

## Original Article

# Prevalence and risk factors of adult attention deficit hyperactivity disorder in university students: A study from the United Arab Emirates

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## Abstract

Attention deficit hyperactivity disorder (ADHD), once considered primarily a childhood condition, is now increasingly recognized as a disorder that persists into adulthood and significantly impacts academic and professional success. The aim of this study was to investigate the prevalence of ADHD and identify associated risk factors among university students. A cross-sectional study was conducted over a period of six months at Ras Al Khaimah Medical and Health Sciences University, United Arab Emirates. Data were collected through a self-report questionnaire addressing sociodemographic, lifestyle, and family environment factors. ADHD symptoms were assessed using the World Health Organization Adult ADHD Self-Report Scale version 1.1, based on the Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition criteria. The study sample included 472 students, with a mean age of  $19.9 \pm 1.85$  years. The overall prevalence of ADHD was 13.6% ( $n=64$ ). Logistic regression analysis revealed significant associations between the mother's smoking status (odds ratio (OR): 2.35; 95% confidence interval (95%CI): 1.949–5.862,  $p=0.050$ ) and living in shared housing (OR: 3.35; 95%CI: 1.674–6.723,  $p=0.001$ ) with increased odds of ADHD. Conversely, being male (OR: 0.4; 95%CI: 0.216–0.891,  $p=0.02$ ) and being born full-term (OR: 0.331; 95%CI: 0.138–0.794,  $p=0.013$ ) were associated with decreased odds of ADHD. Other factors, such as college affiliation, smoking status, exercise habits, maternal employment, mode of delivery, and pregnancy complications, were not significant risk factors. These findings highlight the need for targeted interventions in university settings, including early screening, tailored support services, and increased staff awareness, to support students with ADHD and enhance their academic success and well-being.

**Keywords:** ADHD, university students, risk factors, United Arab Emirates, prevalence

## Introduction

Attention deficit hyperactivity disorder (ADHD) is a prevalent neurodevelopmental disorder, affecting approximately 5–8% of children worldwide [1,2]. This condition is characterized by symptoms of inattention, hyperactivity, and impulsivity, which may present individually or in



combination [3]. Although ADHD is commonly diagnosed during childhood, evidence indicates that the disorder persists into adolescence in 50–80% of cases and continues into adulthood in 35–65% of cases, impairing academic, social, and occupational functioning [4,5]. University students are particularly susceptible to the difficulties associated with ADHD, as the transition to independent adulthood, coupled with academic demands, may exacerbate symptoms and contribute to adverse outcomes, including reduced educational attainment and increased rates of attrition [6].

The prevalence of ADHD among university students varied across different regions. In the United States, 5–8% of university students demonstrate clinically significant symptoms of ADHD [7,8]. In the Middle East, studies have reported prevalence rates ranging from 3.31% to 10.9% among university students in Saudi Arabia [9,10], while growing concerns regarding mental health conditions, including probable ADHD, have been observed among students in the United Arab Emirates (UAE) [11,12]. Students enrolled in medical and health sciences programs may face an elevated risk of ADHD, attributable to the rigorous academic demands inherent in these fields [13,14].

Identifying the risk factors associated with ADHD is essential for early recognition and intervention efforts. Genetic predisposition is recognized as one of the most significant risk factors, with heritability estimates reaching 76% [15]. Neurobiological factors, including structural abnormalities in the prefrontal cortex, have been associated with cognitive impairments contributing to ADHD symptomatology [16,17]. Environmental exposures, such as prenatal exposure to alcohol, nicotine, and other substances, further elevate the risk of developing ADHD [18]. Additionally, preterm birth and low birth weight are considered important contributors to the development of ADHD, likely due to adverse effects on early brain development [19]. Psychosocial stressors during childhood, including family dysfunction and parental mental health disorders, have also been associated with an increased risk of ADHD [20,21]. Among university students, academic stress, poor sleep patterns, and substance use may worsen ADHD symptoms or contribute to the emergence of late-onset ADHD [22]. Among university students, students in health sciences disciplines and students enrolled in health sciences programs, particular, are subjected to intensified academic pressures and competitive environments, which may increase the risk of symptom exacerbation or emergence [13]. Such stressors may disrupt emotional regulation and neurodevelopment, compounding genetic and biological susceptibilities.

