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EFFECTS OF DAYLIGHT EXPOSURE ON THE SYMPTOMS OF ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD) IN SCHOOL-AGED CHILDREN

Master's Thesis

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ABSTRACT

EFFECTS OF DAYLIGHT EXPOSURE ON THE SYMPTOMS OF ATTENTION DEFICIT HYPERACTIVITY DISORDER (ADHD) IN SCHOOL-AGED CHILDREN

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Master of Architecture

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Attention Deficit Hyperactivity Disorder (ADHD) in developed countries is a broadly studied problem. However, ADHD is rarely reported in developing countries. The literature on the subject does not provide a clear understanding of the relationship between daylight and ADHD. Thus, the purpose of this study is to investigate whether the amount of daylight exposure has a role in reducing ADHD symptoms of school-aged children. The study follows quantitative methods, and it was carried out in two phases: In the first phase, the severity of ADHD symptoms was measured by using Connors Teacher Rating Scales and Connors Parent Rating Scales in a sample of 32 Arab students aged 12-13 years. In addition, the amount of daylight exposure in the sample was also measured for a school week. In the second phase, the children were exposed to outdoor daylight conditions for an hour in the morning between 10:00 AM and 11:00 AM during the following school week. The severity of their ADHD symptoms was also assessed by both the parents and teachers following the exposure period.

Results based on the evaluation of both teachers and parents showed that after exposing the children to daylight outdoors, a moderate decrease in symptoms of ADHD was observed in the second week compared to those measured in the first week. In addition, the results show a moderate negative relationship between teacher and parent assessments and student academic scores. Also, a positive relationship was identified between participants' Oppositional scores based on parents' ratings and English scores. Moreover, the results of parent-teacher assessments based on gender variable did not make much difference to ADHD scores.

Exposure to daylight has numerous positive effects. Integrating daylight to buildings could be enhanced productivity and ability of learning. Research has shown that children in classrooms with daylight exhibit improved learning ability. The findings mentioned above indicate that exposure to daylight outdoors or outdoor illuminance levels can reduce the severity of ADHD symptoms in school-aged children. The research recommends that architectural designers should take into consideration integrating daylight with built environments like schools. Also, routine exposure to daylight is beneficial for children with and without ADHD symptoms. Further investigations for better understanding the complex problems about the interaction with and perception of the built environment are needed. The study strongly recommends architectural designers

to deal with ADHD children’s needs by incorporating daylighting in learning environments.

Keywords: ADHD, Daylight Exposure, School-Aged Children, Architectural Design, Classrooms.

ÖZET

GÜN IŞIĞI MARUZİYETİNİN OKUL ÇAĞINDAKİ ÇOCUKLARDA GÖRÜLEN DİKKAT EKSİKLĞİ HİPERAKTİVİTE BOZUKLUĞU (DEHB) BELİRTİLERİ ÜZERİNDEKİ ETKİLERİ

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Dikkat Eksikliği Hiperaktivite Bozukluğu (DEHB) gelişmiş ülkelerde geniş çapta incelenmiş bir sorundur. Bununla birlikte, DEHB gelişmekte olan ülkeler bağlamında nadiren rapor edilmektedir. Konuyla ilgili literatür incelendiğinde, gün ışığı ve DEHB arasındaki ilişki tam olarak bilinmemektedir. Bu nedenle gerçekleştirelen bu çalışma, okul çağındaki çocukların DEHB belirtilerini azaltmada gün ışığına maruz kalma miktarının rolünün olup olmadığını araştırmayı amaçlamaktadır. Çalışma kantitatif yöntemleri kulanmakta ve iki aşamada gerçekleştirilmektedir: İlk aşamada DEHB belirtilerinin şiddeti, 12-13 yaşlarındaki 32 Arap öğrenciden oluşan Connors Öğretmen Puanlama Ölçekleri ve Connors Ebeveyn Derecelendirme Ölçekleri kullanılarak ölçülmüştür. Ayrıca, bir okul haftası için örneklemdeki gün ışığına maruz kalma miktarı da ölçülmüştür. İkinci aşamada, çocuklar bir sonraki okul haftasında sabah saat 10.00 ile 11.00 arasında sabah saat açık hava koşullarına maruz kalmıştır. DEHB belirtilerinin şiddeti maruziyet dönemini takiben hem ebeveynler hem de öğretmenler tarafından değerlendirilmiştir.

Hem öğretmenlerin hem de ebeveynlerin değerlendirmesine dayanan sonuçlar, DEHB olan ve olmayan çocukları orta gün ışığına maruz bıraktıktan sonra, ilk haftada ölçülenlere kıyasla ikinci hafta DEHB semptomlarında bir düşüş olduğunu göstermiştir. Ayrıca, sonuçlar öğretmen ve edeveyn değerlendirmeleri ile öğrenci akademik puanları arasında orta düzeyde negatif bir ilişki olduğunu göstermektedir. Ayrıca, öğrencilerin "Oppositional" puanları ve İngilizce notları arasında pozitif ilişki tespit edilmiştir. Bu sonuçlara ek olarak, cinsiyet değişkenine dayalı ebeveyn-öğretmen değerlendirmelerinin sonuçları DEHB puanlarında fazla bir fark yaratmamıştır.

Gün ışığına maruz kalmanın sayısız olumlu etkisi vardır. Gün ışığını binalara entegre etmek üretkenliği ve öğrenme yeteneğini artırabilir. Araştırmalar, gün ışığı alan sınıflardaki çocukların gelişmiş öğrenme yeteneği sergilediğini göstermiştir. Yukarıda belirtilen bulgular, dış mekanda gün ışığına veya dış mekan aydınlık düzeylerine maruz kalmanın, okul çağındaki çocuklarda DEHB belirtilerinin şiddetini azaltabileceğini göstermektedir. Araştırma, mimari tasarımcıların gün ışığını okullar gibi inşa edilmiş ortamlarla entegre etmeyi dikkate almasını önermektedir. Ayrıca, gün ışığına rutin maruz kalma DEHB belirtileri olan ve olmayan çocuklar için faydalı olabileceği düşünülmektedir. Yapılı çevreyle etkileşimi ve algılanması ile ilgili karmaşık sorunları daha iyi anlamak için daha fazla araştırmaya ihtiyaç vardır. Çalışma, mimari tasarımcılara, gün ışığını öğrenme ortamlarına dahil ederek DEHB çocuklarının ihtiyaçlarını karşılamalarını şiddetle tavsiye etmektedir.

Anahtar Kelimeler: DEHB, Gün Işığına Maruz Kalma, Okul-Yaşındaki Çocuklar, Mimari Tasarım, Sınıflar.

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ABBREVIATIONS

ADHD	:	Attention Deficit Hyperactivity Disorder
ART	:	Attention Restoration Theory
CD	:	Conduct Disorder
CPRS-R:S	:	Conners’ Parent Rating Scale-Revised: Short
CTRS-R:S	:	Conners’ Teachers Rating Scale-Revised: Short
ODD	:	Oppositional Defiant Disorder
SAD	:	Seasonal Affective Disorder

1. INTRODUCTION

1.1 THE GENERAL BACKGROUND OF STUDY

The most prevalent cognitive and behavioural disorder diagnosed in school-age children is Attention Deficit Hyperactivity Disorder (ADHD). Furthermore, insufficient attention, insufficient problem-solving skill, hyperactivity, and problems in retaining incorrect behavioural responses are characteristic of ADHD. It is estimated that 5-10 % of children suffer from this prevalent disorder. In many cases, it continues into adulthood, leading to 4% prevalence among adults (Banerjee *et al*., 2007).

The aetiology of ADHD has not been identified. However, evidence supports its neurobiological and genetic origins (Biederman, 2005). Conventional treatment of this disorder usually consists of behavioural accommodations and medication, with stimulant medication most commonly being prescribed. However, there are many potential side effects associated with this treatment. Parents worry about the side effects and the long-term use of conventional drugs and therefore, are usually looking for alternatives to pharmacological treatment (Pellow *et al.,* 2011).

ADHD is one of the most accurately investigated medical disorders (Goldman *et al.*, 1998). It has been associated with a wide range of negative outcomes for the affected subjects (Dulcan, 1997). For this reason, it is characterized as a considerable public health problem (Faraone *et al.*, 2003). ADHD is influencing the main life routines of children with this disorder, including education, working social relationships, the functioning of households, self-sufficiency and conformity with laws and norms (Carey and Diller, 2001).

According to clinical research, it is suggested that children with ADHD are far more likely than the general population to leave school (32-40%), to engage antisocial activities (40-50%), and have few or no friends (50-70%) (Barkley *et al.*, 2002). This important understanding shows the way to deal effectively with these issues (Kutscher, 2008).

1.2 THE SIGNIFICANCE OF STUDY

Early identification of children with ADHD symptoms is a valuable and responsible approach to serving children with special requirements (Rutter and Taylor, 2002). As a result of ADHD and other difficulties, such as learning disabilities, evaluation of the disorder should consider psychological and behavioural factors. Compared with the behaviours of other children of the same mental age, those behaviours should be assessed in a developmental context using methods for assessment, which provide sufficient normative data (Spencer *et al.,* 2007).

The literature of nature benefits has been growing steadily (Kaplan, 1989). Many studies have confirmed nature's role in improving attention (Ulrich, 1992). Kaplan has suggested that attention enhances after exposure to natural environments. In addition, there is a study that investigated the effects of exposure to nature among ADHD children (Taylor, Kuo and Sullivan, 2001). It concentrated on children aged (7-12 years) who clinically diagnosed with ADHD. Parents rated different leisure activities for whether the symptoms of their children were better than, or the same as usual after engaging in those activities. The findings showed that symptoms were better than usual after activities in green settings, furthermore, the greener a child's typical play settings, the less severe her or his general symptoms. Moreover, the effects of green outdoor activities could not be lead to overall influence stemming from being outdoors to a social setting, type of activity or preference for nature. Nonetheless, it can be concluded that nature has a strong role in reducing symptoms of ADHD.

Daylight helps maintain good health and can treat many health issues children, also perform better with daylight. Numerous studies have shown that children in classrooms with daylight achieve higher test scores than students in windowless classrooms. In addition, many indications linked to nature could reduce the symptoms of ADHD (Kuo and Faber Taylor, 2004). Moreover, research among ADHD children and healthy children reveals that contact with nature can reduce the symptoms of ADHD and associated problems like mood and depression. Therefore, it can be said that daylight as one of the components of nature could influence on the symptoms of ADHD, as the recent study aims to investigate this possible influence.

1.3 PURPOSE AND QUESTIONS OF RESEARCH

The main aim of this study was to know the effect of exposure to daylight in reducing symptoms of the disorder in primary school children.

The main question of the research was: Is there a relationship between the amount of daylight exposure and ADHD symptoms in school-age children? Moreover, what is the nature of this relationship if it exists?

2. LITERATURE REVIEW

2.1 DEFINITION OF ADHD

Attention Deficit Hyperactivity Disorder (ADHD) is the most common diagnostic label for children. It is generally associated with considerable problems with attention, impulsiveness and overactivity (Barkley, 1998a). Children with ADHD form a heterogeneous group with significant differences in their degree of symptoms. Furthermore, diagnosis requires that some of the inattentive or hyperactive-impulsive symptoms be present before age 7; in at least two settings such as school, home or work, a certain deficiency should be evident.

While its name is somewhat recent, the behavioural ADHD condition has been known since the beginning of the twentieth century. Moreover, the aspects of this syndrome gradually emerged from observations over many years from empirical research in pharmacology, paediatrics medicine and education and the primary symptoms of ADHD are constant in the earliest observations and throughout numerous changes in terminology (Kessler and Cleary, 1980). The changes in definitional boundaries and, thus, conceptions of aetiology reflect changing scientific paradigms (Epstein *et al.*, 1998). The concept of ADHD has evolved with changing evidence that be considers as a strength. A comprehensive review of the evidence about diagnostic and treatment carried out by the studies of ADHD concludes that the diagnostic criteria of ADHD are based on extensive emotional studies and, if applied suitably, lead to the diagnosis of the disorder with high interpret reliability (Goldman, 1998).

It has been documented that children who had ADHD symptoms were recognized in the mid-1800s (Kessler *et al.*, 2005). The first well-reported information of the disorder noted in England. Specifically, when Still (1902) labeled the group of behaviours as "defects in moral control" subsequently, other labels were given children associated with similar symptoms of ADHD.

In the fifties, the disorder was called "hyperactivity" and typically was associated with "brain damage" (Barkely, 2005). Later, this disorder was characterized by inattention, impulsivity, and hyperactivity.

The new condition label, Attention Deficit Hyperactivity Disorder (ADHD), appears in the DSM-IV. The criteria are widely applied for the identification of children with ADHD defined by the DSM-IV (APA, 2000).

According to Lloyd and Norris (1999), the identification of ADHD children increased rapidly in the nineties. The majority of disorder-related work comes from Western and developed countries; little is seen in developing countries about ADHD (Rohde, 2002).

There are several explanations of ADHD appeared in the literature in terms of definition, cause and treatment, the first interpretation is that ADHD is a "disease" or "medical deficiency" (Shaw *et al.,* 2007). Milich (1994) has demonstrated that there is evidence that medications improve the performance of children with ADHD. However, this view was perceived differently from country to country. A limited number of schoolchildren diagnosed with ADHD have prescribed medicines annually in the UK, and a more adopted method is considered in the USA (Lloyd *et al.,* 2006).

Furthermore, according to Tannock (1998), the ADHD interpretation revealed that children with ADHD have important difficulties in cognitive processes, such as activation, attention, and memory. Cognitive research evidence emphasizes that children with ADHD have difficulty in inhibiting and working memory. It is suggested that deficits in executive functions characterize ADHD (Barkley, 1997).

According to some researchers, they are not convinced about the biological basis of ADHD and claim that the behavioural characteristics of children with ADHD who identified by DSM-IV do not have validity in a given culture (Lloyd *et al.,* 2006).

The medical interpretation considers ADHD as a medical issue and proposes a medical treatment for ADHD children. The psychological interpretation presents ADHD as cognitive deficiency and hence proposes cognitive therapy for these children; both interpretations consider ADHD as impairment within the child. It needs a solution to treat and reduce the symptoms. The social interpretation of ADHD argues that some factors affect the behaviour of the child. The basis of the sociological perspective of ADHD is that the current medical methods of identifying ADHD do not connect enough with learning and behavioural difficulties associated with sociological factors (Lloyd *et al.,* 2006).

Furthermore, Lloyd and Norris (1999) propose that the medical interpretation does not include the child's responsibility for their actions or the role of the society in creating childhood behavioural problems. That is why ADHD can best be explained as a social construct than as a medical construct (Timimi, 2002). It is proposed that the behavioural issues of ADHD children are derived from social causes (Lloyd, 2006). However, Timimi and Taylor (2004) suggested that this interpretation alone is not enough to obtain valuable information about the causing factors associated with symptoms of ADHD in children. There appears to be no professional agreement about what is or should be done with ADHD (Timimi and Taylor, 2004).

Cooper (1997) recognized the limitations of both medical and non-medical interpretation, based on the absence of certain neurological or cognitive signs, or a biomedical test for ADHD and, therefore, understanding that the disorder is complex in terms of biomedical perspective very limited (Timimi and Taylor, 2004). However, a set of psychological and biomedical factors should be used to explain ADHD (Hughes and Cooper, 2007).

Where Timimi (2004) proposes a view that clear immaturity of children is a biomedical aspect, but the way of understanding and making it valuable is a matter of social effects (Cooper, 1997). The essence of this idea is that ADHD is a dynamic phenomenon that can be understood in different ways (Cooper and Bilton, 2002). However, the literature on this kind of research is minimal. A systematic approach is therefore required to evaluate ADHD, which may require multiple evaluation methods, including teachers, parents, and children. Each of these participants can provide different views which could serve to assist in explaining many concepts of ADHD. Most of these interpretations of ADHD have presented in western literature, while non-Western rarely appeared (Hughes and Cooper, 2007). Although ADHD is generally considered as a medical problem, the nature of behavioural symptoms of ADHD mostly influences social situations like schools.

According to Wheeler *et al.* 2008 showed that educational context is affected mostly by this disorder; that is why the presence of ADHD children is a crucial cause of concern for teachers and parents.

Additionally, Hughes and Cooper (2007) propose that the importance of understanding ADHD as an educational problem to guide teachers to identify children with symptoms of ADHD, in order to provide their needs. Another vital point of considering ADHD as an educational issue of inadequate. Home and classroom environments may increase the difficulties related to this problem in every country. The academic performance of children is a significant criterion for evaluating the current education system. Therefore, children with limited academic performance are not only an issue for teachers and parents but also the responsibility of educational policymakers.

Numerous studies have shown that causes of ADHD are not fully known even though they have considered one of the most highly studied psychiatric disorders (Cooper, 2008). Tannock (1998) identified three major areas of cognitive, neurobiological, and genetic research for the scientific study of ADHD. Studies in these areas offer a solid framework for proposing a multi-model treatment protocol integrating medical, psychological, and educational aspects. These dimensions are important for understanding ADHD construct. There are three main symptoms associated with ADHD, that are inattention, hyperactivity, and impulsivity. The first main symptom of ADHD is inattention, children with ADHD exhibit difficulties with attention problems such as; "does not seem to listen", " fails to finish assigned tasks", " often loss things", "cannot concentrate", "easily distracted", "cannot work independently of supervision", “shifts from one uncompleted activity to another” and “confused or seems to be in a fog” (Mahone *et al.*, 2002).

ADHD's second primary symptom is impulsiveness. Children with ADHD often respond to situations quickly without waiting for instructions; careless errors are often the result. They also take frequent risks. They can damage or destroy the properties of other people far more frequently than children without ADHD (Granger *et al.*, 1996). Moreover, it is often difficult for children with ADHD to wait until their turn in a game or group before going to activity. They are also notorious for taking "shortcuts" (Murphy *et al.*, 2001).

The third main symptom of ADHD and the impulse control challenges are hyperactivity. A child with ADHD describes as: "always up and on the go", "acts as if driven by a motor", "climbs excessively"," cannot sit still", " often hums or makes odd noises", talks excessively" and "is squirmy". These children at school are often moving around in their classroom, restlessly moving their legs and arms.

Because of all that has been mentioned so far, one may say that “ADHD is a more persistent and severe pattern of inattention and hyperactivity-impulsion than is usually found in people with a similar stage of growth" (APA, 2001). The DSM-IV-TR (APA, 2001) also states that: "some hyperactive-impulsive or inattentive symptoms that cause impairment must have been current before age seven years; some impairment from the symptoms must be present in 2 environments for instance, at home and school"; there must be clear evidence of meddling with developmentally appropriate social, academic, or occupational functioning; and the disturbance is not better accounted from any another mental disorder".

2.2 THE PREVALENCE OF ADHD IN SCHOOL-AGED CHILDREN

It is proposed that nearly 1.7% of the United Kingdom population is thought to have ADHD (Likierman and Muter, 2005). Epidemiological research in the USA assesses that ADHD might be the main cause for concern 3-5 % Equivalent 2 million children who receive a formal diagnosis with ADHD (NIMH, 2008). In other places of the world, the rate of ADHD prevalence is poorly defined. However, the literature in these regions proposed that ADHD is generally acknowledged as a significant source of concern. According to Faraone *et al.*, 2003 the world prevalence rate for ADHD reported ranged from 1% to 20% for children of school age, this reflects negatively on obtaining an accurate form of issues associated with ADHD (Timimi, 2005; Lioyd *et al*., 2006).

Polanczyk reviewed prevalence studies in (2007) and found minor variations in different regions of the world. Rating summary showed that about 5.3% of school children with ADHD worldwide, meaning that one or two children with ADHD are expected to exist in a class of 30 children. The study also found that the highest rates from Africa were 8.5% and South America 11.8%. North America's rate of 6.2% was only slightly above the European rate of 4.6%. In this study, the prevalence rate in Asia is stated to be 4.1 per cent.

Efron (2008) suggested that all teachers should have a sound knowledge of ADHD. Because of their significant role of obtaining information about children, which shows a challenge for some researchers who think that ADHD symptoms change throughout the school years of children, hence it might affect the prevalence rates (McGoey, Eckert and Dupaul, 2002). For example, around 7.8 per cent of schoolchildren have been shown to meet the ADHD diagnostic criteria (Egger *et al*., 2006).

