

Meta-Analysis

Prevalence of attention deficit hyperactivity disorder in the Arab Gulf countries: systematic review and meta-analysis

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ABSTRACT

Attention deficit hyperactivity disorder (ADHD) is an important growing psychiatric health problem of children and adolescents all over the world. This review aimed to investigate the prevalence of ADHD in the Arab Gulf countries. A literature search was conducted on 14 January 2022. Any paper reporting the prevalence of ADHD in Arab Gulf countries was included. R software was used for the meta-analysis. We included 14 papers. The prevalence of ADHD was 5.90% (95% confidence interval (CI)=1.73-20.14). We found no significant difference in the prevalence of ADHD between males and females (odds ratio (OR)=1.48; 95% CI=0.53-4.14; p value=0.456). The leave-one-out sensitivity analysis did not change the statistical significance proving that a single study did not drive the pooled effect size. Regarding parents' educational level, the prevalence was the highest among children born to fathers with at least a secondary education 51% (95% CI= 22.97-100.00), while the prevalence rate was comparable among those with primary school education 16.6% (95% CI=1.28-100.00) and illiterate fathers 17% (95% CI=12.84-22.59). The difference between different education subgroups was statistically significant (p=0.040). There were no statistically significant differences in ADHD prevalence when comparing different mothers' educational levels (p=0.260). The estimated cumulative evidence is high but comparable with the reported worldwide rates. Unlike these studies, the prevalence of ADHD was not associated with gender or maternal education. On the other hand, the highest prevalence of ADHD was found among children of fathers with at least a secondary education.

Keywords: ADHD, Arab Gulf, Prevalence, Systematic review, Meta-analysis

INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder defined as having two different behavioral dimensions, including hyperactive-impulsive and inattentive, according to the International classification of diseases and the diagnostic and statistical manual of mental disorders (DSM).^{1,2} Affected patients usually have characteristic symptoms, including impulsivity, hyperactivity, and inattention.³ However, the diagnosis of ADHD is not established unless it causes significant functional impairment and distress, and the symptoms are reported in two different settings.⁴ Evidence shows that ADHD is primarily diagnosed in childhood and

adolescence.⁵ However, some studies reported that the disease could manifest during adulthood.³

Epidemiological studies also indicate that ADHD is a significant health issue that significantly burdens the affected patients and their families. In this context, it has been shown that in adolescents aged 10-19 years, ADHD and conduct disorder are the 3rd commonest psychiatry-related causes of disability-adjusted life years after depressive and anxiety disorders.⁵ ADHD also imposes an economic burden. For instance, a previous report estimated that the direct medical costs for children with ADHD were 4306\$ per nine years compared to 1944\$ for normal children.⁶ Various investigations in the literature have

provided ample evidence regarding ADHD in many worldwide countries, including Canada, Eastern Asia, the United States, and Europe.^{7,8} Accordingly, based on evidence from these studies, more and more studies and reviews were published to provide better insight into the etiology, impact on education, educational interventions, assessment of the condition, medical treatment, etiology, epidemiology, psychosocial interventions, and applying early interventions based on the significant risk factors.⁸⁻¹⁶

The estimated worldwide prevalence of ADHD is hugely variable and inconsistent among studies from different communities.^{8,9} Many studies were conducted in the Arab Gulf region and reported inconsistent rates regarding the prevalence of the condition.^{17,18} Moreover, we did not find relevant investigations that provided cumulative evidence over the prevalence of ADHD in the Arab Gulf. Accordingly, the current meta-analysis aims to analyze data from relevant studies that included populations from the Arab Gulf to estimate the total prevalence of ADHD and the effect of gender and level of parenteral education on the prevalence and development of the condition.

METHODS

Search strategy and study collection

We followed the well-performed guideline of the preferred reporting items for systematic review and meta-analyses statement (PRISMA) for conducting systematic reviews.¹⁹ In which, the first step was building search term for collecting relevant papers. Though, in 14 January 2022 a computerized search was conducted. Key words were collected and a search term “(attention deficit hyperactivity disorder or ADHD) and (“Saudi Arabia” or Bahrain or Kuwait or Oman or Qatar or “the United Arab Emirates” or Gulf or “Gulf countries”)), was used in seven databases described in Figure 1. Then manual search was conducted through searching in Google Scholar database by the terms: ADHD and “Saudi Arabia”, ADHD and Bahrain, ADHD and Kuwait, ADHD and Oman, ADHD and Qatar, and ADHD and “the United Arab Emirates”. The aim of manual search is to collect any missed paper that was not imported through the search term in all the seven databases.

Inclusion criteria

Any paper discussing the prevalence of ADHD in Arab Gulf countries was included without limitations to sample size, age of participants, occupation or population.

Exclusion criteria

We excluded review studies, conference papers, preprints and non-available full texts.

After settling the inclusion and exclusion criteria, two members started to screen the results of the imported records into an excel sheet. The screening process was

done into two major parts, title and abstract screening then full text screening. In each step, another author reviewed the decision of both authors who performed the screening for solving the conflicts raised between them.

