Effect of Maternal Adverse Childhood Experiences on the Stress Level of Mothers of Children Diagnosed with Attention-Deficit/Hyperactivity Disorder: A Case-Control Study

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Abstract: Attention deficit-hyperactivity disorder (ADHD) is a psychiatric disorder that affects children's ability to function and could be carried into adolescence and adulthood with a prevalence of approximately 66-85%. However, few studies have assessed the association between prenatal maternal stress and ADHD in children in Jeddah, Saudi Arabia. This study aimed to assess the impact of adverse childhood experiences on parents of children with ADHD. This was a case-control study with a sample size of 180 mothers of children with ADHD diagnosed in a child psychiatric clinic at King Abdulaziz University Hospital from 2015 to 2020. We recruited 94 mothers of non-ADHD children for the control group. We investigated stress with a validated questionnaire using the Perceived Stress Scale and Adverse Childhood Experience questionnaire and considered ADHD symptoms as determined using the Conners' Parent Rating Scale–revised (CPRS-R). The one-way ANOVA revealed a significant association ($p=0.002$) between multiple early-life traumas and elevated adult stress. Mothers with ADHD children affected severely by past traumas displayed significantly higher stress ($p<0.05$), unlike the control group, which showed no notable link between PSS levels, ACE questionnaire scores, or the effect of past experiences on maternal health ($p>0.05$). Of note, mothers of children with ADHD had higher levels of stress than control participants. Boys had a higher prevalence (67.8%) of ADHD than girls.

Keywords: Attention deficit-hyperactivity disorder, Conners' Parent Rating Scale-revised.

1. INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental and psychiatric disorder among children. Children with ADHD may struggle to pay attention, manage impulsive behaviors, or be extremely active.

The Diagnostic and Statistical Manual of Mental Disorders DSM-5 classifies ADHD into three presentations: inattentive, impulsive/hyperactivity, and mixed presentation [1,2]. ADHD causes significant impairment in the patient's life since most struggle with other mental health issues, and it increases the likelihood of undergoing a divorce, withdrawal from college, smoking, and substance abuse [3-5].

Although the exact pathogenesis and causes of ADHD are unclear, it is known to be associated with dopamine deficiency and structural brain differences [6]. Maternal stress or anxiety during pregnancy decreases blood flow to the fetus [7]. Consequently, the developing organs, especially the brain, will be affected, leading to ADHD [8]. Furthermore, interactions between genes and the environment play a significant role in ADHD incidence [9]. Other risk factors include maternal age, exposure to illness, smoking status, and medications during pregnancy [10].

For patients with ADHD, pharmacological medication remains the mainstay of treatment [11]. However, behavioral therapy has shown benefits, which comprise psychoeducation for both the patient and family. Furthermore, combining medications/ behavioral treatments has proven more beneficial [12].

During childhood, emotional obstacles such as insecurity, economic hardship, material loss,

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depression, stress, and anxiety can result from prenatal maternal stress [13]. Many studies suggest that maternal psychological issues, including anxiety, depression, and exposure to stressful life events during pregnancy, can increase the risk of behavioral and neurodevelopmental problems such as ADHD in the developing fetus [14,15]. Another study found that ADHD in 100 infants had an association with comorbidities and risk factors that the mother faced during pregnancy, including anxiety, social problems such as work, and environment-related stress [16].

No studies have identified the relationship between prenatal maternal stress (PNMS) and ADHD in Saudi Arabia. Since PNMS is influenced by societal and cultural perspectives, the results of studies that are not based in Saudi Arabia do not accurately explain the relationship between PNMS and ADHD in the region. Therefore, this study aimed to determine the association between adverse childhood experiences (ACEs) and ADHD in children in Jeddah, Saudi Arabia.

2. MATERIALS AND METHODS

2.1. Study Design, Setting, and Participants

This case-control descriptive study was conducted between June 2021 and June 2022 at King Abdulaziz University Hospital (KAUH) in Jeddah, Saudi Arabia. It targeted mothers with children of both sexes, aged 5-12, diagnosed with ADHD in the psychiatric department in KAUH during 2015-2020. The mothers were matched with undiagnosed healthy children randomly recruited from the population using the Conners' Parent Rating Scale (CPRS).

