice sports regularly in a natural green arena show milder symptoms of ADHD compared to children who play in man-made play settings whether it is indoor or outdoor. This suggests that along with the practice of regular physical activity, the environment also plays a significant role in the reduction of symptoms in children. These children reportedly indicated lesser hyperactivity, inattention and restlessness and were able to practice the suitable sport more efficiently. Additionally, hereditary factors play a bigger role in resulting ADHD in children as compared to any other factors. There is a high level of phenotypical heterogeneity among people with ADHD. Phenotypic heterogeneity takes place when different mutations occur in the same gene which results in notably different phenotypes\(^{(11)}\). Apart from this, studies in children with ADHD have indicated abnormalities in the frontal striatal system, temporal lobes, and cerebellar volume. Unaffected children or the ones possessing one or two minor symptoms of ADHD show some cerebral abnormalities, but not the cerebellar abnormalities. This indicates that the cerebellum is more responsible for generating hereditary abnormalities which result in ADHD. Another cause of concern which triggers symptoms of ADHD in a child is the lack of homovanillic acid, a
byproduct of dopamine which gets generated during the excretion process. There are four ways of inheritance of ADHD: genetic, epigenetic, behavioural, and cultural. Inhibitory control is an essential component of the psychological aspects associated with ADHD. Inhibitory control is a cognitive process that permits a person to restrain their habitual behaviours or impulses and instead choose a more sensible behaviour to solve accept, assess, and solve the situation at hand in a logical manner. Children with ADHD who are older, poorer or fall into the overweight category are influenced by age, environmental and diet factors respectively and are subjected to increased risk of a lower standard in movement behaviour.

2. Material & methods:

To generate facts about the involvement of sports in channelizing the symptoms of ADHD towards the right direction and in a more productive manner, a method of systematic literature review has been conducted to discuss, analyze and evaluate the experiences of a person diagnosed with ADHD. ADHD is a type of mental condition which gradually indicates any signs of improvement in the behavioural patterns of an individual and the processes involved in treating such individuals need to be very specific that will help in developing the mental stability in a subtle but continual manner. Sports, in general, provides a deep understanding of how it affects the mind of an individual while he is practising any kind of physical activity. Lufi and Parish-Plass conducted a comparative study of children diagnosed with ADHD and children having other problems with behavioural patterns and mental stability. After the children of both categories participated in a sport session that occurred once every week in a year, there was a significant change in their emotional well-being which resulted in the reduction of anxiety. Restlessness and dominance are a natural factor that comes into play while training sessions but with constant skill improvement this instinct can be used to encourage positive energy for a social setting. Although stimulant medications can well control the symptoms in an ADHD patient, sports and physical activity has also proved to be an alternative treatment of ADHD which is less harmful in terms of lack of intake of pharmaceutical products.

In sports, the symptoms of ADHD in adolescents can be identified through gameplays, behaviour during interaction of the sportspersons with each other and life of the sportsperson outside sports. Sports Behavior Checklist (SBC) examined the differences between sportspersons with and without ADHD. Results from the study conducted by SBC showed that participants with ADHD showed higher levels of aggression, emotional reactivity, and disqualification than did their non-ADHD peers. Many sportspersons are diagnosed with ADHD because many young people with ADHD are drawn to sports, or encouraged to participate, to manage ADHD symptoms. Indulgence in sports can bring many positive changes in a child suffering from ADHD. Any athletic skill, sport, or physical activity that a child enjoys practising can become a competency level that helps in building his self-confidence and motivates him to face and overcome the challenges associated with ADHD and its diagnosis. When a person suffering from ADHD engages himself in a sport like surfing, gymnastics, ballet or karate, it gives him the sense to control the risk that comes with the sport and increases his ability to maintain his focus and concentrate well on other areas of life. Participating in more and more sport activities increases neurotransmitters in the brain of an ADHD patient and helps subside the symptoms for a short period of time. However, regular physical exercise can also increase the amount of time where the child experiences improvement in the symptoms which includes an increased ability to pay attention, to stay on task, and reduced impulsiveness. Sports also results in increased quality of sleep which helps in reducing ADHD symptoms throughout the day.

To justify the positive impacts of sports on ADHD patients and how it helps them to thrive in both their physical and mental functionality, a thorough analysis has been performed on the renowned athlete Michael Fred Phelps. The American former competitive swimmer who has been labelled as the most successful and most decorated Olympian of all time had been diagnosed with attention deficit hyperactivity disorder in his sixth grade. Unbeknownst to many fans, he had undergone several changes in his demeanour towards work, school and play during his early life before he started his career as a swimmer. The two books are written with a tribute to Phelps' journey: "Beneath the Surface: My Story" and "No Limits: The Will to Succeed" have thoroughly

