Introduction

Attention-deficit/hyperactivity disorder (ADHD) is the most common neurodevelopmental disorder of childhood identified by cognitive-behavioral deficits. It may affect up to 5% of the population. The core characteristics of ADHD at the behavioral level involve hierarchically interrelated domain a general ADHD dimension and distinct traits of inattention and hyperactivity- impulsivity. ADHD patients may exhibit cognitive impairment in several specific cognitive domains, including response inhibition,working memory, short-term memory, processing speed, vigilance, and response variability. These multiple cognitive deficits manifest as the mild intellectual inefficiency typical of ADHD, as fluid intelligence – a more general cognitive function related to solving new problems– is related to all of the aforementioned cognitive domains. Both the cognitive and the behavioral aspects of ADHD have a major impact on patient functionality, and understanding how fluid intelligence and ADHD symptoms are related to ADHD outcomes is of the outmost relevance. Poor academic performance, particularly in written language and mathematics, is a usual feature of children with ADHD.

ADHD, intelligence, and reading and mathematical disabilities are heritable, and their association may primarily be explained by shared genetic influences.

Nevertheless, how this association occurs at different levels remains controversial.

The hyperactive-impulsive symptoms of ADHD appear to be associated with academic failure, but behavioral inattentive symptoms are more strongly related to school performance. Reading and math abilities exhibit

stronger phenotypic and genetic associations with the inattentive dimension than with the hyperactive-impulsive dimension. In fact, the genetic association between hyperactivity- impulsivity and academic performance seems related to shared genetic influences between the hyperactive- impulsive and inattentive traits. In this sense, inattention is likely to be the core source of lower academic performance in ADHD.

Although there is no consensus about the nature of the relationship between the cognitive and behavioral aspects of ADHD (the influence may be bidirectional), cognitive characteristics alone are strongly related to academic success. Fluid intelligence is itself one of the strongest predictors of school performance. At any rate, the common inverse correlation between neuropsychological domains and hyperactivity-impulsivity does not remain significant when controlling for inattentive symptoms, suggesting that behavioral inattention is more closely associated with cognitive level in ADHD. As the cognitive characteristics of ADHD are often pointed out as intermediate features between clinical and genetic levels (cognitive that the inattentive dimension accounts for the cognitive endophenotypes), it is possible influence of ADHD on educational outcomes (cognitive to- behavioral influence). However, few studies have addressed the way in which the cognitive aspects and behavioral dimensions of ADHD influence academic performance. Previous studies have found no impact of intelligence level on the association between ADHD symptoms and school achievement after statistically controlling for IQ in predictive models. On the other hand, cognitive impairment may lead to more severe ADHD symptoms, suggesting a clear relationship between the cognitive and behavioral aspects of ADHD. Still, these results are not necessarily opposites. When

strongly associated variables are taken simultaneously in predictive models, some of the predictors may not appear to exert a significant influence on outcomes. However, when each variable is viewed separately as a unique predictor, all of them may show significant predictive power. This might suggest that, in a simultaneous model, an indirect effect is at play – i.e., one of the variables does not hold as a significant predictor because its predictive power is accounted for by the other independent variable. Therefore, the effect of cognitive variables such as intelligence on school performance in ADHD may be mediated by the behavioral symptoms of the disorder. However, to the best of our knowledge, no studies have directly examined this mediation model at the phenotypic level.

Importance of The Study:

Early diagnosis and treatment of learning disorders in children with ADHD will affect the severity of the clinical picture and subsequently the prognosis and thus we can prevent school failure in these cases because many of those children are missed in diagnosis with the hazards of school drops out and other psychiatric co-morbidities of ADHD. So, they can have better life opportunities & life styles to them and their families.

AIM OF THE STUDY

1. To evaluate the prevalence of learning disorders in children diagnosed as having ADHD.
2. To study profile of ADHD comorbidity with learning disorders.

