Executive Functions, Challenging Behaviors and Sleep Habits Among Children with Attention Deficit Hyperactivity Disorder

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Abstract

Background: Executive dysfunction is a major factor in the consequences of neurological developmental disorders including attention deficit hyperactivity disorder (ADHD), which causes challenging behavior and decreased social functioning. Additionally, higher sleep problems have been linked to lower executive skills in children with ADHD. **Aim:** To evaluate executive functions, challenging behaviours, and sleep habits among children with ADHD. **Design of research:** A descriptive correlational study approach was used to conduct the current research. **Setting:** The study was performed at the Outpatient Psychiatric Clinic at Zagazig University Hospitals and the ElAhrar Outpatient Psychiatric Clinic in Zagazig City, Alsharkia Governorate, Egypt. **Subjects:** A non-probability convenient sampling strategy for 100 children and their parents aged 5 to 15 years old during a 6-month period. **Tools:** Four instruments were utilized for data gathering as follows: personal and medical histroy of ADHD children and their parents, executive function questionnaire, strengths and difficulties questionnaire, and childern sleep habits questionnaire. **Results:** The children with ADHD had mild impairment in global executive functions, greater rates of behavioral difficulties, and lower scores of prosocial skills, and the majority of them had disturbances in sleep habits. Also, statistically meaningful positive correlations were discovered between the scores of executive functions, behavioral difficulties, and sleep habits. Furthermore, a strongely negative correlation was created between prosocial skills and behavioral difficulties of ADHD children. **Conclusion:** Among children with ADHD, challenging behaviors were significantly positively predicted by executive functions impairment and sleep problems.**Recommendations:** It is recommended to provide psychological intervention programs to strengthen executive functions in children with ADHD. In addition, behavioral training programs can help control children's problematic behaviors, promote the development of social skills, and improve sleep patterns.

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Keywords: *ADHD, Challenging behaviours, Executive functions, Sleep Habits*

Introduction

Attention-Deficit/Hyperactivity Disorder (ADHD) is a prevalent childhood-commencement developmental disease, with rate rising in recent decades **(El-Bakry et al., 2019)**. 7.47% of African children and teens of school age are affected **(Ayano et al., 2020)**. The incidence in Egypt's population varied between 9.4% and 21.8% **(Gumma et al., 2024)**. Impulsivity, hyperactivity, and inattention are widespread, chronic, and debilitating symptoms of ADHD that start before the age of seven and may last into adulthood. The hyperactive/impulsive subtype, the mixed type, and the inattentive subtype are the three subtypes of ADHD **(Al-Habib et al., 2019)**.

Executive functions are critical to cognitive, social, and psychological development. According to research, executive functions are involved in daily tasks such as taking decisions, hazards assessment, planning, prioritization, action organizing, and dealing with unfamiliar situations **(Diamond and Ling, 2020)**. Furthermore, early executive function is necessary for self-monitoring and involves abilities related with prefrontal cerebral cortex activity, such as resolving problems, attention, inhibition, retention of information, and flexibility in thoughts. These capacities arise throughout the initial period of childhood, and the development of these early skills serves as a vital basis for the development of higher-order executive function skills later in childhood **(Aylward et al., 2022)**.

Furthermore, executive function is a top-level collections of cognitive processes associated with goal-oriented behavior, which has two mental subcategories: hot (psychological) and cool (thinking) executive function. Executive function deficiencies in ADHD cause considerable social problems in the house, school, and society**(Kamalahmadi et al., 2024)**.

The primary executive functions thought to be impaired in ADHD is controlling inhibitions . This deficit has a recurring effect, creating problems with working memory endurace, internal language management, behavior reconstruction, controlling emotions, arousal, and motivation **(Antshel and Barkley, 2020)**. Deficits in these domains can have a substantial impact on daily living, resulting in improper behavior and decreased social functioning **(Cerruti et al., 2024).**

Challenging behaviors (also known as acts of disruption and classified beneath larger externalized spectrum of behaviors) are a distinguishing feature of conduct and oppositional defiant disorders. However, challenging behavior is not limited to conduct and oppositional defiant disorders **(Kang & Kwack, 2019).** Children with ADHD frequently experience emotional problems. Actually, 40 to 50% among ADHD children have difficulty regulating their emotion, resulting in displays of anger, impatience, or irritation **(Faraone et al., 2019).**

Disruptive behaviors are typically associated with ADHD. Children with ADHD are 11 times more likely than those without ADHD to acquire comorbid disruptive behavior disorders, such as oppositional defiant disorder and conduct disorder, which affect 30-50% of children. **(Mohammadi et al. 2021).**

Additionally, **Mlodnicka et al. (2024)** found that the intensity of ADHD symptoms during preschool and middle elementary school (ages 3–9) was linked to increased internalizing (such as anxiousness and depressive disorders) and externalizing behavior (violent behavior, issues with conduct , oppositional defiant disorder, and disruptive behavior) in later elementary school and high school (ages 9–18) , ignoring gender.

Numerous studies have found strong connections between deficiencies in response inhibition and increased externalizing difficulties. Individuals with poor response inhibition may exhibit hyperactive, impulsive, or disruptive behaviors, which contribute to aggressive and externalizing behaviors at home, school, or with peers **(Wang et al., 2017; Puiu et al., 2018)**. Therefore, lower levels of difficult behavior had a strong relationship with better executive functioning (particularly inhibition), management of emotions, and avoiding risks skills **(Frazier et al., 2022)**.