In the other hand, ADHD in primary school years (6-12 years) is found to be highly prevalent. In contrast, overactivity in these children is believed to decline with age (Faraone et al., 2006). Hart (1995) found that the children (5-10 years) have higher overactivity and impulsivity than children over 11 years of age. However, there are some variations in the findings between studies. For example, a German study conducted by Huss (2008) tested a sample consisted 17461 children and adolescents (7569 boys 7267 girls) found that the percentage of children with ADHD was 1.5% in preschool age, 5.3% in elementary school (6-12 years) and, 7.1% in secondary school (13-17 years).

Weyandt and DuPaul (2008) propose that plenty of symptoms, such as inattention and impulsivity, continue into adulthood. However, there is strong evidence to propose that ADHD prevalence rate may decrease (Asherson *et al.*, 2007). According to different studies and through these figures, it can be said that there is a group of characteristics associated under ADHD label, which considerably influence the general performance of many children of school age. However, the evidence on particular symptoms of ADHD within the difference in the age group is confused obviously. The literature does, however, suggest that symptoms of ADHD significantly impair the child's educational functioning in classrooms.

Harty *et al.*, 2009 reported that adolescents with ADHD known of characteristics of emotional difficulties like anger and anxiety with less hyperactivity compared to those in their early childhood years. Although limited research has been done on adolescents with ADHD, it is hard to generalize adolescent prevalence from limited data. In addition, the exact number of ADHD adults is unknown (Weyandt and DuPaul, 2008).

The incidence of ADHD in children is varied among girls and boys in the recent studies assessments of a percentage ranging from 2:1 to 6:1 (Littman, 2009). In general, the number of ADHD boys is higher than girls. In the UK, according to Ford and Goodman (2003) surveyed 10,438 children aged (6-15 years) they have found that 0.85% of girls and 3.62% of boys had symptoms of ADHD. While Pineda *et al.*, 2003 estimate the prevalence rate of ADHD among boys and girls in Colombia as 12.3% and 19.8% for girls and boys, respectively.

Moreover, Quinn and Nadeau (2002) noted the gender differences in ADHD children were higher in earlier studies than in recent studies because ADHD in girls was undiagnosed. Furthermore, they indicated that the lists of symptoms of ADHD in DSM-IV(TR) remain appropriate for assessing males more than females with consent to more evident male ADHD behaviours than girl-related characteristics. Rucklidge (2006) discuss that ADHD male patterns have appeared in the literature; as a result, in terms of academic performance, psychological functioning and socialization it can not recognize the gender difference between boys and girls. There is limited literature that investigated the gender issues in ADHD; that is why more research in this field is required.

Since the current study is conducted in Turkey with the Arabic sample, for this reason, it significant to know the prevalence rate of ADHD children in Turkey. One of the contributed studies is this conducted by (Erşan *et al.*, 2004) intended to estimate ADHD prevalence rate in school-aged children in Sivas-Turkey included 1425 children (6-15 years) from eight primary schools. The results showed that 8.1% of children identified with ADHD symptoms. The ratios represented that the prevalence rate is higher in boys than in girls approximately 3:10. Also, it had been noted that the prevalence rate is the highest with children aged ten years. To explain the prevalence rate of ADHD more accurately. Senol *et al.* conducted a study and assessed the prevalence rate of ADHD, Oppositional Defiant Disorder (ODD) and conduct disorder (CD), as well as their influencing factors on primary school-aged children. The sample selected randomly from 7 schools in Kayseri-Turkey. The target group include 2045 student. The findings demonstrated that the rates of disruptive behaviour disorders among children were ADHD, 6.2 %, CD 14.4% and ODD 6.7% of the cases.

The prevalence rates of ADHD Turkey as studies have presented 6-8 % in children. In addition, the prevalence rate of ADHD was higher with children who live in low-income families and poorly educated comparing with their peers. Moreover, the overall prevalence rate of these disorders was 27.4% similar to the worldwide prevalence.

Since the selected children of the current study are Arabian students, living in Turkey, it is important to know the prevalence rates of ADHD in children in Arab societies. One of these contributed studies conducted by (Bener *et al.*, 2006) took place in the state of Qatar, aimed to assess the prevalence rate among children of primary school. The results illustrated that the overall prevalence rate was 9.4%. While the reported prevalence of ADHD among primary school children in Menoufia, Egypt ranged between 6.8 % and

6.9%, there was a higher prevalence of ADHD in male than female children with male to female ratio of nearly 3.5:1(Farahat *et al.*, 2014). According to El-Gendy (2017), their study included 921 children aged 6-13 years. More than 50% of the selected children were female. The researchers found that ADHD was 21.8 % based on the rating scale of the teachers and 16.2 % based on the rating scale of the parent. It can be concluded that ADHD presents worrying public health problem among elementary school children.

The prevalence of ADHD is higher in the Arab region than the prevalence of ADHD in Turkey. In contrast, the prevalence rate of ADHD in the United States seems to be the lowest comparing to the Arab countries. Moreover, the highest prevalence rate of ADHD among children is in South America (11.8%) comparing to other countries, Africa represents the second-highest rate of ADHD prevalence in the world (8.5%). On the other hand, Europe has reported the lowest ADHD prevalence rate in children, which is just 4.6%. Finally, the variation in ADHD incidence is evidently due to various causes, such as the prevalence, based on the individual measuring symptoms like a parent, teacher, or child. In some studies, the high prevalence rate may be attributed to ADHD diagnoses dependent on sensitive screening instruments. The low prevalence rate in other research could be due to utilizing different instruments.

ADHD is a major health issue in elementary school children. Also, the studies that involved on ADHD in children and its inferences on them are explicitly limited. Therefore, there is a necessity to conduct more empirical studies that focus on ADHD symptoms in children and to what extent this disorder affects these children.

2.3 ADHD AND GENDER

Possible gender differences in ADHD and their subtypes were examined in a representative community sample in Puerto Rico for children 4 to 17 years of age (N = 1896). ADHD was 2,3 times more common in boys than in girls; however, with one exception, little evidence existed for the different patterns of ADHD associations with correlations between boys and girls. The exception was school suspension, which was more common among ADHD boys than girls. The gender does not interact with correlates for ADHD overall, but that it may play a role in subtypes (Bauermeister *et al.*, 2007).

To investigate gender differences between children meeting the DSM-IV attention deficit/hyperactivity (ADHD) symptom criteria in an Australian child representative sample. From 2,404 children aged 6 to 13 years, 225 boys and 99 girls with ADHD symptoms were identified using the parent version of the Diagnostic Interview Schedule for children and compared on parent reports of children's behavioural problems and impairment. The findings suggest the possibility of gender-specific risks associated with high levels of inattentive and hyperactive-impulsive symptoms, indicating that ADHD subtype membership should be considered when conducting ADHD gender comparisons (Graetz, 2005).

The scientific literature on ADHD is exclusively based on males. Despite the evidence that a vast number of females may have ADHD, several studies have demonstrated that males are much more likely to be diagnosed with ADHD and are diagnosed at much higher rates. Recently, males have been assessed to be three times more likely to be diagnosed with ADHD than females. Males can be diagnosed with ADHD at a younger age and higher rates than females. Males usually display hyperactivity symptoms that are disruptive to others. When exhibiting these bothersome symptoms, diagnosis and treatment are often encountered sooner, while these behaviours are not bothersome the children experiencing the hyperactivity. However, females tend to be inattentive. This behaviour is not immediately diagnosed where Skogli *et al.* (2013) tested co-occurring disorders in males and females with ADHD. They found that males to be more commonly diagnosed with the oppositional defiant disorder, while females to be diagnosed with depression and anxiety.

In addition, males are more likely to have an externalizing disorder and females are more likely to have a non-clear internalizing disorder. Because females often display inattentive symptoms, which lead to females being five times more likely than males to be diagnosed with depression (Skogli *et al.*, 2013).

Studies had demonstrated that females with ADHD are unidentified when they compared with combined gender norms. One of these studies conducted by Waschbusch and King (2006) suggests that gender is a significant variable to consider when evaluating the main symptoms of ADHD using direct measures. The relationship between impulsivity and gender is more obvious than is the relationship between inattention and gender.

Based on these results, there are differences between males and females with regards to how the symptoms manifest. Females tend to exhibit inattention, whereas males are often hyperactive. Therefore, researchers are encouraged to consider using gender-specific norms if available, when assessing symptoms of ADHD.

2.4 THE EFFECTS OF ADHD ON CHILDREN

2.4.1 Academic Effects

ADHD Students represented a significant number of problems with cognitive and academic performance, display a vital decline in full-scale IQ (Loe and Feldman, 2007). Also, these students have significantly lower reading and mathematics achievement test scores than their peers (Loe and Feldman, 2007). Nearly 25% of ADHD students have learning problems and typically achieve less than their potential. They are, therefore, at risk of dropping out (DuPaul and White, 2005).

According to Rosenberg *et al.* (2008) from 53% to 80% with ADHD, by the time they enter preparatory school, pupils will undoubtedly have learning problems with main subjects, and that explains why the majority of these children have difficulty progressing academically. Also, there is a smaller number of children will display difficulties in mathematics and reading (19-26%). According to Trout *et al.* 2007, they observed underachievement as following: around 80% of children with ADHD display issues regarding academic performance or learning; nearly half of them may require special educational needs. As well as ADHD, children are more possibly to receive test scores that less than their "normal" peers.

Farthermore, Hughes and Cooper (2007) reported that ADHD children have apparent difficulties in maintaining attention when continuing with their educational and other activities. These issues were suggested because ADHD children did not instantly focus on the task, and they had difficulties with separating the important stimulus from a meaningless stimulus.

Zentall (2005) said that children with ADHD avoid different types of activities appropriate to classroom pupils, and Zentall (2005) also indicated that such an aversion might be a potential conflict between the task criteria and their natural ability. Moreover, Zentall (2005) also noted that ADHD children easy to feel bored with repetitive activities which they have little interest in themselves. Bruce *et al*. (2006) reported that ADHD children have problems with comprehensive instructions, including the commitment to school material and homework. Especially, their capability to extract understanding from what they hear (Cooper and Ideus, 1995) is low. Some studies demonstrate that ADHD children have issues in their perception and processing, which impedes learning (Tannock, 1998). Also, they might have issues in organization and memory, which affect their academic performance negatively (Zentall, 2005).

2.4.2 Behavioural Effects

In addition to the academic effects of ADHD in children, it is well worth mentioning the behavioural effects of ADHD in children. ADHD students usually have short attention, often run improperly, fail to listen when they speak to and always interrupt. These behaviours often are undesirable by their peers. Therefore, these ADHD students are excluded by other students (Rosenberg *et al.*, 2008). The progression of significant conduct issues, especially aggressive behaviour, might display the greatest difficulty for children diagnosed with ADHD, and such behavioural difficulties mostly complicate behavioural adjustments and peer relations in the school and home environments (Braswell and Bloomquist, 1991).

Lauth *et al.* (2006) reported that ADHD children are more disturbing and inattentive than their peers, as expected in the results of DuPaul and White (2005). Nearly 50%to 60% of those children display considerable symptoms of other disruptive behaviour disorders, especially “Oppositional Defiant Disorder” and “Conduct Disorder” compared to children with only ADHD or control children. According to Johnston *et al.*, (2002) children with behavioural problems and comorbid ADHD have a greater degree of negative behaviour, and children with ADHD have a shorter attention span and always need to move around. Thus, they often are restless, hyperactive and persistently curious regarding their environment (Vaughn *et al.*, 2003). Cooper and Ideus (1996) documented that the behavioural difficulties of ADHD children are unacceptable in structured situations and disturb and frighten others.

Furthermore, Ted *et al.* (2003) reported that ADHD children with behavioural problems are the most challenging group to manage by schools and teachers in the learning process. Barkley (1997) indicates a loss of self-control or self-regulation for children's behavioural symptoms of ADHD. In other words, Barkley said that children with ADHD are uncertain of their motives and less aware of their needs. As a consequence, they tend not to respond to the consequences of their actions with others. Furthermore, Braten and Rosen (2003) noted that ADHD boys had more anger, sadness and guilt-related behaviour than boys without ADHD. In most cases, these uncontrolled behaviours are more prominent among boys with ADHD than among girls. (NICE, 2009). In the literature, there is still uncertainty as to whether such issues are affective, cognitive processes (Barkley, 1994).

2.4.3 Social Effects

ADHD children specifically have difficulty to maintain friendships due to their aggressive behaviours. Familial issues consider a factor because these children tend to argue with adults (DuPaul and White, 2005). ADHD children tend to engage in harmful behaviours than do their typical peers. For example, ADHD students have had ten times more negative oral statements and three times more aggressive behaviours than their peers in playgroups (Braswell and Bloomquist, 1991). Evidence has found that children with ADHD symptoms are significantly impaired by their peer interaction (Tseng *et al.*, 2011). The main symptoms of ADHD place both genders at greater risk for social problems, which are correlated later in life with adverse outcomes. Such adverse results occur between 5 and 10% of all children worldwide. Therefore, the interactive settings where these issues occur must be studied closely (Zentall and Stagner, 2011).

Moreover, ADHD children have contrasting symptoms in social tasks, which is often shown to be shy and socially withdrawn, as well as to blame others for social failure (Mrug *et al.*, 2001). In terms of issues with social interactions associated with ADHD children (McKinney *et al.*, 1993) reported that it is one of the most crucial issues of such children. Where Hinshaw and Melnick (1995) documented that these children when interacting with others, they are disorganized, irritable and insistent. That is why they generally viewed the interaction with teachers, peers, and their parents as being incredibly difficult. As a result, these effects reflect negatively on them and lead to social rejection. However, there are controversial views about peer rejection and ADHD, where McKinney *et al.*, (1993) noted that ADHD children were rejected by peer group members.

2.4.4 Psychological Effects

Psychologically unhealthy conditions such as anxiety, depression and mood disorder can occur in children with ADHD (Robin, 1998). As ADHD students become adults, their ever-increasing failure in life experience begins to take a toll on their self-esteem, leading mostly to periods of depression (Robin, 1998). This depression is difficult to notice in children because of its symptoms that reflect different problems such as low self-esteem, feelings of rejection and negative self-image. The concept of a student with depression can, therefore, be ignored entirely (Smith, 2004). It could, therefore, be presumed that depression among children with ADHD could cause a considerable risk of suicide. Nevertheless, more work is needed on this possibility (Robin, 1998).

There is a link between school performance and children with ADHD, demanding teachers produce situations of failure and anxiety. However, the anxiety could be proportional to the condition at hand (Braswell and Bloomquist, 1991). Around 40% of the clinical population has an overlap between ADHD and anxiety disorders. Comorbid students with ADHD and anxiety are seen to have lower external behaviours generally and less impulsivity, particularly. Studies have found that overactive subjects had less self-esteem and less educational success than their siblings' controls (Wenar and Kerig, 2006).

2.5 CONVENTIONAL TREATMENT OF ADHD

2.5.1 Medical Treatment

One of the primary services provided for children with ADHD is medication. ADHD is known to be treated with psychotropic medicine. Studies have found that three-fourths of children clinically diagnosed with ADHD that they used medication for a period is increasing (Schnoes *et al.*, 2006). Conventional treatment for ADHD usually consists of using medications that are considered as one of the most popular approaches to treat ADHD (DuPaul and Weyandt, 2006).

These medications are classified pharmacologically into stimulant drugs, non-stimulant drugs and anti-depressant medications (Kranowitz, 2005). Although these medications have proven to be effective somehow, however, these medications have some side effects that vary in their severity. Also, the stimulants have a role in reducing the symptoms of

ADHD; but around 20-30% of these children do not respond to these medications, because of the adverse consequences, they may produce it (Findling, 2008).

Furthermore, these side effects divided into two categories. These medications can have short-term side effects, like lack of appetite, insomnia, anxiety, mood changes, elevated blood pressure, heart rate, tics and rebound conduct (Balch, 2006; Barkley, 1998). The long-term side effects of these stimulant treatments may include suppression of growth and cardiovascular effects (DuPaul *et al.*, 1998). Also, stimulant medications might promote physical and psychological dependence (Balch *et al.*, 2008). Secondly, non-stimulant medications that act as a norepinephrine reuptake inhibitor has been displayed effectiveness somewhat in minimizing the symptoms of ADHD (National Institute of Mental Health (NIMH), 2006). However, there is a possibility to some side effects, including cardiovascular symptoms, psychotic symptoms, or increased suicidal tendencies (Leslie *et al.*, 2008). Third, anti-depressant medicines are often helpful for people with a mood disorder. However, these medications can have many side effects, such as dry mouths, fatigue, insomnia, reduced appetite, headaches and nausea (Cipriani *et al.*, 2009).

Since the aetiology of this disorder may be heterogeneous, many factors could be identified that increase the severity of ADHD with learning difficulties and behavioural disorder. All of this led to fear of side effects and long-term safety of conventional pharmacological treatment which relies on stimulant treatment that negatively affect the long-term health of children. According to (Sadiq, 2007), the vast majority of parents of children with ADHD are looking for medical and complementary treatments. Nevertheless, further research related to children with ADHD is required in order to provide a safe approach to treat these children.

2.5.2 Behavioural Treatment

Behavioural therapy reflects a wide variety of different interventions with the general goal of improving the physical and social environment to change behaviours (AAP, 2001). These are used in the treatment of ADHD to guide the child and to improve healthy behaviour. Parents, as well as a variety of professionals, such as psychologists, school staff, community mental health therapists and primary care physicians, typically apply behavioural approaches.

Behavioural approaches include behavioural instruction for parents and teachers (in which the parent and/or teacher are educated to handle children), a systematic crisis management plan (e.g. constructive reinforcement, "time outs," reaction and token economy), clinical behavioural therapy (problem resolution and social skills training) and cognitive-behavioural treatment (e.g. self-monitoring, verbal self-study, problem-solving strategies development, self-intensification) (AAP, 2001; Barkley, 1998; Pelham *et al.*, 1998). These approaches are generally designed to use direct teaching and strengthening strategies for positive behaviour, and direct consequences of inappropriate behaviour. Systematic programmes of comprehensive crisis management in advanced classrooms and summer camps, managed by professionally qualified staff, have proven extremely successful across these alternatives (Abramowitz *et al.*, 1992; Carlson *et al.*, 1992; Pelham Jr and Hoza, 1996).

A later study by Pelham *et al.* (1998) shows that the behaviour of children with ADHD has also been changed successfully with two approaches of parenting in behavioural therapy and in-classroom intervention. Home-school experiences, which foster a cohesive approach, are often important for the effectiveness of therapeutic interventions.

The use of therapeutic approaches is effective but still constrained. Compartmental approaches can appeal to parents and clinicians for the following reasons: compartmental measures are more widely used when parents do not wish to provide medication to their children; for tandem with therapy, compartmental strategies can also be used; compartmental interventions may be used in a number of settings like school, home, and community; The findings of studies into the effects of behavioural interventions are contradictory. Although research evaluating the behaviour of adolescents during and out of behavioural therapy show the success of behavioural therapy (Pelham Jr and Fabiano, 2000), their effectiveness is difficult to distinguish. The multiplicity of procedures and outcome measures makes it very difficult to analyze the effects of behavioural therapy alone or with drugs (AAP, 2001).

A review conducted by McInerney, Reeve and Kane (1995) confirms that effective education for children with ADHD needs changes in academic, behavioural and classroom instruction.

While some studies indicate that therapeutic approaches enable children to work with their talents and learn to control themselves, some studies demonstrate that behavioural strategies are successful but to a smaller degree than psychostimulant treatment (Jadad *et al.*, 1999; Pelham *et al.*, 1998).

Behavioural therapy has only been shown to be effective when implemented and maintained (AAP, 2001). It can be daunting to reliably apply behavioural strategies in all the environments required for optimal performance. Although behavioural management programs have been shown to enhance the academic performance and behaviour of children with ADHD, follow-up and maintenance of the treatment are often lacking (Rapport *et al.*, 1986).

Indeed, some work has demonstrated that behavioural interventions can not mitigate ADHD's central hyper activeness, impulsivity, and concentration deficit characteristics. (AAP, 2001). On the other hand, the problems of children with ADHD are rarely limited to the main symptoms (Barkley, 2014). Kids also exhibit certain forms of psychosocial issues, such as bullying, aggressive resistance, under-performance, and depression (Barkley, 2014). Since psychostimulants can not handle all these other issues, behavioural therapies can better solve ADHD and other concerns that can be addressed to a child.

Research by Froelich and Lehmkuhl (2002) supported the successful role of behavioural therapy in the treatment of core symptoms of ADHD in children. However, behavioural treatment has also been reported to only be effective in the treatment of ADHD in combination with medication (Abikoff and Gittelman, 1985).