ATTENTION DEFICIT HYPERACTIVITY DISORDERS

Definition:

Attention-deficit/hyperactivity disorder (ADHD) is currently defined as a cognitive developmental disorder where all clinical criteria are behavioral. Overactivity, impulsiveness, and inattentiveness are presently regarded as the main clinical symptoms. **(Sagvolden, 2011)**

Prevalence:

This disorder is one of the most prevalent neurobehavioral conditions of childhood, affecting a substantial proportion of the population **(Faraone et al., 2003).**

Although prevalence estimates reported by individual studies varied widely, pooled results suggest that the prevalence of DSM-IV ADHD is similar, whether ADHD is defined by parent ratings, teacher ratings, or a best estimate diagnostic procedure in children and adolescents **(5.9– 7.1 %),** or by self-report measures in young adults **(5.0 %).** Analyses of diagnostic subtypes indicated that the predominantly inattentive type is the most common subtype in the population, but individuals with the combined type are more likely to be referred for clinical services. **(Willcutt, 2012)**

ADHD also occurs more often in boys than in girls, although estimates of the ratio of boys to girls vary considerably, with ratios in clinic – based samples reported to be as **high as 6:1** and **as low as 1:1** in community – based samples. **(Barkley, 2006).**

In Egypt, many studies were done to estimate prevalence rate of ADHD in different cities. A study was done in Assuit City among elementary schools children of both sexes which revealed that the rate was **6%,** the subtypes were: ADHD-predominant hyperactive-impulsive type **3.3%** ADHD-combined types **2%** and ADHD- predominant inattentive type 0.7%, male to female ratio 1.5:1. **(El-Tallawy et al., 2000).**

The prevalence of ADHD among primary school children in Cairo was **6.1% (Abuo El Maaty, 1996**), while the prevalence among boys at primary school was **8.0%** and among girls was **3.3%**. **(Azab et al., 2010)**.

Etiology:

ADHD is not a single pathophysiological entity and appears to have a complex etiology. Multiple genetic and environmental factors act together to create a spectrum of neurobiological liability. **(Curatolo et al., 2010** liability.

TABLE (1) :Etiologic Classification of ADHD

Group	Timing	Etiologic Factors
Genetic		Dopamine deficit, idiopathic
Acquired	Prenatal	Developmental cerebral abnormality, chromosome anomaly, viral exanthema, alcohol, nicotine, lead, cocaine, anemia, hypothyroidism, iodine lack.
	Perinatal	Prematurity, low birth weight, anoxic-ischemic encephalopathy, meningitis, encephalitis.
	Postnatal	Viral meningitis, encephalitis, cerebral trauma, iron Deficiency, a fatty acid deficiency, a thyroid dysfunction, otitis Media

(Millichap, 2008)

Gene-environment interactions

Gene-environment interactions (GxE) operate in two ways: 1) a genetic factor may enhance or diminish the impact of a particular environment and 2) an environmental factor may activate a genetic effect.

GxE has been reported between various genetic variants and environmental factors such as maternal smoking and maternal alcohol use during pregnancy, LBW, season of birth, and psychosocial adversity. **(Purper – Ouakil et al., 2011)**. Recent studies have focused on the joint effects of gene variants (of DRD4 and DAT1) and prenatal substance exposures on subtypes of ADHD children, demonstrating that smoking during pregnancy is associated with the combined ADHD type in genetically susceptible children**.** A significant interaction between DAT1 genotype and prenatal smoke exposure was found in males. (**Curatolo et al., 2010)**.

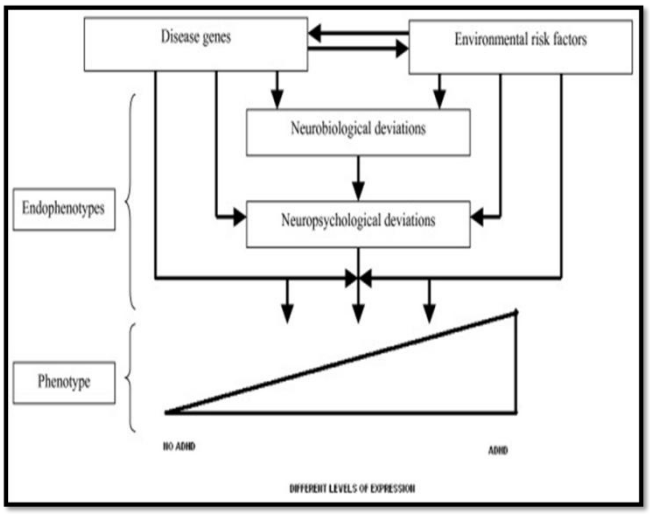

Figure (1): **The relationship between genetic and environmental risk factors, endophenotypes, and phenotype in ADHD (Rommelse et al., 2008)**