Sleep is a physiological process that alternates with a state of awake. This is an active condition produced by the body in which the brain is mostly at rest and responds primarily to internal stimuli **(Zhao et al., 2019)**. Sleep length influences several elements of children's mental health, including motor learning abilities, working memory, self-efficacy, effortful control, resilience, mood, and behavior. Sleep length influences children's academic performance and social connections. Evidence suggests that getting enough sleep is essential for memory consolidation as well as for emotional well-being and cognitive function **(Zinke, Noack, and Born, 2018)**.

Sleep problems affect 25–85% of ADHD children. Schoolboys with uncomplicated ADHD and sleep disruption were shown to have more sleep anxiety and nightly awakening problems, suggesting that they could require treatment from the healthcare system for these issues **(Lindholm et al. 2024)**. Frequent ADHD comorbidities (e.g., anxiousness disorders, depressive disorder, oppositional defiant disorder, and autism) may have a negative effect on nocturnal sleep, resulting in bedtime resistance, difficulty sleep , poor quality sleep, and short sleep duration, especially when psychosocial environment/ family is disorganized **(Wang et al., 2024)**.
Additionally, sleep is essential for controlling emotions and behavior, according to **Dimakos et al. (2024)**. Children with ADHD who have more sleep issues also have worse executive function **(Holingue et al., 2021)**.

Nurses should do more to help parents and their children with ADHD by using a variety of educational and therapeutic strategies to help them choose the optimal therapy strategy for their child's needs and abilities. Psychological education and counseling for caregivers are provided through workshops, courses, and posters to help parents better understand how to interact with their ADHD children. Furthermore, behavioral training programs, psychopharmacological therapies, psychological therapy, and behavioral management methods must be implemented in hospitals, as well as school interventions, to address academic challenges **(Abdelwahab et al., 2024)**.

Significance of the Study:

Attention-deficit/hyperactivity disorder is the most prevalent problem for behavior and the second common chronic disease among children. It is a common neurological developmental condition that affects 7% of children globally **(Ayano et al., 2020)**.In Egypt, ADHD affects 5-10% of school-aged children and 2-4% of adults **(El Monshed et al., 2020)**.

Research indicates that dysfunction in executive functions is the primary difficulty in attention-deficit/hyperactivity disorder, negatively impacting daily functioning and social interactions. Furthermore, ADHD and impulsivity can interfere with school life, goal attainment, various talents, and competitions of students, resulting in academic failure and more accidents and injuries of all children than those who do not have ADHD **(Joseph & Devu, 2019; Tabiee et al.,2023)**.

Moreover, untreated ADHD can also result in persistent sleep issues, criminality or dangerous activities, and problems with relationships and peers. So that this research will be performed to evaluate executive functions, challenging behaviours and sleep habits among ADHD children.

Aim of the study:

This study aimed to assess executive functions, challenging behaviors, and sleep habits among ADHD children.

Research questions:

- What are the executive functions among children with ADHD?
- What are the challenging behaviors among children with ADHD?
- What are the sleep habits and disturbances among children with ADHD?
- Is there relationship between executive functions, challenging behaviors and sleep habits among children with ADHD?

Methods:

Research design:

A correlational -descriptive study approach was conducted for this research.

Study setting:

The current study was conducted in outpatient psychiatric clinics at Zagazig University Hospitals and ElAhrar Hospital that associated with the Ministry of Health in Zagazig City; these two hospitals are the most major government facilities providing medical services in the Sharkia Governorate. Among the services provided are behavioral modification, speech therapy, mental examinations, psychometric investigations, and pharmaceutical therapies.

Study participants:

The study was recruited using a non-probability convenient sampling strategy with 100 children based on DSM-5 diagnostic criteria by the psychiatrist, aged from 5 to 15, who accepted participating and did not have any comorbid diseases such as intellectual impairments or autism spectrum disorder in their medical history.

Tools for data collection:

Data were gathered via a standardized interview questionnaire, included three distinct tools along with sections for personal data involving the age, gender, school grade, residence, parents' educational level, age, and family members. It also examined child's medical history, including the various types of ADHD, his or her behavior with family, duration of the condition, and any family histories of ADHD.

Tool I: **Behavior Rating Inventory of Executive Function Questionnaire, sceond edition (BRIEF2).**

It is a parent-rated questionnaire designed by **Gioi et al. (2015)** to examine executive functioning for young children aged between five and eighteen. It is thought to be an accurate predictor for a child's or adolescent's performance in a variety of categories, including academic, social, behavioral, and emotional. The questionnaire has 60 questions categorized into four indexes (the Behavior Regulation Index (BRI), Emotion Regulation Index (ERI), Cognitive Regulation Index (CRI), and Global Executive Functions Composite (GEC)) and nine subdivisions.

The Behavior Regulation Index is formed from Self-Monitor (4 items). and Inhibit (8 items) subscales. The Emotion Regulation Index is formed from Emotional Control (8 items) and Shift (8 items) subscales. The Cognitive Regulation Index consists of five scales: working memory (8 items), plan/organize (8 items), task-monitor (5 items), organization of materials (6 items), and initiate (5 items),. The entire BRIEF2 subscales are included in the global executive function composite (GEC), a comprehensive overview rating. The researchers used the translation-back-retranslation method to translate the scale into Arabic in order to guarantee its validity.