2.6 ATTENTION RESTORATION THEORY (ART)

Spending time in nature, sitting in a park, or even just spending a few minutes outside, provides us with the opportunity to rest this collective experience demonstrates nature's valuable role in our lives. Moreover, contributing to overcoming mental fatigue and improving our ability to focus and direct our attention effectively (Kaplan, 1995). While such views have been kept being assumptions or personal opinions, scientific studies have over the last several decades show that natural environments may rejuvenate and increase our focus and keep us healthier. Given that, if true, this notion has important implications for everyday life and workplace, it is important to understand Kaplan's theory of attention restoration.

Attention Restoration Theory (ART), proposes that exposure to nature is not just for enjoyment. Nevertheless, it can also help us to improve our ability to concentrate (Ohly *et al.,* 2016). ART hypothesizes that nature can renew attention after exerting mental energy (Kaplan, 1995).

Kaplan and Kaplan (1989) proposed that there are four cognitive states, along the way to restoration: concentration, mental fatigue recovery, soft fascination, reflection, and restoration. A clearing of the mind characterizes the first phase, in this phase, the thoughts concerns and residual bits of information from whatever were demanding; attention is allowed to pass through the mind, this is achieved by letting them flow through and out of mind naturally. During the second phase, real rehabilitation begins: the mental fatigue recovery process helps the concentrated attention to recover and return to normal levels after an operation that needs direct attention. The third phase enables the person to engage in a low-stimulation activity, which reduces internal noise and provides a quiet interior space. In the final phase, which is evoked by spending extended time in an atmosphere that reacts to all four requirements of restorative settings, which individuals can relax and restore their attention, and reflect on their life (Han, 2003).

2.6.1 Components of Attention Restoration Theory

Regarding the restorative environment, ART states that therapeutic activities and environments have four particular qualities: being away, fascination, extent, and compatibility (Moreira *et al.*, 2001; Kaplan, 2001). Being away: the first aspect of ART is the sense of being away from one's everyday thoughts and concerns, and it does not mean physically away to satisfy this aspect but, being away psychologically detached from the present, which draining the attention (Daniel, 2014). Fascination is the aspect of ART involves one's attention being held without any effort expanded (Kaplan, 1995). Also, according to Kaplan, there are two types of fascination: the first one is hard fascination when the attention is held by highly stimulating activity. Moreover, the other type is the soft fascination when the attention is held by a less active (Daniel, 2014). Both types can contribute to higher rebuilding. Delicate interest highlights reflection and permits sense production, while hard interest is bound to engage and diminish fatigue (Daniel, 2014).

Extent refers to the quality of restorative environments that encourages individual to feel engaged and immersed (Kaplan, 2001). Compatibility is all about feeling enjoyment in the environment to consider the environment a restorative, ought to be one in which the individual is out of natural inspiration and individual inclination. Moreover, the compatibility is higher when individuals are engaging in an activity that is familiar to them (Daniel, 2014).

Researchers have studied the focus restoration hypothesis over the past three decades and have experimented with its limits on three different fields: stress recovery, mental fatigue, and ADHD.

2.6.2 ADHD and Attention Restoration Theory

The relationship between ADHD and normal restorative settings is less than that of mental exhaustion and stress recovery, where there is evidence that ART can also be extended to people with ADHD.

There was a study conducted by van den Berg (2011) compared the behavioural, cognitive, and emotional functioning of children with ADHD during their visits to two different areas: a built, small-town, area and a natural, wooded area. The children appeared better on a concentration task when they visited the wooded area than when they visit the town, even though the town visit took place after the wooded area visit. Also, the children performed better in general, especially, they reported less behavioural problems and more positive emotions in the wooded area with the exposure to light outdoors as a part of nature than in the small area (van den Berg and Van den Berg, 2011).

Another contributed research that carried out by (Thal, 2014) discovered the impacts of 20-minute walk in either an urban area or a natural area on measures of symptoms of ADHD and cognitive performance. Furthermore, those who walked in the natural environment displayed that their walk in the natural environment was more restorative than others who walked in an urban area. In addition to these progressions, their finding on an individual of the cognitive performance was essentially higher than others who completed the urban walk.

To focus on ADHD and the vulnerability of children affected by the natural environment, the study that carried out by Taylor and Kuo (2009) aimed to show the effects of the natural environment on the level of attention in children with ADHD. These students tested in three different environments city (urban area), park (natural park), urban area with some green spaces. The findings found that after the children spent 20 minutes in the garden, their level of concentration increased in the highest proportion, also, in the other two environments, the concentration level is low. The positive effect included children with ADHD. According to these results, these effects persist for a long time. That is why it is possible to have an indirect influence on the academic performance of these students.

The study of Taylor and Kuo (2011) examined whether routine exposure to green environments for children with ADHD in the USA through daily play settings may lead to a continuous decrease in symptoms of the disorder. Data on 421 children's ADHD symptoms and usual play settings were collected using a national Internet-based survey of parents. The age distribution of children in this sample was 5-18 years old. Eighty per cent were boys, and 20 per cent were girls. Findings suggest that everyday play settings make a difference in overall symptom severity in children with ADHD. Specifically, children with ADHD who play regularly in green play settings have milder symptoms than children who play inbuilt outdoor and indoor settings.

Several studies approved the beneficial effects of walking in natural environments and exposing to nature, especially the positive changes on individuals who suffer from mental health problems (Roe and Aspinall, 2011). One of these studies focused on the effects of nature on ADHD children, (Kuo and Faber Taylor, 2004) conducted a survey study, and they found that nature activities reduce the symptoms of ADHD in children. There are two other studies investigated the effects of natural environments on ADHD children where Taylor and Kuo (2009) found that walking in natural environments has beneficial effects on concentration of ADHD children compared to walking in urban settings. Also, Van den Berg *et al.* (2010) found that nature has positive effects on concentration.

The results from these studies and other similar research suggest that spending more time in natural environments could ease the symptoms of ADHD for young adults and children who struggle from it. It might not consider as an alternative treatment, but it certainly affects these children positively. Also, spending some time outdoors as a direct consequence, increased exposure to natural light could be used to ameliorate the symptoms of ADHD.

It can be concluded that natural environment has a significant role in reducing the symptoms of ADHD, further understanding to these findings lead to a state that natural light may have the same positive influence on children with ADHD as one of the components of the natural environment. In another meaning, it can be a contributing factor in this influence.

2.7 THE RELATIONSHIP BETWEEN DAYLIGHT AND ADHD

Daylight is the combination of the diffuse light from the sky and sunlight (Baker and Steemers, 2002). Daylighting was a standard tool in building design until electricity became available in the early 19th century.

Subsequently, Greeks and Romans added Courtyards into buildings to bring the natural light into interior spaces these civilizations located in hot climates. While cities in western civilizations appeared more populated and crowded and streets became narrower, and the buildings higher than before. The amount of daylight in interior living spaces decreased massively (Boubekri *et al.*, 2014). After the 19th century, schools became stand-alone buildings, and then became multi-story buildings with more full windows, which increased the amount of natural light in the interiors. Also, in the early 19th century, Architects believed daylighting was an essential element of school building design. For example, the Architect Robson (1874) proposed that in classroom design, considering comfort and health is essential, in order to provide effective teaching to children.

Moreover, he emphasized the role of daylight in classrooms, as well as the location of windows, should be selected carefully to avoid more glare (Robson, 1874). He proposed the best positions and steadiest light were found on the north side. However, this thinking continued until the 60s (Hobday *et al.*, 2015). Then school design, in general, did not reserve enough daylight, which led to using the fluorescent lights, especially when this technology became widely used (Boubekri, 2014) due to its lower cost.

Schools with few windows mean little of sunlight in interiors and increase loads of cooling and lighting even windowless school created uncomfortably and a productive learning environment (Gelfand & Freed, 2010). There was also a reinvestigation of the use of daylighting in design in the late 19th century.

Particularly to progress lighting control in school buildings (Lechner, 2014). Additionally, that was because of the apparent benefit of natural lighting which the unlimited in supply, and it is free. Therefore, augmenting the use of natural light, not just an essential element to achieving sustainable school designs, but also it has economic benefits where daylighting needs could decrease electricity by 45-61% (Roisin *et al.*, 2008).

2.7.1 Indirect Relationship

2.7.1.1 Daylight and Academic Performance

Conversely, over-illumination by artificial light has been connected to considerable negative health effects, specifically psychological, physical issues that might impact a student's ability to learn. Although it is not certain that daylight affects ADHD, there is some evidence that daylighting can improve academic performance (Atre, 2005). Heerwagen (1986) argued that increasing the size of windows has positive effects on components, where make a room feel bigger and comfortable. Also, expanding the time exposure to natural light has improved outcomes.

Conversely, decreasing the time exposure to natural light has adverse effects on productivity where Heerwagen (1986) researched at the University of Washington about occupant responses to windowless spaces, with the presence of appropriate glare. The selected students were more than 8000 students from more 450 classrooms. Each of the following was analyzed: the academic performance of this sample, the effects of interior lighting, the size of the windows, comfort, the view of the window on direct sunlight penetration, control and shading, affected student's academic performance negatively.

To emphasize the view of the importance of natural lighting in the classroom gained from windows research also investigated the difference in response between windowed and windowless classrooms. It surveyed about 3000 students from one school. The result was around 94% of participants preferred the classrooms with windows (Lechner, 2014).

It is evident from the above studies the importance to integrate natural lighting with school design, especially in the classrooms and the positive impacts on students from another perspective, White (2009) believed that the body's internal clock related to awareness of the daylight cycle to function well. Furthermore, the lack of exposing to daylight affect body clock negatively; as a result, and it might lead to issues in concentration and memory (White, 2009).

This research resulted that classrooms with skylights affect student performance positively, where the improvement of student's performance at a rate of 20% faster than pupils who study in classrooms without skylight (White, 2009). Also, another study found that nearly 14% progress in the academic performance of a student who in classrooms with windows from 12000 elementary school students (Dudek, 2007).

Several studies involved the influence of daylight on academic performance and test scores; one of these studies analyzed the scores of reading tests and math of 21000 students of an elementary school located in California. The study found that students who are in classrooms with the most daylighting performed better in math exams, about 20% and 26% better on reading tests. Moreover, this study showed that classrooms with larger windows related to progress in academic performance 15-23% (White, 2009). Further results showed positive effects on behaviour and test scores, where the highest behaviour and test scores when students exposed to natural light.

Moreover, there was a positive impact on views of outdoors, especially on academic performance (White, 2009). That might because the ability of the human body to adapt to change in light level quickly, where more natural light reflects on the scores of math and reading tests and the speed of completion of these tests about 7- 26 % higher than others (Gifford, 2007; white, 2009). According to researchers in California, the amount of daylight that entering through windows has a positive impact on academic performance. Also, their studies demonstrated that learners in classrooms with windows have an improvement in their scores rated 15-23% over one- year period compared to students who study in windowless classrooms (Taylor, 2009).

From another perspective, there were numerous studies conducted in Washington and Colorado confirmed that students who in daylit classrooms had a higher rate of test score 7-18% than others who in the classroom with less daylighting (Gelfand, 2010). Additionally, Heschong (2002) approved that students who study in the classroom with largest window areas have progress 15% faster in math and about 22% faster in reading than students who are stating at classrooms with smaller windows areas. Moreover, Heschong emphasized that classrooms with well-designed skylight where components could control the level of light in the room displayed improvement in learning ability compared to those students who study in classes without skylights.

2.7.1.2 Daylight and Physical Health

For a deep understanding of the indirect relationship between daylight and ADHD, it is significant to present the literature that relevant with daylighting and physical and mental health, especially, those were concerned in the educational context.

Daylighting encourages a balanced educational atmosphere in particular, through the development of vitamin D and circadian regulation. The daylight level is significant to the vision of the student and reduces the impact of harmful electric light daylight also, has both negative and positive effects on health. Artificial light has related to many negative effects by using it. Where Steamers stated that artificial light cause fatigue, strain, and circadian dysfunction among occupants of the building (Baker, 2002).

Exposing to outdoor daylight has the most powerful effect, Although, overexposure to ultraviolet (UV) has adverse effects on children like skin cancer. However, sunlight and daylight through glass windows contain considerably less ultraviolet short wavelength radiation than the same outside radiation (Hansen, 2006). Windows limit several health problems (Boyce *et al.*, 2003). Sunlight is the principal source of vitamin D that is beneficial to the internal structure of the body (Edwards and Torcellini, 2002; Hansen, 2006). Lucas and Ponsonby confirmed that less UV exposure courses vitamin D deficiency (Hansen, 2006).

University of California researchers have proposed that light sources with richer spectrums provide more effective vision lighting. Daylight also generates the richest spectrum, reducing eye stress (Hansen, 2006).

2.7.1.3 Daylight and Mental Health

Van Bommel and Vanden recorded that having enough daylight every morning syncs the internal body clock to the Earth's 24-hour rotation period (Van Bommel and Vanden Beld, 2004). They are often exposed to daylight early in the morning with a short duration, which affects the biological clock. Students should, therefore, receive morning lights that act on the circadian system and avoid light at night, with a similar wavelength, to ensure a regular cycle of sleep and sleep earlier. (Figueiro and Rea, 2010).

Students are usually at school daily in the morning; Thus, windows should be designed to allow sufficient daylight in classrooms, where many students could have difficulty synchronizing with the circadian 24h cycle. Therefore, daylighting is a significant component of school designs. Natural light has considerable benefits where adding daylighting in an environment may improve health. Various lighting conditions affect the feelings of occupants of the building. However, guidelines for choosing the type of lighting to maximize the positive mood are limited (P. Boyce, C. Hunter, 2003).

Daylight promotes the mental and well-being of students and teachers. According to Knez, 1995; Veitch, 1997, lighting affects attitude and mood. Heschong et al. (2002) argued that the physical characteristics of the classroom, like lighting, does not affect student absenteeism. On the other hand, Hathaway (1992) noted a significant correlation between lighting and student attendance.

The level of illumination has a specific psychological function in school. Where researchers indicated that daylighting improves mental performance, decreases depression, declines violent behaviour, and enhances sleep quality. Exposing to intense light has been used to treat the seasonal affective disorder (SAD) (L. Gelfand, 2010). According to Dudek (2007), the lack of daylight is triggering the depression and seasonal affective disorder (SAD) where he argues that children who study in windowless classrooms seemed to display symptoms of SAD especially those of irritability and restlessness.

Research has resulted that SAD affects about 20% of Americans every winter; they suffer from depression and fatigue because of the lack of natural light (Dudek, 2007). Additionally, the absence of windows contributes to the stress on occupants (Cooper, 1988). Jackson and Maslach and Revieki *et al.* studied stress and depression. The findings of their studies demonstrated that daylight is directly connected with stress and depression. At least 3 hours of exposure to daylight is required in order to decline stress and depression (Heerwagen *et al.*, 1995; Revicki *et al.*, 1991).

Furthermore, researchers argue that internal daylight provides a feeling of security for students (Djamila, Ming and Kumaresan, 2011). Because of daylight affects the function of a space and personal biological and internal clock of humans. All these positive effects of daylight should be taken into consideration in architectural design (Shameri *et al.*, 2011).

For further health benefits of daylight, Nall (2015) exposing to sunlight could improve concentration, and increases the brain's release of the hormone serotonin, which boosts mood that aid in relaxation. The effects of daylighting on the health of learners should be taken into consideration for school design because daylight significantly influences the health, cognitive abilities of students and psychology.

To conclude, the majority of research in this domain correlates with the relation between daylight and health in general and mental health in specific. It has been presented with an overview of how daylight can positively influence health in a variety of ways.

There is some research regarding the increased prevalence of sleep disorders in children with ADHD and sleep problems, including insomnia, increased night motor activity and restless legs (Van der Heijden *et al.*, 2005).

Furthermore, a systematic review demonstrated that ADHD children spend relatively more time in (shallow) sleep compared to controls (Díaz *et al.*, 2016). In addition, the severity of sleep problems in children with ADHD was associated with lower cognitive function (Sciberras *et al.*, 2015). The functional and neurological interaction between brain regions illustrates the complex relationship between ADHD and sleep (Owens, 2008). Sleep problems may be courses, effects, or intrinsic features of ADHD (Hvolby, 2015).

Sleep and ADHD are also connected by the fact that sleep disorders can also lead to behaviours, symptoms evoking those in ADHD, such as impairment of learning, concentration issues or emotional disorder (O'Brien, 2011).

People who normally are exposed to (natural) outdoor light sleep earlier than those generally exposed to (non-natural) indoor light (Walch *et al.*, 2016). Arns *et al.* (2013) demonstrate a strong geographical correlation between higher solar intensity and a lower prevalence of ADHD. This relationship is clarified by the fact that daylight intensity serves as a significant cue for the brain's circadian rhythm regulation, which also improves deep sleep (Wams *et al.*, 2017).

After clarifying the link between sleep problems and the symptoms of ADHD and other health problems, it is significant to consider ADHD as a "heterogeneous" disorder. Where several subtypes with different aetiology exist most clearly evidenced by the fact that none of the current conventional treatments has perfect efficacy. In line with this concept of heterogeneity of ADHD, it makes more sense to aim to understand this heterogeneity, in order to find out more specific treatment or supplementary treatment.

Based on the literature that explained above, particularly that related to the effects of nature on ADHD, also studies relative with the daylight and its positive influence on health, and well-being in general and psychological health problems in specific. Also, with the most evidence for the positive effects of daylight on educational problems, such as concentration, academic performance, test scores and learning ability. ADHD symptoms such as attention, impulsivity, and hyperactivity may affect by daylight.

Although it could be an identifiable relationship between ADHD prevalence rates and sunlight intensity levels (Martijn, 2013) also, this study assessed the relationship between the prevalence of ADHD and solar intensity (SI) (kilowatt hours/square meters/day). In three datasets (across 49 US states for 2003 and 2007, and 9 non-US countries) a relationship between SI and the prevalence of ADHD was found, explaining 34%-57% of the variance in ADHD prevalence, with high SI having an apparent preventative effect. This study found a lower prevalence of ADHD in areas with high SI for both US and non-U.S. data; however, it is yet unknown if daylight reduces the severity of ADHD symptoms because of the scarcity in these studies in the literature.

Based on the above information, further work is necessary, including a prospective relation between daylight and ADHD symptoms. The current study aims to investigate this relationship through the following question: Is daylight affect the ADHD symptoms, and if so, what is the nature of this effect?

3. METHOD

3.1 PARTICIPANTS

In conducting the study of this kind, it is important to acknowledge the constraints that influence the selection of the sample and fieldwork process. In this study, the sample selected randomly from one school. Furthermore, the research was concerned with respondents' recognition of the daily school and home experiences of children with ADHD. Also, teachers and parents contribute to this study equally as it will be shown in the following parts.

The sample of this research was selected from an Arabic school in Istanbul, Turkey. This selection was governed mainly by practicalities such as feasibility, availability of time and the research framework. It should be noted here that the data from the selected sample can not be generalized to a wider population. However, it is thought that it will provide a better understanding of the effect of daylight exposure on ADHD.

3.1.1 Teachers

Many studies have shown that teachers are the best source of information on ADHD. They have reported that their important role in identifying children with ADHD is very significant (Barkley, 1998; Hughes and Cooper, 2007). Teachers play a pivotal role in identifying and referring even to formal diagnosis (Snider *et al*., 2003). Under the structured conditions of the classroom, teachers recognize the difficulty of children in behaviour school and class care standards; they may suspect symptoms of ADHD and propose them to parents or refer them to other specialists (Kos *et al.*, 2006). Teachers are often considered to be an important source for educational assessment of children with ADHD (Burcham and DeMers, 1995). They help the researcher to obtain information about child behaviour, skills and real performance at school (Burcham and DeMers, 1995).

In the current research, teacher views are the key source of information as children spend time in school, and teachers know the real performance of students in the classroom. Therefore, it was seen as appropriate to obtain valuable and rich information from teachers.

The selected teachers in this study were the main teachers, one for each class. The cause for choosing these teachers is that: the wide experience of these teachers with the selected children. They know the academic performance, behaviours, and interaction of these children with their peers.

3.1.2 Parents

In addition to teachers, parents are also considered as a significant source of information about the different levels of children's development (Burcham and Members, 1995; Barkley, 1998). Also, parents are acknowledged as the main source of information about the home and social context for ADHD children (Wolfendale, 2013). In this study, parents were the main source of obtaining data about selected children. Both parents participated in responding to the same form of the scale. The fundamental aim of the parents' involvement in the study is to obtain data on cases of interest from home and to explore more information on these children. More significantly, traditional evaluation protocols support parent involvement as an inseparable part of ADHD evaluations (Barkley, 1998; Burcham and DeMers, 1995). In other words, parents could provide an expansive view of selected children in the home context that filled the gap in information from the teachers (Barkley, 1998).

