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ATTENTION dEFICIT HYPERACTIVITY DISORDER

PSYCHOLOGY RESEARCH PAPER

ADHD is a learning disorder that affects millions of people, both children and adults. It is estimated that it affects 3-7% of all school age children (DSM IV-tr p.90). Symptoms are typically most observable during the elementary school years. As the child grows older, the stereotypical symptoms of hyperactivity associated with ADHD become less visible however, the feelings of internal jitteriness and inattentiveness continue on through adulthood (DSM IV-tr p. 89). There are many theories as to what causes ADHD, from a reduced GABA concentration to prenatal smoking, to brain shrinkage. Modern psychiatrists and Psychologists have developed various ways to diagnose this disorder from the DSM to new quantitative impairment measurements; once diagnosed, a patient can be prescribed various courses of treatment including stimulants, non-stimulants, and therapy.

**Possible Causes**

There are three main theories as to what causes Attention Deficit Hyperactivity Disorder (ADHD). These theories include a reduced GABA concentration in the patient’s brain, prenatal smoking, and brain shrinkage. In 2012, a group of medical doctors ran an experiment trying to find out if there was a link between a reduced cortical concentration of GABA and the development of ADHD. It started when they noticed that when children with ADHD were analyzed using transcranial magnetic stimulation it was observed that they had reduced short intercortical inhibition (Edden p.1). This led them to believe that this was somehow related to the patient’s concentration of GABA-A because it was known that GABA-A agonists affect this pathway (Edden p.1). Upon analysis of the magnetic resonance spectroscopy imaging it was discovered that ADHD patients of both sexes had reduced cortical GABA concentrations (Edden p. 3). This discovery was consistent with their hypothesis and the GABA deficits matched up with what would trigger the inhibition of the short intercortical inhibition system in their brains. It is believed that this short intercortical inhibition system allows us to “filter sensory information and select appropriate behavioral responses” (Edden p. 3). This research shows the correlation between a diagnosis of ADHD in children and adolescents and reduced cortical GABA concentrations. This means that this reduced concentration of cortical GABA could be causing the reduced short intercortical inhibition and therefore be causing the patient’s ADHD symptoms.

Another possible cause of ADHD is prenatal smoking. It has been known for a while that cigarette smoke acts a teratogen. This means that if a mother is exposed to cigarette smoke while she is pregnant, the smoke will cause the child severe defects physically, mentally, or both. In 2016, a team of researcher led by Petteri Joelsson attempted to find out if there was a link between a mother’s exposure to cigarette smoke during pregnancy and the child being diagnosed with ADHD later on in life. This study compared Finnish children who had been diagnosed with ADHD to those who hadn’t, asking if their mother smoked during her pregnancy. After they had collected responses the researchers found that “30.3% of the mothers of [patients with ADHD] smoked during pregnancy, whereas the corresponding figure was 15.3% for the mothers of the controls [ADHD free children]” and “there were increased odds for ADHD with maternal smoking after the first trimester” (Joelsson p. 6). The article then discusses the possible reasons for this correlation. The first was that nicotine, which has been shown to be able to cross the placenta was directly damaging the baby by acting as an agonist for acetylcholine. This could interfere significantly with the fetus’ developing central nervous system (Joelsson p.7). This damage could lead to ADHD later on in the child’s life. The second reason is that this trend can be explained by the interaction between the child’s genes and the environment. This means that the child could be already genetically vulnerable to smoking damage and the mother smoking during pregnancy could lead to the epigenetic effect of ADHD. The child could be vulnerable to the prenatal smoking, but if it was not present the child would not develop ADHD. Thirdly, it could be explained by the parents having sub-clinical ADHD which causes them to want to smoke. The sub-clinical ADHD is then passed down to the child who develops clinical ADHD (Joelsson p.7). Finally, the smoking could lead to chronic fetal hypoxia as blood vessels in the mother constrict in response to the smoking. It has already been documented that there is an “association between neonatal hypoxia and ADHD-like behavior” (Joelsson p. 8)

 The third possible cause of ADHD is brain shrinkage. There hasn’t been much research on this recently however in 2004 there was an experiment done where scientists compared brain scans of ADHD patients and non-ADHD patients and noticed that those who had been diagnosed had much smaller brain volumes. The scientists in this article discuss how it was difficult to pin down an exact reason for this correlation whether it was the ADHD, brain defects, or drug use (Cohen p. 161). However, around the same time the National Institute of Mental Health was running a similar experiment where they tested 103 medicated and 49 un-medicated ADHD patients and compared their brain shrinkages. It showed all of the patients regardless of their medication status had smaller brain volumes (3% smaller) when compared to their non-ADHD having peers (Cohen p.165).