Scoring system:

The BRIEF2 is a questionnaire in which respondents record their answers via a Likert-type format with scores ranging from 1 to 3 for ("Never"), ("Sometimes"), and ("Often"). Higher scores imply more serious executive function impairment.

T-scores were used to interpret parents' stated executive function levels. T ratings between 60 and 64 as mildly elevated, T ratings between 65 and 69 as potentially clinically elevated, and T scores of 70 or higher as clinically elevated. This indicates problems for every aspect of executive function, including inhibition, self-regulation, mood management, adaptability, and cognitive regulation function.

***Tool II*: Strengths and Difficulties Questionnaire(SDQ)**

Goodman (1997) designed it then modified into Arabic by the researchers. It is a screening instrument created to evaluate difficult behavioral and emotional issues in young children and teenagers. It comprises four subscales to measure common behavioral challenges in children and adolescents (conduct problems, hyperactivity-inattention problems, emotional problems, and peer problems) and one subdomain to examine strengths or positive social behavior (prosocial skills). Five questions on a 3-point Likert scale—not true, somewhat true, and definitely true—are included in each subscale. These score ranges from 0 to 2.

Scoring system

The overall problems score is generated from adding the scores obtained from all four difficulties subscales, with higher scores indicating more behavioral challenges. Total behavior challenges have four cutoff scores: similar to average (0-13), slightly higher (14-16), high (17-19), and very high (20-40).

As for subscale of prosccial skills has four cuttoff scores as follows: Similar to average (8-10), slightly lower (7), low (6), very low (0-5*)*. Higher scores on this subscale indicate greater strengths.

***Tool III*: Children's Sleep habits questionnaire (CSHQ).**

Owens (2000) created it and coverted into Arabic by **Asaad and Kahla (2001) ,** who analyzed children's sleep habits and disturbances one week ago based on caregivers' reports. The CSHQ consists of 35 items reflecting sleep disorders. The CSHQ measured eight domains: daytime sleepiness (8 things), parasomnias (7 items), bedtime resistance (6 questions), sleep anxiety (4 problems), sleep-disordered breathing (3 questions), Night waking or sleep interruption (3elements), sleep duration (3 elements), and sleep onset delay (1 question).

Scoring system:

A three-point rating system is used for each item: seldom = 1 (zero to one ocassion per week), occasionally = 2 (two to four ocassions per week), and frequently = 3 (five to seven ocassions per week). Increased ratings indicate greater challenging sleeping patterns. However, certain items are reversed, such as (1, 2, 3, 10, 11, 26). The total sleep disruption score includes items from all eight subscales. If the degree exceeds 41, it implies a sleeping disturbances

Content validity and reliability:

When translating the tools into Arabic, we used both translation and reverse translation techniques to ensure their original authenticity. Prior to data collection, the content validity was assessed. Three psychiatric nursing professionals examined the instruments after they were issued, together with a cover letter and an explanation page detailing the study's aims. All proposed modifications were implemented. Instruments were highly reliable: Cronbach's Coefficient Alpha of 0.910 for executive function questionnaire, 0.757 for difficulties and strengths questionnaire, and 0.708 for sleep habits questionnaire.

Field work:

After receiving clearance to proceed with the study, the researchers began gathering information by speaking to ADHD children with their parents. After explaining and reassuring the parents and their children, the researchers sat with the parents in the waiting area. Then each parent was supplied with a brief summary of the research's aim and the type of questionnaire they would be needed to complete. In addition to voluntary engagement, confidentiality was maintained. After receiving written clearance, each child and parent underwent an individual interview to collect the relevant data utilizing data collection instruments..Approximately 3-5 children and their parents are interviewed each week. The parents took approximately 40-50 minutes to complete the questionnaire.

The researchers met parents twice to three days per week. They were held on Monday, Tuesday, and Thursday from 9 am to 1 am. The process of data collection took a period of 6 months, from the first of December 2023 to the end of May 2024.

Pilot study:

Before instruments were used in fieldwork, they were tested in a pilot study to make sure they were feasible and clear, as well as to determine how long it would take to finish each component. Ten ADHD children with their parents took part in the research, but they were later removed from the larger research group.

Ethical consideration

Prior to the pilot project, the Nursing Research Ethics Committee in the Faculty of Nursing at Zagazig University approved the study protocol under the number M.DZU.NUR/249. Following a detailed explanation of the research's benefits, the parents signed their agreement to participate. Parents had the option to reject participation and to leave at any point throughout the data collection interviews. Furthermore, the researched children and their parents were informed all their details could be kept private and utilized solely regarding study use. Furthermore, all data was coded to ensure the participants' confidentiality and anonymity.

Statistical analysis:

The Statistical Package for Social Science (SPSS) program (version 20) was utilized for organizing , coding, computerizing, tabulating, and analyzing all of the data that had been gathered. The program used chi-square for relationship tests, percent and frequency values for qualitative data, standard deviation and mean for quantitative data, and the Pearson correlation coefficient (r) for correlation analysis in order to determine the degree of significance. A p-value was deemed highly statistically significant if it was less than 0.01, statistically significant if it was less than 0.05, and non-statistically significant if it was greater than 0.05.

Results:

Table 1 makes clear that 64.0% of ADHD children studied between the ages of six and ten had a mean of 8.28±2.37 and 72.0% were male. Furthermore, 64.0% of children had primary education, and 66.0% resided in rural regions. As for parents, 47.50% had an intermediate education, were aged between 30 and 40 years old with a mean of 34.92±6.15, and 66.0% had 4-5 family members.