Adult ADHD has received comparatively less attention in epidemiological studies compared to childhood ADHD, primarily due to the absence of well-established and validated diagnostic criteria [22,23]. Among medical and health sciences students, ADHD may remain undiagnosed, partly due to limited awareness and the misconception that high academic achievement is incompatible with the disorder [11]. Furthermore, the intense cognitive and emotional demands experienced by students in these fields may obscure ADHD symptoms, which are often misinterpreted as typical responses to academic stress or burnout [11]. The failure to diagnose ADHD can result in various adverse consequences, including academic underperformance, an elevated risk of mental health disorders such as anxiety and depression, and challenges in maintaining a healthy work-life balance. Therefore, early identification of ADHD is critical to enable timely intervention, optimize academic outcomes, and support overall student well-being.

Although prior studies have investigated the prevalence of ADHD within general university student populations and identified several contributing risk factors, data focusing on students in medical and health sciences programs remain limited. In the UAE, a country characterized by significant cultural diversity, rising concerns regarding mental health have been observed [11,12]. However, studies evaluating the prevalence of ADHD and associated risk factors among university students, particularly those enrolled in medical and health sciences disciplines, are scarce. The demanding cognitive and emotional environment encountered by these students may conceal ADHD symptoms, often resulting in underrecognition or misattribution to academic stress or burnout [11]. The aim of this study was to assess the prevalence of ADHD symptoms among students at Ras Al Khaimah Medical and Health Sciences University, UAE, and to identify the associated risk factors. To the best of our knowledge, this study represents the first study conducted in Ras Al Khaimah, UAE.

## Methods

### Study design and setting

This study utilized a cross-sectional design to investigate the prevalence of ADHD symptoms and associated risk factors among undergraduate students enrolled in Medical and Health Sciences programs at Ras Al Khaimah Medical and Health Sciences University. The study was conducted over a six-month period, from September 2023 to February 2024. Data collection took place across the four main colleges of the university: Ras Al Khaimah College of Medicine, College of Dental Sciences, College of Pharmacy, and College of Nursing. Consecutive sampling was employed, with a minimum required sample size of 306 students. Data were collected through a self-report questionnaire addressing sociodemographic, lifestyle, and family environment factors. ADHD symptoms were assessed using the World Health Organization Adult ADHD Self-Report Scale version 1.1, based on the Diagnostic and Statistical Manual of Mental Disorders - Fifth Edition criteria.

### Eligibility criteria

The target population consisted of undergraduate students aged 18–30 years who were enrolled across various academic years within the four colleges. The student body reflected a diverse range of nationalities, consistent with the overall demographics of the university. Inclusion criteria required the provision of informed consent and active enrollment in one of the medical and health sciences programs. Students with a formally documented diagnosis of ADHD by health care professionals were excluded to focus on identifying undiagnosed or unreported cases.

### Sample size and sampling method

A consecutive sampling technique was utilized to recruit all eligible students from the four colleges at Ras Al Khaimah Medical and Health Sciences University. The minimum required sample size was calculated to be 306 students, based on a total student population of 1,500, applying a 95% confidence interval (95%CI), a 5% margin of error, and an assumed population proportion of 50%. Sample size determination was conducted using the Raosoft sample size calculator (Raosoft, Seattle, WA, USA) [24].

### Data collection

Following ethical approval from the University Human Ethics Committee, participant recruitment emphasized the importance of obtaining informed consent. In-class presentations were delivered to explain the study objectives, procedures, and ethical considerations. Immediately after these sessions, surveys were distributed in person at designated times and locations across the four colleges of Ras Al Khaimah Medical and Health Sciences University. Data were collected using a self-administered questionnaire comprising two sections.

The first section collected information on participant characteristics, including age (<19 years or ≥19 years), sex (male or female), birth order (<3 or ≥3), nationality (Arab, non-Arab, or local (Emirati)), college affiliation (medicine, dentistry, pharmacy, or nursing), year of education (ranging from year 1 to 5), and self-reported grade point average (GPA) based on the 4.0 scale used by RAKMHSU. GPA was categorized as high (3.5–4.0), moderate (2.5–3.49), or low (<2.5). Additional variables included lifestyle habits (smoking status (Yes/No) and regular exercise (Yes/No)) and family environment factors. Family environment variables encompassed mother's employment status (Yes/No), mother's education level (secondary and below, bachelor's, or postgraduate), parental smoking habits (father's smoking status: Yes/No; mother's smoking status: Yes/No), maternal factors during pregnancy (received any medical treatment during pregnancy (Yes/No), mode of delivery (vaginal or cesarean section), infant feeding method (breastfeeding or bottle feeding), mother's age at birth (<35 or ≥35 years), parental marital status (divorced parents: Yes/No), birth status (full-term or pre-term), and living arrangement (alone, with friends, or with parents).