**Diagnosis of ADHD**

 For a patient to receive treatment for ADHD, they must first be diagnosed. There are many different options for clinicians to use to diagnose ADHD, however I will only be discussing two of these methods. These two methods are the use of the DSM and a newly developed quiz that is used as a quantitative measurement tool to reveal the extent of a child’s impairment from ADHD. Ever since the first edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM) was published in 1952, it has been the go to guide for psychologists and psychiatrists for diagnosing mental disorders. The DSM IV-tr divided the diagnosis of ADHD into 3 subtypes: predominantly inattentive type, predominantly hyperactive-impulsive type, and combined type (DSM p. 87). The DSM lays out various criteria for each of these three categories that must be filled in order to solicit a diagnosis of ADHD. It also states that in order for a child to be diagnosed, symptoms must be present before the patient reaches the age of 7 (this was changed in the DSM V to 12 years old). Additionally, it states that “some impairment from the symptoms must be present in two or more settings (e.g., at school, work, home, etc.)” (p. 92). However, in the DSM-V it allows for the possibility of adult ADHD.

 The other way that has only recently been created was a quiz that was intended to be a quantitative assessment of ADHD impairment. Researchers from the Federal University of Rio de Janeiro search for a qualitative test that would identify whether a patient had ADHD. Current quantitative tests are “seldom used in research and are often one-dimensional, mixing severity of psychopathology with functional impairment and frequently requiring clinical judgement for scoring” (Fortes para. 5). The reason that the researchers did this was due to the fact that current testing for ADHD was unable to determine whether the effects were a result of ADHD or other comorbid conditions such as Autism Spectrum Disorder (ASD) (Fortes para. 5). Additionally, prior tests did not take into account the various cultural opinions about this disorder that could affect the answers people gave to the test as well as how the clinician will interpret the results of the quiz. To combat these flaws with current testing such as the DISC (Diagnostic Interview Schedule for Children) the researchers from Brazil created their own assessment to measure the amount that ADHD was impairing a child. The researchers gave the quiz orally in order to remove the possibility that the impairment was a result of speech problems. The quiz was broken up in to six categories that measure the patient’s impairment in the different settings: family, school, work, social activities, daily activities, self-perception, and performance (Fortes para. 12). The researchers gave it to patient as well as his or her parents in order to get answers from multiple perspectives. This was compared to other diagnosis methods and it was determined to be accurate in determining an ADHD diagnosis.

**Treatment of ADHD**

After a diagnosis of ADHD, there are many courses of action that a psychiatrist or psychologist can take to help resolve this issue. These options include stimulant medication, non-stimulant medication, and therapy.

The most common course of treatment out of these three is the use of stimulant medication. The most common stimulant medication out of them is the drug Ritalin. In 1995, it was estimated that “2.8 percent of U.S. youth between the ages of 5 and 18 years were taking the medication [Ritalin]” (Greenhill p. 85). This number has tended to increase over the years (Greenhill p. 85) leading some to wonder if we are simply giving children who have too much energy medication to make life easier on ourselves, rather than for them. There is a growing number of people who believe that we are overmedicating our children using medications that are really nothing more than band aid solutions that temporarily deal with the symptoms. Most stimulants start to work approximately 30 minutes after ingestion. They reach their maximum effectiveness from 1-3 hours after ingestion. However, these effects fade approximately 5 hours after taking the medication (Greenhill p. 86). While this can be effective as a short-term solution as it does last as long as an average school day, it should not be seen as a long-term solution to ADHD. These stimulants work by affecting the norepinephrine system, improving the function of the executive control system, allowing the patient to overcome his or her deficits. This course of treatment has proven exceptionally well in resolving ADHD symptoms, however it does not fix the underlying causes of ADHD. Studies have actually shown that after approximately 3 months these stimulants no longer work as well as they had originally (Greenhill p. 88). Lastly, these stimulants have been shown to be addicting and is frequently abused by those with and without an ADHD diagnosis (Greenhill p. 85).