In terms of medical history, **Table 2** reveals that 44.0% of children had been ill for three years, with a mean of 3.84±2.11. Additionally, the majority of them (81.0%) had no family history of ADHD, nearly half (47.0%) had aggressive behavior with family, and 60.0% had a combination type of ADHD.

T scores of behavior rating inventory executive functions as reported by th parents of children are

explained in **Table 3**. The emotion regulation index's T score was determined to be 68, followed by the cognitive regulation index's score of 66 and the behavior regulation index's score of 63. Additionally, the global executive functions composite T score was 63, indicating mild impairment in both the behavior regulation index and overall children's executive functions. Meanwhile, indicators of possible clinical impairment in emotion regulation and cognitive regulation suggested challenges with all facets of executive processes.

Table 4, displays that the greatest number of the ADHD children under study experienced hyperactivity-inattention problems (52.0%), followed by conduct problems (41.0%), peer problems (37.0%), and emotional problems (33.0%).

Figure 1 illustrates that all of the ADHD children studied experienced significant behavioral challenges. 39.0% of the ADHD children studied had extremely high total behavior difficulty levels, 35.0% had high levels, and 26.0% had slightly high levels.

Figure 2 shows that all of the ADHD children had lower levels of prosocial skills. 36.0% of them had extremely low prosocial skills, 33.0% had slightly low prosocial skills, and 31.0% had low prosocial skills.

Table 5 demonstrates that 45.0% of children experienced sleep anxiety, followed by disturbance in sleep time (44.0%) and bedtime resistance (39.0%), while sleep-disordered breathing accounting for 3.0%.

Figure 3 shows that 81.0% of the children evaluated experienced sleep problems, whereas 19.0% had normal sleep habits.

Table 6 reveals a statistically significant negative correlation between total behavioral challenges and strengths (r =.359). On the one hand, there are statistically significant weak affirmative correlation between children's behavioral challenges and both executive functions difficulties (r=.243) and sleep habits and disturbances (r=.299).

Table 7 illustrates a multiple linear regression model for children's behavioral difficulty scores. It clarifies that the children's total sleep habits and disturbances, as well as their overall executive functions impairment, were statistically significant independent positive predictors of behavior challenges. The r-squared shows that the model accounts for 12.6% of this score.

Table 1: Personal data of evaluated ADHD children and their parents among the research sample (n=100).

Personal characteristics	No	%
Child age		
<6 years	18	18.0
6-10 years	64	64.0
<10 years	18	18.0
Min- Max	4-14	
Mean ±SD	8.28±2.37	
Gender		
Male	72	72.0
Female	28	28.0
Education		
Don't attend to school	30	30.0
Primary education	64	64.0
Preparatory education	6	6.0
Residence		
Rural	61	61.0
Urban	39	39.0
Parent education		
Illiterate	6	6.0
Read and write	6	6.0
Basic education	17	17.0
Intermediate education	47	47.0
High education	24	24.0
Age		
>30	18	18.0
30->40	56	56.0
40+	26	26.0
Min –Max	21-50	
Mean ±SD	34.92±6.15	
Family member		
>4 member	22	22.0
4-5 member	66	66.0
<5 member	12	12.0

Table2: Medical history of the studied ADHD children in the study sample (n=100)

Medical history	No	%
Duration of illness/ year		
1year	26	26.0
2 years	8	8.0
3 years	44	44.0
4 years	4	4.0
5 years	12	12.0
6 years	6	6.0
Mean ±SD	3.84±2.11	
Type of ADHD		
Inattention type	20	20.0
Hyperactivity	20	20.0
combined type	60	60.0
Child behavior with family		
Active	7	7.0
Calm	4	4.0
Aggressive	47	47.0
Introvert	30	30.0
Negative	12	12.0
Family history of ADHD		
Yes	19	19.0
No	81	81.0

Table 3: T scores of ADHD childern's executive functions as reported by their parents (n =100)

Behaviour rating inventory executive functions	Raw	T score	Percentile	90% C.I
Inhibit scale	24	62	81	57-67
Self monitor scale	12	59	77	54-64
Behaviour regulation index	36	**63**	80	56-70
Shift scale	20	71	71	67-75
Emotion control scale	24	65	73	59-71
Emotion regulation index	42	**68**	76	61-75
Initiate scale	15	63	75	59-67
Working memory scale	24	60	81	54-66
Plan scale	24	61	85	56-66
Task monitor scale	15	58	89	54-62
Material organization scale	18	63	77	58-68
Cognitive regulation index	96	**66**	81	53-79
Global executive functions composite	162	**63**	86	43-83

Table 4: Distribution of studied ADHD children's challenging behaviour(children's behaviour difficulties) according to their parents (n=100).