The second section utilized the Adult ADHD Self-Report Scale (ASRS v1.1), an 18-item self-report questionnaire developed to assess ADHD symptoms in adults aged 18 years and older. The ASRS v1.1, created by the World Health Organization in collaboration with the Composite International Diagnostic Interview (2001), aligned with the DSM-IV diagnostic criteria for ADHD

[25]. Participants were asked to respond based on how they had felt and behaved over the preceding six months. Responses were recorded using a five-point Likert scale, ranging from "never" to "very often," scored from 0 to 4 (0=never, 1=rarely, 2=sometimes, 3=often, 4=very often).

The scale was divided into two parts: part A, consisting of six items most predictive of ADHD, served as the primary screening tool. A score of four or more in part A indicated a symptom profile highly consistent with adult ADHD. Part B comprised 12 additional items that further assessed ADHD symptomatology according to DSM-IV criteria. These items were utilized by a psychiatrist to support the diagnosis of ADHD. The ASRS v1.1 demonstrated high internal consistency (Cronbach's  $\alpha=0.88$ ) and strong concurrent validity ( $r=0.84$ ) [25,26].

### Statistical analysis

Statistical analyses were conducted using SPSS statistics version 23 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated, including frequency counts and percentages for categorical variables, as well as mean and standard deviation for continuous variables. Chi-squared test was applied to analyze the association between adult ADHD and independent variables. To identify variables significantly associated with ADHD, a multivariate logistic regression model was used for variables that showed  $p<0.05$  in the Chi-squared test. Statistical significance was determined at  $p<0.05$ .

## Results

### Characteristics of the included participants

The study included 472 participants, with a mean age of  $19.9\pm1.85$  years, and 54.9% were aged over 19 years. Females represented 65.9% of the sample, and 77.3% were among the first three siblings. More than half of the participants (51.6%) were Arab, 36.3% were non-Arab, and 12.1% were Emirati. Students were enrolled across various colleges, predominantly from the college of medicine (46.8%), with 36.9% in the first year of study. More than half of the participants (55%) reported high GPA. Most students (82.6%) reported no smoking habits, and 64.4% engaged in regular exercise. Regarding family characteristics, 61.7% of participants reported that their mothers were unemployed, and 48.5% reported that their mothers had attained a bachelor's degree. Concerning parental smoking habits, 73.9% of fathers and 92.6% of mothers were non-smokers. During pregnancy, 9.8% of mothers received medical treatment, and 5.2% experienced complications. Vaginal delivery was reported by 58.5% of participants, and 88.1% were breastfed. Additionally, 86.8% of participants were born to mothers younger than 35 years at the time of delivery. Family structures appeared largely preserved, with 94.5% of participants reporting that their parents were together, and 94.3% of participants were single. Most participants (92%) were born full-term. Regarding living arrangements, 61% resided with parents, 22.7% lived alone, and 16.3% lived with other students (**Table 1**).

**Table 1. Characteristics of the studied participants (n=472)**

Variable	n (%)
Age (years), mean $\pm$ SD	19.9 $\pm$ 1.85
$\leq 19$	213 (45.1)
$> 19$	259 (54.9)
Sex	
Male	161 (34.1)
Female	311 (65.9)
Sibling birth order	
$< 3$	364 (77.3)
$\geq 3$	108 (22.7)
Nationality	
Local	57 (12.1)
Arab	243 (51.5)
Non-Arab	172 (36.4)
College	
Medicine	221 (46.8)
Dental	94 (19.9)