Unlike stimulant medication, the new class of non-stimulant medication is not addictive because it is not a stimulant. Studies have shown that around 10-30% of ADHD patients do not respond or are unable to handle treatment using stimulants. This new class of non-stimulant ADHD medication hopes to be an effective course of treatment for these people as well others who wish to use non-stimulants to deal with their symptoms of ADHD. The paper by Dr. Jannardhanan Santosh mentions a few types of non-stimulant medication. These include atomoxetine, tricyclic antidepressants (TCA’s), and alpha-2-anrenergic agonists. The most promising of these non-stimulant medications is atomoxetine (Santosh p. 2). “Atomoxetine is a highly selective inhibitor of the presynaptic noradrenaline transporter with relative low affinity for the serotonin 5-HT and dopamine transporter and neuronal receptors” (Santosh p. 3). In a double-blind placebo-controlled study it was determined that the use of atomoxetine did in fact help resolve the symptoms associated by ADHD. Atomoxetine is the first drug of its kind to be approved for use in the United States. It is also the first drug approved for the treatment of adult ADHD (Santosh p. 1). Unlike TCA’s which have side effects that are so brutal, it is rarely prescribed to treat ADHD, atomoxetine has only minor possible side effects such as weight loss, increased heart rate, increased blood pressure, etc. Since atomoxetine is also a non-stimulant medication it is less likely to be abused by people with or without an ADHD diagnosis. However, much like the stimulant medication, this is only a short term-solution that only deals with the symptoms of ADHD, not the underlying causes.

The third option for the treatment of ADHD is therapy. Dr. Meppelink in his article discusses the facts about the typical ADHD treatment: stimulants. He states that “In the Netherlands 130,000 adolescents were using methylphenidate [Ritalin] in 2012, which was at the time 3.2 % of Dutch adolescents” (Meppelink p. 2). As an alternative to these short-term fixes for the symptoms of ADHD a type of therapy, mindfulness therapy was created. Mindfulness therapy focuses on making the child better able to concentrate on tasks and enhance their self-control. Through this therapy children are asked to practice daily meditations and work outside of therapy to increase their mindfulness (Meppelink p. 8). This eight week training session uses this extensive instruction to deal with the problems at the root of the ADHD diagnosis as opposed to just dealing with the symptoms. This is definitely more of a long-term solution compared to medication alone. However, it was discovered that when the therapy was administered by itself its affects were smaller than that of the medication. When the therapy was paired with the medication however, there were long-term results in addition to short term results. However, the main difference maker in this situation would be cost. “Medical costs per child with ADHD is$1079 during a period of 14 months, whereas costs for behavioral treatment per child with ADHD is $7176 during that same period of time” (Meppelink p. 3). Therapy is nearly 7 times more expensive when compared to medication alone. It is this extreme cost, time commitment, and general difficulty that make therapy a less popular choice than medication. While this therapy may help more in the long-term it is a tough ask for parents to pay 7 times as much as they would for medication in order to receive this treatment. These are the three types of treatment for ADHD and how each of them work as well as the pros and cons of each type of treatment.

**Conclusion**

While nobody truly knows exactly what causes Attention Deficit Hyperactivity Disorder (ADHD) doctors have various theories including a lack of GABA, maternal smoking during pregnancy, and brain shrinkage possibly related to genetics. Even though they don’t know the physiological side of this disease, doctors have still created multiple ways to help diagnose patients with this disorder. In addition to diagnosing patients with this disease, researchers have also been able to create several means to go about treating this disorder including stimulant medication, non-stimulant medication, and mindfulness training. This is why researchers believes that ADHD develops in certain people, how to diagnose it, and how to go about treating it in both the short term as well as the long term.

**Work Cited**

**FORTES, D., SERRA-PINHEIRO, M. A., COUTINHO, G., BERNARDES, C., REGALLA, M. A., SERGEANT, J., & MATTOS, P. (2014). Quantitative measurement of impairment in ADHD: perspectives for research and clinical practice. Retrieved March 06, 2017, from http://www.scielo.br/scielo.php?script=sci\_arttext&pid=S0101-60832014000500124&lng=en&tlng=en**

In this this research paper, the researchers from the Federal University of Rio de Janeiro search for a qualitative test that would identify whether a patient had ADHD. Current quantitative tests are “seldom used in research and are often one-dimensional, mixing severity of psychopathology with functional impairment and frequently requiring clinical judgement for scoring” (para. 5). Current quantitative such as the DISC (Diagnostic Interview Schedule for Children) assessment have problems with measuring symptoms so that they are specific only to ADHD patients. They determined that there are two aspects that need to be considered when evaluating current quantitative tests: a) When the clinician finds it difficult to distinguish between the impairment associated with ADHD and the one associated with highly frequent comorbid conditions which are also investigated during clinical interview and b) research data does not support the idea that ADHD is a cultural construct, and there is a wide variation in beliefs related to ADHD among countries – both cultural and historical. An assessment of ADHD-associated impairment should take this into consideration. They opted for an oral assessment to avoid people who have a reading disability being diagnosed as having ADHD. This quiz measured 6 factors: family, learning, work, social activities, activities of daily life, self-perception, and performance to help diagnose ADHD. This quiz was taken by the patient and their families and it measured ADHD occurrence relatively well compared to other methods.