3.1.3 The Sample

The selection of sample in this research was carried out in a single elementary school. The school characteristics were carefully selected with the view that it was able to provide in-depth information for the study. The school contains pupils who are aged between 7 and 18 years. In this research, pupils in the sixth and seventh grades (12-13 years) were recruited. The reason why choosing this group of age for the current study is that children are the most affected individuals by ADHD (NIH, 1998). Also, these children are studying many school subjects, which could provide a significant opportunity to estimate the relationship between ADHD and these subjects. It also guided the researcher in planning the fieldwork to achieve the aims of the research. Therefore, a total of 32 children (14 females and 18 males), who were aged between 12 and 13 years, participated in this study. The details of these participants are presented in Table 3-1.

Table 3.1: Gender and Age of student

Count		Age		Total
		12 year	13 year	
Gender	Male	6	12	18
	Female	6	8	14
Total		12	20	**32**

McMillan and Schumacher (2001) mentioned some significant components that the sample size be specified. They argued a researcher should take into consideration some aspects: the nature of the study and the hypotheses, importance of results, the number of variables investigated, monetary limitations, techniques of data collection and measure of accuracy required. In the current study, the research is conducted in an Arab school in Turkey. Each participant voluntarily participated in the study with the consent of his or her parents orally. Also, the researcher carried out the study with the permission of the Libyan Embassy (see Appendix A.1).

The study was also conducted in the ordinary context of school and home settings, where teachers and parents could supply "real" and "rich" information (Lincoln and Guba, 1985). The study has followed a case study approach, where the researcher has chosen one school as a case sample and the characteristics of this school selected with the view that was able to provide valuable and in-depth information for this part of the quantitative study.

In this school, the participants were children, who had selected at a specific age (12-13 years old), they were studying in the same educational environment, and most of them live in similar live conditions. All these factors minimize the differences which might influence the results.

Completion of the study was voluntary, and therefore any participant (teacher and parent) can stop responding to the rating scale at any time. The participation in this scale was involved in minimal risk to participants. Moreover, the data was kept in strict confidence and only used for research. The identities of participants would not be disclosed in research reports or publications.

3.2 ADHD ASSESSMENT

Extensive research of the literature review was carried out in this study to identify methods that could be used in assessing children with ADHD. There are two sets of diagnostic criteria commonly used in assessing ADHD children, and these are DSM IV(TR) and ICD-10, classification system on an international scale. ICD is considered as an official classification of the World Health Organization (Who, 1993). The ICD-10 is made up of 2 different volumes, one for clinical and diagnostic details and one for research diagnostic criteria.

It utilizes a list of categories of behaviours that the same in diagnosing children disordered behavioural conditions. The ICD-10 classification was not suitable for this research. The first reason is ADHD does not appear separately in the ICD-10 classification system (Karlović *et al.*, 2002). An additional reason not to use the ICD tool is that it is preferred in the UK and other western, while in other developing countries standardized tools or scales are used to assess children with ADHD (Karlović *et al.*, 2002).

As for DSM-IV (TR), its list of items is greater than the classification system ICD-10 that allows for the recognition of ADHD subtypes (Karlović *et al.*, 2002). However, this tool needs to be translated into the Arabic language. This process would lead to the potential for fallacy when transferring the concept of ADHD to a culturally different population. In addition to that, the DSM-IV (TR) criteria did not approve its validity and reliability in the Arabic context. That is why this tool did not suit for this research.

Another important method that widely used in assessing children with ADHD is conducting interviews (Burcham and DeMers, 1995). Interviews help the investigators obtain data on child abilities, working habits, behaviours and actual performance in school compared with peers of the same age (Burcham and DeMers, 1995). It is generally recognized that the ADHD assessment uses interviews with teachers because of the time spent by children at school (Molina *et al.*, 2001).

Interviews have had many benefits as an important method to test children with ADHD. For example, the participants considered the opportunity to discuss their situations, beliefs and questions relating to their classrooms. (Beale *et al.*, 2004). Furthermore, it is considered to be the most suitable way to provide details about respondents while answering the questions. Moreover, the interviews maximize the possibility of richness, depth and vividness of the data (Hara, 1995).

On the other hand, interviews are often criticized as a way to interpret the interview topics formed by the researchers subjectively (Beale *et al.*, 2004). There is a possibility of emotional engagement during the process of the interview. Many researchers argued in structured interviews; there is a chance of the interviewees being exploited by the interviewer through being unduly led in a particular direction. In other words, this kind of interview is an interplay of power between the interviewer and the interviewee where the interviewer has control over the situation, the topics and guidance and can influence the views and opinions of the interviewee (Flick, 2014).

According to Nunkoosing (2005), interviews are a story-making process of research, where the interviewer uses her or his attitude to enable the interviewee to tell stories that would otherwise stay untold.

Another method that utilized to assess ADHD children is classroom observation, which considered as a supplementary method of collecting data (Burcham and DeMers, 1995). This method explores the real-life situations of children with ADHD. It is also the easiest way to test whether child conduct in the class is compatible with what the teachers define. This method has some advantages; for example, collected data from the main methods need to be tested with the first-hand experience of observing actual classroom situations. Also, classroom observation provides an opportunity for the researcher to observe and record the actual behaviours of the children and notice the children with behavioural and attention problems in their classrooms.

Nevertheless, this method has some drawbacks, firstly, the children and teachers may have altered their behaviours, that is commonly known as "observation effect" or "reactivity" in research (Sideridis, 1998). Secondly, the observation has a high level of "observer bias" (Robson, 2002). Additionally, the information collected from observations may be influenced by prior knowledge or experience of the situation under investigation.

Brock and Clinton (2007) documented that rating scales are the most widely used method for assessing children with ADHD. In Brock and Clinton's review of about 41 studies, they demonstrated 100% use of rating scales (mostly standardized) across different countries in assessing children with ADHD. These rating scales are derived directly from the DSM-IV "symptoms" criteria (Döpfner *et al.*, 2006).

3.3 INSTRUMENTS

This part explains the design of the study and the instruments used in this research. The current study used three instruments. They are a) The Arabic version of the Conners Teacher Rating Scale, b) The Arabic version of the Conners Parent Rating Scale, c) illuminance meter to measure the illuminance.

3.3.1 Conners Teachers Rating Scale-Revised: S

The Conners Teacher Rating Scale (see Appendix A.2) was used to obtain valuable information from informants and identify children with ADHD in the school context. It worth to mention, the Arabic version of this scale was used in this investigation, to ensure its understanding by teachers, with a little explanation about the way of usage. The teacher scale provides the most economical and objective way to obtain relevant assessment information because they provide the ideal means for describing academic, social, and emotional behaviours in the classroom (Conners, 2001).

The current study uses the Conners Rating Scale for parents and teachers (standardized rating scale) due to several reasons: First, it is easy to use and specified to assess children with ADHD. Second, the original version of it is conducted in English speaking countries, most notably in the US. Nevertheless, the Arabic version was widely used, and its validity and reliability of this scale have strongly approved.

For the current research, the Conners Rating Scale (teachers and parents) consisted of a set of categories of behaviours that are related to children's academic, social, and behavioural functioning. The purpose of using this scale is to obtain precious and valuable information from teachers about children's actual performance in the school context. In addition, another reason obtaining further information from parents of selected children in the home context. Another advantage of this scale is that the possibility of using this scale in non-medical research. Moreover, this method saves time and the most preferred by teachers and parents due to time-saving that this method provides to respondents in comparison to interviews that may cause difficulties for the researcher during them.

The short form for teachers contains 28 items. Items on the teacher short form are worded the same as on the other form of it (long form). Additionally, the four subscales on the teacher and parent short forms are the same to facilitate comparisons between teacher and parent responses (Conners, 2001). This scale contains three forms: the first form called response sheet for the CTRS-R:S, it contains 28 items and covers the following subscales: Oppositional (5 items, 2, 6, 10, 15, 20). Cognitive Problems (5 items, 4, 8, 13, 18, 22). Hyperactivity (7 items, 3, 7, 11, 17, 21, 24, 27). and ADHD Index (12 items, 1, 5, 7, 10, 13, 15, 17, 19, 21, 23, 25, 27). The second form is the scoring sheet for the CTRS-R:S, which was designed to facilitate swift administration and scoring the respondent writes on it the transferred results. The third form is the profile sheet, and the forms are formatted like a grid. The researcher does all the scoring on that grid. The subscales are identified horizontally across the top of the grid.

The researcher shall observe the circled number on the right side of the scoring grid for each element and follow the horizontal line through white boxes in that row. Then, the researcher adds the numbers in the white boxes for each column and writing the resulting number in the appropriate "Total" box at the bottom of the scoring sheet.

The numbers in the total boxes are raw. Enable the appropriate side of the profile template to translate the row scores to T-Scores (male or female). On the profile forms, there are subscale names above (a big-shaded box). There are numbered columns under each of the subscale names. Each of these numbered columns corresponds to a different age group; the norms for the CTRS-R:S are age and gender-dependent. There are five age-related columns. For example, if the child in question is a 12-year old boy, use the columns headed "4" (on the male side of the profile form) for each subscale on the teacher form. Then transfer the raw scores from the "Total" boxes at the bottom of the scoring sheet to the profile form by circling the corresponding raw score numbers on the profile form, under the matching subscale columns, and the appropriate age range column number. Once all the raw scores have been circled on the profile sheet. Then lines should be drawn between the circles to obtain the profile of the child the T-score. That corresponds to each raw score can easily be located by moving directly across the row to the left-hand column labelled "T" (Conners, 2001).

In general, T-scores allow each obtained score to be compared to the same reference value. The T-scores are interpreted according to the guideline (Table 3-2). The higher the scores, the greater (or more severe) the problems.

3.3.2 Conners' Parent Rating Scale-Revised: S

The Conners Parent Rating Scale-Revised: Short form CPRS-R:S (Conners, 2001); (see Appendix A.3) was used for the current study in order to identify children with ADHD. It is considered as the main tool to identify ADHD children in the home context. It worth to mention, the Arabic version of this scale was used in this investigation, to ensure its understanding by parents, with a little explanation about the way of usage. Furthermore, the information from the parent is uniquely important because the parent has seen the child over many years in many situations. The parent also has a greater knowledge of the situational context of the behaviours and whether there are certain environments where there are relatively greater problems. CPRS-R:S contains 27 items and covers a subset of the subscales and items on the long parent form. Identical subscale names are used in the short form for teachers. The four subscale names are Oppositional (6 items, 2, 6, 11, 16, 20, 24), Cognitive Problems (6 items, 3, 8, 12, 17, 21, 25), Hyperactivity (6 items, 4, 9, 14, 18, 22, 26), ADHD Index (12 items, 1, 5, 7, 10, 13, 15, 17, 19, 21, 23, 25, 27).

The scale contains three from sheets the same as the three ones in the CTRS-R: S. The way of using this scale is the same process that had explained in the CTRS-R:S's section. Then after the results have been tabulated and verified and profiles have been generated, the interpretation begins by using the interpretative guideline for T-scores. High T-scores (raw scores) are usually correlated with a greater number or frequency of recorded issues. T scores of 65 and higher are usually used to suggest a clinically significant issue, as illustrated in Table 3-2.

Table 3.2: Interpretive Guidelines for T-Scores and Percentiles

T-Score	% ile	Guideline
70+	98+	Markedly Atypical (Indicates Significant Problem)
66-70	95-98	Moderately Atypical (Indicates Significant Problem)
61-65	86-94	Mildly Atypical (Possible Significant Problem)
56-60	74-85	Slightly Atypical (Borderline: Should raise concern)
45-55	27-73	Average (Typical Score: Should not raise concern)
40-44	16-26	Slightly Atypical (Low scores are good: Not a concern)
35-39	6-15	Mildly Atypical (Low scores are good: Not a concern)
30-34	2-5	Moderately Atypical (Low scores are good: Not a concern)
<30	<2	Markedly Atypical (Low scores are good: Not a concern)

3.3.3 Reliability and Validity of Conners Teacher-Parent Rating Scale-Revised: S

As indicated by Gay (1981) validity is how much an expected test is estimated; a check is valid for a specific reason and group while reliability refers to the consistency of scores on a particular instrument (Morgan *et al.,* 2006).

The Conners Teacher-Parent Rating scale has been used widely in assessment and treatment studies of Attention Deficit Hyperactivity Disorder (ADHD). Also, it proved to be of high reliability and validity (Conners, 2001). In the present study, the Arabic version of Conners Teacher-Parent Rating Scale-Revised: short was used. According to M. H. Eldefrawi *et al.* (1992), the reliability and validity of this version were tested and approved as an instrument modified upon the diagnostic criteria of ADHD. Also, El Defrawi, Mahfouz and Ragab (1992) indicates that this scale could also be useful as a screening method for distinguishing children at high risk of ADHD in non-psychiatric settings.

3.3.4 Illuminance device

This device (UNI-TUT 383 Mini Digital Lüxmetre:). Product code: C161034105, utilized to measure illuminance during the experiment of this research. The measurement range of this device is from 0-199999 Lux (4%+8). The general characteristics are power 1.5 V battery AAAX3, LCD size 32*26 mm, weight 118g, size 160*50*28 mm (Figure 3-1).

Figure 3.1: Illuminance device

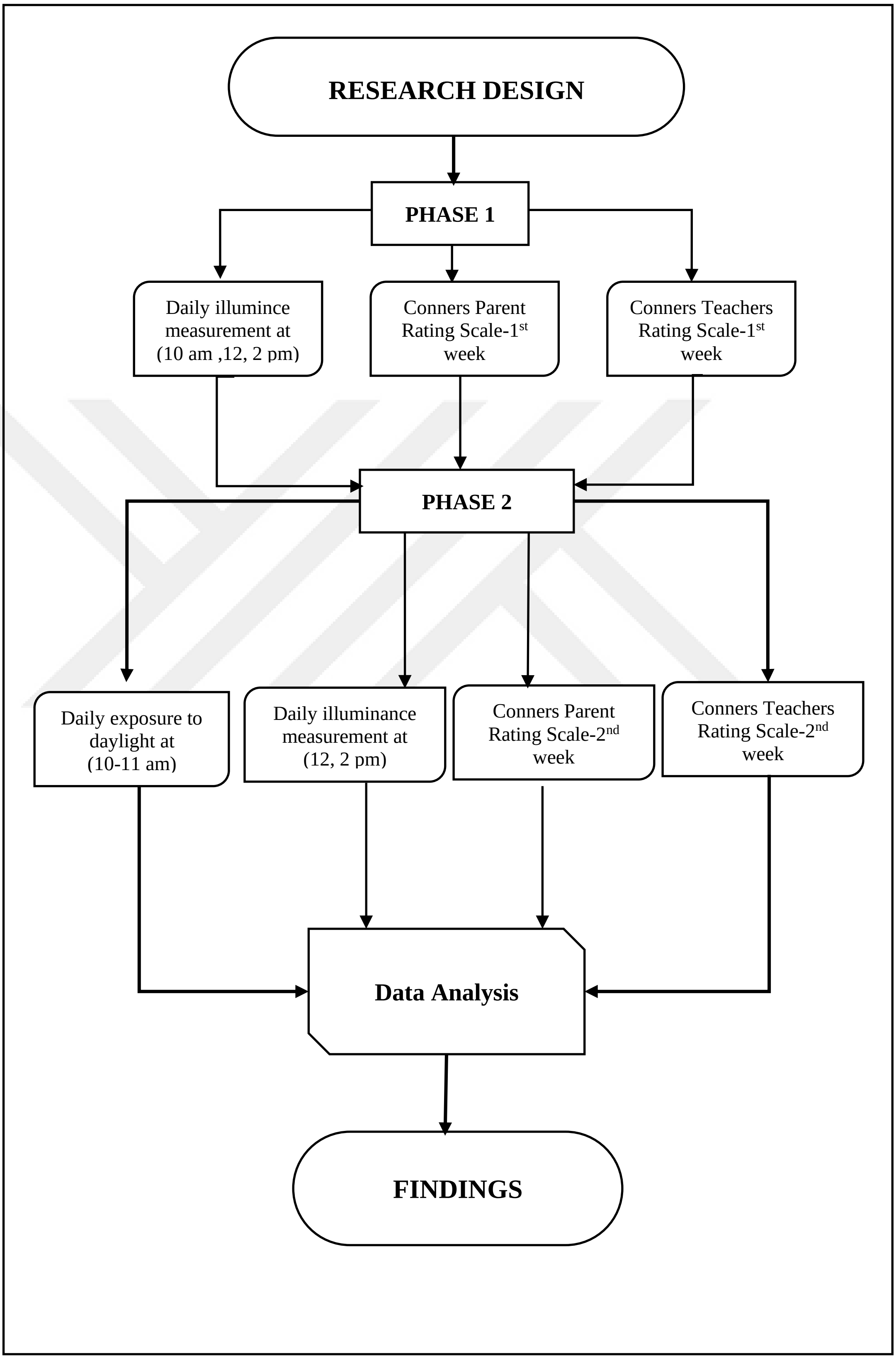
3.4 PROCEDURE

This study was conducted in two phases (Figure 3.2). In the first stage, children who had symptoms of ADHD were identified by using CTRS-R:S and CPRS-R:S. In addition, illuminance levels were measured in the selected classrooms. In the second phase, CTRS-R:S and CPRS-R:S were used for a second time to determine changes in results. At the same time, during the second phase (second week), the selected children were exposed to outdoor daylight for one hour (10-11 am) daily during the second week. In addition, illuminance levels were also measured in the classrooms, daily from 11:00 am to 2:00 pm during the second week.

3.4.1 Phase one

A permission letter was obtained from Libyan Embassy-Academic attache to conduct the study in this school. It also contained the purpose of the study approached (see Appendix A. 1). The researcher approached the headteachers (two teachers) of the school formally sought their willingness to take part in the research. The general focus of the research was discussed with these teachers. Also, this ensured that information collected from school would be entrusted with confidence, strictly used for only research purposes and that the school and the individual names would not be revealed for any other individual (Beale *et al.*, 2004).

Figure 3.2: Research Design



3.4.1.1 Conners' Teacher Rating Scale-Revised: S

In this phase, teachers took part in this investigation were the headteachers, they have wide experience with the sample children, and they know each students' learning difficulties. The selected teachers were two, one for children in the sixth grade (12 years old), and another for the seventh grade (13 years old). The scale distributed to these teachers on the first day of (first week). The CTRS-R:S was submitted at the end of this phase on Friday of the first week (10/5/2019).

3.4.1.2 Conners' Parent Rating Scale-Revised: S

The CPRS-R:S was used in this investigation, to obtain information about the selected children in the home context, also in this phase, the CPRS-R:S distributed to the parents of sampled children on the first day of this phase (first week) (on Monday 6/5/2019) to ensure enough time to answer the questionnaire. Then, the scale was submitted on the same day of submission of CTRS-R:S (on Friday 10/5/2019).

3.4.1.3 Measurements of illuminance levels

In the first phase of the research, the target children were studied in two classrooms. Every classroom had attributes that vary from each other for example, the size of the room, the size of windows, and the area of these windows were different, as shown in (Figure 3-4). Therefore, it was a necessity to measure the illuminance conditions of both classrooms separately. The process of measuring these conditions was as following: First, developing and designing a schedule to facilitate the measurement process.

The whole measurement in this phase was indoor measurement to determine the actual lighting conditions of the two classrooms. The measurement of the illuminance of daylight took place every two hours during the school day for both classrooms. Specifically, the first measurement was at 10:00 am; the second measurement was at 12:00 pm, the third measurement was at 2:00 pm by using the illuminance meter (Figure 3.1).

The measurements during this phase were daily in the two classrooms to determine the amount of light which children were exposed to. The characteristics of the sixth grades' classroom were: it contained 12 students; the size of the windows in this classroom was large; the windows were located on the left side of the student as shown in (Figure 3-3, 3-4). While the characteristics of the seventh grade's classroom were: it contained 20 students; the windows were smaller than the windows of sixth grade's classroom; the windows were located at the back of the classroom, as shown in (Figure 3-5, 3-6).