Total behaviour difficulties	definitely true		somewhat true		not true	
	No	%	No	%	No	%
Emotion problems	33	33.0	38	38.0	29	29.0
Conduct problems	41	41.0	29	29.0	30	30.0
Hyperactivity –in attention problems	52	52.0	23	23.0	25	25.0
Peer problems	37	37.0	39	39.0	24	24.0

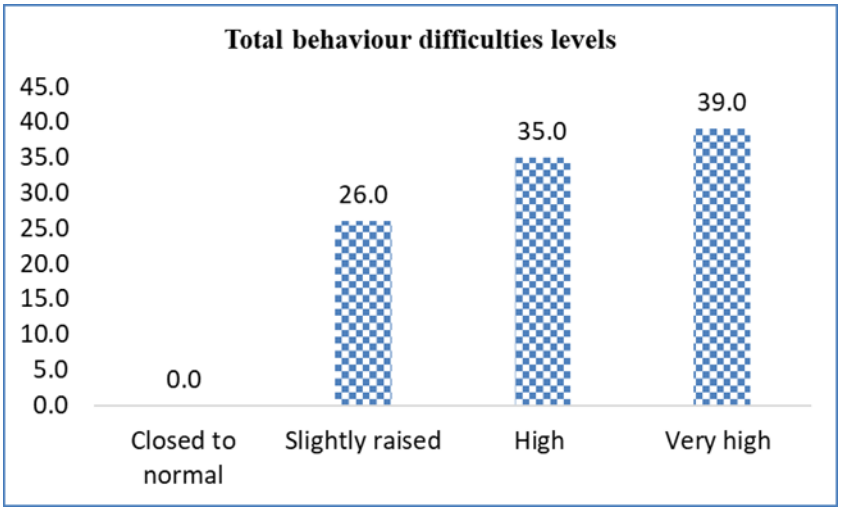

Figure 1 :frequency distributions of studied ADHD children regarding their total behaviour difficulties levels (n=100).

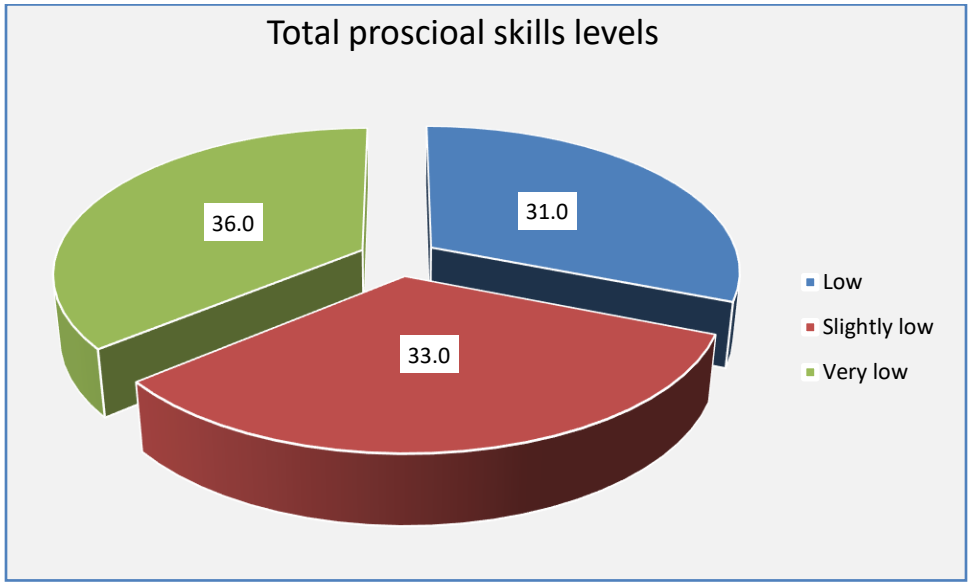

Figure 2: frequency distributions of studied ADHD children regarding their total strengths levels (proscoial skills) (n=100).

Table 5:The studied ADHD children' s sleep habits and disturbances according to their parents(n=100).

Children sleep habit questionnaire	Usually		Sometimes		Rarely	
	No	%	No	%	No	%
Bed time resistance	39	**39.0**	26	26.0	35	35.0
Sleep onset delay	33	33.0	43	43.0	24	24.0
Disturbance in Sleep time	44	**44.0**	24	24.0	32	32.0
Sleep anxiety	45	**45.0**	18	18.0	37	37.0
Night waking and sleep interruption	28	28.0	29	29.0	43	43.0
Parasomnias sleep	13	13.0	21	21.0	66	66.0
Sleep disordered breathing	3	**3.0**	17	17.0	80	80.0
Day time sleepiness	15	15.0	37	37.0	48	48.0

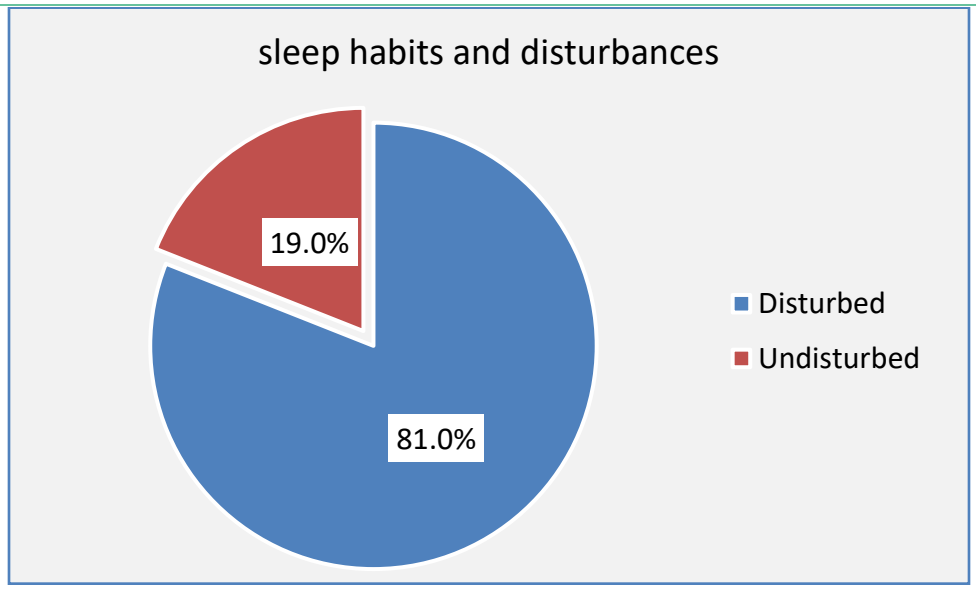

Figure 3:frequency distributions of studied ADHD children regarding their total sleep habits and disturbances (n=100).

