CHAPTER - 1

INTRODUCTION
Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders of childhood and one of the most common among the chronic health conditions that impact school-aged child, globally. Studies suggest over 5 per cent of children to be affected by ADHD across the world and over 2.5 per cent being carried on to adults (American Psychiatric Association, 2013). The reported rates differ across the various populations being studied across the globe.

1.1 Definition and characteristics of ADHD

Attention Deficit Hyperactivity Disorder as defined by The Diagnostic and Statistical Manual of Mental Disorders (DSM) (American Psychiatric Association, 2013) is a persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development. It has been described as the most common neurodevelopmental disorder of childhood and one of the most common chronic health conditions affecting school going children (American Psychiatric Association, 2013).

It is characterized majorly under three main categories namely inattention, hyperactivity and impulsivity which comprises of various other sub characteristics that could be seen among different individuals. ADHD is deliberated to begin in childhood and the symptoms present before the age of 12 years are considered to be substantial for a diagnosis. Duration of six months is required for the symptoms of ADHD to persist. Moreover, to qualify for a clinical diagnosis, the symptoms should be an obstacle to regular functioning of the individual in a social and occupational setting (American Psychiatric Association, 2013).
Under Inattention some prevalent characteristics could be making mistakes in work at school as there would be inability to provide attention to detail, at work, difficulty in play due to lack of sustaining attention, the individual finds it difficult to complete school work as he/she also does not seem to follow instructions given directly, tends to avoid tasks that require sustained mental effort and often finds its challenging to organize tasks, he/she might be forgetful about any day to day activities, tend to misplace or lose things required to complete any task and is easily distracted by any external stimuli (American Psychiatric Association, 2013).

Under Hyperactivity and Impulsivity the commonly occurring characteristics could be often fidgeting or tapping with hands and feet on the seat, fails to sit in his/her seat whenever there is a requirement of doing so, climbing and running about inappropriately, he/she finds it difficult to quietly engage in play or leisure activities, is often seen ‘on the go’ or acting as if ‘driven by a motor’, is talkative, finds it difficult to hold on an answer even when a question asked is incomplete, difficulty waiting for his or her turn, interferes in others actions (American Psychiatric Association, 2013).

These defined symptoms are not any indicators of hostility, oppositional behaviour and inability of understanding tasks or instructions. These symptoms could also persist before the age of 12 years (American Psychiatric Association, 2013).

ADHD is further classified into three types mention in the DSM-5, ADHD Predominantly Inattentive Presentation (ADHD-PI), ADHD Predominantly Hyperactive-Impulsive Presentation (ADHD-PHI) and ADHD Combined

Symptoms of ADHD are also specified based on three categories namely Mild, Moderate and Severe. Six or only slightly more symptoms are endorsed and impairment in social or school functioning is minor is considered to be Mild, symptoms or impairment in between mild and severe is considered to be moderate and many symptoms are above required 6 are endorsed and/or symptoms are severe; impairment in social or school functioning is severe is considered to be severe in nature (American Psychiatric Association, 2013).

These characteristics or symptoms are not sole manifestations of oppositional behaviour, defiance, hostility or even failure of understanding tasks or instructions. Some symptoms could also be present prior 12 years of age group (American Psychiatric Association, 2013).

International Classification of Mental and Behavioural Disorders (ICD-10) under World Health Organization (WHO) define ADHD under ‘Hyperkinetic disorders- F90’. For a diagnosis the cardinal features of impaired attention and over-activity are both considered necessary for diagnosis after being evident in more than one situation, be it school, home or clinic (The ICD-10 Classification of Mental and Behavioural Disorders: Clinical descriptions and diagnostic guidelines, 1992).

Impaired attention could be understood here as prematurely breaking off from tasks and leaving activities unfinished, shifting from one activity to another, losing interest in one activity as the child gets diverted to another. As per ICD-10, the deficits should be diagnosed only when they appear excessive to the child’s age and
IQ (The ICD-10 Classification of Mental and Behavioural Disorders: Clinical descriptions and diagnostic guidelines, 1992).

Over-activity on the other hand could be understood as being excessively restless, in situations requiring the child to be relatively calm. As compared to other children of the same age group and IQ, the child is considered to be noticeably more talkative, noisy, fidgety and wriggly, or is seen jumping and running in situations where he/she needs to be seated which could be more evident in organized institutions where there is a higher degree of self-control required (The ICD-10 Classification of Mental and Behavioural Disorders: Clinical descriptions and diagnostic guidelines, 1992).