Variable	n (%)
Pharmacy	69 (14.6)
Nursing	88 (18.6)
Year of education	
Year 1	174 (36.9)
Year 2	87 (18.4)
Year 3	72 (15.3)
Year 4	94 (19.9)
Year 5	45 (9.5)
Grade point average (GPA)	
High (3.5–4.0)	259 (55.0)
Moderate (2.5–3.49)	202 (42.9)
Low (<2.5)	10 (2.1)
Smoking status	
Yes	81 (17.2)
No	391 (82.8)
Exercise practice	
Yes	305 (64.4)
No	167 (35.6)
Mother's employment	
Yes	181 (38.3)
No	291 (61.7)
Mother's education level	
Secondary or below	119 (29.2)
Bachelor's	262 (48.5)
Postgraduate	91 (22.3)
Father's smoking status	
Yes	123 (26.1)
No	349 (73.9)
Mother's smoking status	
Yes	35 (7.4)
No	437 (92.6)
Medical treatment during pregnancy	
Yes	46 (9.8)
No	426 (90.2)
Problem during pregnancy	
Yes	24 (5.1)
No	448 (94.9)
Mode of delivery	
Vaginal	276 (58.5)
Cesarean	137 (29.0)
Unknown	59 (12.5)
Mode of feeding	
Breastfeeding	416 (88.1)
Bottle feeding	56 (11.9)
Mother's age at birth	
<35	410 (86.8)
≥35	62 (13.1)
Divorced parents	
Yes	26 (5.5)
No	446 (94.5)
Birth status	
Full-term	436 (92.3)
Pre-term	36 (7.7)
Marital status	
Single	444 (94.3)
Married	28 (5.7)
Living arrangement	
Alone	107 (22.7)
With other students	77 (16.3)
With parents	288 (61.0)

The study findings indicated that, among 472 participants, 137 (29.03%) demonstrated symptoms suggestive of probable ADHD based on the initial screening (ASRS v1.1-Part A). Following a subsequent evaluation (ASRS v1.1-Part B) conducted by a psychiatrist, the number of confirmed cases was refined to 64, resulting in a prevalence rate of 13.6% within the studied population (**Table 2**).



Table 2. Prevalence of ADHD among the studied participants

Category	Total participants	Cases exhibiting symptoms/confirmed cases	Prevalence (%)
Initial screening (ASRS v1.1 - Part A)	472	137	29.03
Subsequent evaluation (ASRS v1.1 - Part B)	137	64	13.6

ADHD: attention deficit hyperactivity disorder; ASRS: adult ADHD self-report scale

### Factors associated with attention deficit hyperactivity disorder (ADHD) among participants

Females showed a higher prevalence of ADHD than males (16.1% vs 8.7%;  $p=0.033$ ). Smoking (17.3% vs 12.6%;  $p=0.02$ ), regular exercise (14.1%;  $p=0.033$ ), maternal employment (14.4%;  $p=0.03$ ), and maternal smoking (25.7%;  $p=0.039$ ) were associated with higher ADHD rates. Pregnancy complications ( $p=0.008$ ), cesarean delivery (19%;  $p=0.047$ ), and preterm birth (27.8% vs 12.5%;  $p=0.019$ ) were also significantly associated with ADHD. Participants living with other students had the highest ADHD prevalence (28.6%;  $p=0.001$ ). No significant associations were found with academic performance, father's smoking status, mode of feeding, or parents' marital status.

Table 3. Association between participants' characteristics and those with and without ADHD

Variable	Positive ADHD (n=64) n (%)	Negative ADHD (n=408) n (%)	p-value <sup>a</sup>
Age (years), mean±SD			
≤19	33 (15.5)	180 (84.5)	0.282
>19	31 (12.0)	228 (88.0)	
Sex			
Male	14 (8.7)	147 (91.3)	0.033*
Female	50 (16.1)	261 (83.9)	
Sibling birth order			
<3	49 (13.5)	315 (86.5)	0.873
≥3	15 (14.0)	92 (86.0)	
Nationality			
Local	4 (7.0)	53 (93.0)	0.124
Arab	31 (12.8)	212 (87.2)	
Non-Arab	29 (17.0)	142 (83.0)	
College			
Medicine	35 (15.8)	186 (84.2)	0.500
Dental	16 (17.0)	78 (83.0)	
Pharmacy	8 (11.6)	61 (88.4)	
Nursing	5 (5.7)	83 (94.3)	
Year of education			
Year 1	25 (14.3)	150 (85.7)	0.830
Year 2	15 (17.2)	71 (82.8)	
Year 3	8 (11.1)	64 (88.9)	
Year 4	11 (11.7)	83 (88.3)	
Year 5	5 (11.4)	39 (88.6)	
Grade point average (GPA)			
High (3.5–4.0)	30 (11.6)	230 (88.4)	0.150
Moderate (2.5–3.49)	31 (15.3)	171 (84.7)	
Low (<2.5)	3 (30.0)	7 (70.0)	
Smoking status			
Yes	15 (17.3)	68 (82.7)	0.020*
No	49 (12.5)	342 (87.5)	
Regular exercise			
Yes	43 (14.1)	262 (85.9)	0.033*
No	21 (12.0)	147 (88.0)	
Mother's employment			
Yes	26 (14.4)	155 (85.6)	0.030*
No	37 (12.7)	254 (87.3)	
Mother's education level			
Secondary or below	11 (9.2)	108 (90.8)	0.200
Bachelor's	42 (16.2)	220 (83.8)	
Postgraduate	12 (13.2)	79 (86.8)	
Father's smoking status			
Yes	21 (17.2)	101 (82.8)	0.600
No	43 (12.3)	307 (87.7)	