2.2. Sample Size and Sampling Procedure

The sample size needed in this study was calculated using Raosoft software (Seattle, WA); it was 139 participants with a 95% confidence level and a 5% margin of error. The sampling technique used was a convenient randomized sample recruited through the KAUH database. A total of 94 mothers of unaffected children were included as controls. The procedures followed were in accordance with the ethical standards of the responsible committee based on the Good Clinical Practice guidelines, and the study adhered to the 2013 Declaration of Helsinki.

2.3. Data Collection Instruments

Data were collected using certain validated scales, which included the Perceived Stress Scale (PSS), a psychological instrument used to evaluate participants' perception of stress [17], and the ACE questionnaire, a specific measuring scale of several traumatic experiences in childhood that includes various components of adversity [18]. Child ADHD symptoms were evaluated using the Conners' Parent Rating Scale–revised (CPRS) [19]. The CPRS questionnaires were distributed only to mothers of undiagnosed children. The questionnaire included "Yes" or "No" and multiple-choice questions. The child's age and sex, mother's age, marital status, and level of education, among other demographic data, were collected.

The PSS is an assessment of stress levels and frequency of how the mother felt or thought in a certain way in the past month. The questionnaire comprised 10 questions exploring mood state, sense of control, presence of stress or nervousness, self-confidence, and the ability to cope. There were five alternative rating choices (0=never, 1=almost never, 2=sometimes, 3=fairly often, and 4=very often). The scoring of questions 4, 5, 7, and 8 were reversed as follows: 0=4, 1=3, 2=2, 3=1, and 4=0. The total scores ranged from 0 to 40: a score of 0-13 was considered low stress, 14-26 as moderate stress, and 27-40 as high perceived stress. An Arabic version was used (exactly as published in the previous publication) for which permission was obtained from the original authors [20].

The ACE questionnaire helps to estimate the previous adverse experiences of the mother's childhood during the first 18 years of life in 10 domains: emotional, physical, or sexual abuse; emotional or physical neglect; violent treatment; household substance abuse; any other mental illness; parental separation; and any household member incarceration. The scores were coded as 1 for positive history and 0 (zero) for no exposure. Moreover, a total score of 10 points reflected the highest traumatic exposure. The chance of unfavorable outcomes increases as the number of ACEs increases, which can have a long-term effect on individuals' physical and emotional health if these occur in childhood. An Arabic version was used in this study [21].

The Arabic version of the CPRS was used to screen for ADHD symptoms, as reported by the parents [22]. This form includes 80 items grouped into different categories: cognitive problems/inattention, hyperactivity, oppositional, shyness, anxiety, ADHD index, social problems, psychosomatic, perfectionism, Conners' Global Index, and DSM-IV symptoms [23]. The reliability and validity of this instrument were

determined through the use of the questionnaire in many previous studies [24].

2.4. Data Entry and Analysis

The data were entered into Microsoft Excel 2016 (Microsoft, Redmond, WA) and analyzed using SPSS (version 21; IBM, Armonk, NY). Categorical variables are presented as frequencies and percentages, and continuous variables are expressed as means± standard deviations. The chi-squared test was used to analyze the categorical data to observe the association between outcomes and different variables, and continuous variables were analyzed using the *t*-test. Statistical significance was set at a *p*-value of <0.05.

3. RESULTS

3.1. Participants' General Characteristics

The mothers' ages ranged from 20 to 65 years. However, 26.1% (n=25) of mothers were aged 31-35, while 25.5% (n=24) of controls were aged 36-40. As per the marital status of the mothers in the case group, 90% (n=162) were married, and 9.4% (n=17) were divorced; their children were aged 5-12 (8.91±2.58) years, most of whom were boys (67.8%, n=122) and only 32.2% (n=58) were girls. As per the marital status of the mothers in the control group, 86.2% (n=81) were married, and 11.7% (n=11) were divorced; their kids were aged 5-12 (7.77±2.41) years, among whom 50% (n=47) were boys and 50% (n=47) were girls (Table **1**).

