

## Attention Deficit Hyperactivity Disorder: Coping or Curing?

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Attention Deficit Hyperactivity Disorder (ADHD) is a modern day paradox. From its descriptions of being an untreatable moral defect,<sup>1</sup> often associated with antisocial behaviour, to its current acceptance as a treatable neurodevelopmental disorder that has a lifelong impact, it is one of the most prevalent childhood psychiatric disorders. A recent meta-analysis estimated the worldwide prevalence of ADHD to be 5.29%.<sup>2</sup> A survey of 2400 children aged 6 to 12 years in Singapore showed that 4.9% had disruptive behaviour disorders by parent ratings.<sup>3</sup> The importance of ADHD in modern society lies in its impact on academic, social and occupational development. A burden of disease study conducted by the Ministry of Health, Singapore placed ADHD as the third highest contributor of Disability Adjusted Life Years (DALYs) in the 10 to 16 age group.<sup>4</sup> This burden is likely to be carried into adulthood and beyond. Yet in a survey of 48 family physicians in Singapore, knowledge about ADHD was found to be unsatisfactory suggesting that the training of doctors in identifying ADHD, much less treat it was poor. Similar findings in teachers were also found.<sup>5,6</sup>

### Diagnosis of ADHD

ADHD is a categorical diagnosis based on 5 main considerations:<sup>7</sup> (a) determining if there are 6 out of 9 symptoms grouped descriptively as inattentive such as paying attention to tasks, both at home and in other situations, and another 6 out of 9 symptoms in the hyperactivity-impulsivity domain including fidgetiness and inability to stay still; (b) it must persist for more than 6 months, starting before the age of 7; (c) exist in more than 2 situations; (d) cause clinically significant impairment in social, academic, or occupational functioning; (e) not better accounted for by more severe conditions such as autism, schizophrenia and other mental health disorders.

A careful review of the symptoms of ADHD will show that these are common to many psychiatric and developmental disorders. Using a categorical classification like the Diagnostic Statistical Manual (DSM), doctors are able to determine if a child should receive treatment, claim insurance and obtain special needs interventions and

accommodations in school. However, clinical experience supported by evidence from behavioural genetics challenges the categorical diagnosis of ADHD and suggests that ADHD symptoms lie on a continuum. Perhaps a better understanding of the aetiology of ADHD may aid this nosological quandary. The phenotype is traditionally understood to be the symptoms that represent ADHD. However, these symptoms are descriptive and do not necessarily represent underlying brain mechanisms such as working memory deficits. The concept of the endophenotype, a term used originally in entomology, implies that a range of neuropsychological constructs may underlie ADHD. Identifying these will allow for a more accurate description of ADHD.<sup>8</sup>

Genetic heritability in ADHD is high at about 70%. The genotype of ADHD is often described as a result of multiple gene interactions. Replicated associations with polymorphisms in several genes have been identified. Recent evidence in the area of epigenetics suggests that gene environment interactions may be mediated by DNA methylation. This epigenetic process produces a reversible yet heritable effect on gene expression. Specific early childhood insults in the form of diet, exposure to toxins or poor child rearing practices may mediate the expression of ADHD characteristics.<sup>9</sup>

Based on both the endophenotype and epigenetic mechanisms, it is conceivable that future diagnosis of ADHD may take on a more dimensional perspective in terms of symptom description and risk mediators in the environment. However, it may still be pragmatic to consider diagnostic thresholds based on impairment and the need for treatment.

### Outcomes of ADHD

One of the more controversial issues facing doctors today is the question of whether ADHD exists in adulthood. Epidemiologic evidence suggests that behavioural symptoms of hyperactivity and impulsivity would improve with age. However, symptoms of inattention often persist and are also associated with an inner restlessness, poor organisational skills and risk taking behaviours. In a study cohort of 128 male patients followed over 4 years,

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more than 60% of adults (aged 18-20 years) achieved full syndromatic remission, less than 30% achieved symptomatic remission, and only approximately 10% achieved functional remission.<sup>10</sup> This suggests that ADHD is likely to persist into adulthood and may be complicated by other coexisting conditions such as anxiety and depressive disorders.

### Treatment of ADHD

Methylphenidate remains the most potent treatment for ADHD. Its impact on the child's life and more importantly the lives of all those around the child has been shown in a large scale multicentre trial<sup>11</sup> over 1 year. However, there are common side effects including loss of appetite, growth retardation, sleep disturbances and other safety concerns. Atomoxetine, discovered serendipitously, is a newer non-stimulant medication with apparently fewer side effects. One of the reasons for the difficulty in developing effective treatment for ADHD across the lifespan is the fact that, like much of psychiatry, the understanding of the underlying brain mechanisms that lead to the disorder is still poorly understood.

Many parents prefer to try non-pharmacologic approaches. The most common is behavioural management which includes practical assistance with schoolwork, teaching children social skills and self-monitoring of behaviours. Our group has developed a brain-computer interface system using electroencephalogram (EEG) inputs to help train ADHD children to improve their attention. Although how this works in terms of brain mechanism has not yet been elucidated, such training approaches can give hope to developmental disorders because it addresses the issue that such disorders are more about coping rather than curing.

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