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Epidemiology of Attention Deficit/Hyperactivity Disorder

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<http://dx.doi.org/10.5772/61016>

Abstract

Attention deficit/hyperactivity disorder (ADHD) is a neuropsychiatric disorder characterized with attention deficits, hyperactivity, or impulsiveness. The prevalence of ADHD varies from country to country and from various cultural and geographical zones. The pattern and distribution of ADHD also vary with gender and age. It has also been noted that some factors are associated with ADHD. For instance, some central nervous system anomalies had been associated with ADHD. Genetic and environmental risk factors have also been implicated. Some conduct and learning disorders have also been associated with ADHD. Of recent, some cardiac anomalies and behavioral disorders such as enuresis and encopresis have all been associated with children with ADHD.

Conclusion: Attention deficit/hyperactivity disorder (ADHD), a neuropsychiatric disorder, varies in prevalence from one country to another with several associations.

Keywords: Attention deficit/hyperactivity disorder (ADHD), prevalence, associated factors

1. Introduction

Attention deficit/hyperactivity disorder (ADHD) is a neurological condition which more often than not is genetically influenced [1]. It is characterized by impulsivity and restlessness or hyperactivity [1]. It is the most frequently encountered childhood-onset neurodevelopmental disorder in the primary care setting. Symptoms usually emerge before 7 years of age [2].

There are three types of ADHD, depending on which symptoms are prominent in an individual. In the predominantly inattentive type, an affected child finds it difficult to organize or finish a task, to pay attention to details, or to follow instructions. Such a child is easily distracted or forgets details of daily routines [3,4]. The second type is the predominantly hyperactive-impulsive type; a child with this type tends to fidget and talk a lot. Children find it hard to sit still for long. The child also feels restless and has trouble with impulsivity [4]. The combined type is the third variety and is associated with symptomatology of the other two types in varying degrees [3,4].

ADHD affects children and adolescents in various ways and extents; however, the effects of the condition usually impact greatly on patients and their families and relations. When not treated, ADHD is frequently associated with underachievement in school, increased rates of criminality and accidents, and development of comorbid psychiatric symptoms, including anxiety, depression, and substance use and misuse [5].

It is important to note that not all children with ADHD will have all the symptoms, and the severity of ADHD and the level of impairment will vary between individuals. In addition, ADHD symptoms and severity can change with age [6]. Some symptoms, such as hyperactivity-impulsivity, may decrease with age. In the corollary, other symptoms, like inattention, are more likely to continue till adulthood [6]. It is pertinent to know that children with ADHD may present with other psychiatric disorders, such as learning difficulties or anxiety [6]. The long-term sequel in children with ADHD is variable. For most subjects with ADHD, the disorder will persist through childhood into adolescence and adulthood. Although children with ADHD may present with no issues later in life, they are at increased risk of a range of adverse outcomes [6]. These include poor academic performance, poor social interaction, and low self-esteem.

Prevalence varies from country to country. In Nigeria, for instance, the latest prevalence is 3.2% [6], while in other African countries, such as South Africa, Democratic Republic of Congo, and Ethiopia, the reported prevalence varies from 5.4% to 8.7% [7]. The reported prevalence from other continents follows a similar trend. For instance, the prevalence of ADHD in Saudi Arabian primary schools is reported to be as low as 2.7%, while that in Iran is reported to be as high as 13% [8]. In South America, the prevalence of ADHD in children is about 6%, while in Germany, ADHD has been reported with a prevalence of 4.8% [9-12].

Although variation in prevalence has been shown to be associated with geographic origin, this trend has been refuted in recent times. For example, it was postulated that ADHD is an American dictum, yet recent findings showed that the variation in prevalence with geographic origin did not fit a pattern consistent with the notion that ADHD is a byproduct of American culture [12]. For instance, the North American prevalence rate of 6.2% only slightly exceeded the European rate (4.6%) [12]. The highest rates emerged from Africa (8.5%) and South America (11.8%). In a collaborative study using a dimensional ADHD scale and in which 21 countries were involved, Japanese and Finnish children scored lowest, Jamaican and Thai children scored highest, while American children scored about average [13].

It has been argued that the variability in ADHD/HD prevalence figures obtained from different countries in different continents may be best explained by the use of different case definitions and methodologies. It is further argued that the actual prevalence across geographic sites should not vary when case definitions are identical. For instance, it has been documented that the main difference in ADHD prevalence between North America and Europe was explained by methodology [12]. North American researchers used the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) for their case definition, whereas many European researchers had preferred the *International Classification of Diseases* (ICD). The ICD-10 strictly requires that a child must show symptoms in all three dimensions (inattention, hyperactivity, and impulsivity) and must meet all criteria at home and at school, while the DSM-IV is more “lenient.” It is possible to diagnose a child who shows symptoms in only one dimension (inattention) using the DSM-IV criteria, for instance [13].

2. Sex

ADHD usually occurs more in boys than in girls. The male-to-female ratio ranges between 3:1 and 4:1 [14]. Diagnosis of ADHD has improved in recent years, with decreasing male-to-female ratio [14]. This is due to increased recognition of inattentive ADHD [14].