Variable	Positive ADHD (n=64) n (%)	Negative ADHD (n=408) n (%)	p-value <sup>a</sup>
Mother's smoking status			
Yes	9 (25.7)	26 (74.3)	0.039*
No	55 (12.6)	382 (87.4)	
Medical treatment during pregnancy			
Yes	12 (26.1)	34 (73.9)	0.168
No	52 (12.2)	374 (87.8)	
Problem during pregnancy			
Yes	13 (53.2)	11 (45.8)	0.008*
No	51 (11.4)	397 (88.6)	
Mode of delivery			
Vaginal	34 (12.3)	242 (87.7)	0.047*
Cesarean	26 (19.0)	111 (81.0)	
Unknown	4 (6.8)	55 (93.2)	
Mode of feeding			
Breastfeeding	55 (13.2)	361 (86.8)	0.536
Bottle feeding	9 (16.1)	47 (83.9)	
Mother's age at birth			
<35	55 (13.4)	355 (86.6)	0.672
≥35	9 (14.5)	53 (85.5)	
Divorced parents			
Yes	6 (23.1)	20 (76.9)	0.145
No	58 (13.0)	388 (87.0)	
Birth status			
Full-term	54 (12.4)	382 (86.5)	0.019*
Pre-term	10 (27.8)	26 (85.7)	
Marital status			
Single	60 (13.5)	384 (86.5)	0.710
Married	4 (14.3)	24 (85.7)	
Living arrangement			
Alone	15 (14.0)	92 (86.0)	<0.001*
With other students	22 (28.6)	55 (71.4)	
With parents	27 (9.4)	261 (90.6)	

ADHD: attention deficit hyperactivity disorder

<sup>a</sup>Analyzed using Chi-square test\*Statistically significant at  $p < 0.05$ 

### Logistic regression analysis of factors associated with attention deficit hyperactivity disorder (ADHD) among participants

The logistic regression analysis of ADHD and participants' characteristics (Table 4) identified several risk factors associated with the occurrence of ADHD. Male participants had significantly lower odds of ADHD compared with female participants (odds ratio (OR): 0.43; 95%CI: 0.21–0.89;  $p=0.023$ ). Students born at full term had significantly lower odds of ADHD compared with those born preterm (OR: 0.331; 95%CI: 0.138–0.794;  $p=0.013$ ). Students residing with colleagues were 3.3 times more likely to experience ADHD compared with those living with parents (OR: 3.355; 95%CI: 1.67–6.72;  $p=0.001$ ). Maternal smoking was also significantly associated with higher odds of ADHD, with students whose mothers smoked found to be 2.3 times more likely to have ADHD compared with those whose mothers did not smoke (OR: 2.35; 95%CI: 1.949–5.86;  $p=0.05$ ). Other variables, including mode of delivery, problems during pregnancy, smoking status, regular exercise, and maternal employment, did not demonstrate significant associations with ADHD risk.