Other supporting symptoms could be lack of inhibition in social relationships, recklessness in situations involving danger; like being prone to accidents, impulsive flouting of social rules like intruding or interrupting activities of others, difficulty in waiting for one’s turn, answering questions prematurely before they have been completed. They might be also unpopular with other children and may become isolated. Cognitive impairment and associated reading difficulties and/or other scholastic occurs in common while specific delays in motor and language development occur disproportionately frequent. The supporting symptoms are not sufficient for diagnosis without the cardinal features of this disorder. There could be few secondary complications like low self-esteem and dissocial behaviour (The ICD-10 Classification of Mental and Behavioural Disorders: Clinical descriptions and diagnostic guidelines, 1992).
Hyperkinetic disorders are considered to have an early onset according to the ICD-10. Its onset is no later than the age of 7 years. The problems persist through the school years and even into the adult life but many individuals also show gradual improvement in activity and attention in this course of time. It is considered to occur more frequently in boys than in girls (The ICD-10 Classification of Mental and Behavioural Disorders: Clinical descriptions and diagnostic guidelines, 1992).

ADHD is considered to be carried into the adulthood of an individual, if there has been a childhood history which is diagnosable of this chronic condition. This remains debatable as studies show mixed findings of susceptibility of ADHD as a result of a childhood pre-disposition or an adult condition by itself (Mcgough & Mccracken, 2006).

There is no specified evidence which can rule out only one single cause of ADHD. Several factors lead to this condition which could be genetics, brain dysfunctions and other exposure to social and cultural factors from the environment. Over 75 per cent constitutes hereditary and brain dysfunction to be prominent causes for this condition and rest 25 per cent is considered to be environmental factors alone that play a role in developing symptoms of ADHD. The nature versus nurture discrepancy could also be observed various approaches DSM has used to diagnose ADHD from the conception of ADHD.

In 1968, DSM-II described ADHD as ‘hyperkinetic reaction of childhood’ adhering the behavioural disturbance as a reactive reaction to family environment the individual has been exposed to. Later edition of the DSM III in 1980, DSM-III-R in 1987, and DSM-IV in 1994, reported how classification of mental disorders
including ADHD in a more neutral or ‘atheoretical’ manner. The latter editions were found to be optimized with reliability and differentiation from other disorders, precisely based on more empirical basis. It has recognized ADHD as a biologically driven, neurodevelopmental disorder. It highlights how this condition is among the most heritable psychiatric disorders and how it arises from the environmental risk factors cum multiple susceptibility genes of the individual (Mcgough & Mccracken, 2006).

1.2 Background

1.2.1 Biological basis of ADHD

Aetiology of ADHD could be traced back to 1798 where the first example of a disorder appeared like ADHD and when George Still conducted a study on 20 children whom he described as having a deficit in ‘volitional inhibition’. He found how these children, among which most were males has a family history of alcoholism, depression and criminal conduct (Ramya, Goutham, & Pandit, 2017).

He found that this condition may also arise from injuries to the central nervous system. Studies conducted much later found biological predispositions to ADHD which highlighted mild forms of brain damage during infancy (Ramya, Goutham, & Pandit, 2017).

This was again followed by studies on life-span perspective which defined characteristics of ADHD affecting 5-10 per cent of school age children which again was found persisting into adulthood to about 2.5 per cent (Ramya, Goutham, & Pandit, 2017).
Genetic Studies by Deutsch in 1987 found that 25 percent of the natural parents has histories of ADHD compared to 4 percent of adoptive parents (Anastopoulos & Barkley, 1988). Another study in 2012, showcased both common and rare genetic variants that are relevant to ADHD. It tried to analyse genome-wide associations with Single- nucleotide polymorphisms (SNP) frequencies and were tested for an excess of genes spanned by large, rare Copy number variants (CNV) in the children with ADHD. Thirteen biological pathways enriched for SNP association overlapped with that of rare CNVs including cholesterol and Central nervous system (CNS) development pathways (Stergiakouli, et al., 2012).

Few other studies found that there are specified differences in brain activity and brain structure of children with ADHD. Positron Emission Tomography (PET) and Magnetic Resonance Imaging (MRI) scan found there is less flow of blood and less activity in areas of the brain like the prefrontal cortex, basal ganglia, temporal grey matter, caudate nucleus and cerebellum and the brain structure is 3 to 4 percent smaller in children with ADHD than the ones without this condition. Thus, for such prominent differences there are difficulties in execution of planning, attention and concentration, motor activity, impulse control and inhibition (Swanson & Castellanos 2002; Hill 2003). Also, as described by Levin in 2009, unusual behavior patterns and lack of learning in these children is due to excessive activity in the right brain and left brain immaturity, respectively (Levin, 2009).