Table 6: Correlation matrix between total executive functions, total challenging behaviours, and total sleep habits and disturbances.

Study variables		Total behaviour difficulties	Total strengths(proscoial skills)	Sleep habit and disturbances
Total executive function	R	.243*	-.144	.182
	p-value	.015	.153	.069
Total behaviour difficulties	R	1	-.359	.299
	p-value		.000**	.003*
Total proscoial skills	R	-.359	1	.045
	p-value	.000**		.656
Sleep habits and disturbances	R	.299	.045	1
	p-value	.003*	.656	

* significance (p <.05). ** highly significance (p < .001).

Table 7: Multiple linear regression analysis for challenging behaviors.

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(predictors)	4.037	4.345		0.929	0.355	-4.587	12.66
Sleep habits and disturbances	0.153	0.056	0.263	2.726	0.008 *	0.042	0.264
Total executive functions scores	0.048	0.024	0.195	2.017	0.046 *	0.001	0.096
r-square =.126							
Model ANOVA:F =.6.986,p < .001							

a. Dependent Variable: total behaviour difficulties
Predictors: (Constant), total executive functions, sleep habits and disturbances

Discussion:

This research aims to evaluate children with ADHD's executive functions, challenging behaviors, and sleep patterns. The results revealed that a mild impairment in executive functions, greater levels of behavior difficulties, decreased levels of prosocial skills, and a majority of ADHD children had sleep disturbances. Furthermore, a significant positive correlations were discovered between the scores of executive functions, behavioral difficulties, and sleep habits and disturbances.

According to the findings, children with ADHD have deficiencies in multiple basic domains of executive functioning, such as memory consolidation, inhibit control, shift, emotional regulation, planning, organizing, and monitoring.This is because, in reality, these skills are frequently hindered in ADHD, resulting in difficulties in school, at home, and in social situations. Executive dysfunction is a defining characteristic of ADHD, making it challenging for children to finish tasks, maintain organization,or control their emotions. The conclusion was consistent with studies in Canada by **Townes et al. (2023)** and another in Italy by **Ceruti et al. (2024)** both of which found significant impairment in executive skills in ADHD.

Furthermore, one of the current study's notable findings was the difficulties with the emotional regulation index of executive functions, as stated by parents of ADHD children. Emotional regulation difficulties were particularly common in our group, with ADHD children having possibly clinically increased T scores on the total emotion regulation index, indicating emotional dysregulation or impairment in ADHD children. Furthermore, the current study found that the emotional regulation index had the highest level of executive dysfunction, followed by the cognitive and behavioral regulation indices.

Emotional impairment in children with ADHD is primarily caused by deficiencies in executive functions and emotion regulation abilities, which are influenced by core ADHD symptoms such as inattention and impulsiveness. This can result in hypersensitivity, overwhelm, difficulty detecting emotions, and difficult-to-control emotional reactions.

In agreement with this, **Faraone et al.(2019)** found that children with ADHD typically exhibit emotional dysregulation in the form of excessive impatience, rage, and irritability. They frequently struggle to regulate their extremely intense emotions because they are un able to utilize executive functions to control their feelings and behavior. Furthermore, **Rohr, Bray, & Dewey (2021)**[], stated that children with ADHD frequently exhibit greater negative affect, tantrums, and emotional instability when confronted with challenging or negative events.
Similarly, a research performed in Spain by **Pardo-Salamanca et al. (2024)a ,** observed that the emotional regulation index had the highest T score and T score of emotional regulation was clinically elevated, indicating impairment in emotion regulation of executive functions by ADHD children.

On the other hand, **Jacobson et al. (2024) ,** discovered the behavioral regulation index had the highest T score among ADHD childern, with ADHD children had potentially clinically elevated in total emotion regulation scores in the United States . In addition, **Hai et al. (2024**) in Canada explained that the right caudate was correlated with emotional regulation as ratings of parents, emphasizing the importance of considering emotional regulation impairment in ADHD, and the cognitive regulation index had the highest T score.

Furthermore, these results demonstrated that the studied ADHD children had possibly clinically elevated T scores on the cognitive regulation index, implying that ADHD children have cognitive regulation deficiencies. This is because studies has revealed that hypoactivation in the prefrontal cortex causes deficiencies in cognitive processes including decision-making and working memory. As well as emotional management and inhibitory control, making ADHD children struggle to properly organize and execute tasks and understand when their behavior is improper. Finally, cognitive deficiencies, notably inattention and executive skills, are regarded as a basic component of ADHD and are thought to have a major part in the challenging adaptation of ADHD.