Table 1: Distribution of Cases and Controls according to Child Demographics and Mothers' Age and Marital Status

Variable	Group	
	Cases (no.: 180)	Controls (no.: 94)
Child age (years) (mean±SD)	8.91±2.58	7.77±2.41
Child sex		
Female	58 (32.2)	47 (50)
Male	122 (67.8)	47 (50)
Mother's age (years)		
20-25	6 (3.3)	2 (2.1)
26-30	23 (12.8)	22 (23.4)
31-35	47 (26.1)	23 (24.5)
36-40	45 (25)	24 (25.5)
41-45	32 (17.8)	13 (13.8)
46-50	23 (12.8)	7 (7.4)
51-55	2 (1.1)	3 (3.2)
56-60	1 (0.6)	0 (0.0)
61-65	1 (0.6)	0 (0.0)
Mother's marital status		
Widow	1 (0.6)	2 (2.1)
Married	162 (90)	81 (86.2)
Divorced	17 (9.4)	11 (11.7)

SD, standard deviation.

3.2. Univariate Analysis

Mothers of children with ADHD had a significantly higher percentage of having a high PSS level than controls did (22.8% *vs.* 7.4%) (Figure **1**): 31 (11.3%) had low stress, 195 (71.2%) had moderate stress, and 48 (17.5%) had severe stress (Figure **2**).

3.3. Bivariate Analysis

Mothers of children with ADHD had a significantly higher mean stress than controls (21.58±5.84 *vs.* 18.59±7.88) ($p \leq 0.05$). However, a non-significant difference was found between the cases and controls according to the ACE questionnaire mean scores or their opinions about the effect of previous experiences on their health ($p > 0.05$).

3.4. Level of Stress and Demographic Data

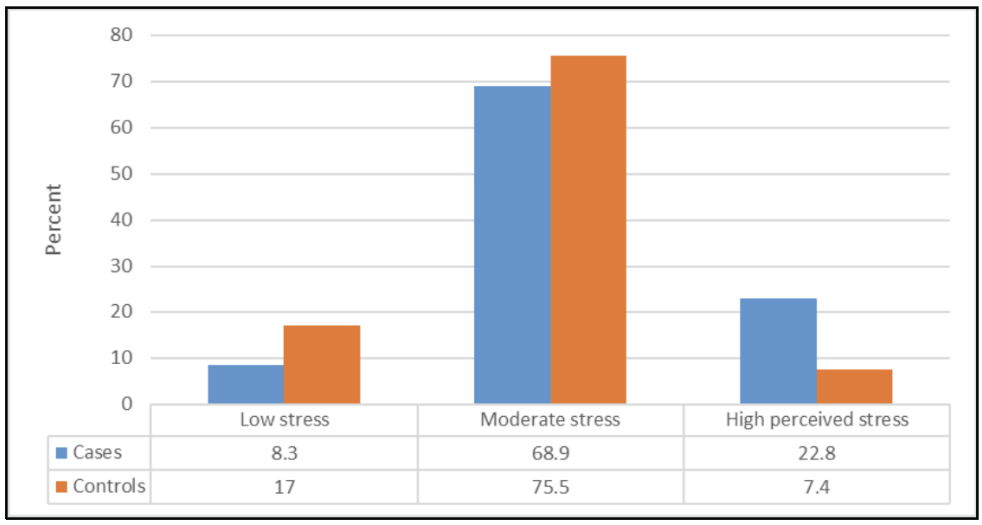
The mean ages of non-ADHD children of mothers with low, moderate, and high stress were 9±2.85, 8.97±2.55, and 8.68±2.62 years, respectively, with no significant differences ($p=0.825$) (Table **2**). The mean ages of children with ADHD of mothers with low, moderate, and high stress were 6.94±2.51, 7.79±2.32, and 9.43±2.57 years, respectively (Table **3**).

In ADHD cases, moderate stress levels were observed in 72.1% of mothers of male children and 62.1% of mothers of female children; 69.8% of the mothers were married, and 64.7% were divorced in ADHD cases. In controls, moderate stress levels were observed in 85.1% of mothers of male children and 66% of mothers of female children; 72.8% of the mothers were married, and 90.9% were divorced. There were no significant differences.