Studies have shown how ADHD symptoms indicate both stability and variability over time. Though students show higher risk rates of ADHD in school going age group. A study showed how half of 3-4 year old children identified by
parent and teacher ratings of behavioural problems no longer had difficulties by 6 years of age (Campbell, 1987). This again happens due to brain maturation of children with ADHD. There is similar sequential cortical development in children with ADHD like typically developing children with an only difference of delayed development of 2-3 years. Evidences of cortical thinning is also traced based on clinical outcomes which is influenced by brain maturation (Rajendran, Trampush, & Rindskopf, 2013).

Functional neuroimaging, neuropsychology, genetics and neurochemical studies consistently point to the involvement of the front striatal network as a likely contributor to the pathophysiology of ADHD which involves the lateral prefrontal cortex, the dorsal anterior cingulate cortex and the caudate nucleus. It has shown widespread dysfunction in neural systems involving the prefrontal, striatal, and parietal brain regions, and has led to a brain model of deficits in multiple developmental pathways (Curatolo, D'Agati, & Moavero, 2010).

Deregulation of neurotransmitter systems as the basis of genetic susceptibility to the disorder has been supported by Molecular genetic studies which also highlights that the genotype may influence the response to medications (Curatolo, D'Agati, & Moavero, 2010).

Scientists consider ADHD to be caused by a complex combination of genetic and other factors. The biggest genetic contribution is identified to be a variation in a receptor for dopamine which increases risk for the disorder by 20 to 30 per cent (Curatolo, D'Agati, & Moavero, 2010).
Philip Shaw a neuroscientist at the National Institute of Mental Health in Bethesda scanned the brains of 105 children with ADHD and 103 healthy controls between 8 and 16 years old by repeating the scans in a subset of children through their teen years. It was done in order to understand how the above mentioned variation influences attention. This helped in determining the number of copies the children carried of the target variation (Singer, 2007).

The results indicated that ADHD-affected children had higher risk of genetic variation and which deteriorated at younger ages. There were parts of the cortex which was thinner in this group than in children with ADHD lacking that variation. The cortices of these children naturally normalized by age 16 in contrast to other children with ADHD (Singer, 2007).

Functional Magnetic Resonance Imagery (fMRI) studies are feasible techniques to investigate neural correlates of ADHD. It highlights internal brain functions of an ADHD brain in comparison to a typically functioning one. A meta-analysis study was conducted through 55 fMRI studies (39 for children and 16 for adults) through databases collected through June, 2011. Results reported that there was significant hypo activation of executive functions in the fronto-parietal network and deficits in attention in the ventral attentional network. On the other hand there were significant hyper activation noticed in the somato-motor networks, default and ventral attention networks. This was even detected without the presence of any comorbid mental disorders or a history of exposure to stimulant treatment (Cortese, et al., 2012).
Another fMRI study conducted on children with ADHD, by adjusted tracking stop task that measures the neural substrates of inhibition and stopping failure. Results emphasized the reduced activation in the left dorsolateral prefrontal cortex and during inhibition failures compared to go responses, these children showed under activation in posterior cingulate gyrus (Rubia, et al., 2008). Another study recorded based on the performance in a stop task, requiring inhibition of a planned motor response, and a motor timing task, requiring timing of a motor response to a sensory cue showed significant lower rates of response in the right mesial prefrontal cortex during both tasks and in the right inferior prefrontal cortex and left caudate during stop task (Overmeyer, et al., 1999).

From the perspective of developmental psychopathology, ADHD is considered to be a result of clinical manifestation of neurodevelopmental vulnerability whose trajectory is mediated by alterations in brain structure and function in response to an array of interacting genetic and environmental factors exposed to the individual throughout development (Barke & Halperin, 2010).