Clinical presentation of ADHD

The presentation of ADHD differs according to the age at which the diagnosis is considered. Negative consequences of undiagnosed or poorly managed ADHD also vary depending on age at presentation ***(Ryan-Krause, 2010).***

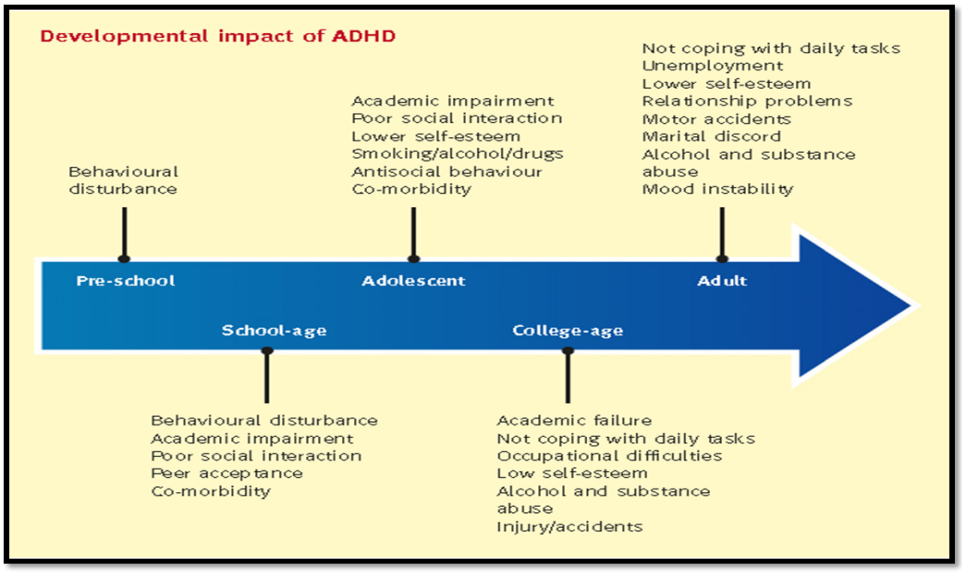

Fig (2): Developmental impact of ADHD (Asherson, 2012).

The correlation between ADHD and executive function:

- **There is a basic characteristic language disorders with ADHD:**

In a subsequent study, ***Lorch et al., (2000)*** found that ADHD children comprehended factual details from televised stories as well as normal children, but were poorer in understanding and recalling some causal relationships among events in the stories. These preliminary findings suggest that ADHD children comprehend surface details adequately, but may show deficits on tasks that require relatively higher degrees of vigilance, effort, and controlled

processing. Beyond these few empirical findings, the area of language comprehension and ADHD has remained virtually unexplored ***(Mcinnes et al., 2003)***.

- **ADHD and Time perception Deficits:**

The ability to perceive and represent time is a fundamental but complex cognitive skill that allows us to perceive and organize sequences of events and actions, and to anticipate or predict when future events will occur. Empirical evidence has shown that children with ADHD manifest**.** deficits in motor timing tasks ***(Van Meel et al., 2005).***

Evidence from neuro-imaging studies has also provided preliminary findings on the dysfunction of duration discrimination in children with ADHD. Duration discrimination tasks involve the cerebellar, prefrontal cortex, and basal ganglia regions ***(Smith et al., 2003),*** which have been consistently implicated in the pathophysiology of ADHD (***Castellanos et al., 2002).***

It is believed that all individuals with ADHD suffer from significant impairment of executive function, and that ADHD essentially is a developmental impairment of executive function. ***(Denkla, 1996).***

Diagnostic Criteria and Definition:

ADHD is associated with the core symptoms of attentiona1 dysfunction, defective response inhibition or impulsivity, and motor restlessness or hyperactivity.