A non-significant relationship was found between PSS levels and the child's age or sex, mother's age, or marital status ($p > 0.05$) in ADHD cases. A non-significant relationship was found between PSS levels and child age or sex, mother's age or marital status, ACE questionnaire mean score, or effect of past experiences on mothers of healthy children ($p > 0.05$).

3.5. ACEs and Demographic Data

A comparison between mothers' age groups and ACEs, which was analyzed using one-way analysis of



N.B.: ($\chi 2 = 12.78$, p-value = **0.002**)

Figure 1: Difference between cases and controls according to Perceived Stress Scale levels.

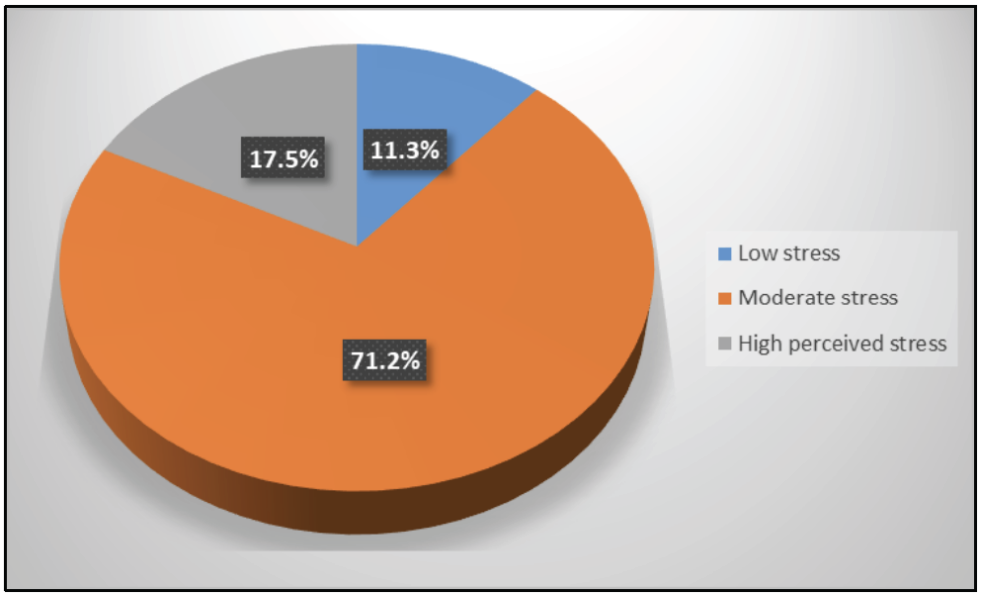


Figure 2: Percentage distribution of all participants according to Perceived Stress Scale levels.

Table 2: Relationship between Perceived Stress Scale Levels and Child Demographics, Mother's Age and Marital Status, Adverse Childhood Experience Questionnaire mean Scores, and Whether Previous Experiences Affected Maternal Health in Cases of ADHD

Variable	Perceived Stress Scale levels			Test	*p*-value
	Low stress	Moderate stress	High stress		
Child age (years)	9±2.85	8.97±2.55	8.68±2.62	2*	0.825
Child sex					
Female	6 (10.3)	36 (62.1)	16 (27.6)	1.86**	0.394
Male	9 (7.4)	88 (72.1)	25 (20.5)		

(Table 2). Continued.