Figure 3.3: Plan of 6th class

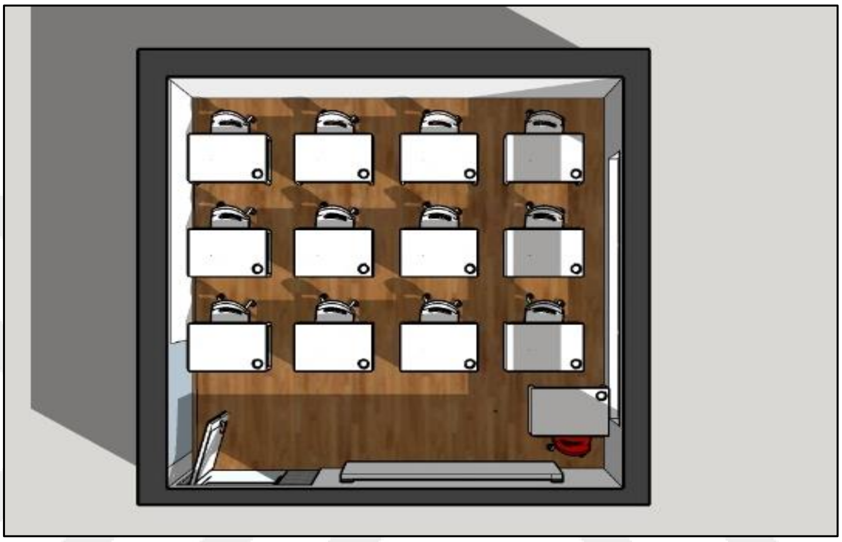


Figure 3.4: Perspective of 6th class

Figure 3.5: Plan of 7th class

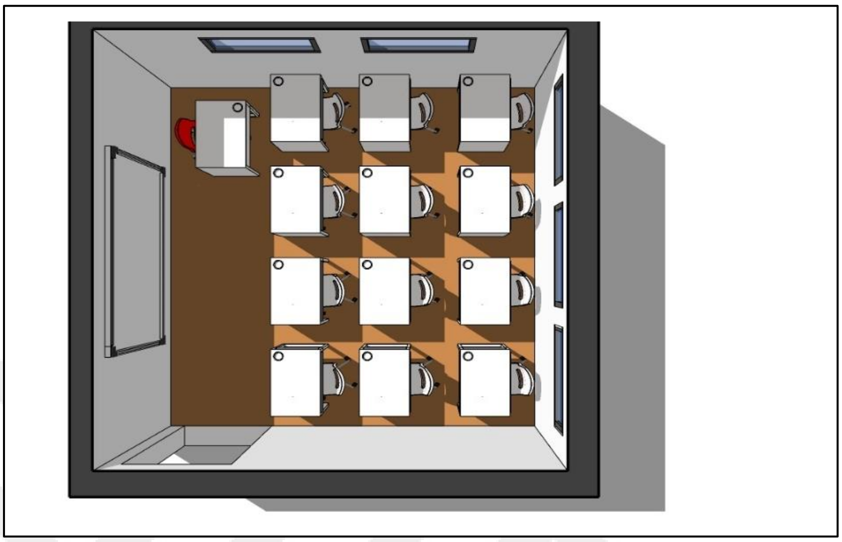
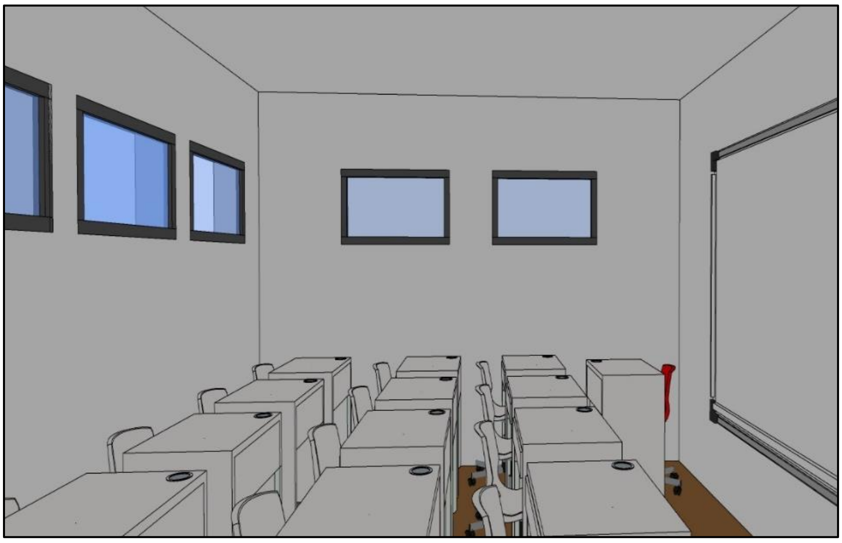


Figure 3.6: Perspective of 7th class



The table below (Table 3-3) clarifies the process of measurement periods and the dates of conducting these measurements.

Table 3.3: Measurements daylight of the first week

	Measurement Period 1		**Measurement Period 2**		**Measurement Period 3**
9:00 AM	**10:00 AM**	11:00 AM	**12:00 PM**	1:00 PM	**2:00 PM**
6	7	8	9	10	
May					
2019					

3.4.2 Phase two

The second phase of the experiment was conducted during the following week of the first phase/first week, specifically from 13th May to 17th May-2019. In this phase, the CTRS-R:S, the CPRS-R:S were distributed to the same teachers and parents of sampled children for a second time. In the second stage, children were exposed to outdoor lighting for one hour daily, particularly from 10:00 am to 11:00 am, in the schoolyard. During this period, the children were sitting around their teacher and taking their lessons according to the school schedule. In this period, the researcher also measured the outdoor illuminance levels every fifteen minutes in order to obtain accurate measurements.

In the second phase of this investigation, the indoor illuminance measurements continued daily in two periods after the exposure hour, specifically, at 12:00 pm, and 2:00 pm. On Friday 17th May 2019 (the last day of this phase), the CTRS-R:S and CPRS-R:S were collected back.

Table 3-4 identifies the period of outdoor exposure and the periods of indoor measurements, and the dates of conducting the second phase of the investigation.

Table 3.4: Measurements daylight of the second week

Exposure Period		Measurement Period		Measurement Period
10:00-11:00 AM		**12:00 PM**	1:00 PM	**2:00 PM**
13	14	15	16	17
May				
2019				

3.5 STATISTICAL ANALYSIS

The first step was describing the data by utilizing descriptive statistics, data collected from the rating scale, including the responses to the rating scale of teachers and parents and the tables of measurements. The collected data was analyzed using mean, percentage, frequency to determine if the scale responses indicated any symptoms of ADHD. The reactions were keyed and coded into the computer using SPSS (Version 22) data analysis program for general statistical analysis.

The data were analyzed presenting median, minimum, maximum, mean, and standard deviation to determine whether the data was in according to a normal distribution. Also, the Shapiro Wilk the test, the Mann-Whitney U test and Wilcoxon Signed Rank test were used to identify differences among continuous variables in this study. Moreover, the association between the continuous variable was tested by Spearman's correlation coefficient.

4. FINDINGS

This examination aims to see if there is an effect of daylight on the symptoms of ADHD in school children-ages (12-13 years) through the target children. In order to answer the question as to whether there were any children in the sampled children with symptoms of ADHD? Using the Arabic version, Conner's Teacher-Parent Rating Scale is the first step in the methodology of the study. During phase one (first week), the results of the scale were as following:

4.1 THE RESULTS OF THE FIRST PHASE (FIRST WEEK)

The collected data of this phase was analyzed using the statistical package of the social sciences version 22 (SPSS, V 22.0). Also, the data were initially screened to select which statistical tests would be used for the analysis.

4.1.1 The results of Conner's Teacher Rating Scale-Revised: S

The values in Table 4-1 show the results of CTRS-R:S for each student of the sample in the four subscales obtained from the teacher questionnaire. For example, student (P1), is a 12 years old male. Moreover, he has a T-score in the first subscale (Oppositional). He has 57 in the second subscale (Hyperactivity), 56 in the third subscale (Cognitive Problems) and 58 in the fourth subscale (ADHD Index). If these scores are interpreted based on guideline (Table 4-2), these obtained scores fall in the range of 56-60 that is indicative of slightly atypical (borderline: should raise concern).

Table 4.1: T-scores of CTRS-first week

Name	Age	Gender	Oppositional	Hyperactivity	Cognitive problems	ADHD Index
P1	12	M	56	57	56	58
P2	12	M	56	49	45	48
P3	12	M	52	54	51	52
P4	12	M	52	49	78	63
P5	12	M	77	81	62	75
P6	12	M	52	52	62	58
P7	12	F	63	61	70	60
P8	12	F	68	84	54	65
P9	12	F	55	61	61	56
P10	12	F	63	53	54	53
P11	12	F	84	61	48	56
P12	12	F	68	72	54	60
P13	13	M	70	74	48	59
P14	13	M	73	71	76	75
P15	13	M	66	62	73	70
P16	13	M	45	44	59	53
P17	13	M	52	47	48	48
P18	13	M	59	59	53	57
P19	13	M	59	57	81	75
P20	13	M	45	44	56	52
P21	13	M	63	47	53	48
P22	13	M	52	47	53	53
P23	13	M	56	52	84	72
P24	13	M	81	64	53	49
P25	13	F	50	46	44	45
P26	13	F	76	64	44	51
P27	13	F	46	49	44	50
P28	13	F	59	46	61	51
P29	13	F	72	53	83	75
P30	13	F	55	61	87	75
P31	13	F	46	46	44	45
P32	13	F	72	53	87	78

Table 4.2: Guideline of classification for students (CTRS-first week)

T-Score	%	Oppositional			Hyperactivity			Cognitive problems			ADHD Index			Guideline
		M	F	Total	M	F	Total	M	F	Total	M	F	Total	
70+	**98+**	**3**	**4**	**7**	**3**	**2**	**5**	**5**	**3**	**8**	**4**	**3**	**7**	**Markedly Atypical (Indicates Significant Problem)**
66-70	**95-98**	**2**	**2**	**4**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**0**	**1**	**Moderately Atypical (Indicates Significant Problem)**
61-65	**86-94**	**1**	**2**	**3**	**2**	**5**	**7**	**2**	**2**	**4**	**1**	**1**	**2**	**Mildly Atypical (Possible Significant Problem)**
56-60	74-85	5	1	6	3	0	3	3	0	3	4	4	8	Slightly Atypical (Borderline: Should raise concern)
45-55	27-73	7	5	12	8	7	15	8	4	12	8	6	14	Average (Typical Score: Should not raise concern)
40-44	16-26	0	0	0	2	0	2	0	4	4	0	0	0	Slightly Atypical (Low scores are good: Not a concern)
35-39	**6-15**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Mildly Atypical (Low scores are good: Not a concern)**
30-34	**2-5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Moderately Atypical (Low scores are good: Not a concern)**
<30	**<2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**Markedly Atypical (Low scores are good: Not a concern)**
TOTAL		18	14	32	18	14	32	18	14	32	18	14	32	

4.1.1.1 Oppositional Subscale

The data, which had been obtained, from the teachers for the Oppositional subscale, was assessed. It was found that seven students (three males and four females), had scores in the upper +70 range, indicating a significant problem. Also, the results showed that four students (two males and two females) were within the range (66-70) and considered moderately atypical, indicating a significant problem.

In addition, three students (one male and two female) had scores in the range (61-65) indicating a possible significant problem. Also, the results demonstrated that six students (five males and a female) were within the range (56-60) and could be considered as slightly atypical (borderline: should raise concern). Accordingly, the proportion of children with oppositional symptoms is 62.5%. In contrast, twelve students (seven males and five females) had scores in the range (45-55) and could be considered as average; indicating typical score (should not raise concern). The percentage of children without oppositional symptoms was 37.5%.

4.1.1.2 Hyperactivity Subscale

The results, which had been obtained from teachers for the Hyperactivity subscale, was assessed. It was found that five students (three males and two females) had scores in the range +70 indicating a significant problem. Also, the findings illustrated that seven students (two males and five females) were within the range (61-65) and was considered as mildly atypical; indicating a possible significant problem. In addition, three male students had scores in the range (56-60); indicating a slightly atypical (borderline: should raise concern). The proportion of children with Hyperactivity symptoms is 46.8%. However, fifteen students (eight males and seven females) had scores in the range (45-55) indicating an average score. Also, the findings showed that two male students were slightly atypical (low scores are good: not a concern). Therefore, the percentage of students without hyperactivity symptoms was 53.2%.

4.1.1.3 Cognitive problems Subscale

It was demonstrated that some of the students were suffering from Cognitive problems in the first phase of the study: Eight students (five males and three females) were reported to experience significant cognitive problems. They had T-scores within the +70 range. In addition, a female student had scores in the range of 66-70 indicating moderately atypical (indicates significant problem) symptoms. Also, four students (two males and two females) had a score in the range of 61-65 indicating mildly atypical (potentially significant problem) symptoms. In addition to these students, there were three male students whose results were in the range of 56-60, indicating a slightly atypical (borderline: should raise concern) symptoms. Thus, the percentage of students who had cognitive problems, according to the teachers was 50%.

In contrast, twelve children (eight males and four females) whose results were in the range of (45-55). Also, the results of four female students were slightly atypical (how scores are good: not a concern). Therefore, the percentage of students without cognitive problems was 50%.

4.1.1.4 ADHD Index Subscale

The data which had been obtained from teachers for the ADHD subscale was assessed. It was found that seven students (four males and three females) had scores in the range +70; indicating as a significant problem. Also, a male student had a score in the range (66-70), indicating a moderately atypical (indicates a significant problem). In addition, two students (a male and a female) whose results were in the range of (61-65), indicating as a mildly atypical (possible significant problem). In addition, eight students, (four male and four female) had scores in the range of (56-60); indicating as slightly atypical (borderline: should raise concern). Thus, the percentage of students who have symptoms is 56.25%. However, fourteen students (eight male and six female) had scores in the range of 45-55. Therefore, the percentage of children without symptoms is 43.75%.

4.1.2 The results of Conner's Parent Rating Scale-Revised: S

The values in (Table 4-3) show the results of CPRS-R:S for each student of the sample in the four subscales obtained from the parent questionnaire.

Table 4.3: T-scores of (CPRS-first week)

Name	Age	Gender	Oppositional	Cognitive problems	Hyperactivity	ADHD Index
P1	12	M	56	51	59	59
P2	12	M	48	44	59	43
P3	12	M	43	51	48	52
P4	12	M	56	65	66	63
P5	12	M	58	53	66	52
P6	12	M	58	51	63	56
P7	12	F	50	48	45	48
P8	12	F	43	42	52	47
P9	12	F	50	53	59	50
P10	12	F	45	42	56	42
P11	12	F	61	59	70	61
P12	12	F	43	42	52	45
P13	13	M	0	0	0	0
P14	13	M	53	59	70	63
P15	13	M	50	65	66	61
P16	13	M	50	65	63	65
P17	13	M	50	49	56	50
P18	13	M	58	57	66	63
P19	13	M	40	48	52	50
P20	13	M	53	42	45	41
P21	13	M	58	55	52	50
P22	13	M	48	44	52	44
P23	13	M	53	63	45	62
P24	13	M	66	55	59	51
P25	13	F	53	42	56	42
P26	13	F	69	48	59	45
P27	13	F	56	44	56	49
P28	13	F	45	42	45	43
P29	13	F	50	57	59	54
P30	13	F	56	63	56	61
P31	13	F	56	42	59	47
P32	13	F	64	67	59	67

4.1.2.1 Oppositional Subscale

There were two students (a male and a female) whose results could be classified as moderately atypical (indicates a significant problem). Also, there was two female whose results were mildly atypical (possible significant problem). Also, nine students (six males and three female) had slightly atypical results (borderline: should raise concern). Moreover, there were fourteen children (eight male and six female) whose results could be classified as average (typical score: should not raise concern). Four children (two males and two females) had scores that were slightly atypical (low scores are good: not a concern). While the percentage of students with symptoms was 41.94%, those without symptoms were 58.06%.

4.1.2.2 Cognitive problem Subscale

The results of the cognitive problem section were as following: There was a female student whose results could be classified as a moderately atypical (indicates a significant problem). Also, there were five students (four male and a female) whose results were mildly atypical (possible significant problems). In addition, four students (two male and two female) had a slightly typical result (borderline: should raise concern). Moreover, there were eleven students (eight male and three female) whose results could be classified as an average (typical score: should not raise concern). Also, ten students (three male and seven female) had scores that were slightly atypical (low scores are good: not a concern). While the percentage of students with symptoms is 32.26%, those without symptoms were 67.74%.

4.1.2.3 Hyperactivity Subscale

There were six students (five male and a female) whose results could be classified as moderately atypical (indicates a significant problem). Also, there were two male students whose results were mildly atypical (possible significant problems). In addition, thirteen students (four male and nine female) whose scores could be considered as sightly atypical (borderline: should raise concern). Moreover, ten students (six male and four female) had scores in the range of (45-55); (typical score: should not raise concern). While the percentage of students with hyperactivity symptoms is 67.74 %, those without symptoms is 32.26%.

4.1.2.4 ADHD Index Subscale

The data which had been obtained from parents for the ADHD section was assessed. It was found that a female student had scores in the range of (66-70), indicating a significant problem. In addition, eight students (six male and two female) whose results could be considered as a mildly atypical possible significant problem. In addition, two male students had sightly typical results (borderline: should raise concern). Furthermore, fourteen students, six male and eight females) whose results could be considered as an average (typical score: should not raise concern). Moreover, six students (three male and three female) whose results could be classified as slightly atypical (low scores are good:

not a concern). The total number of responses for this section was 31child. Thus, the percentage of children with ADHD symptoms is 35.48% those without symptoms is 64.52%.

4.1.3 The results of daylight measurements of sixth grade (first phase)

In the first phase, illuminance levels in each classroom were measured daily in three periods (Table 4-4). It can be seen from the table that the average of the measurements taken at 10.00 AM is 1310 lux in the sixth-grade classroom. Also, the average illuminance levels obtained for 12.00 PM and 02.00 PM, are 1459 lux and 1912 lux, respectively.

Table 4.4: Illuminance measurements for the sixth grade (first week)

DAY	DATE	10:00 a.m.	12:00 p.m.	2:00 p.m.
MONDAY	06/05/2019	1854	2330	1748
TUESDAY	07/05/2019	2203	1054	3346
WEDNESDAY	08/05/2019	816	2170	2259
THURSDAY	09/05/2019	940	1048	1523
FRIDAY	10/05/2019	740	695	683
Average		1310	1459	1912

4.1.4 The results of daylight measurements of seventh grade (first phase)

Illuminance levels were also measured daily in three periods (Table 4-5) in the classroom of seventh-grade students. It can be seen from the table that the average of the measurements taken at 10.00 AM is 1721 lux. Also, the average illuminance levels obtained for 12.00 PM and 02.00 PM, are 1749 lux and 1085 lux, respectively.

Table 4.5: Illuminance measurements for the seventh grade (first week)

DAY	DATE	10:00 a.m.	12:00 p.m.	2:00 p.m.
MONDAY	06/05/2019	1142	1249	989
TUESDAY	07/05/2019	2272	1856	1835
WEDNESDAY	08/05/2019	3150	3147	529
THURSDAY	09/05/2019	1143	1765	1475
FRIDAY	10/05/2019	896	730	595
Average		1721	1749	1085

4.2 THE RESULTS OF THE SECOND PHASE (SECOND WEEK)

During this phase, the illuminance levels in the classrooms were measured as in the first week. The children were exposed to outdoor daylight for an hour daily (10-11 AM) throughout the second week. Therefore, additional illuminance measurements were taken to determine the exposure levels. Also, the scales for teachers and parents were administered again. The results obtained are presented below.

4.2.1 The results of CTRS-R:S

The values in Table 4-6 demonstrate the results of CTRS-R:S for each student of the sample in the four subscales obtained from the teacher questionnaire.

Table 4.6: T-scores of CTRS-second week

Name	Age	Gender	Oppositional	Hyperactivity	Cognitive Problems	ADHD Index
P1	12	M	52	54	51	53
P2	12	M	52	47	45	46
P3	12	M	52	49	48	49
P4	12	M	49	47	67	57
P5	12	M	73	76	56	66
P6	12	M	49	49	56	54
P7	12	F	59	53	67	56
P8	12	F	63	76	48	61
P9	12	F	55	57	57	55
P10	12	F	55	49	51	51
P11	12	F	72	57	48	55
P12	12	F	59	64	48	55
P13	13	M	63	66	45	54
P14	13	M	63	66	67	69
P15	13	M	59	57	65	63
P16	13	M	45	49	53	50
P17	13	M	49	44	45	46
P18	13	M	56	54	49	53
P19	13	M	52	49	73	66
P20	13	M	45	49	53	48
P21	13	M	56	44	51	45
P22	13	M	52	44	51	50
P23	13	M	52	49	76	69
P24	13	M	70	57	51	45
P25	13	F	50	46	44	45
P26	13	F	68	57	44	50
P27	13	F	46	46	44	45
P28	13	F	55	46	54	47
P29	13	F	63	49	70	63
P30	13	F	50	57	83	68
P31	13	F	46	46	44	45
P32	13	F	68	49	80	71

4.2.1.1 Oppositional Subscale

The data which had been obtained from teachers for the Oppositional section was assessed. It was found that two students (a male and a female) whose results could be classified as markedly atypical (significant problem). Also, three students (a male and two female) had moderately atypical results (indicates a significant problem). In addition, four students (two male and two female) whose scores could have been considered as mildly atypical (possible significant problem). Also, five students (three male and two female) had results that could be classified slightly atypical (borderline: should raise concern). Moreover, eighteen students (eleven male and seven female) had an average result (typical score: should not raise concern). Therefore, the percentage of students with Oppositional symptoms is 43.75%, and that without symptoms is 56.25%.