Symptoms must begin before age 7 years, are maladaptive, and are inconsistent with the individual's developmental level ***(American Psychiatric Association 1994).*** **DSM-IV- diagnostic criteri**a require that ADHD - related

behaviors exist in at least two different setting (e.g., home, school), cause significant impairment, and not be better accounted for by another disorder **(Calev, 1999), (American Psychiatric Association 2000).**

DSM- IV - TR notes three subtypes of ADHD. The clinician should identify the individual as having one of the following:

1. Attention-deficit/hyperactivity disorder, combined type:

2. To be used if both Criteria Al and A2 are met for the past months Attention-deficit/hyperactivity disorder, predominantly inattentive type for the past 6 months.: to be used if Criterion A1 is met but Criterion A2 is not met

3. Attention-deficit/hyperactivity disorder, predominantly hyperactive impulsive type to be used if Criterion A2 is met but Criterion Al is not met for the past 6 months.

DSM-IV- TR diagnostic criteria for ADHD

- **A:** A persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development as characterised by inattention and/or hyperactivity/impulsivity.
- Inattention – ≥6 of the following (if 17 years or older, only 5 required):
- often fails to give close attention to details or makes careless mistakes
- often cannot sustain attention in tasks or play activities
- does not seem to listen when spoken to directly (mind seems elsewhere)

- often does not follow through on instruction and fails to finish schoolwork (starts tasks and loses focus easily)
- often has difficulty organizing tasks and activities
- often avoids or dislikes tasks requiring mental effort
- often loses things
- easily distracted
- forgetful in daily activities.
- Hyperactivity and impulsivity – ≥6 of the following (if 17 years or older, only 5 required):
- often fidgets with hands or squirms in seat
- often leaves seat
- often runs or climbs about when inappropriate (adults have inner restlessness)
- unable to play quietly
- is often on-the-go or acts as if driven by a motor
- talks excessively
- blurts out answers before the question has been completed
- often has difficulty waiting his/her turn
- often interrupts or intrudes on others.
    - **B:** Several inattentive or hyperactive-impulsive symptoms were present before the age of 12 years (previously 7 years).

- **C:** Several inattentive or hyperactive-impulsive symptoms are present in two or more settings (e.g. at home, school or work or other activities).
- **D:** There is clear evidence that the symptoms interfere with social, academic or occupational functioning.
- E: Symptoms do not occur exclusively during the course of schizophrenia or are not better explained by another mental disorder. **[APA, 2000]**

Changes in DSM 5

ADHD is now classified as a neurodevelopmental disorder. Such disorders typically manifest early in a child's development and produce impairments of social, academic, personal or occupational functioning.

The neurodevelopmental disorders are:

- intellectual disability
- communication disorders
- autism spectrum disorders
- ADHD
- specific learning disability
- motor disorders (tics, stereotypic movement and developmental co-ordination disorder).
- **Other changes in DSM 5 differed from DSM IV-R:**

- (1)Symptoms must be present prior to the age of 12 years (previously 7 years).
- (2)ADHD can be diagnosed with comorbid autism spectrum disorder.
- (3)-There is a lower symptom threshold for adults/adolescents
- (4)(**5** symptoms compared with **6**).
- Specifies of presentation (combined type, hyperactive/impulsive type or inattentive type) and severity (mild, moderate or severe).[2]
    - ADHD has three main symptom clusters – inattention, hyperactivity and impulsivity.
    - The predominant symptoms of ADHD may vary with age, as shown in Table 4.
    - Other symptoms that may be seen, but that are not necessarily part of the diagnostic criteria, include:
- impaired impulse control and the capacity to delay gratification
- inability to stop and think before acting/doing
- social clumsiness
- poor co-ordination
- disorganization
- forgetting to do things or poor working memory
- delayed development of internal language and rule-following
- difficulties with regulation of emotions, motivation and arousal
- diminished problem-solving ability and flexibility.