3. Age

There are conflicting data that a child with ADHD will also have the disorder as an adult. For instance, approximately 30–80% of children with ADHD have the disorder as adults. Most experts noted a rate well above 50%. However, many adults with ADHD were never diagnosed as children [15]. That their symptoms were missed in childhood is conjectural.

Hyperactive symptoms tend to decrease with age [16]. This is due to developmental trends toward self-control and changes in neural connections in the brain that occurs during late adolescence.

However, inattentive symptoms do not appear to have a similar developmental advantage and tend to remain the same into adulthood [16].

3.1. Risk factors

These include central nervous system involvement, genetics, and environmental risk factors.

4. Central nervous system involvement

It is a well-known fact that abnormalities in the frontal–striatal circuits and the prefrontal cortex (PFC) affect attention and hyperactivity [17]. Furthermore, neurohormonal aberrations are

implicated as triggers of ADHD. For instance, abnormalities in norepinephrine, dopamine, and norepinephrine α -_{2A} inhibits cortical, cerebellar, and striatal processing, which in turn causes inattention and hyperactivity [18,19]. Structural imaging studies have also shown smaller volumes in prefrontal cortex, caudate, splenium of corpus callosum, and cerebellum, as well as smaller total cerebral volume in children with ADHD [20].

5. Genetic influence in ADHD

A higher incidence of ADHD among first-degree family members of ADHD has been reported [21]. ADHD inheritance is estimated at 0.76, which makes it one of the most genetic psychiatric disorders [21].

6. Environmental risk factors

It is worth noting that concordance rate of 33% in dizygotic twins, points to environmental risk factors incurred during the prenatal course [22]. Environmental factors usually implicated in ADHD include maternal smoking during pregnancy, emotional distress or family adversity during pregnancy and early in life, birth weight <1500 g, lead exposure, hypoxemia, encephalitis, trauma, and brain injury from some metabolic disorders [22].

Of all these risk factors, pregnancy-associated risk seems to be the most common. For instance, nicotine (tobacco smoking), alcohol, and caffeine intake during pregnancy pose a greater risk of ADHD-related disorders among children whose mothers smoked during pregnancy. It is noted that in Finnish population, children prenatally exposed to maternal smoking had twice the risk of being diagnosed with ADHD than children of non-smokers [23].

Bekdas, however, used children born after different types of *in vitro* fertilization techniques with egg donation as a way to distinguish between genetic and exposure effects. They found no association between smoking and ADHD phenotype in genetically unrelated mother-child pairs [24].

It has also been documented that patients with ADHD showed higher titer of measles IgG while adolescents with ADHD showed higher levels mumps [24]. When patients with subtypes of ADHD were compared in terms of seropositivity, it was found that patients with ADHD-combined/hyperactive-impulsive subtypes had significantly elevated reactions for Rubella [24].

7. Prevalence of prescribing drugs in the treatment of ADHD

There is varying prevalence of methods of prescription in the management of ADHD. For instance, a trend of increasing prescribing prevalence of ADHD drug treatment has been

observed over time in various countries [25]. It is noted that the annual prevalence of any psychotropic medication in youth was significantly greater in the United States (6.7%) than that in the Netherlands (2.9%) and in Germany (2.0%) [26]. These differences in psychotropic medication practice patterns could be due to differences in diagnostic systems, practice guidelines, drug regulations, availability of funds, and more often than not cultural beliefs [26].

More recent studies from the United States include a study by Zuvekas et al. [27], who used the Medical Expenditure Panel Survey database. They reported that the prevalence of use of stimulants in children aged 6–12 years is about 2.7%.

Furthermore, there exist gender differences in methods of prescription of these drugs with a male preponderance. These findings are in keeping with that reported in a study, where differences in prescribing between the genders ranging from a ratio of 2:1 to 9 were documented [28].

Physicians treating ADHD in European countries noted long-acting methylphenidate as a drug of choice in the management of ADHD. This was prescribed to more than half of patients. It was noted that only a third of the patients showed “complete symptom control” on current treatment, and another third were satisfied with their current treatment [29–30].

8. Prevalence of associated disorders

Furthermore, it is important to note that there exists an overwhelming proof to support the fact that children with ADHD are at increased risk for other psychiatric disorders [31]. For instance, children with ADHD have other associated psychiatric disorders in 66% of cases [31]. The most common of these disorders are oppositional defiant disorders and conduct disorders. It is an established fact that children with ADHD had ODD and CD in about 50% and 20% of cases, respectively [32]. There is also evidence that children and adolescents with ADHD are at risk of depressive disorders. Studies have shown increased prevalence rates of 9% to 38% for depressive disorders in children with ADHD [33,34].

In addition, children with ADHD may present with other medical conditions, for instance, Tourette syndrome (TS) often in tandem with ADHD. This is called co-occurring conditions [35].