**Cohen, D., & Leo, J. (2004, January 01). David Cohen & Jonathan Leo, An update on ADHD neuroimaging research - PhilPapers. Retrieved March 06, 2017, from https://www.jstor.org/stable/pdf/43854028.pdf**

In this article, David Cohen and Jonathan Leo discuss updates in the field of neuroimaging for ADHD. First the speak about their prior paper on neuroimaging for ADHD patients where they compared the brain scans of ADHD patients where some were medicated and some were not to the brain scans of normal people. However, they noted that it was “difficult to know if between-group differences reported by researchers might result from an idiopathic organic brain defect- as implied or stated in most studies- or from brain changes resulting from prior drug use by the subjects diagnosed with ADHD” (P 161). However immediately after the study was published the NIMH released a press briefing stating that the observed brain shrinkage that had been observed in comparisons between normal people and people diagnosed with ADHD were not caused by the medication. This was a result of their study that used 103 medicated and 49 un-medicated ADHD patients and compared their brain shrinkages. It demonstrated all patients regardless of their medication had smaller brain volumes when compared to their normal peers. This led to the theory that the brain shrinkage may be a factor of ADHD.

***Diagnostic and statistical manual of mental disorders: DSM-IV-TR*. (2011). Washington, DC: American Psychiatric Association.**

The DSM IV-tr gives the definition of ADHD and talks about what it takes to be diagnosed with it. The DSM IV-tr breaks ADHD into 3 sub categories. These categories include the combined type, the predominantly inattentive type, and the primarily hyperactive-impulsive type (p. 87). These sub categories have their own requirements for diagnosis. The DSM IV-tr estimates that ADHD is prevalent in about 3-7% of school aged children. It also states that in order for a child to be diagnosed, symptoms must be present before the patient reaches the age of 7 (this was changed in the DSM V to 12 years old). Additionally, it states that “some impairment from the symptoms must be present in two or more settings (e.g., at school, work, home, etc.)” (p. 92). This is in order to rule out what could just be a dislike for school that leads to impulsivity or inattentiveness. The DSM IV-tr also states that “Data on prevalence in adolescence and adulthood is limited” (p. 90). This however was revised in the DSM V to say that data did point to the fact that adults could have ADHD. These criteria are used in order to diagnose a possible ADHD patient with ADHD and give insight into which sub category the patient is in.

**Joelsson, P., Chudal, R., Talati, A., Suominen, A., Brown, A. S., & Sourander, A. (2016, August 31). Prenatal smoking exposure and neuropsychiatric comorbidity of ADHD: a finnish nationwide population-based cohort study. Retrieved March 6, 2017, from http://eds.a.ebscohost.com/eds/pdfviewer/pdfviewer?sid=a1588caa-d942-434e-8562-852dd9026e30%40sessionmgr4009&vid=8&hid=4202**

This article attempts to find out if there is a link between prenatal smoke exposure and the development of ADHD. This is possibly due to the fact that smoking can lead to gestational hypoxia and therefore neuronal death and “gestational hypoxia has been suggested to contribute to ADHD-like symptoms” (p .2). However, it could be that the genetic factors are already present for ADHD and those same genes make a person more likely to smoke. Regardless, it has been shown that smoking during pregnancy can lead to a wide variety of psychological disorders, developmental disorders, conduct disorders, and depression. This leads to a problem when trying to isolate a single condition such as ADHD in a patient. In this study, they used Finland’s national registry of people diagnosed with ADHD and then asked if the parents smoked during pregnancy. This study showed that 30.3 % of the mothers of cases smoked during pregnancy, only 15.3 % of the mothers of control group were smokers. This shows that there is some possible link between smoking and the development of ADHD.