Variable	Perceived Stress Scale levels			Test	*p*-value
	Low stress	Moderate stress	High stress		
Mother's age (years)					
20-25	1 (16.7)	4 (66.7)	1 (16.7)		
26-30	0 (0.0)	18 (78.3)	5 (21.7)		
31-35	8 (17)	30 (63.8)	9 (19.1)		
36-40	3 (6.7)	30 (66.7)	12 (26.7)		
41-45	1 (3.1)	24 (75)	7 (21.9)	11.21**	
46-50	2 (8.7)	15 (65.2)	6 (26.1)		0.796
51-55	0 (0.0)	1 (50)	1 (50)		
56-60	0 (0.0)	1 (100)	0 (0.0)		
61-65	0 (0.0)	1 (100)	0 (0.0)		
Mother's marital status					
Widow	0 (0.0)	0 (0.0)	1 (100)		
Married	15 (9.3)	113 (69.8)	34 (21)	6.43**	0.169
Divorced	0 (0.0)	11 (64.7)	6 (35.3)		
ACE scale scores (mean±SD)					
	2.86±2.89	2.12±2.16	3.02±2.42	2*	0.073
Do you think these experiences affected your health?					
To some extent	1 (2)	42 (84)	7 (14)		
Much	1 (4.5)	12 (54.5)	9 (40.9)	12.01**	0.017
Not much	13 (12)	70 (64.8)	25 (23.1)		

ACE, Adverse Childhood Experience; ADHD, attention-deficit/hyperactivity disorder; SD, standard deviation.

Table 3: Relationship between Perceived Stress Scale Levels and Child Demographics, Mother's Age and Marital Status, Adverse Childhood Experience Questionnaire mean Scores, and Whether Previous Experiences Affected Maternal Health for Controls

Variable	Perceived Stress Scale levels			Test	*p*-value
	Low stress	Moderate stress	High stress		
Child age (years)	6.94±2.51	7.79±2.32	9.43±2.57	2*	0.065
Child sex					
Female	12 (25.5)	31 (66)	4 (8.5)	5.28**	0.071
Male	4 (8.5)	40 (85.1)	3 (6.4)		
Mother's age (years)					
20-25	2 (100)	0 (0.0)	0 (0.0)		
26-30	4 (18.2)	17 (77.3)	1 (4.5)		
31-35	3 (13)	19 (82.6)	1 (4.3)	18.96**	0.089
36-40	3 (12.5)	17 (70.8)	4 (16.7)		
41-45	4 (30.8)	9 (69.2)	0 (0.0)		
46-50	0 (0.0)	6 (85.7)	1 (14.3)		
51-55	0 (0.0)	3 (100)	0 (0.0)		
Mother's marital status					
Widow	0 (0.0)	2 (100)	0 (0.0)		
Married	16 (19.8)	59 (72.8)	6 (7.4)	3.33**	0.503
Divorced	0 (0.0)	10 (90.9)	1 (9.1)		
ACE scale scores (mean SD)					
	2.18±3.35	1.81±1.68	1.57±1.39	2*	0.707
Do you think these experiences affected your health?					
To some extent	2 (10)	17 (75)	1 (5)	2.34**	0.672
Much	2 (20)	8 (80)	0 (0.0)		
Not much	12 (18.8)	46 (71.9)	6 (9.4)		

ACE, Adverse Childhood Experience; SD, standard deviation.

variance (ANOVA), showed no significant relationship. Additionally, there was no significant correlation between ACE questionnaire mean scores and child age in ADHD cases and controls *(p*>0.05). A non-significant relationship was found between ACE questionnaire mean scores and child sex, child age, mothers' age, marital status, and PSS levels in cases and controls.

3.6. ACEs and Levels of Mothers' Stress

The relationship between multiple traumatic events in early life and high levels of stress in later life was significant (*p*=0.002) using one-way ANOVA. Mothers of children with ADHD who reported that their past experiences had a significant effect on their health had a significantly higher percentage of high perceived stress (*p*<0.05). Among controls, a non-significant relationship was found between PSS levels and ACE questionnaire mean scores or the effect of past experiences on mothers' health (*p*>0.05).

3.7. Risk Factors

Multivariate regression analysis was performed to assess the independent predictors (risk factors) of perceived stress among the participants. Having a male child (*p*=0.02) and having an experience that affected mothers' health (*p*=0.03) were significant risk factors for perceived stress among participants.

4. DISCUSSION

This study investigated ACEs in mothers in relation to having a child with ADHD in Jeddah, Saudi Arabia, from 2015 to 2020.

4.1. Demographic Data

This study found that the proportion of boys was significantly higher among cases than controls. These results are equivalent to those of a previous study conducted in Denmark that found that boys born to mothers with PNMS were more frequently diagnosed with ADHD than girls [25]. These findings might be because only fewer girls are assessed in ADHD clinics [26].