Table 4. Factors associated with the experience of ADHD among the studied participants: logistic regression analysis

Variable	Odds ratio (OR)	95% confidence interval (CI)	p-value <sup>a</sup>
Sex			
Male	0.439	0.216–0.891	0.023*
Female (reference)			
Smoking status			
Yes	1.606	0.772–3.341	0.205
No (reference)			
Regular exercise			
Yes	1.444	0.782–2.664	0.240

Variable	Odds ratio (OR)	95% confidence interval (CI)	p-value <sup>a</sup>
No (reference)			
Mother's employment			
Yes	1.157	0.651–2.056	0.619
No (reference)			
Mother's smoking status			
Yes	2.359	1.949–5.862	0.050*
No (reference)			
Problem during pregnancy			
Yes	2.032	0.751–5.501	0.163
No (reference)			
Mode of delivery			
Vaginal	1.929	0.691–5.453	0.265
Cesarean	2.666	0.809–8.781	0.107
Unknown (reference)			
Birth status			
Full-term	0.331	0.138–0.794	0.019*
Pre-term (reference)			
Living arrangement			
Alone	1.536	0.740–3.188	0.249
With other students	3.355	1.674–6.723	0.001*
With parents (reference)			

<sup>a</sup>Analyzed using multivariate logistic regression

\*Statistically significant at  $p < 0.05$

## Discussion

Building upon existing literature addressing the underdiagnosis of ADHD in the region, this study assessed the prevalence and associated factors of ADHD among medical and health science university students in Ras Al Khaimah, United Arab Emirates. A relatively high rate of probable ADHD was identified within this population. Initial screening indicated that approximately 29% of participants reported six or more symptoms suggestive of ADHD. Subsequent psychiatric evaluation confirmed a prevalence of 13.6%. These findings were consistent with previous reports emphasizing ADHD as a significant and frequently underrecognized condition in the region [27,28]. The study identified several factors associated with ADHD, including female sex, smoking (personal and maternal), lack of exercise, maternal employment, pregnancy complications, cesarean delivery, preterm birth, and living with peers. Logistic regression found female sex, preterm birth, living with colleagues, and maternal smoking as significant risk factors. These findings highlight the multifactorial nature of ADHD and the influence of both individual and environmental factors.

A previous study documented a sex difference in ADHD prevalence, with males diagnosed approximately two to three times more frequently than females [29]. This higher diagnostic rate among males has often been attributed to the externalizing nature of symptoms, such as hyperactivity and impulsivity, which tend to be more disruptive and thus more readily identified in educational and clinical settings [30]. In contrast, females more commonly present with internalizing symptoms, including inattention and cognitive difficulties, which frequently result in underdiagnosis or delayed recognition until adulthood [31,32].

Interestingly, the study found a significantly higher percentage of females showing ADHD symptoms, particularly inattention, difficulty concentrating, and memory challenges, as measured by the ADHD self-report scale. This finding aligns with research suggesting that ADHD in females is often characterized by inattentive symptoms, which may be overlooked or misdiagnosed as anxiety or depression [33]. In contrast, males in the study displayed more hyperactivity-related symptoms, such as impulsivity and restlessness, consistent with traditional sex-based symptom patterns reported in the literature [30]. These findings highlight the need for sex-sensitive diagnostic criteria and treatment approaches to ensure accurate identification and appropriate support for females with ADHD [33].

The association between smoking and ADHD is complex, involving neurobiological, genetic, and behavioral factors [34]. Nicotine alters dopamine and norepinephrine levels in the prefrontal cortex, which are often dysregulated in individuals with ADHD [35], potentially leading to smoking as a form of self-medication to enhance focus and reduce impulsivity [36]. However, prolonged nicotine exposure, particularly during adolescence, may exacerbate



neurodevelopmental challenges and impair executive functioning [34]. Genetic factors, including variations in dopamine receptor and transporter genes, contribute to a shared predisposition for ADHD and smoking behaviors [34]. Prenatal exposure to nicotine through maternal smoking has also been linked to an increased risk of ADHD in offspring [37,38]. Behavioral traits of ADHD, such as impulsivity and risk-taking, further elevate the likelihood of early smoking initiation, with comorbid conditions like anxiety and depression encouraging smoking as a coping mechanism [39,40].