Findings from the national Centers for Disease Control and Prevention (CDC) study showed that 86% of children with Tourette syndrome also had ADHD [36]. Furthermore, about 5% of children with Tourette syndrome had ADHD without learning disorder (LD), while 5% had LD without ADHD and 4% had both conditions [36]. Approximately 1 in 360 U.S. children aged 6–17 years ever had TS and are more likely than other children to also have another neurobehavioral condition or a learning disability [36].

9. Epidemiology of gender associations of ADHD

There may be gender differences in the types of comorbid disorders seen in children with ADHD. Findings had suggested higher rates of separation anxiety disorder in females and ODD and CD in males [37]. “This study also found differences between ADHD subtypes,” with separation anxiety disorder more common in females with the inattention subtype and generalized anxiety disorder more common in females with the combined subtype [37].

10. Epidemiology of other co morbid problems

Children with ADHD may experience other problems. They have reduced intelligence than other children of the same age [38]. Several studies had reported varying findings on incidence of learning disorders among children with ADHD [38].

Children with ADHD are exposed to both accidental and nonaccidental injuries. Szatmari et al. [39] noted that 7.3% of children with ADHD experienced accidental poisoning with 23.2% having bone fractures, compared to 2.6% and 15.1%, respectively, in children without ADHD [39].

There exists high prevalence in criminality among children with ADHD later in life. Male children with ADHD always grow up as adult offenders ending up with high incidence of arrests (44%), convictions (29%), and incarcerations (26%). A U.S. longitudinal study among African American youth revealed that those who reported committing an offence in adolescence were more likely to have had ADHD symptoms in late childhood when compared to those who had never did [40].

11. Prevalence of ADHD and co morbidities among offenders

Studies have shown that about a fifth of prisoners with ADHD present with other psychiatric condition. These include substance use and misuse and personality disorder [41]. Learning disorders and personality were most common among them [41]. Furthermore, the prevalence of ADHD among adolescent offenders varies, although this is higher than the general population [42]. Psychiatric comorbidity among adolescents with ADHD is paramount. This include CD, major depressive disorder, dysthymia, mood disorder, anxiety, posttraumatic stress disorder, adjustment disorder, summarization disorder, and substance abuse disorder [42].

12. Prevalence of ADHD in childhood autism spectrum disorders

Autism spectrum disorders (ASD) and ADHD often coexist. It is noted that about 28–44% of adults diagnosed with ASD also meet criteria for ADHD [43]. Both conditions when they

coexist can have a large negative impact on the quality of life of affected individuals and their families. A better understanding of the etiology of this co-occurrence is therefore important [43]. Much is not known on the etiology of the associations between ASD and ADHD in adults. In addition, recent works were unable to eke out any differences in the etiology and associations of ASD and ADHD with respect to gender [43–44].

13. ADHD in children with heart disease

ADHD is found to be more prevalent in children with heart disease than in the general pediatric population. Inattention was identified in 45% of children and hyperactivity in 39% of children with heart disease based on the responses of parents and teachers on the DSM-IV Rating Scale and Behavior Assessment System for Children [45]. It is important to note that more than two thirds of children with hypoplastic left heart syndrome were found to have attention/hyperactivity problems. In the corollary, it was found that 50% of children with total anomalous pulmonary venous return fulfilled the criteria for abnormal hyperactivity and/or attention deficits [45]. This link could be due to chronic or intermittent hypoxia experienced by children with heart disease which culminates into adverse effects on development, academic achievement, and behavior.

14. Enuresis and ADHD

ADHD does not cause enuresis nor is it known to be a symptom of ADHD [46]. However, there seems to be a higher prevalence rate of enuresis in children with ADHD. Children with ADHD had a 2.7 times higher incidence of enuresis and a 4.5 times higher incidence of daytime enuresis [46,47] than children without ADHD.

15. Encopresis and ADHD

Children with ADHD who are about 7.3 ± 1.3 years were twice more likely to meet DSM-IV criteria for enuresis than non-ADHD controls; they were 1.8 times more likely to do so than children without ADHD [48].

16. Conclusion

Attention deficit/hyperactivity disorder (ADHD), a neuropsychiatric disorder, varies in prevalence from one country to another. These variations could be due to geographical and cultural construct. It could also be due to the criteria used in the diagnosis of ADHD.

In addition, ADHD had been known to have a varying epidemiology in gender with a fast reducing gap between male–female ratio probably due to increased recognition of inattentive ADHD. Attention deficit/hyperactivity disorder (ADHD) is indeed a behavioral disorder with several epidemiological associations. Clinicians, especially in developing countries, should therefore manage an individual with ADHD with a view that there could be other associated behavioral disorders, thus the need for multidisciplinary involvement.

Moreover, the fact that abnormalities in the frontal–striatal circuits and the prefrontal cortex (PFC) affect attention and hyperactivity could be a tell tale sign for neuropsychological intervention. In addition, drugs that can completely modify the frontal–striatal circuits and the prefrontal cortex (PFC) in attention and hyperactivity will be worthwhile and a template for future studies.

Acknowledgements

My gratitude extends to my lord Jesus and my dear wife Awoere, who has been very supportive.

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