**Meppelink, R., De Bruin, E. I., & Bogels, S. M. (2016, July 26). Meditation or Medication? Mindfulness training versus medication in the treatment of childhood ADHD: a randomized controlled trial. Retrieved March 6, 2017, from http://eds.a.ebscohost.com/eds/pdfviewer/pdfviewer?sid=a1588caa-d942-434e-8562-852dd9026e30%40sessionmgr4009&vid=13&hid=4202**

This article talks about the pros and cons of the traditional medical treatment. Additionally, it talks about the potential benefits of non-medicated mindfulness training. The article first talks about what ADHD is saying that it one of the most common childhood disorders, with a prevalence of 5 %. Children and adolescents with ADHD show inattentive, impulsive, and hyperactive behavior that interferes with their (social) functioning or development and occurs in more than one setting” (p. 2). The article then goes on to explain the most common method for treating ADHD: stimulant medications. “In the Netherlands 130,000 adolescents were using methylphenidate in 2012, which was at the time 3.2 % of Dutch adolescents” (p. 2). While this method of treatment is exceedingly effective at resolving the symptoms of ADHD it is just a short-term solution for a long-term problem. However, psychosocial treatment looks like it could be a possible solution to this problem. When it was used alone its affects were smaller than that of the medication. When the therapy was paired with the medication however, there were long-term results in addition to short term results. However, this leads immediately into another problem: cost. “was estimated that medical costs per child with ADHD is$1079 during a period of 14 months, whereas costs for behavioral treatment per child with ADHD is $7176 during that same period of time” (p. 3). Therapy is nearly 7 times more expensive when compared to medication. When it was tested to see if their assertion was correct, the researchers found out that they were correct that psychosocial did help a patient more in the long run when compared to the use of psychostimulants. However, one must make a decision as to whether it would be worth it to pay so much money for these meager results.

**Edden RAE, Crocetti D, Zhu H, Gilbert DL, Mostofsky SH. Reduced GABA Concentration in Attention-Deficit/Hyperactivity Disorder. Arch Gen Psychiatry. 2012;69(7):750-753. doi:10.1001/archgenpsychiatry.2011.2280 from** <http://jamanetwork.com/journals/jamapsychiatry/fullarticle/1211983>

This article discusses a possible link between a deficit in cortical inhibition from GABA and the development of ADHD. The article then discusses how they can measure GABA concentrations using magnetic resonance spectroscopy. The article then discusses that GABA concentrations can correlate with impulsivity and motor control in adults. Using transcranial magnetic stimulation, it was discovered that school-age children with ADHD typically have reduced short intercortical inhibition (SICI). This reduced SICI correlates with ADHD symptom severity and motor control and is known to be affected by GABA-A agonists. After testing it was discovered that males and females with ADHD had a lower GABA concentration when compared with males and females without an ADHD diagnosis.

**Santosh, P. (2004, January). Non-stimulant ADHD Medication. Retrieved from https://www.researchgate.net/publication/281319502\_Non-stimulant\_ADHD\_Medication**

For most ADHD patients, the go to treatment is psychostimulants such as Ritalin or Adderall. However, there is a substantial amount (10-30%) of patients who either cannot tolerate this treatment or do not respond to this treatment. A new class of non-stimulant medications have been released in the hopes that this would work as an option for patients that are unable to use the stimulants to effectively treat their disorder. This article mainly focuses on the four medications, Atomoxtine, tricyclic antidepressants, Bupropion, and alpha-2-adrenegic agonists. Atomoxtine is a medication that functions as a selective noradrenalin reuptake inhibitor. It is the first drug of its kind to be approved for use in the United States. It is also the first drug approved for the treatment of adult ADHD. This article discusses the effects of each drug as well as the possible side effects for the people who use these drugs in order to treat their condition.

**Greenhill, L. M., M.D. (1998). Stimulant medications. Retrieved from https://consensus.nih.gov/1998/1998AttentionDeficitHyperactivityDisorder110Program.pdf#page=79**

The most common treatment for ADHD is the prescription of psychostimulants. The most common ones are Ritalin (methylphenidate) and Adderall (amphetamine). This line of treatment has been common for decades. In 1995, it was estimated that 2.8% of US youth between 5 and 18 were taking the prescription drug Ritalin for the treatment of ADHD. The article cites the increase in girls being diagnosed with ADHD, the addition of the inattentive classification of ADHD, and the treatment of high school students as the reasons for this high number. The author the explains how stimulant medications work in the treatment of ADHD. He states that these stimulants effect on norepinephrine pathways which reduces the deficits on the inhibitory system which are to blame for a large number of symptoms. These effects disappear over a few hours as the body metabolizes the medication. This makes this a very short-term solution for ADHD. The article then talks about the adverse effects of the use of this medication as well as the long-term risks of stimulant use.