The result was aligned with research carried out by **Huang et al. 's (2024)** research in China, which reported ADHD children had potentially clinically elevated cognitive regulation T score. On the other hand, a research conducted by **Jacobson et al. (2024)** [in the United States found that ADHD children had clinically elevated cognitive regulation T scores.

Concerning the total behavior regulation index of executive functions, the result of this research displayed that ADHD children had mild elevated T score of the behavior regulation index, which suggested behavior regulation impairment in ADHD children. It might be due to the fact that ADHD children often struggle to restrain their impulses and consider the implications of their actions before taking them.

This outcome came in line with studies by **Wang et al. (2025) ,** and **Yang et al. (2024) ,** in China, who found that ADHD children had a mildly higher behavior regulation T score. On the other hand, research performed in Spain by **Pardo-Salamanca et al. (2024)a** reported that ADHD children exhibited clinically higher behavior regulation T scores.

In terms of the global executive function composite, the present research displayed ADHD children evaluated had a mild elevated T score in the global executive function composite , indicating impairment in all domains of executive functions. In fact, earlier research has shown that ADHD children exhibit neuroanatomical and neurochemical abnormalities, notably in brain areas associated with executive function skills. The outcome reached came in line with the **Huang et al. (2024)** , which found that ADHD children in China had a mild elevated global executive function composite score.

Other studies, on the other side, reported that the score of global executive functions was higher than in the current study. For example, **Pardo-Salamanca et al. (2024)a** in Spain and **Jacobson et al. (2024)** in the United States discovered that ADHD children had clinically elevated global executive function composite scores. Furthermore, research conducted in Canada by **Hai et al. (2024)** discovered considerably greater executive function challenges reported by parents among ADHD children. Thus, it is critical to evaluate the relevance of structural variations with routinely used executive function tests, which can be regarded as a potential biomarker of ADHD.

Concerning the challenging behavior, the present research revealed that the most challenging behavior among ADHD children was hyperactivity-inattention concerns. In reality, these are the primary symptoms that indicate the disorder. In agreement with this, **Silva et al. (2015)** from Brazil, impulsivity, restlessness, and lack of attention are the main characteristics of ADHD. Furthermore, **El Sebaei, Abdellatif, & Ali (2017)** discovered that the most prevalent signs of ADHD in children are low concentration, excessive activity, and learning difficulties.

Similarly, **Wannapaschaiyong et al. (2024)** discovered that hyperactivity-inattention difficulties are the first behavioral problems in preschool children with ADHD in Thailand, accounting for 33.8% of all behavioral disorders.

Furthermore, the current study revealed that two-fifths of ADHD children experienced conduct problems. This could be because ADHD children struggle with impulse control, emotional regulation, and social understanding, all of which can lead to behavioral disorders. This finding was consistent with **Jonté's (2017)** study in California and **Varheenmaa et al.'s (2024)** study in Switzerland, which discovered that the conduct subscale grades of the ADHD and non-ADHD groups differed significantly, with the ADHD group scoring significantly higher.

Peer difficulties were another challenging behavior among the ADHD childern evaluated, accounting for less than 40%. This could be related to children with ADHD who struggle with establishing adequate social skills due to their lack of attention and impulsivity, problem-solving, and navigating social settings, all of which can contribute to issues in peer relationships. In line with this finding, **Grasso et al. (2022)** discovered 39% of ADHD children experience problems with peer. Similarly, **Varheenmaa et al. (2024)** in Switzerland discovered that children with ADHD had much greater problems with peers compared with normal children.

Furthermore, the current study found that emotional difficulties were the fourth most challenging behavior among ADHD children, accounting for more than one-fifth. This could be because ADHD makes it difficult for children to control their frustration and concentrate, resulting in tantrums and defiant behavior. This finding was consistent with studies conducted in Spain by **Berenguer, Rosello,**

& Mirand (2021) and **Pardo-Salamanca et al. (2024)b,** who found that ADHD children had much greater emotional difficulties than the non-ADHD group.

The present research also found more than one-third of the ADHD children evaluated experienced extremely low prosocial skills. This could be because children with ADHD struggle to pay attention in class or during social interactions, resulting in misunderstandings or difficulties interpreting social signs, perhaps leading to conflict or misbehavior with others.

In line with these findings, **Tengsujaritkul, Louthrenoo, and Boonchooduang (2020)** in Thailand and **Varheenmaa et al. (2024)** in Switzerland found that ADHD children had significantly lower prosocial scores than children without ADHD.

In terms of total challenging behaviors, this research reported that all ADHD childern evaluated had behavioral broblems while two-fifths of them exhibited severe behavioral problems. According to prior study, behavioral and emotional difficulties are widespread among ADHD children, and a higher percentage of them also have additional psychological illnesses.

Similarly, **Tengsujaritkul, Louthrenoo,** & **Boonchooduang (2020)** discovered that ADHD-studied children had a significant level of total behavioral problems. Similarly, **Berenguer, Rosello, and Miranda (2021) ,** who conducted research in Spain, discovered that children with ADHD had significantly higher behavioral and emotional problems than the group without ADHD, as reported by their mothers, reaching 51.40%. **Wannapaschaiyong et al. (2024)** discovered that 31.3% of preschool ADHD children in Thailand had clinically significant behavioral difficulties.