4.2.1.2 Hyperactivity Subscale

The results of Hyperactivity section were as following: there were two students (a male and female) whose results could be considered as markedly atypical (indicates a significant problem). Also, two male students had moderately atypical results (indicates a significant problem). In addition, a female student had a result that could be classified as mildly atypical (possible significant problem). Also, six students (two male and four female) had a slightly atypical result (borderline, should raise concern). In addition, eighteen children (ten male and eight females) had results that could be considered as an average (should not raise concern). Also, three male students had slightly atypical results (low scores are good: not a concern. Thus, the percentage of children with Hyperactivity symptoms is 34.37%; that without symptoms is 65.63%.

4.2.1.3 Cognitive problem Subscale

The data that had been obtained from teachers for the cognitive problem section was assessed. It was found that four students (two male and two female) whose results could be classified as markedly atypical (indicates a significant problem). Also, four students (two male and two female) had a moderately atypical (indicates a significant problem). In addition, a male student had a mildly atypical result (possible significant problems). Moreover, three students (two male and a female) had results that could be considered as a slightly atypical (borderline: should raise concern). Also, sixteen students (eleven male and five female) had an average result (typical score: should not raise concern). In addition, four female students had results that could be classified as slightly atypical (low scores are good: not a concern). Thus, the percentage of students with Cognitive problem symptoms is 37.5%; that without symptoms is 62.5 %.

4.2.1.4 ADHD Index Subscale

There was a female student whose result was markedly atypical indicates a significant problem. Also, five students (four male and a female) had moderately atypical results (indicates a significant problem). In addition, three students (a male and two female) had results that could be classified as mildly atypical (possible significant problem). Moreover, two students (a male and a female) had a slightly atypical result (borderline: should raise concern). In addition, twenty-one students (twelve male and nine female) had results that could be considered as an average (typical score: should not raise concern). Therefore, the percentage of children with ADHD is 34.37%; that without symptoms is 65.63 %.

4.2.2 The results of CPRS-R:S

The values in Table 4-7 demonstrated the results of CPRS-R:S for each student of selected children in the four subscales.

Table 4.7: T-scores of CPRS-second week

Name	Age	Gender	Oppositional	Cognitive Problems	Hyperactivity	ADHD Index
P1	12	M	48	48	52	52
P2	12	M	48	44	56	43
P3	12	M	43	49	48	49
P4	12	M	50	59	63	57
P5	12	M	56	49	59	50
P6	12	M	56	49	63	54
P7	12	F	43	46	45	44
P8	12	F	43	42	52	47
P9	12	F	48	49	52	48
P10	12	F	40	44	45	43
P11	12	F	58	53	66	55
P12	12	F	40	44	48	42
P13	13	M	0	0	0	0
P14	13	M	53	59	63	55
P15	13	M	50	55	63	56
P16	13	M	50	55	56	58
P17	13	M	50	45	48	45
P18	13	M	53	53	59	57
P19	13	M	40	49	48	49
P20	13	M	50	44	45	41
P21	13	M	58	55	52	50
P22	13	M	45	44	45	43
P23	13	M	48	53	45	55
P24	13	M	58	53	56	50
P25	13	F	48	44	52	42
P26	13	F	64	48	56	45
P27	13	F	53	46	52	48
P28	13	F	40	44	45	43
P29	13	F	48	51	52	49
P30	13	F	50	57	53	58
P31	13	F	53	44	56	43
P32	13	F	58	61	59	58

4.2.2.1 Oppositional Subscale

There was a female student whose result could be classified as mildly atypical (possible significant problem). Also, six students (four male and two female) had a slightly atypical result (borderline: should raise concern). In addition, seventeen students (eleven male and six female) had results that could be considered as an average (typical score: should not raise concern). Moreover, seven students (two male and five female) had results that could be classified as slightly atypical (low scores are good: not a concern). Thus, the percentage of children with Oppositional symptoms is 22.58 %; that without symptoms is 77.42%.

4.2.2.2 Cognitive problem Subscale

There was a female student whose result could be classified as mildly atypical (possible significant problem). Also, three students (two male and female) had slightly atypical (borderline: should raise concern). In addition, eighteen students (twelve male and six female) had results that were average (typical score: should not raise concern). Also, nine children (three male and six female) had a slightly atypical (low scores are good: not a concern). Therefore, the percentage of students with cognitive problem symptoms is 12.9%; that without symptoms is 87.1%.

4.2.2.3 Hyperactivity Subscale

The findings of each student of the selected children for the Hyperactivity section were classified. It was found that a female child whose result was a moderately atypical (indicates a significant problem), also four male students whose results could be considered as mildly atypical (possible significant problem). In addition, eight children (five male and three female) had slightly atypical results (borderline: should raise concern) Moreover, there were eighteen students (eight male and ten female) whose results were average (typical score: should not raise concern). The percentage of students with hyperactivity symptoms is 41.9%; that without symptoms is 58.1%.

4.2.2.4 ADHD Index Subscale

It was found that six students (four male and two female) whose results were slightly atypical (borderline should raise concern). In addition, sixteen students (ten male and six female) whose results could be classified as average (typical score: should not raise concern). Moreover, there nine students (three male and six female) whose results were slightly atypical (low scores are good: not a concern). Therefore, the percentage of students with ADHD symptoms is 19.35%; that without symptoms is 80.65%.

4.2.3 The results of the illuminance of daylight measurements (6th grade)

In the second phase of the study, the illuminance levels exposed by the participating sixth-grade students were measured daily throughout, the school day (Table 4-8). It is evident from the table that the average of illuminance levels measured outdoors at 10.00 AM was 4828 lux. The averages of illuminance levels measured indoors at 12.00 PM and 02.00 PM were 959 and 1007 lux, respectively.

Table 4.8: Average of illuminance measurements (sixth grade/second week)

DAY	DATE	OUTDOORS	INDOORS	
		10:00 am - 11:00 am	12:00 PM	2:00 PM
MONDAY	13/05/2019	6617	1239	1157
TUESDAY	14/05/2019	3222	547	661
WEDNESDAY	15/05/2019	3957	1217	1191
THURSDAY	16/05/2019	5229	883	1117
FRIDAY	17/05/2019	5094	909	911
AVERAGE		4824	959	1007

4.2.4 The results of the illuminance of daylight measurements (7th grade)

The illuminance levels exposed by the participating seventh-grade students were measured daily throughout the school day (Table 4-9). It is evident from the table that the average illuminance level measured outdoors at 10.00 AM was 4828 lux. The averages of illuminance levels measured indoors at 12.00 PM and 02.00 PM were 545 and 555 lux, respectively.

Table 4.9: Average of illuminance measurements (seventh grade/second week)

DAY	DATE	OUTDOORS	INDOORS	
		10:00 am - 11:00 am	12:00 PM	2:00 PM
MONDAY	13/05/2019	6617	397	368
TUESDAY	14/05/2019	3222	600	542
WEDNESDAY	15/05/2019	3957	537	620
THURSDAY	16/05/2019	5229	613	607
FRIDAY	17/05/2019	5094	580	640
AVERAGE		4824	545	555

4.3 STUDENT GRADES

Student grades obtained for the period before the study are shown in Table 4-10. The grades are for the following six subjects: Islamic, Mathematics, Science, English, Writing, and Reading. Upon examining the table, it was found that three students did not obtain pass grade (a grade of 50% and above). The student P4 did not succeed in Mathematics, and he had a grade of 38% for this subject. Also, the student P23 was unable to succeed in Reading and a grade of 47.5%. The student P30 was unable to obtain the degree of success in Science and Reading. The grades for each subject are 44.5% and 44.38% respectively.

Table 4.10: Student Grades

Student	Student Grades					
	Islamic	Mathematics	Science	English	Writing	Reading
P1	84.17%	75.00%	85.00%	76.88%	82.50%	79.38%
P2	90.83%	72.50%	89.17%	75.63%	94.17%	86.25%
P3	90.83%	68.00%	86.67%	71.88%	87.50%	80.63%
P4	80.00%	38.00%	75.83%	68.13%	80.00%	70.00%
P5	96.67%	76.00%	82.50%	91.88%	88.33%	81.25%
P6	73.33%	74.50%	80.00%	99.38%	74.17%	71.88%
P7	88.33%	78.50%	92.50%	98.13%	85.00%	80.00%
P8	91.67%	80.00%	83.33%	91.25%	88.33%	83.75%
P9	90.00%	88.00%	92.50%	88.13%	78.33%	88.75%
P10	97.50%	56.50%	95.00%	73.75%	83.33%	89.38%
P11	100.00%	96.50%	100.00%	98.13%	95.83%	94.38%
P12	100.00%	94.00%	98.33%	96.25%	94.17%	96.88%
P13	72.50%	93.00%	73.50%	83.75%	86.25%	71.88%
P14	72.50%	89.00%	67.50%	69.38%	77.50%	62.50%
P15	75.00%	79.50%	60.50%	66.88%	77.50%	66.88%
P16	77.50%	73.50%	68.50%	73.75%	81.25%	63.13%
P17	87.50%	74.50%	64.50%	65.00%	81.25%	68.75%
P18	78.75%	81.50%	71.00%	81.88%	80.00%	77.50%
P19	75.00%	73.00%	71.00%	70.63%	80.00%	62.50%
P20	77.50%	91.50%	82.50%	72.50%	73.75%	63.75%
P21	81.25%	75.00%	80.00%	92.50%	85.00%	73.13%
P22	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
P23	67.50%	52.50%	50.50%	52.50%	76.25%	47.50%
P24	96.25%	93.00%	98.50%	95.63%	92.50%	85.63%
P25	83.75%	90.50%	73.50%	88.75%	90.00%	76.25%
P26	100.00%	99.50%	93.50%	98.75%	95.00%	95.63%
P27	98.75%	93.50%	89.50%	96.88%	96.25%	91.25%
P28	81.25%	75.00%	82.00%	79.38%	81.25%	74.38%
P29	73.75%	79.00%	50.00%	73.75%	80.00%	66.25%
P30	57.50%	61.00%	44.50%	55.00%	70.00%	44.38%
P31	100.00%	99.00%	99.50%	99.38%	97.50%	90.63%
P32	62.50%	81.50%	50.00%	78.75%	81.25%	60.63%

4.4 STATISTICAL ANALYSIS

The statistical significance level was defined as $p<0.05$.

4.4.1 Daily measurements of daylight in the first and second weeks

The average of daily measurements of illuminance levels for the first, second weeks was calculated. These are presented in Table 4-11 and, 4-12.

Table 4.11: Daily measurements for daylight sixth and seventh grade-first week

DAY	DATE	INDOOR					
		10:00 AM		12:00 PM		02:00 PM	
		6 TH Grade	7 TH Grade	6 TH Grade	7 TH Grade	6 TH Grade	7 TH Grade
MONDAY	06/05/2019	1854	1142	2330	1249	1748	989
TUESDAY	07/05/2019	2203	2272	1054	1856	3346	1835
WEDNESDAY	08/05/2019	816	3150	2170	3147	2259	529
THURSDAY	09/05/2019	940	1143	1048	1765	1523	1475
FRIDAY	10/05/2019	740	896	695	730	683	595
AVERAGE		1311	1721	1459	1749	1912	1085

Table 4.12: Daily measurements for daylight sixth and seventh grade-second week

DAY	DATE	OUTDOOR		INDOOR			
		10:00- 11:00		12:00		02:00	
		6 TH Grade	7 TH Grade	6 TH Grade	7 TH Grade	6 TH Grade	7 TH Grade
MONDAY	13/05/2019	6617	6617	1239	397	1157	368
TUESDAY	14/05/2019	3222	3222	547	600	661	542
WEDNESDAY	15/05/2019	3957	3957	1217	537	1191	620
THURSDAY	16/05/2019	5229	5229	883	613	1117	607
FRIDAY	17/05/2019	5094	5094	909	580	911	640
AVERAGE		4824	4824	959	545	1007	555

4.4.2 Comparisons of the daily illuminance measurements in the first and second weeks

As shown in Table 4-13, it was observed that the illuminance exposure variable presented no normal distribution ($p<.05$).

Table 4.13: Test of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Mean1	.402	32	.000	.615	32	.000
Mean2	.402	32	.000	.615	32	.000

a. Lilliefors Significance Correction

Table 4-14 illustrates the descriptive statistics related to the illuminance exposed in the first and the second week. Wilcoxon Signed-Rank Test a method which is used in non-parametric repeated measures- was applied to distinguish any potential difference between the measures of the above stated periods. Tables 4-15 and 4-16 show the Median of the (Mean of illuminance levels) that were exposed by 6th and 7th-grade students during the second week (Mdn=1974.6667) was significantly higher ($p<.05$) than, the Median of the (Mean of illuminance levels) that were exposed by 6th and 7th-grade students during the first week (Mdn=1518.3333).

Table 4.14: Case Summaries

		P	Mean	Std. Deviation	**Median**	Minimum	Maximum
Case Summaries	Mean1	32	1534.0833	20.65851	**1518.3333**	1518.33	1560.33
	Mean2	32	2082.9167	141.98629	**1974.6667**	1974.67	2263.33

Mean 1= The mean of the illuminance levels that students were exposed in 6th and 7th-grade during the first week.

Mean 2= The mean of the illuminance levels that students were exposed in 6th and 7th-grade during the second week.

Table 4.15: Ranks

`		N	Mean Rank	Sum of Ranks
mean2 -	Negative Ranks	0[a]	.00	.00
mean1	Positive Ranks	32[b]	16.50	528.00
	Ties	0[c]		
	Total	32		

a. mean2 < mean1

b. mean2 > mean1

c. mean2 = mean1

Table 4.16: Test Statistics

	mean2 - mean1
Z	-5.121[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

4.4.3 Statistical relationships between students' grades and a) CTRS first week; b) CPRS first week

4.4.3.1 CTRS-first week

Table 4-17 represents the relationship between the teachers' ratings for the first week on students' ADHD scores and the students' academic scores.

It is evident from the table that a moderate negative relationship between Cognitive Problems and Islamic scores ($r=-0.610$; $p<.01$). A moderate increase in the students' Islamic scores was observed due to the decrease in their Cognitive Problems. Similarly, moderate negative relationship between their Mathematics scores and Cognitive Problems was found ($r=-0.427$; $p<.01$). It was detected that as the Cognitive Problems of the students increased, a moderate level decrease occurred in the students' Mathematics scores. Also, a moderate negative relationship was indicated between Cognitive Problems and Science scores ($r=-0.525$; $p<.01$). Accordingly, increased Science scores were determined along with the decrease in their Cognitive Problems. In the same way, a moderate negative relationship was shown between Cognitive Problems and English scores ($r=-0.445$; $p<.01$). A moderate rise in the students' English scores occurred with the fall in their Cognitive Problems. In the same way, a moderate negative relationship was present between Cognitive Problems and Writing scores ($r=-0.692$; $p<.01$). As the students' Cognitive Problems presented a decrease, their Writing scores exhibited a moderate increase. The relationship between Cognitive Problems and Reading scores was identified as moderate negative ($r=-0.625$; $p<.01$). As their Cognitive Problems showed a decrease, there the students' Reading scores presented a moderate level increase.

A moderate negative relationship was identified between ADHD Index and Islamic scores ($r=-0.484$; $p<.01$). When ADHD Index presented a decrease, the students' Islamic scores were observed to present a moderate increase. A moderate negative relationship was detected between the ADHD Index and Science scores (r=-0.453; p<.01). The data showed that as the ADHD Index decreased, a moderate level increase occurred in the students' Science scores. In addition, a moderate negative relationship was indicated between ADHD Index and Writing scores (r=-0.462; p<.01). As ADHD Index decreased, a moderate level increase occurred in the students' Writing scores. Also, a moderate negative relationship was found between the ADHD Index and Reading scores (r=-0.445; p<.01). It was found out that the Reading scores of students received a moderate increase as the ADHD Index decreased.

Table 4.17: Correlation table between teachers' T-scores

	Mean	Std.D	1	2	3	4	5	6	7	8	9	10
1. Oppositional	60.72	10.86	——									
2. Hyperactivity	56.87	10.63	.755**	——								
3. Cognitive Problems	60.19	13.87	.163	.158	——							
4. ADHD Index	58.91	10.28	.423*	.540**	.829**	——						
5. Islamic	81.32	18.84	.144	.172	.610**	-484**	——					
6. Mathematics	76.64	19.71	.327	.309	-.427*	-.191	.451**	——				
7. Science	75.98	20.82	.142	.191	.525**	.453**	.893**	.475**	——			
8. English	78.90	19.59	.243	.202	-.445*	-.309	.632**	.671**	.712**	——		
9. Writing	81.70	16.58	.240	.160	-.692**	-.462**	.833**	.534**	.727**	.686**	——	
10. Reading	73.30	18.72	.208	.275	-.625**	-.445*	.942**	.523**	.916**	.738**	.815**	——

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

4.4.3.2 CPRS- first week

Table 4-18 illustrates the relationship between the parents' ratings for the first week on students' ADHD scores and the students' academic success scores. Upon the examination of the table, a moderate positive relationship was identified between the Oppositional and English scores (r=0.369; p<.05). It was detected that the lower the Oppositional scores, the lower the students' English scores were. However, a moderate negative relationship was detected between Hyperactivity and Islamic scores (r=-0.381; p<.05). In that sense, as Hyperactivity decreased, a moderate increase in the students' Islamic scores was identified. A moderate negative relationship was identified between Hyperactivity and Science scores (r=-0.429; p<.05). It was observed that as Hyperactivity decreased, the students' Science scores presented a moderate level increase.

Similarly, considering the relationship between Hyperactivity and Writing scores, a moderate negative relationship has been detected ($r=-0.387$; $p<.05$). Accordingly, when Hyperactivity lessened, the students' Writing scores exhibited a moderate rise. In the same way, between Hyperactivity and Reading, a moderate negative relationship was identified ($r=-0.419$; $p<.05$). To clarify, as the Hyperactivity also decreased the moderate level increase in the students' reading scores was found. Moreover, a moderate negative relationship was also present between ADHD Index and Science scores ($r=-0.390$; $p<.05$). The students' Science scores were identified to present a moderate level increase as the ADHD Index decreased. As for the relationship between ADHD Index and Reading, again, a moderate negative relationship was determined ($r=-0.374$; $p<.05$). To be more specific, the lesser the ADHD Index became, the more of a moderate level increase was observed in the students' reading scores.

Table 4.18: Correlation table between parents' T-scores

	Mean	Std.D	1	2	3	4	5	6	7	8	9	10
1. Oppositional	51.22	11.59	———									
2. Hyperactivity	50.25	12.31	.487**	———								
3. Cognitive problems	55.31	12.33	.555**	.589**	———							
4. ADHD Index	50.81	12.13	.452**	.932**	.614**	———						
5. Islamic	81.32	18.84	.098	-.381*	.100	-.341	———					
6. Mathematics	76.64	19.71	.305	-.245	.146	-.205	.451**	———				
7. Science	75.98	20.82	.099	-.429*	.011	-.390*	.893**	.475**	———			
8. English	78.90	19.59	.369*	-.320	.108	-.245	.632**	.671**	.712**	———		
9. Writing	81.70	16.58	.105	-.387*	.015	-.339	.833**	.534**	.727**	.686**	———	
10. Reading	73.30	18.72	.097	-.419*	.110	-.374*	.942**	.523**	.916**	.738**	.815**	———

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

4.4.4 Statistical differences between (CTRS-1st, second week) and (CPRS-1st, second week)

4.4.4.1 CTRS (a first week and second week)

When Table 4-19 was examined, it was found that the teachers' first and second-week scores did not exhibit normal distribution ($p<.05$).