Diagnostic remission and changes in behavioural patterns across a lifespan could be an outcome of compensatory brain maturation (Proal, et al., 2011). Neuropsychological studies also debate about the trajectories of ADHD symptoms getting modified over time. In previously mention study by Phillip Shaw found that in contrast to other children with ADHD, the cortices of the participant children naturally normalized by age 16 (Curatolo, D'Agati, & Moavero, 2010).
Based on these lines a longitudinal study was conducted to find out any association between variations in Neuropsychological development and trajectory of ADHD severity in early childhood. The sample size comprised of 38, 3-4 year old children with ADHD and data was collected from the year 2004 to 2012. Neuropsychological functioning was measured annually using Neuropsychological Assessment (NEPSY) at four time points. Symptoms of ADHD were assessed semi-annually using ADHD Rating Scale-IV and the Children’s Problems Checklist at 10 time points, both with parent and teacher, separately. In order to assess the trajectories of changes in neuropsychological functioning and ADHD severity as well as the association of change in neuropsychological functioning with change in ADHD severity over time, Hierarchical linear modelling was used (Rajendran, Trampush, & Rindskopf, 2013).

Results showcased change in ADHD symptoms and impairment indicating varied ADHD severity in the age of 8 years from age 3 and 4 years. The estimated mean at age 8 years was 13.40 and the change noticed was -0.55 units. Even neuropsychological functioning improved among the children over time. The predicted value of neuropsychological functioning was 94.64 at 4 years of age and the increased value was 3.11 units on average with a unit increase in time span of one year. The study also highlighted the fact that improvement in neuropsychological functioning was significantly associated with a decrease in ADHD severity over time. Thereby, a unit change of neuropsychological functioning was associated with a decrease of 0.28 units in ADHD severity (Rajendran, Trampush, & Rindskopf, 2013).
Also, Both DSM-5 and ICD-10 and several studies have documented how the susceptibility of ADHD among males is greater than in females. The male and female ratio among ADHD children range from 2:1 to 9:1 depending on the subtype (Lee, Lahey, Owens, & Hinshaw, 2008). Few more studies consider how levels of male hormone ‘testosterone’ boosts the right hemisphere of the human brain which result in excessive activity, unlike in females.

1.2.2 Psychosocial basis of ADHD

Family studies and social psychology research evidence suggest that family background is associated with childhood ADHD with conduct problem. There are numerous factors that could be contributing in developing ADHD like disturbances in family and marital functioning, reduced parental efficacy, strained parent-child relationship, parenting stress and parental psychopathology (Johnston & Mash, 2001).

There are few studies conducted to understand the nature of ADHD prevalence around the globe. It raises questions about the susceptibility of disorder itself which ranges from gender based studies, age related studies, sibling studies, biological factors and many more studies on psychosocial factors.

There are many conventional notions about the prevalence of ADHD and its management. One of it could be how ADHD cases diagnosed under a pediatrician receive diagnosis and are managed in the primary care setting and have fewer comorbid psychiatric disorders and milder impairments as compared to those diagnosed and managed in a Psychiatric clinic. This could prevent significant cases of ADHD from seeking appropriate intervention followed by delay in early detection
and intervention. This notion on the other hand has been refuted in few other studies that consider equal prevailing factors of ADHD in both Pediatric and Psychiatric clinic. The noted how all patients could be desirable of having comorbid symptoms with mood disorders, other disruptive behaviour, anxiety disorders and substance use disorders (Busch, et al., 2002).

Most of the studies carried out on prevalence of ADHD are done on the Western Population. There is a lack of adequate information about this population in India. This could be due to delayed diagnosis among children, lack of awareness among the Indian population especially the parents and children, lack of adequate resources like health professionals, screening tools, cases of misdiagnosis in the health sector (Crawford, 2017).

Due to the above-mentioned reasons, prevalence of ADHD goes unaccounted in our country which in turn disables further progressive opportunities in the field of Mental Health in designing appropriate methods of assessments, early intervention and creation of holistic awareness among parents and teachers.

1.2.3 Behavioural vulnerabilities of untreated ADHD

According to Alan Wachtel in 2018, ADHD when left untreated could result in academic, social and emotional difficulties in childhood, upto 58% of such children fail a grade in school, 46% face suspension and 30% adolescent fail to complete high school. These children during adolescence are more likely to self-medicate with drugs and alcohol and tobacco, making them prone to substance abuse (Kessler, 2018).
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It also has higher risks of following a person into adulthood as Adult ADHD, impacting job performance, marital and family relationships, mental health, and automobile safety. 79% of them, as not treated during childhood experience symptoms of comorbid conditions such as anxiety, depression and physical ailments. Evidence suggests 78% of untreated adults are addicted to tobacco and 58% are more likely to use illegal drugs than people without adult ADHD. Due to inattention, impulsiveness and hyperactivity, young drivers and even adults with untreated ADHD have two or more vehicle crashes due to rash driving (Kessler, 2018).