The academic demands of university life, along with social pressures, pose significant challenges for students with ADHD [13,22]. Difficulties in academic performance, social interactions, and time management can increase the risk of developing anxiety and depression [14,22]. This study found a significant association between smoking and ADHD symptoms, aligning with existing research that indicates individuals with ADHD are more likely to smoke [34,39,40]. Additionally, the findings revealed a statistical association between maternal smoking during pregnancy and the development of ADHD in children, highlighting the need for targeted public health interventions to reduce smoking during pregnancy. Despite these risks, individuals with ADHD face substantial difficulties in quitting smoking, due to increased withdrawal symptoms and the limited efficacy of conventional cessation treatments [39]. These challenges emphasize the need for tailored interventions that integrate pharmacological and behavioral strategies.

This study identified a statistically significant association between ADHD symptoms and exercise habits, suggesting that physical activity may contribute to symptom management [41]. Existing research indicates that exercise alleviates common ADHD symptoms, including restlessness, inattention, impulsivity, and hyperactivity, by stimulating the production of neurotransmitters such as dopamine and norepinephrine, which are frequently deficient in individuals with ADHD [35]. Long-term participation in structured exercise programs has been associated with improvements in attention span and behavioral regulation, positioning exercise as a promising adjunctive intervention for ADHD [42,43]. However, maintaining consistent exercise routines may present challenges for individuals with ADHD due to executive function deficits, such as difficulties in planning, organizing, and task completion [44].

Regarding maternal employment, while employment itself is not considered a direct cause of ADHD, associated factors such as prenatal stress and reduced parental engagement during critical developmental periods may increase the risk of ADHD [45-47]. A prospective cohort study demonstrated that children born to mothers experiencing significant stress or psychosocial adversity during pregnancy had a higher probability of receiving an ADHD diagnosis, emphasizing the impact of prenatal stress on neurodevelopment [45,46]. Furthermore, maternal employment may limit opportunities for direct parental interaction, particularly if childcare environments do not adequately address early behavioral needs, which may contribute to the manifestation of ADHD symptoms [47]. Mitigating these risks through supportive workplace policies and early childhood interventions is essential to promote maternal and child well-being.

Although the exact causes of ADHD remain under investigation, increasing evidence highlights the influence of prenatal and perinatal factors. A previous study identified maternal diabetes during pregnancy as an important factor affecting fetal brain development through mechanisms involving hyperglycemia and inflammation [48]. Maternal stress during pregnancy has also been associated with an elevated risk of ADHD, potentially mediated by the DRD4 7/7 genotype, a variant previously associated with impulsivity and ADHD [49]. Consistent with these findings, the present study supports an association between prenatal factors, including maternal diabetes and stress, and the risk of ADHD.

Additionally, this study identified a significant association between cesarean section delivery and the risk of ADHD. Infants born via cesarean section experience a more rapid delivery transition from intrauterine to extrauterine life, which may disrupt neurohumoral adaptations that are typically facilitated by the stress of vaginal delivery [50]. Disruption of these physiological processes has been hypothesized to alter the maturation of the central nervous system, potentially predisposing children to behavioral impairments. Retrospective cohort analyses have consistently demonstrated that children delivered by cesarean section have an increased probability of being diagnosed with ADHD compared to those born vaginally [51,52]. Furthermore, these children

often present with lower performance IQ scores, suggesting that cesarean delivery may adversely affect both behavioral regulation and cognitive function [51,52]. These findings emphasize the importance of considering mode of delivery as a potential modifiable factor when evaluating early neurodevelopmental risks.

Consistent with the present study's findings, previous research has demonstrated that preterm birth significantly increases the risk of developing ADHD-like symptoms, particularly impairments in attention and inhibitory control [53]. Preterm birth disrupts brain development during critical periods, often resulting in incomplete maturation of key neural structures such as the prefrontal cortex, which regulates attention, impulse control, and executive functioning [53]. Furthermore, complications commonly associated with preterm birth, including perinatal inflammation, hypoxia, and nutrient deficiencies, can further impair neural development [54]. These biological vulnerabilities, compounded by environmental stressors encountered during neonatal intensive care, are believed to contribute to the heightened prevalence of ADHD among preterm children.

Living arrangements also appear to influence the risk and manifestation of ADHD symptoms. Research indicates that residing with other students is associated with an increased risk of ADHD compared to living with parents or alone. This may be attributed to the highly stimulating and unstructured environment typical of student housing, which can exacerbate symptoms such as distractibility, impulsivity, and difficulties in maintaining focus [55]. In contrast, living with parents often provides greater structure, routine, and supervision, elements that are essential for effective ADHD management. The findings highlight the importance of a stable and structured living environment in mitigating ADHD symptom severity, particularly during the transitional period of university life.