Table 4.19: Test of Normality

Subscale	Group	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Opp1	Teacher	.137	32	.134	.952	32	.169
Opp2	Teacher	.167	32	.023	.932	32	.045
Hyp1	Teacher	.142	32	.098	.908	32	.010
Hyp2	Teacher	.250	32	.000	.840	32	.000
Cog1	Teacher	.181	32	.009	.884	32	.002
Cog2	Teacher	.193	32	.004	.863	32	.001
ADHD1	Teacher	.155	32	.050	.896	32	.005
ADHD2	Teacher	.141	32	.105	.903	32	.007

a. group = Teacher

b. Lilliefors Significance Correction

Table 4-20 illustrates the descriptive statistics related to the scores given by the teachers within the first and second weeks relevant to the illuminance exposed. In order to determine whether there was a difference between the measurements in these two time periods, the Wilcoxon Signed Rank Test, used in the non-parametric repetitive measures was utilized. It was observed that the first-week Oppositional median (MDN=59) was shown to decrease significantly in comparison with the second week's median (MDN=55).

Moreover, as the illuminance boosted, Hyperactivity first-week median (Mdn=53.50) showed a significant decrease compared to the second week's median (Mdn=49). In that respect, from the teachers' point students' Hyperactivity behaviour, presented a statistically significant decline ($p<.05$).

In addition, as the illuminance boosted, Cognitive Problems first-week median (Mdn=55) showed a significant fall compared with the second week's median (Mdn=51). In that respect, a statistically significant decrease (p<.05) in the students' behaviours relevant to the Cognitive Problems was observed from the teachers' aspect, due to the increase in illuminance.

Similarly, with the increase in the amount of illuminance, first week ADHD Index median (Mdn=56.50) showed a significant decrease in comparison to the second week's median (Mdn=53.50). A statistically significant decrease (p<.05) in the ADHD Index behaviours of students was detected from the teachers' aspect due to the increase in illuminance.

Table 4.20: Comparison of CTRS' T-scores for the first and second week

		P	Mean	Std. Deviation	Median	Minimum	Maximum	
Case Summaries	Opp1	32	60.7188	10.86051	59.0000	45.00	84.00	a. group = Teacher
	Opp2	32	56.1875	8.05400	55.0000	45.00	73.00	
	Hyp1	32	56.8750	10.63394	53.5000	44.00	84.00	
	Hyp2	32	53.1875	8.55509	49.0000	44.00	76.00	
	Cog1	32	60.1875	13.86673	55.0000	44.00	87.00	
	Cog2	32	55.7500	11.39326	51.0000	44.00	83.00	
	ADHD1	32	58.9063	10.28422	56.5000	45.00	78.00	
	ADHD2	32	54.6875	8.30250	53.5000	45.00	71.00	

Table 4.21: Ranks

		N	Mean Rank	Sum of Ranks
Op2 - Op1	Negative Ranks	24[b]	12.50	300.00
	Positive Ranks	0[c]	.00	.00
	Ties	8[d]		
	Total	32		
H2 - H1	Negative Ranks	27[e]	14.70	397.00
	Positive Ranks	2[f]	19.00	38.00
	Ties	3[g]		
	Total	32		
Cog2 - Cog1	Negative Ranks	26[h]	13.50	351.00
	Positive Ranks	0[i]	.00	.00
	Ties	6[j]		
	Total	32		
ADHD2 - ADHD1	Negative Ranks	30[k]	15.50	465.00
	Positive Ranks	0[l]	.00	.00
	Ties	2[m]		
	Total	32		

a. group = Teacher

b. op2 < op1

c. op2 > op1

d. op2 = op1

e. h2 < h1

f. h2 > h1

g. h2 = h1

h. cog2 < cog1

i. cog2 > cog1

j. cog2 = cog1

k. adhd2 < adhd1

l. adhd2 > adhd1

m. adhd2 = adhd1

Table 4.22: Test Statistics

`	Op2 - Op1	H2 - H1	Cog2 - Cog1	ADHD2 - ADHD1
Z	-4.303[c]	-3.901[c]	-4.470[c]	-4.795[c]
Asymp. Sig. (2-tailed)	.000	.000	.000	.000

a. group = Teacher

b. Wilcoxon Signed Ranks Test

c. Based on positive ranks.

4.4.4.2 CPRS (a first week and second week)

Table 4-23 illustrates the descriptive statistics related to the scores given by the parents within the first and second weeks relevant to the illuminance exposed. Wilcoxon Signed-Rank Test used in the non-parametric repetitive measures was applied in order to determine whether there was a change between the measurements in these two time periods. Upon examination of the table, a significant difference ($p<.05$) in terms of the ADHD dysfunctions has been identified. Together with the increase in the luminance exposed, first-week Oppositional median (MDN=53) was shown to have a significant decrease compared with the second-week median (MDN=50).

In addition, accompanied by the rise in the amount of illuminance, first-week Hyperactivity median (Mdn=51) showed a significant decrease compared with the second week's median (Mdn=49). In that manner, from the parents' point, students' Hyperactivity behaviour illustrated a statistically significant decline ($p<.05$).

Furthermore, with the boost in the illuminance amount, Cognitive problems first-week median (Mdn=57.50) presented a significant decline compared with the second week's median (Mdn=52). In that respect, a statistically significant decrease ($p<.05$) in the students' behaviours relevant to the Cognitive problems was observed from the parents' aspect, via the increase in illuminance.

Similarly, with the rise in the amount of illuminance, first week ADHD Index median (Mdn=50) exhibited a significant decrease in comparison to the second week's median (Mdn=49). Hence, from the parents' aspect, a statistically significant decrease ($p<.05$) in the ADHD Index behaviours of students was inspected due to the increase in illuminance.

Table 4.23: Tests of Normality

Subscale	Group	Kolmogorov-Smirnov[b]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Op1	Parent	.177	32	.012	.751	32	.000
Op2	Parent	.212	32	.001	.723	32	.000
H1	Parent	.220	32	.000	.803	32	.000
H2	Parent	.285	32	.000	.658	32	.000
Cog1	Parent	.207	32	.001	.720	32	.000
Cog2	Parent	.246	32	.000	.697	32	.000
ADHD1	Parent	.178	32	.011	.787	32	.000
ADHD2	Parent	.226	32	.000	.677	32	.000

a. group = Parent

b. Lilliefors Significance Correction

Table 4.24: Comparison of CPRS' T-scores for the first and second week

		P	Mean	Std. Deviation	Median	Minimum	Maximum	
Case Summaries[a]	Op1	32	51.2188	11.58902	53.0000	0.00	69.00	a. group = Parent
	Op2	32	48.1875	10.70254	50.0000	0.00	64.00	
	H1	32	50.2500	12.31312	51.0000	0.00	67.00	
	H2	32	48.0000	10.22016	49.0000	0.00	61.00	
	Cog1	32	55.3125	12.32736	57.5000	0.00	70.00	
	Cog2	32	51.6875	11.31210	52.0000	0.00	66.00	
	ADHD1	32	50.8125	12.13483	50.0000	0.00	67.00	
	ADHD2	32	47.7813	10.35416	49.0000	0.00	58.00	

Table 4-25: Ranks

		N	Mean Rank	Sum of Ranks
op2 - op1	Negative Ranks	22[b]	11.50	253.00
	Positive Ranks	0[c]	.00	.00
	Ties	10[d]		
	Total	32		
h2 - h1	Negative Ranks	17[e]	16.18	275.00
	Positive Ranks	8[f]	6.25	50.00
	Ties	7[g]		
	Total	32		
cog2 - cog1	Negative Ranks	22[h]	11.50	253.00
	Positive Ranks	0[i]	.00	.00
	Ties	10[j]		
	Total	32		
adhd2 - adhd1	Negative Ranks	23[k]	12.91	297.00
	Positive Ranks	1[l]	3.00	3.00
	Ties	8[m]		
	Total	32		

a. group = Parent

b. op2 < op1

c. op2 > op1

d. op2 = op1

e. h2 < h1

f. h2 > h1

g. h2 = h1

h. cog2 < cog1

i. cog2 > cog1

j. cog2 = cog1

k. adhd2 < adhd1

l. adhd2 > adhd1

m. adhd2 = adhd1

Table 4-26: Test Statistics

	op2 - op1	h2 - h1	cog2 - cog1	adhd2 - adhd1
Z	-4.130[c]	-3.062[c]	-4.151[c]	-4.209[c]
Asymp. Sig. (2-tailed)	.000	.002	.000	.000

a. group = Parent

b. Wilcoxon Signed Ranks Test

c. Based on positive ranks.

4.4.5 Comparison of CTRS and CPRS' T-Scores for the first and second week

Upon examination of Table 4-27, it was observed that the difference scores of attention-deficit Hyperactivity disorder given by the teachers and parents did not present a normal distribution (p<.05).

Table 4.27: Tests of Normality

Subscale	Group	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Opp	Teacher	.153	32	.054	.922	32	.023
	Parent	.190	32	.005	.892	32	.004
Hyp	Teacher	.197	32	.003	.889	32	.003
	Parent	.194	32	.003	.893	32	.004
Cog	Teacher	.134	32	.150	.941	32	.081
	Parent	.191	32	.005	.877	32	.002
ADHD	Teacher	.157	32	.043	.945	32	.106
	Parent	.166	32	.025	.914	32	.014

a. Lilliefors Significance Correction

Table 4-28 presents the descriptive statistics given by the teachers and parents related to the difference scores of ADHD within the first and second week. To determine if there was a difference between these two groups, the Mann-Whitney U method, utilized in non-parametric measures, was applied. Upon examination of the table, a statistically significant difference (p<.05) was found only in Hyperactivity behaviour. As for the other behavioural disorders, both teachers and parents showed similar results. With the increase in illuminance, teachers' Hyperactivity scores a statistically significant decrease compared to the parents' scores.

Table 4.28: Comparison of CTRS and CPRS' T- Scores for 1st, 2nd Week

	Group	Teacher					
		P	Mean	Std. Deviation	Median	Minimum	Maximum
Case Summaries	Opp	32	-4.5313	3.55586	-4.0000	-12.00	0.00
	Hyp	32	-3.6875	3.23726	-4.0000	-8.00	5.00
	Cog	32	-4.4375	3.35951	-4.0000	-13.00	0.00
	ADHD	32	-4.2188	2.70882	-4.0000	-12.00	0.00
	Group	**Parent**					
		P	Mean	Std. Deviation	Median	Minimum	Maximum
Case Summaries	Opp	32	-3.0313	2.60872	-3.0000	-8.00	0.00
	Hyp	32	-2.2500	3.75027	-2.0000	-10.00	2.00
	Cog	32	-3.6250	3.10826	-3.0000	-11.00	0.00
	ADHD	32	-3.0313	2.87912	-2.5000	-9.00	1.00

Table 4.29: Ranks

Subscale	Group	P	Mean Rank	Sum of Ranks
Opp	Teacher	32	28.69	918.00
	Parent	32	36.31	1162.00
	Total	64		
Hyp	Teacher	32	27.88	892.00
	Parent	32	37.13	1188.00
	Total	64		
Cog	Teacher	32	30.70	982.50
	Parent	32	34.30	1097.50
	Total	64		
ADHD	Teacher	32	28.64	916.50
	Parent	32	36.36	1163.50
	Total	64		

Table 4.30: Test Statistics

	Opp	Hyp	Cog	ADHD
Mann-Whitney U	390.000	364.000	454.500	388.500
Wilcoxon W	918.000	892.000	982.500	916.500
Z	-1.663	-2.000	-.784	-1.669
Asymp. Sig. (2-tailed)	.096	.045	.433	.095

a. Grouping Variable: group

4.4.6 Comparison of CTRS' T- Scores based on the gender variable

Table 4.31: Tests of Normality

Subscale	Gender	Kolmogorov-Smirnovb			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Opp	F	.177	14	.200*	.908	14	.148
	M	.200	18	.055	.912	18	.093
Hyp	F	.234	14	.036	.861	14	.032
	M	.242	18	.006	.826	18	.004
Cog	F	.197	14	.145	.869	14	.040
	M	.187	18	.095	.949	18	.408
ADHD	F	.154	14	.200*	.898	14	.104
	M	.214	18	.028	.882	18	.028

*. This is a lower bound of the true significance.

a. group = Teacher

b. Lilliefors Significance Correction

Table 4-32 illustrates the descriptive statistics related to teachers'ADHD scores based on gender. To investigate whether there was a difference between these two groups, the Mann-Whitney U method, used in non-parametric measures, was applied. Upon examination of the table, it was found that the ADHD scores did not present a gender difference ($p>.05$). While the decrease in Cognitive and ADHD scores among females was detected to be more, on the other hand, the decline in Oppositional and Hyperactivity scores was observed to be more in males.

Table 4.32: CTRS' T-scores and students' gender

Gender	Subscale	P	Mean	Std. Deviation	Median	Minimum	Maximum
Female	Opp	14	-4.8571	3.93910	-4.5000	-12.00	0.00
	Hyp	14	-4.1429	2.85164	-4.0000	-8.00	0.00
	Cog	14	-3.7857	3.80644	-3.5000	-13.00	0.00
	ADHD	14	-3.7857	3.35533	-4.0000	-12.00	0.00
Gender		P	Mean	Std. Deviation	Median	Minimum	Maximum
Male	Opp	18	-4.2778	3.32204	-4.0000	-11.00	0.00
	Hyp	18	-3.3333	3.54799	-3.0000	-8.00	5.00
	Cog	18	-4.9444	2.97978	-4.5000	-11.00	0.00
	ADHD	18	-4.5556	2.12055	-4.0000	-9.00	-2.00

Table 4.33: Ranks

Subscale	Gender	N	Mean Rank	Sum of Ranks
Opp	F	14	15.21	213.00
	M	18	17.50	315.00
	Total	32		
Hyp	F	14	15.54	217.50
	M	18	17.25	310.50
	Total	32		
Cog	F	14	18.46	258.50
	M	18	14.97	269.50
	Total	32		
ADHD	F	14	18.29	256.00
	M	18	15.11	272.00
	Total	32		

a. group = Teacher

Table 4.34: Test Statistics

	Opp Difference	Hyp Difference	Cog Difference	ADHD Difference
Mann-Whitney U	108.000	112.500	98.500	101.000
Wilcoxon W	213.000	217.500	269.500	272.000
Z	-.694	-.519	-1.055	-.959
Asymp. Sig. (2-tailed)	.488	.603	.292	.338
Exact Sig. [2*(1-tailed Sig.)]	.512[c]	.613[c]	.301[c]	.357[c]

a. group = Teacher

b. Grouping Variable: gender

c. Not corrected for ties.

4.4.7 Comparison of CPRS' T- Scores based on the gender variable

Table 4.35: Tests of Normality

Subscale	Gender	Kolmogorov-Smirnov[b]			Shapiro-Wilk		
		Statistic	Df	Sig.	Statistic	Df	Sig.
Opp	F	.210	14	.096	.942	14	.441
	M	.290	18	.000	.790	18	.001
Hyp	F	.250	14	.017	.775	14	.002
	M	.175	18	.153	.872	18	.019
Cog	F	.232	14	.039	.881	14	.060
	M	.244	18	.006	.818	18	.003
ADHD	F	.174	14	.200*	.922	14	.233
	M	.182	18	.118	.870	18	.018

*. This is a lower bound of the true significance.

a. group = Parent

b. Lilliefors Significance Correction

Table 4-36 shows the descriptive statistics related to parents' ADHD scores based on gender. In order to detect whether there was a difference between these two groups, the Mann-Whitney U method, used in non-parametric measures, was applied. Upon examination of the table, it was found that the ADHD scores did not present a gender difference (p>.05). However, the decrease in Hyperactivity, Cognitive and ADHD scores among females was detected to be more. The decline in Oppositional scores also was observed to be more among males.

Table 4.36: CPRS' T- scores and students' gender

Gender		N	Mean	Std. Deviation	Median	Minimum	Maximum
Female	Opp	14	-3.9286	1.94004	-4.0000	-7.00	0.00
	Hyp	14	-1.2857	3.56108	0.0000	-6.00	2.00
	Cog	14	-3.5714	3.17961	-3.5000	-11.00	0.00
	ADHD	14	-2.5714	2.84779	-2.5000	-9.00	1.00
Gender		N	Mean	Std. Deviation	Median	Minimum	Maximum
Male	Opp	18	-2.3333	2.89015	-1.0000	-8.00	0.00
	Hyp	18	-3.0000	3.81945	-2.0000	-10.00	2.00
	Cog	18	-3.6667	3.14362	-3.0000	-8.00	0.00
	ADHD	18	-3.3889	2.93336	-2.5000	-8.00	0.00

Table 4.37: Ranks

Subscale	Gender	N	Mean Rank	Sum of Ranks
Opp	F	14	12.96	181.50
	M	18	19.25	346.50
	Total	32		
Hyp	F	14	19.00	266.00
	M	18	14.56	262.00
	Total	32		
Cog	F	14	16.64	233.00
	M	18	16.39	295.00
	Total	32		
ADHD	F	14	18.18	254.50
	M	18	15.19	273.50
	Total	32		

a. group = Parent

Table 4.38: Test Statistics

	Opp	Hyp	Cog	ADHD
Mann-Whitney U	76.500	91.000	124.000	102.500
Wilcoxon W	181.500	262.000	295.000	273.500
Z	-1.925	-1.349	-.078	-.902
Asymp. Sig. (2-tailed)	.054	.177	.938	.367
Exact Sig. [2*(1-tailed Sig.)]	.059[c]	.193[c]	.955[c]	.377[c]

a. group = Parent

b. Grouping Variable: gender

c. Not corrected for ties.

5. DISCUSSION AND CONCLUSION

This chapter aims to present and discuss the results of the study by referring to research questions. Also, it discusses previous studies whose results are consistent with this study, as well as studies that contradict them, points out its similarities and differences, indicates the limits of the current study, and finally makes suggestions for future research.

The study asked several questions to achieve its goals. The key question of the research was whether there is a relationship between the amount of daily light exposure and ADHD symptoms in school-age children. Moreover, the study tries to clarify the nature of this relationship if it exists.

It was necessary to ask other sub-questions to answer the main one. The first sub-question was: Are there any children with symptoms of ADHD in the studied sample? Moreover, what is the percentage of these children compared to the number of the sample?

In the study, the Conner's Scale for both teachers and parents was used to identify children who may have symptoms of ADHD, and the results are as follows:

The results of the teachers in the Oppositional subscale indicated that 62.5% of children have symptoms of this disorder. The severity of symptoms ranged from (56-60), which means slightly atypical (borderline: should raise concern) to (70+) that interpreted as markedly atypical (indicates a significant problem) according to the Conner's guideline CTRS-R:S. While 37.5% of children had no symptoms, and their rates were (<30-55). Likewise, in the hyperactivity subscale, it was found that 47% had symptoms, and 53% had no symptoms. The results also showed that 50% of children have symptoms of cognitive problems. In the ADHD subscale, teachers were told that 44% of the studied sample had symptoms, and 56% had no symptoms.

As for the parents' opinions, 42% of children had Oppositional symptoms, and 58% have no symptoms. Also, 67% of the children had symptoms of Hyperactivity; in contrast, 33% had no symptoms. Moreover, it was 67.7% they have cognitive problems, and 32.3% had no cognitive problems. Either the parents' opinions about ADHD were 35% of the students had positive symptoms, while 65% had no symptoms.

It was also necessary to measure the illuminance of daylight indoor and outdoor of the classroom and to answer the second sub-question as to whether there is a difference in daylight measurements between the first and second weeks. The study found that the average measurement in the second week (1974 lux) was much higher than the average measurement in the first week (1518 lux). It was rational to obtain this result; for the reason of adding the period of outdoor exposure to the measurements of the second week. Although the illuminance level in the second week during the 12:00 pm and 2:00 pm periods is lower than the illuminance level in the first week, the illuminance level during the morning period was much higher in the second week than in the first week because the measurements of the second week were during the period of children's exposure to outdoor daylight conditions. Thus, when comparing the illuminance level between two weeks, the results showed a higher illuminance level during the second week than in the first week.

Academic grades for students have been requested from the school administration to use them in answering the following research question: Is there a relationship between academic grades and the opinions of teachers as well as parents about children's ADHD symptoms in the first week?

Firstly, the comparison of teachers' opinions and academic grades of students showed a moderate negative relationship in the four subscales; these results confirm the results of much of the previous work; for example, DuPaul (2005) found that 25% of students with ADHD suffer from difficulties in academic achievement. These results are consistent with the study of Trout (2007) indicate that 80% of children who have ADHD have problems in academic performance and learning and are more likely than their peers to obtain fewer grades. Also, Loe (2007) found that students who have ADHD have lower test scores in reading and mathematics than their peers. These results can be interpreted that children with ADHD suffer from difficulties of concentration and their maintained attention, therefore academic achievement in these school courses less than their peers.