4.2. Stress Level

The main finding of this study was that mothers of children with ADHD were exposed to a higher level of stress than controls were. In contrast to the present study, Davis and Sandman found that during pregnancy, depression, state anxiety, and perceived stress were not related to child development; only pregnancy-specific stressors were related [27]. A recent study suggested that exposure to high-stress levels activates the maternal immune system and affects neonatal functional brain connectivity and offspring behavior [28].

In this sample, most mothers (71.2%) had moderate stress levels, and only 17.5% were exposed to a high stress level. Similar to a previous study, this study also highlights the increased burden of raising a child with ADHD and the reciprocal relationship this has with parents' ADHD, depressive symptoms, and stress levels [29]. The reason behind these results is that mothers are typically more involved than fathers in organizing the household, ensuring that children go to school on time, groceries are brought, and household necessities are met [30]; thus, feeling incompetent and remorseful may lead to moderate stress [31].

4.3. Maternal Stress and Child Sex

In the present study, the results of the relationship between stress and sex were not significant, similar to the findings of Breen and Barkley [32], who found no difference between parents of boys and girls with ADHD, in contrast to the findings of Podolski and Nigg [33] who found that parents of girls with ADHD experienced more stress than parents of boys with ADHD because they were more distressed about girls than boys externalizing behavior problems.

4.4. Marital Status and ACEs

This study confirmed a positive relationship between exposure to ACEs and marital status. A previous study has shown that individuals who reported traumatic experiences during childhood had a higher chance of getting divorced. This result was in line with the hypothesis that people who had traumatic experiences in early life found long-term relationships difficult to maintain [34].

4.5. Maternal Stress and ACEs

The results of this study revealed a relationship between maternal stress and early exposure to traumatic events in her childhood. A previous study indicated that negative health outcomes and stress in adulthood were related to exposure to early traumatic life events [35]. A previous study reported that a lack of social support, behavioral management, and self-awareness enhances the effect of stress in individuals

while keeping ACEs a secret due to their cultural background [36]. Therefore, perceived social support has been associated with improved mental health and reduced stress [37].

4.6. Limitations

First, this was a single-center study conducted at KAUH, with a limited sample owing to fewer recruited cases. Second, only a few participants agreed to participate in the study. Therefore, analyzing the difference between stress levels of the mother and father and the effect of specific stressors that arise when raising a child with ADHD might be helpful to specify the etiology of stress levels.

4.7. Recommendations

In the future, we recommend recruiting data from more than one center in Jeddah and managing the included population through different ways to help clear any doubts and feelings regarding privacy invasion and to increase participation in the study.

Clinicians treating ADHD should be aware that subclinical symptoms of ADHD in parents may exacerbate stress, creating an unfavorable family environment for children who are already vulnerable. It is necessary to design specific diagnostic and therapy programs for mothers of children with ADHD to improve their parenting skills (for example, dealing with challenging behavior and finding social support) and reduce parenting stress and depressive feelings. Moreover, we recommend using other scales, such as the Parenting Stress Index and the PSS, to measure the stress level of both parents and relative stress in the parent-child relationship. Full-scale child characteristics include distractibility/hyperactivity, adaptability, parental reinforcement, demandingness, mood, and acceptability.

AUTHOR CONTRIBUTIONS

Malak A. Alshareef, Reham E. Alaklouk, Amer A. Edries, Zahraa A. Alkhadrawi, Abdulrahman Y. Alhashmi, Badrah H. Alghnami, and Sulhi A. Alfakeh contributed to the design and implementation of the research, the analysis of the results, and the writing of the manuscript.

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INSTITUTIONAL REVIEW BOARD STATEMENT

The Institutional Review Board of KAUH (Ref: 83-21) approved this study on October 3, 2021.

INFORMED CONSENT STATEMENT

The mothers provided written informed consent to participate in the study.

DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting this study's findings are available within the article and its Supplementary material. Raw data supporting this study's findings are available from the corresponding author upon reasonable request.

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CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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