In a study the average age at which the children were diagnosed of ADHD was 11.36 years (with a range from 7 to 17 years), while the average age at which the children symptoms had first been noticed was only 5.55 years (with a range from 4 to 6 years). The delay between symptoms first being noticed and the child being diagnosed ADHD was nearly 6 years on average for the children (Crawford, 2007).

Another study had reported that the mean age at diagnosis for 391 children with ADHD was 8.7 years and that girls were more likely to have been diagnosed prior to age 8. Thus, it is not surprising that all of the children in their study demonstrated poor school performance by the time they were assessed in the author’s clinic (Crawford, 2007).

It is noticeable how a child with ADHD has major difficulty in performing scholastically to finest levels, which indirectly creates an emotional loop in the family setting where the inability of the child’s performance creates distress among family members which in return has an emotional impact on the child. This becomes
an on-going process which requires vigorous guidance to overcome (Crawford, 2017).

1.2.4 Treatment of ADHD

There are numerous treatment alternatives available for managing ADHD. It ranges from ‘behaviour therapy’ to ‘medications’ available in the field of mental health. American Academy of Paediatrics (AAP), 2017, suggests ‘behaviour therapy’ to be the first line of treatment for children under six years of age before medication. ‘Behaviour therapy’ includes 8-16 sessions of ‘parental training’ with a therapist who enables them to learn strategies to help their child. Medications categorized under stimulants and non-stimulants are also useful in treating ADHD in childhood as well as in adulthood (Attention-Deficit/Hyperactivity Disorder (ADHD), 2017).

In order to facilitate such a scenario of early diagnosis and productive intervention, there is an immediate need for a continued research work on prevalence of ADHD. Most of the studies conducted on the prevalence rate of ADHD are Western Research studies. The handful of studies that aimed to study the same in India was mostly in parts of the Tamil Nadu, Karnataka, Uttar Pradesh, Maharashtra and New Delhi. There are minimal of studies being conducted in the rest of India, including the state of Madhya Pradesh. This again, calls for an urgent need to conduct an in-depth teamwork on its prevalence.

1.3 Statement of the problem:

This research work aimed to study the prevalence of ADHD among school going children in the city of Gwalior, Madhya Pradesh. It also highlighted any
differences among various other factors like gender difference and comorbid behavioural deficits among the children screened for ADHD.

1.4 Operational Definitions:

1.4.1 In this study, the *diagnosis of ADHD* is purely based on the assessment tool used for interviewing the teachers and parents of the children selected for the study. Conner’s Abbreviated Rating Scale (Conners, 1969) was used as a ‘screening tool’ to assess the presence of ADHD symptoms among the school going children. The diagnosis of ADHD was considered as 15 and above as mentioned by Conners. And apart from this, the researcher had introduced three other categories on the basis of severity namely, Sub-Clinical (11-14), Abnormal (15-20) and Severe (21-30)

1.4.2 The presence of any *comorbid behavioural deficit* was also measured based on the screening tool Children Behaviour Questionnaire- B (Rutter, 1967) to determine any maladaptive behaviour observed in the child in school.

1.5 Rationale of the study:

Attention Deficit Hyperactivity Disorder (ADHD) is among the most prevalent neuro-developmental childhood disorders in the world. Unlike other childhood psychiatric disorders like Intellectual Disability, Autism Spectrum Disorder, Learning Disability etc., there is a degree of lack in awareness about ADHD. The rapid growth of this chronic condition among school-going children is partially known in our country. The higher the awareness among people, especially, parents and school authorities and mental health professionals, the earlier would be
the identification of the disorder among children which could facilitate appropriate intervention and lack of misdiagnosis (Crawford, 2017).

Also, there is only a handful of research conducted on the prevalence of ADHD in India. As the researcher has not come across any such study conducted in Gwalior, Madhya Pradesh, this study would act as a contribution to the research field that aims to study the prevailing growth of ADHD across various states of India.

This would enable detection at an infant level and promote better intervention measures and create awareness among the school authorities and parents. It would act as a bridge which might facilitate a collaboration of mental health professionals with these schools which could enable adequate awareness in the city.

1.6 Objectives of the research study-

1.6.1 To study the prevalence of ADHD in children aged 5-12 years in urban schools of Gwalior, Madhya Pradesh.

1.6.2 To identify the gender difference in the prevalence of ADHD.

1.6.3 To identify the presence of any co-morbid factors associated with ADHD.