Secondly, the comparison between the parents' evaluations and academic grades of students found a moderate positive relationship between Oppositional and English scores. In other words, the lower the Oppositional scores, the lower the English scores.

As for the rest of the scale sections, the parents' assessments were as follows: The study found that there was a moderate negative relationship was detected between

Hyperactivity and Islamic, science, writing, and reading scores. Moreover, a moderate negative relationship was also present between ADHD Index and science, reading scores.

Surprisingly, the positive relationship between Oppositional and English scores. A possible explanation for this result is that the Oppositional subscale contains elements that might be difficult to declare by parents. Such as, (he argues with adults), (Actively defies or refuses to comply with adults' requests), (deliberately does things that annoy other people), in other words, the parents may have affectionate their assessments.

Johnston (2007) found that children with behaviours problems and ADHD exhibit a higher rate of negative behaviours, and they always need to move around. In addition, Cole, Ted (2003) documented that hyperactive children have unacceptable behaviours that hard to manage in the classroom. In contrast, Barkley (1994) reported that there is no evidence about whether children with Hyperactivity have cognitive problems. These relationships may partly be explained by the fact that hyperactive children associated with a lack of self-control or self-regulation, which affects their academic achievement negatively.

These results correspond to Trout's findings (2007) that found the ADHD children have difficulties in reading 26% less than their "normal" peers. These results reflect those of (Tannock, 1998) who also found that children with ADHD have issues in organization and memory, which affect their academic performance negatively. It can be interpreted these results through the characteristics of ADHD that included in CPRS-R:S (Inattentive, easily distracted), (short attention span), (messy or disorganized at home or school), (difficulties with tasks requiring continuous mental efforts such as schoolwork or homework). All these issues may influence on academic scores negatively.

By comparing the opinions of teachers in the first and second weeks relevant to the illuminance exposed. As well as comparing the results of the parents' questionnaire in the first and second weeks relevant to the illuminance exposed, it turned out that:

Firstly, comparing the results of teachers' opinions in the two weeks and within the average amount of daylight that children were exposed. This study found that the moderate Oppositional in the first week (median 59) decreased significantly compared to the average of the second week (median 55).

Moreover, with the increase in daylight exposure measurements, the results of the current study showed a significant decrease in the average Hyperactivity in the first week (median 53.50). Compared to the second week (median 49), it can be said that students' Hyperactivity has decreased significantly with an increase in daylight exposure.

In addition, with high daylight measurements, cognitive problems in the first week showed (median 55) significant decreases compared to the average of the second week (median 51). Likewise, with an increase in the average illumination, the average ADHD in the first week showed (median 56.5) significant decreases compared to the average of the second week (median 53.5).

Secondly, comparing the results presented by the parents during the two weeks relevant to the amount of daylight exposure. The current study found that with the increase in daylight, the moderate Oppositional decreased from (median 53) in the first week to (median 50) in the second week. From the parents' point of view, the Hyperactivity of the students also showed a significant decrease with the high daylight. Similarly, A significant decrease was observed in Cognitive problems scores, as well as in Hyperactivity and ADHD than in the first week.

Despite the few studies that are directly related between ADHD and daylight, but by reference to the previous literature, for example, (White, 2009), it was found that students who were exposed to daylight got higher scores in mathematics 20% and higher in reading 26%.

Also, Gifford (2007) showed that daylight has a positive effect on students' academic grades, and the speed of completion of these tests is about 7-26% higher than others.

Through these comparisons, it became clear that increasing the amount of daylight exposure decreases the symptoms of ADHD. These results are partly consistent with that of Thal (2014) who reported the impacts of 20-minute walk-in natural area on the symptoms of ADHD and cognitive performance. This study also confirms the positive influence of the natural environment on the level of concentration in children with ADHD.

Further support study of Taylor (2011) documented that the positive effect of green environments on the symptoms of ADHD in children. Apart from mentioned above, confirm the role of nature exposure in reducing the symptoms of ADHD. Further understanding of earlier studies leads to a state that daylight has positive effects on ADHD symptoms in children as one of the components of nature.

Based on the studies mentioned above, which emphasized the positive role of exposure to nature in reducing symptoms of ADHD, we can conclude that if the study was conducted in a green, natural environment, it is possible to obtain better results, taking into account other components of nature such as fresh air and greenery. One of the effects of the results of the current study is the role of environmental factors that must be taken into account when conducting future studies in this field, such as climate, assuming that the study was conducted in different climatic conditions from the conditions in which the current study was conducted. In terms of the difference in temperature, the illuminance level, and the weather in general, could lead to different results. This hypothesis is partly consistent with Martin's (2013) assertion of lower ADHD prevalence rates in regions with high solar intensity. Where Martin (2013) in his study found a lower prevalence of ADHD in regions with high Solar intensity 34-57% of the variance in ADHD prevalence, with high SI and this finding was specific to ADHD, not found for the prevalence of the major depressive disorder.

The current study also raises the possibility that the increase in the amount of daylight exposed to it may have a more significant positive impact, bearing in mind that excessive exposure to ultraviolet rays has negative effects on children such as skin cancer (Hansen, 2006). Moreover, the results of the current study raised an interesting point, which is the duration of exposure to daylight. What if the duration of exposure to daylight increases, will it affect the results or lead to different results? This point is indirectly consistent with the study conducted by Faber Taylor and Kuo (2011) routine exposure to natural spaces might yield an ongoing reduction in ADHD symptoms. This finding indicated the link between green play spaces and mild symptoms of ADHD. The possible explanations, for example, with more sunlight exposure, might be children get out more to play and get more of the exercise that increasingly, which is beneficial for attention and concentration level, and reduce ADHD symptoms. Further research is necessary to assess and these findings, and it is also significant to extend the study area in future work.

Although the current study answered the main question of the research, which is a negative relationship between the symptoms of ADHD and daylight, however, it may also be important to know whether there is a difference between the opinions of teachers and parents in the first and second weeks.

When making the comparison, only a significant difference was found in hyperactivity behaviour, as with the increase in daylight, the teachers' scores were lower than those of the parents. As for other behavioural disorders, both teachers and parents showed similar results to some extent. The similarities in the results of both teachers and parents reinforce and confirm the validity of these results. Also, the comparison between CTRS-R:S and CPRS-R:S is useful in revealing conflicting information from parents and teachers, which may indicate a problem that is being denied or not recognized by one teacher or parent.

The reason for comparing teachers' and parents' results is that determine the level of agreement between teachers' and parents' results; evidence showed that parents reported more emotional and conduct problems than teachers, while the difference was found for peer problems (Papageorgiou *et al.*, 2008). This result corresponds to observation by Roussos (1999) that parents tend to pay more attention to the emotional and social aspects of their children's problematic behaviour. The current study of comparing teachers' and parents' opinions showed consistent results, with more decrease in hyperactivity subscale of CTRS-R:S than those in CPRS-R:S. That is partly predictable since parents' and teachers' agreement for individual oppositional, cognitive, and ADHD dimensions of the scale was high. Parents evaluated their children higher than their teachers on the hyperactive dimension of the scale. It could be due to parents are not adequately informed about the actual behaviours of their children in a classroom setting (de Nijs *et al.*, 2004). In addition, teachers attend to the same student on multiple occasions and with long breaks and vacations (Biederman *et al.*, 2004). Moreover, children behave differently in diverse settings (de Nijs *et al.*, 2004).

Further results obtained by the study are that the teachers told that the scores of ADHD did not represent a significant difference between genders. At the same time, a decrease in Cognitive scores and Hyperactivity among females was revealed to be more in males.

Moreover, the parents' opinions were somewhat like those of the teachers. Parents found that the scores of ADHD did not make a gender difference. However, a decrease in Hyperactivity, Cognitive problems, ADHD among females, was revealed to be more; in contrast, it was observed that the decrease in the scores of Oppositional was more among males.

This comparison could be useful to determine the differences between the opinions of teachers and parents based on gender variables in order to identify the gender that had significant problems; as a result, finding out which gender is most affected to daylight exposure. These results are somewhat consistent with said by Erşan (2004) that the proportion of male children with ADHD to females is 10:3 boys more than girls, and also the study conducted by Farahat (2014) on primary school children indicated that there was a higher prevalence of ADHD in male than female (3.5:1).

The results of the current study correspond to previous literature regarding Hyperactivity Subscale, Cognitive problems, and ADHD. In contrast, conflicts with the Oppositional Scores, as reported by the parents, fell more among males compared to females. A possible explanation for this is parental bias in answers compared to teacher responses that may indicate greater neutrality.

Several studies reported contradicting results about ADHD and gender differences among males and females (Bauermeister *et al.*, 2007). Numerous studies confirm the theory that the majority of females with clinical diagnosis exhibit greater levels of attention difficulties, whereas males are more likely to display hyperactivity and impulsivity symptoms (Zambo, 2008; DuPaul and Stoner, 2003).

Evidence showed that the proposition of girls being diagnosed less frequently than boys; they refer to girls tending to be inattentive and less obvious with their symptoms. This view is consistent with what is discussed in the literature review chapter exhibiting different symptoms than males and tending to be more inattentive. The results of the current study demonstrated that no significant differences based on gender variable, with more decrease in hyperactive, cognitive, and ADHD results for females than males.

In contrast, oppositional results seemed to be more decreased in males than females. The possible interpretation might be demonstrated that females tend to try to cope with their symptoms until the symptoms become incredibly problematic. In addition, there are certain factors to consider when interpreting the results of this study, such as a small sample size with only 32 children, and these children come from similar communities. The selected children also live in similar live conditions and similar education systems.

However, it can be stated that the influence of daylight exposure was the same for both genders, with no significant differences.

5.1 LIMITATION OF THE STUDY

The main purpose of this study was to determine whether there is any effect of daylight on the symptoms of ADHD in school-age children in Istanbul, Turkey. Conduct the study during appropriate lighting conditions in terms of daylight illuminance during the school year (May), which is the last month of the academic year, which can as an essential limit in the current study. More research is needed in this area with more time available.

Although the results of this study were taken from one Arab school in Istanbul and a relatively small number, which may limit the possibility of generalizing the results, however, the study provided a somewhat useful model that can be replicated to a larger sample in future research.

Regardless of the number of the sample, some factors may influence the results, one of these factors is ethnicity. The results can be different in another country, should be verified in future studies. Also, the age of children is another factor that needs to be considered for the obtained results. In other words, using younger or older children might have yielded different results. As well, the number of boys and girls may affect the results.

Unfortunately, one of the students' parents declined to participate in the questionnaire despite the classification being sent in different ways.

5.2 RECOMMENDATIONS FOR FUTURE RESEARCH

Through this study, which was somewhat able to achieve its goals, features emerged from some problems that can be found through future research. It may also be useful to use the clinical diagnosis of students of the studied sample in addition to the questionnaire used in the current study to detect symptoms of ADHD more accurately.

There is a need to conduct other studies in this field with larger sample size and more schools, which may lead to more results generalization.

Given the limited previous literature on the direct relationship between daylight, ADHD, and its importance, there is a crucial need for further research in this area.

As with all scientific research, further work is necessary, including a prospective replication of these findings. It is also critical to realize that these findings reflect only one-hour daylight exposure. Nevertheless, if the amount of exposure is increasing to a Higher-level, the results could be different. These results could also point the domains to further investigations by increasing the time exposure to daylight during the day. Also, investigating the influence of other factors that outdoor exposure consists of, such as fresh air, greenery, and other components of the outdoor environment. In line with the schedule, playtime could be explored further.

6. CONCLUSION

One of the most significant results of this study is that there is an important effect of daylight in reducing the severity of symptoms of ADHD. In addition, the results showed a negative relationship between the severity of symptoms of ADHD and the academic performance of students. Moreover, it was revealed that the cognitive problems, ADHD symptoms in females is lower than that of males with the increase in the illuminance of daylight. In contrast, it was found that the illuminance of Oppositional symptoms decreased further in males.

More studies are required to understand better the nature of issues relating to the perception and interaction of children with ADHD with the built environment. The study recommends that architectural designers should look at the building as a whole and not only the sum of its parts. Especially with ADHD children, hopefully, creating awareness of design such an environment with considering the needs of all users. Daylighting needs to be well-orchestrated throughout educational and noneducational facilities. Also adjusted daylighting levels can create active and calm zones throughout the built environments and should be designed appropriately for activities.

Moreover, future research should encourage using daylighting in interior spaces. This attitude allows benefiting from daylight for both people with ADHD and others. However, careful control of glare, reflections are necessary. Considering the importance of the results in this study could be daylight considered as an essential feature of building design. The appropriate integration of daylighting into the architectural design will positively affect the physical and mental health of occupants. It is significant to remember that the use of daylight is not a contemporary concept. However, the concept of using daylight as an influential tool to reduce the symptoms of ADHD considers being an interesting approach for architectural designers.

Based on the results of the current study and confirming the positive effects of daylight exposure on ADHD symptoms in children, the researcher strongly recommended integrating the daylighting system in the built environment, especially in school design.

Also, the daylighting system should be chosen according to climatic characteristics, such as the latitude at the building site and the predominant sky type. In addition, early in the design process, careful integration of the daylighting system with the rest of the building design should lead to a high- quality educative environment. Moreover, the elements that use in daylighting systems still need to be addressed. These systems are important for the successful integration of daylighting, which is the effect on occupants. Also, in my opinion, the key focus for future work is the development of a comprehensive understanding of occupants' needs, especially children with ADHD and occupant satisfaction. Also, in schools, natural lighting, views of nature, and areas for outdoor learning have been shown to increase attention and retention of information and reduce disciplinary incidents and ADHD symptoms. Therefore, connecting the built environment with nature, directly and indirectly, should be taken into account in the design process. In addition, standards and guidelines are essential to enforcing these techniques.

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APPENDICES

APPENDIX. A. 1 APPROVAL LETTER

Libya Büyükelçiliği
Akademik Ataşeliği
Ankara / Türkiye

السـفارة الليبية
الملحقية الأكاديمية
أنقـرة / تركـيا

TARİH :.......................
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الرقم الإشاري :...ر/2018/007

إلى من يهمه الأمر...

نفيدكم... بأن السيدة/ **هاله محمد محمد السويح**، أحد الطلبة الموفدين على حساب الدولة الليبية لتحضير درجة الماجستير في الهندسة المعمارية.

وعليه... نأمل تفضلكم مشكورين باتخاذ مايلزم من إجراء بشأن تمكينها من الحصول على البيانات والمعلومات اللازمة لاستكمال دراستها الأكاديمية والمتعلقة بأطروحة الماجستير بعنوان:

"تأثير ضوء النهار في التخفيف من أعراض اضطراب فرط الحركة ونقص الانتباه عند أطفال المدارس بين (7-12) سنة"

شاكريـن حسـن تعاونكم
وتفضلـوا بقبـول فائـق الاحتـرام والتقدير

مفتاح عبدالقادر المبروك
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APPENDIX. A. 2 CONNERS' TEACHERS RATING SCALE-REVISED: S

Conners' Teacher Rating Scale–Revised (S)

by C. Keith Conners, Ph.D

Child's ID: ______________________ Gender: M F (Circle one)

Birthdate: ___/___/___ (Month Day Year) Age:______ School Grade:_____

Teacher's ID:______________________ Today's Date:___/___/___ (Month Day Year)

Instruction: Below are a number of common problems that children have. Please rate each item according to your child's behaviour in the last month. For each item, ask yourself, "How much of a problem has this been in the last month?", and circle the best answer for each one. If none, not at all, seldom, or very infrequent, you would circle 0. If very much true, or it occurs very often or frequently, you would circle 3. You would circle 1 or 2 for ratings in between. Please respond to each item.

	NOT TRUE AT ALL (Never, Seldom)	JUST A LITTLE TRUE (Occasionally)	PRETTY MUCH TRUE (Often, Quite a bit)	VERY MUCH TRUE (Very often, Very Frequent)
1. Inattentive, easily distracted	0	1	2	3
2. Defiant	0	1	2	3
3. Restless in the "squirmy" sense	0	1	2	3
4. Forgets things he/she has already learned	0	1	2	3
5. Disturbs other children	0	1	2	3
6. Actively defies or refused to comply with adults' requests	0	1	2	3
7. Is always "on the go" or acts as if driven by a motor	0	1	2	3
8. Poor in spelling	0	1	2	3
9. Cannot remain still	0	1	2	3
10. Spiteful or vindictive	0	1	2	3
11. Leaves seat in classroom or in other situations in which remaining seated is expected	0	1	2	3
12. Fidgets with hands or feet or squirms in seat	0	1	2	3
13. Not reading up to par	0	1	2	3
14. Short attention span	0	1	2	3
15. Argues with adults	0	1	2	3
16. Only pays attention to things he/she is really interested in	0	1	2	3
17. Has difficulty waiting his/her turn	0	1	2	3
18. Lacks interest in schoolwork	0	1	2	3
19. Distractibility or attention span a problem	0	1	2	3
20. Temper outbursts; explosive, unpredictable behaviour	0	1	2	3
21. Runs about or climbs excessively in situations where it is inappropriate	0	1	2	3
22. Poor in arithmetic	0	1	2	3
23. Interrupts or intrudes on others (eg., butts into others' conversations or games)	0	1	2	3
24. Has difficulty playing or engaging in leisure activities quietly	0	1	2	3
25. Fails to finish things he/she starts	0	1	2	3
26. Does not follow through on instructions and fails to finish schoolwork (not due to oppositional behaviour or failure to understand instructions)	0	1	2	3
27. Excitable, impulsive	0	1	2	3
28. Restless, always up and on the go	0	1	2	3

APPENDIX. A. 3 CONNERS' PARENT RATING SCALE-REVISED: S

Conners' Parent Rating Scale–Revised (S)

by C. Keith Conners, Ph.D.

Child's ID: ______________________________ **Gender: M F** (Circle One)

Birthdate: ___/___/___ (Month Day Year) **Age:**______ **School Grade:**______

Parent's ID: ______________________________ **Today's Date:** ___/___/___ (Month Day Year)

Instructions: Below are a number of common problems that children have. Please rate each item according to your child's behavior in the last month. For each item, ask yourself, "How much of a problem has this been in the last month?", and circle the best answer for each one. If none, not at all, seldom, or very infrequently, you would circle 0. If very much true, or it occurs very often or frequently, you would circle 3. You would circle 1 or 2 for ratings in between. Please respond to each item.

	NOT TRUE AT ALL (Never, Seldom)	JUST A LITTLE TRUE (Occasionally)	PRETTY MUCH TRUE (Often, Quite a Bit)	VERY MUCH TRUE (Very Often, Very Frequent)
1. Inattentive, easily distracted	0	1	2	3
2. Angry and resentful	0	1	2	3
3. Difficulty doing or completing homework	0	1	2	3
4. Is always "on the go" or acts as if driven by a motor	0	1	2	3
5. Short attention span	0	1	2	3
6. Argues with adults	0	1	2	3
7. Fidgets with hands or feet or squirms in seat	0	1	2	3
8. Fails to complete assignments	0	1	2	3
9. Hard to control in malls or while grocery shopping	0	1	2	3
10. Messy or disorganized at home or school	0	1	2	3
11. Loses temper	0	1	2	3
12. Needs close supervision to get through assignments	0	1	2	3
13. Only attends if it is something he/she is very interested in	0	1	2	3
14. Runs about or climbs excessively in situations where it is inappropriate	0	1	2	3
15. Distractibility or attention span a problem	0	1	2	3
16. Irritable	0	1	2	3
17. Avoids, expresses reluctance about, or has difficulties engaging in tasks that require sustained mental effort (such as schoolwork or homework)	0	1	2	3
18. Restless in the "squirmy" sense	0	1	2	3
19. Gets distracted when given instructions to do something	0	1	2	3
20. Actively defies or refuses to comply with adults' requests	0	1	2	3
21. Has trouble concentrating in class	0	1	2	3
22. Has difficulty waiting in lines or awaiting turn in games or group situations	0	1	2	3
23. Leaves seat in classroom or in other situations in which remaining seated is expected	0	1	2	3
24. Deliberately does things that annoy other people	0	1	2	3
25. Does not follow through on instructions and fails to finish schoolwork, chores or duties in the workplace (not due to oppositional behavior or failure to understand instructions)	0	1	2	3
26. Has difficulty playing or engaging in leisure activities quietly	0	1	2	3
27. Easily frustrated in efforts	0	1	2	3