Regarding children's sleep habits among ADHD, the current study demonstrated that disturbances in sleep habits were common in children with ADHD for about eighty percent, with most of them overachieving the required level of sleep disorders (total CSHQ score >41), and possible explanations for this could be that children with ADHD find it challenging to calm their minds or stop speaking about what happened throughout the day and be relaxed enough to sleep well. Furthermore, previous studies hypothesized that one cause for sleep difficulties is that ADHD may disrupt circadian rhythm, which is the optimal wake-sleep cycle.

According to a study by **Yektaş, Tufan, & Sarıgedik (2020)** in Turkey, 93.5% of ADHD children had problems with sleep, which is greater than our findings. Similarly to a study by **Sharma et al. (2022)** in Europe, **Bond et al. (2024)** in Ireland, and **Bondopandhyay, McGrath, & Coogan (2024)** in Ireland discovered that the majority of ADHD children rated more than requirement of a sleep disorder on the CSHQ.
This conclusion contradicted a study by **Grünwald & Schlarb (2017)** in Germany, which indicated that one-third of ADHD children had a sleep disturbance score over the cutoff for clinically sleep disturbances.

Furthermore, the current data showed that sleep disturbances specific to the sleep anxiety domain, disturbance in sleep time, bedtime resistance, sleep onset delay, and night waking domains were significantly more common in children with ADHD. These findings are consistent with earlier research showing that children with ADHD experience sleep disturbances more frequently than a typical sample of young children.

This finding was in line with a study done in India by **Vaidyanathan, Shah, & Gayal (2016) ,** who discovered that sleep disturbances were specific to the subscales of bedtime resistance, difficulties with sleep onset, duration of sleep, sleep anxiety, and daytime sleep and were significantly more common in

the ADHD group than in other group. Furthermore, **El-Monshed, Fathy, & Shehata (2020)** discovered that ADHD children had a greater score of sleep disruptions on the CSHQ.

The current research discovered an important correlation between overall sleep habits and disturbances and total behavioral challenges among ADHD children. These results suggested that sleep disturbances among ADHD children may contribute to the development of behavioral disorders, as predicted by multiple linear regression. Problems with sleep would have an impact on behavioral issues. Previous research has shown that good sleep patterns are beneficial to both mental and physical health, including improved attention, conduct, memory, cognition, emotional control, and quality of life.

This finding was consistent with a research done in the United States by **Becker, Langberg, & Evans (2015)** , who found that sleep difficulties may lead to the occurrence of behavioral problems in ADHD children; increased sleep problems have been linked with greater externalized problems and would predict externalizing problems. In addition, **Lycett et al. (2016)** [57] discovered that over a 12-month period, children with ADHD who reported short-term or constant sleep issues had more behavioral and conduct issues than those who did not. Finally, **Wannapaschaiyong et al. (2024)** discovered that higher sleep disturbances were strongly associated with all behavioral difficulties in the strength and difficulty scale in ADHD children in Thailand.

In contrast, this finding contradicted **Mulraney et al. (2016)** , an Australian study that found no relation between reported difficult behaviors and sleep issues among ADHD children after 6 months.

Furthermore, this research revealed a significant positive correlation between children's executive functions and challenging behaviors; executive function deficits contributed to the emergence of difficult behaviors in ADHD children, as predicted by multiple linear regression analyses. This finding was congruent with a study done by **Frazier et al. (2020) ,** which found a strong correlation between lower levels of challenging behaviors and executive functioning skills, particularly inhibition control, control of emotions, and avoiding risk in the United States.
Similarly, in the United Kingdom, **Owen et al. (2025)** discovered positive and substantial relationships between executive functions impairment and behavioral challenges in ADHD children.

Conclusion

Evaluated ADHD children demonstrated mild impairment in global executive functions, as well as extremes in the emotional regulation and cognitive regulation indexes compared to the behavioral regulation index. Furthermore, all ADHD children exhibited significant levels of behavioral challenges, particularly hyperactivity, inattention problems, and low levels of total prosocial abilities. Furthermore, the majority of ADHD childern reported disturbed sleep patterns. Moreover , there were statistically significant positive correlations between executive functions, behavioral issues, and sleep habits scores. Global executive function impairment and sleep problems were strong positive predictors of ADHD challenging behaviors.

Recommendations:
The study recommends psychoeducational and counseling sessions for parents to raise their awareness of how to behave with their children and manage challenging behaviors and sleep problems; establishing healthy sleep practices, such as structured bedtime routines, is the first recommended line of treatment for sleep disturbances; and psychological intervention programs aimed at improving ADHD children's executive functions, sleep disturbances, and management of challenging behaviors.

Limitations of the study:
The sample size was too small to evaluate factors associated with emotional/behavioural problems and functional impairment in the ADHD group, although the sample size was considered adequate based on a previous study which affects the generality of the findings. Information was obtained from parents only; reports from other sources such as teachers would give more information.

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Authour's contributions:
M.F.L. developed the research concept, carried out data collection and analysis, and drafted the manuscript; **S.R.E.** contributed to methodology development, data analysis and interpretation, comparison of results, discussion, and manuscript revision; and **R.A.A.** contributed to manuscript revision and edition. The final thesis was examined and approved by all authors.

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List of Abbreviations:
(ADHD): Attention Deficit Hyperactivity Disorder; (DSM-5): the Diagnostic and Stastistical Manual of Mental Disorders,Fifth Edition; (BRIEF2): Behavior Rating Inventory of Executive Function Questionnaire, sceond edition; (SDQ):Strengths and Difficulties Questionnaire; (CSHQ): Children Sleep Habits Questionnaire.

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