Although ADHD is recognized to negatively affect academic outcomes through impairments in attention, focus [56], and executive functions [57], the association is complex and moderated by several factors. These factors include the severity of ADHD symptoms, access to academic support services, and the use of effective treatment interventions such as behavioral therapy, which may enable students with well-managed ADHD to achieve academic performance comparable to those without ADHD [58]. Moreover, the effect of ADHD on academic achievement can be influenced by environmental support, the development of self-regulation skills, and the utilization of adaptive coping mechanisms. Students who cultivate effective coping strategies and receive appropriate support, including tutoring and academic accommodations, are more likely to achieve academic success and maintain comparable GPAs [59]. In the current study, no significant association was identified between ADHD and academic performance, as assessed by GPAs.

The present study findings have important implications for both research and clinical practice. From a research perspective, the results highlight the necessity for further investigation into regional ADHD prevalence, with particular attention to associated risk factors and potential comorbidities, such as anxiety and depression, thereby contributing to the expanding body of literature addressing underdiagnosis within this population. Clinically, the findings emphasize the urgent need for enhanced screening and early identification of ADHD in university settings. The development and implementation of tailored support services are essential, including academic coaching to improve study skills, time management, and organization; accessible counseling services utilizing evidence-based therapies, such as cognitive behavioral therapy, to address emotional dysregulation and co-occurring mental health conditions; provision of appropriate academic accommodations; facilitation of peer support groups; and educational initiatives for faculty aimed at fostering a better understanding of ADHD and promoting the effective application of accommodations. Considering the unique challenges associated with the transition to university life, particularly within demanding medical and health sciences programs, these interventions are vital for supporting academic achievement and overall well-being among students with ADHD.

Several limitations should be acknowledged when interpreting the study findings. First, the use of convenience sampling from a single institution may limit external validity, thereby restricting the generalizability of the results to other academic settings. Second, the statistical significance tests reported in this manuscript are intended for illustrative purposes only, given

the non-randomized nature of the sample. Third, reliance on self-administered questionnaires, while practical and less time-consuming, occasionally resulted in incomplete data, which impacted the overall response rate. Future research should incorporate participants from multiple institutions representing diverse demographic, geographic, and socio-economic backgrounds to enhance external validity and generalizability. This broader approach would allow for a more comprehensive understanding of ADHD prevalence and associated factors across varied educational environments and cultural contexts. Furthermore, longitudinal studies that follow students over time would provide valuable insights into the progression of ADHD symptoms and their effects on academic, social, and psychological outcomes. Such studies could also clarify how environmental and lifestyle factors interact with ADHD symptoms throughout the academic trajectory. Future investigations are also encouraged to assess the effectiveness of tailored interventions, including academic coaching, structured living environments, and mental health support services, in reducing ADHD symptom burden and improving academic performance and overall quality of life among university students.

## Conclusion

This study highlights a significant prevalence of ADHD among university students in the United Arab Emirates, with key risk factors including maternal smoking during pregnancy, shared living arrangements, and male sex. These findings emphasize the need for targeted interventions to support students with ADHD, particularly in the university setting, where academic and social pressures may exacerbate symptoms. Early screening, tailored support services, and increased awareness among university staff can help mitigate the challenges faced by students with ADHD, promoting their academic success and overall well-being. Further research is essential to explore the underlying mechanisms of ADHD in this population and to evaluate the effectiveness of interventions designed to support students throughout their academic journey.

## Ethics approval

The protocol of this study was reviewed and approved by the Ethics Committee of the Faculty of Medicine, Ras Al Khaimah Medical and Health Science University, Ras Al Khaimah, United Arab Emirates.

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## Competing interests

All the authors declare that there are no conflicts of interest.

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## Underlying data

Derived data supporting the findings of this study are available from the corresponding author on request.

## Declaration of artificial intelligence use

This study used artificial intelligence (AI) tool and methodology, in which AI-based language model, ChatGPT, was employed in the language refinement (improving grammar, sentence structure, and readability of the manuscript). We confirm that all AI-assisted processes were critically reviewed by the authors to ensure the integrity and reliability of the results. The final decisions and interpretations presented in this article were solely made by the authors.

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