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mentioned about the experiences he had during his childhood\(^{13}\). In his first book, he has mentioned about how his inattentive behaviour used to make it difficult for him to focus on mundane tasks like homework and he used to create a lot nuisance to be the centre of attention. It was difficult for him to focus on one thing at a time compared to other kids of his age. A lot of difficulties faced at home including the divorce of his parents when he was 7 years old led him to divert his attention to something intriguing since he could not see his father for a long time. Initially, when Phelps’ mother encouraged him to swim, he did not like swimming at all. However, with constant practice, he became better at it and started enjoying it more because the water physically helped to slow down his otherwise fast pace and that is how he felt in control of what he was doing. Swimming might seem difficult for normal people as the water tends to be a huge hindrance and decelerate body movements, but it felt completely normal for Phelps and complimented his restless behaviour\(^{13}\). Swimming is generally a very exhausting sport when it is performed at a competitive level which is why Phelps’ mother wanted him to drain as much energy out of his body as he could. While Phelps could not sit through a class without fidgeting, he could easily swim up to 3 hours at the pool after school. That is when he was diagnosed with ADHD in sixth grade. By age 10 he was a nationally ranked swimmer and by age 11 he met coach Bob Bowman who saw through his potential that other kids did not have. Despite his coach’s constant stringent behaviour, he had an attitude of indifference, held a strange kind of determination towards swimming and kept thriving for gold every time in Olympics. His mother Debbie played a key role in placing him where he is today. Certain types of behavioural therapies helped Phelps to regain his attention and focus during swimming meets. Every time Debbie saw Phelps getting frustrated, she would come up with signals she could use from the stands like making a ‘C’ with her hand which stood for “compose yourself”\(^{14}\). She also noticed how his attention would waver during math, so she came up with word problems and relate math questions with swimming like “How long would it take to swim 500 meters if you swim three meters per second?”’. She also made a point to listen to her son when he demanded to stop taking his stimulant medication. Michael’s busy schedule of practices and meets imposed so much structure on his life that he was able to stay focused without medication.

It has also been observed that engaging children with ADHD into a team sport also helps to develop and improve their social skills which are initially often absent from their cognition. To be able to be more mentally developed in social skills, they need to be practically exposed to several such positive social settings\(^{18}\). It has also been suggested by Grassmann, Alves, Santos-Galduróz and Galduróz\(^{25}\) that an average of 30 minutes of regular physical exercise can effectively activate the executive functions in the body and the individual can plan, focus and increase his attention span for a longer period. Recently, the demand for alternative therapies apart from stimulant medications for curing ADHD has increased among parents and many government agencies and not for profit organizations have noted the psychological benefits derived from playing a sport. To put these observations in use, the implementation of increased physical activities for ADHD patients has led to decrease in the symptoms otherwise a lack of inactivity often leads to deterioration of emotional and mental well-being\(^{20}\). Sports also initially helps in determining the children who are suffering from ADHD as they clearly show the symptoms while performing any kind of physical activity. A test conducted by Harvey\(^{25}\) showed that children with ADHD paid lesser attention to details and their gross motor skills seemed to be less developed and accurate as compared to their non-ADHD peers.

3. Results and Discussion:

A bigger percentage of benefits for symptoms of inattention and hyperactivity have been derived from regular physical activity compared to symptoms of impulsivity\(^ {22}\) and sports has been confirmed as a health beneficial practice to manage the symptoms overall. It is important to keep the duration of activity in mind as training sessions like HIIT (High-Intensity Interval Training) might not provide maximum benefits for every child who bears the symptoms. The child should be subjected to a level of exercise depending on the severity of the disorder as it directly affects the mood and emotions of the individual\(^ {24}\).

Participating in more and more sport activities increases a certain kind of neurotransmitter called norepinephrine in the brain of an ADHD patient and helps subside the symptoms for a
considerable amount of time. Out of all the ways of inheritance, certain diet and hereditary factors trigger the symptoms of ADHD. Abundant of protein intake in the diet can build up neurotransmitters which are derived from dopamine. Hereditary factors conclude that the cerebellum of the brain is responsible for generating hereditary abnormalities which result in ADHD. Behavioural therapies are a major source to manage the symptoms of ADHD where certain techniques are derived from behaviourism and psychotherapists who perform behavioural therapies observe specific kind of learned behaviours and how the environment influences them. Sport also widens the perception of an athlete suffering from ADHD as it helps to identify the strengths and challenges that the athlete faces while practising their chosen sport\(^{(23)}\). Also, it is important to keep criticism to a limit during physical training sessions because it reduces the premature anxiety levels in the athlete. On Phelps managing his symptoms through sports, the fact has also been proven that specific kinds of sports which have controlled risk or excitement involved play an essential role in the life of a person suffering from ADHD and help to manage and control emotions, improves focus and the ability to concentrate on various other tasks outside of sports\(^{(14)}\). Intensive behavioural intervention that involves sports training programs can significantly improve performance in sports of children with ADHD\(^{(15)}\). Therefore, a balanced schedule of sports training brings more structure into their lives like Phelps’ experiences. It has also been concluded after the study conducted by Silva\(^{(27)}\) that intense physical exercise significantly improves the ability to concentrate on tasks in ADHD patients. A difference of 30.52% was noted between the concentration levels of ADHD patients who participated in an intense physical exercise and ADHD patients who did not participate in the same. Intermediately intense aerobic exercise has led to lesser distraction and children are better able to perform tasks such as continuous reading and solving math problems, the two fields in which most children with ADHD find difficulty performing whereas intermediate exercise and workout sessions have shown positive results only in the behavioural aspect\(^{(12)}\).

4. Conclusion:

Sports, along with its characteristics to indulge kids in specific practice sessions teaches them discipline especially when it is performed at a competitive level and tailors to their interests. Sports also help kids with ADHD to better manage their emotions because it involves moments of joy, frustration, pride, courage, fear, anxiety all occurring simultaneously. It gives a sense of competitiveness and the will to thrive forth as every positive action taken with focus feels extremely rewarding in sports. As a result, sports always help to stay motivated intrinsically, extrinsically, or both. Additionally, it is the parenting that plays the most significant role in shaping kids with ADHD. For the parents, patience and trust is the key to developing the child mentally since ADHD is prevalent in people who lack brain maturity. Their support and non-judgmental behaviour can be a great boost for the kids to feel confident enough to be able to do well in any career path that they choose.

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**References:**