Data extraction and quality assessment

A well performed extraction sheet was done by one member for retrieving the necessary data from each paper. The sheet included several metrics: study characteristics (study ID, sample size, country of participants, population and the method of ADHD diagnosis) and outcomes (the prevalence of ADHD (total, in males only and in females only) and the total prevalence of ADHD according to the father or the mother education. Two members extracted the data and a third author reviewed their results. Two authors rated the quality of evidence using the National Institute of Health quality assessment tool.²⁰

Statistical analysis

One author analyzed the data using R software version 4.1.2. The effect size used was the event rate (95% confidence interval (CI) when pooling the data of one group and the odds ratio (OR) (95% CI) when comparing the outcomes in two or more groups.^{21,22} We used the Q statistics and the I^2 test for detection of the heterogeneity which was observed significantly when $I^2 > 50\%$ or p value < 0.05 .²³ We chose random effect model if we found significant heterogeneity among the pooled studies. Publication bias was performed using the Egger's regression test.²⁴ If we found significant publication bias, Baujat plot was used to assess the source of heterogeneity between studies.²¹

RESULTS

Search results and characteristics of the included studies

After removing the duplicated records, 427 records were eligible for title and abstract screening. Of those, only 43 papers were screened for their relevance to be included in our meta-analysis. Finally, we included 14 papers including 5 papers from manual search trials (Figure 1).²⁵⁻³⁸ Nine studies were conducted in Saudi Arabia, two in The United Arab Emirates, two in Oman and one in Qatar. The total sample size was 459233. Twelve studies recruited school children participants while one study recruited medical students and the last study recruited adults.

Prevalence of ADHD

Fourteen studies reported the prevalence of ADHD among the Arab Gulf population. Out of 459,233 studies individuals, 2,472 were diagnosed with ADHD with a pooled prevalence of 5.90% (95% CI=1.73-20.14). There was no significant risk of bias as seen by Egger's regression test (p value=0.121); however, there was a significant heterogeneity ($I^2=100\%$; p value < 0.001) (Figure 2a).

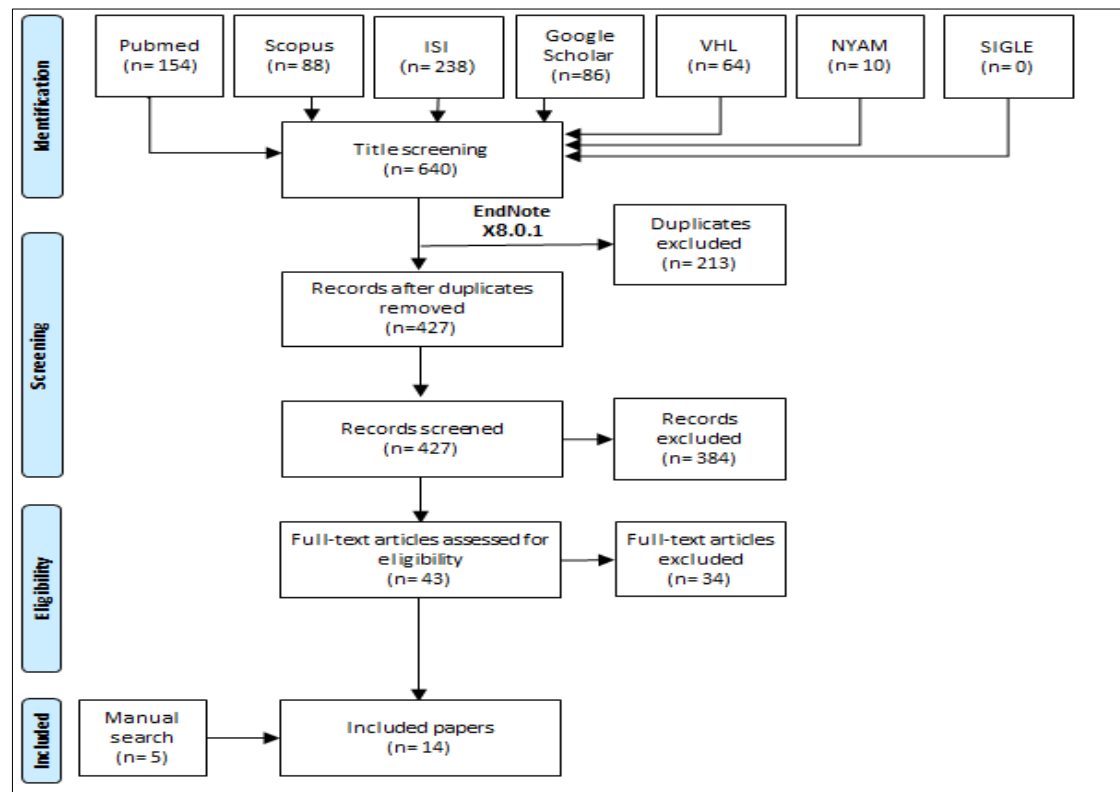


Figure 1: Data bases used for tracking ADHD cases in Gulf countries.

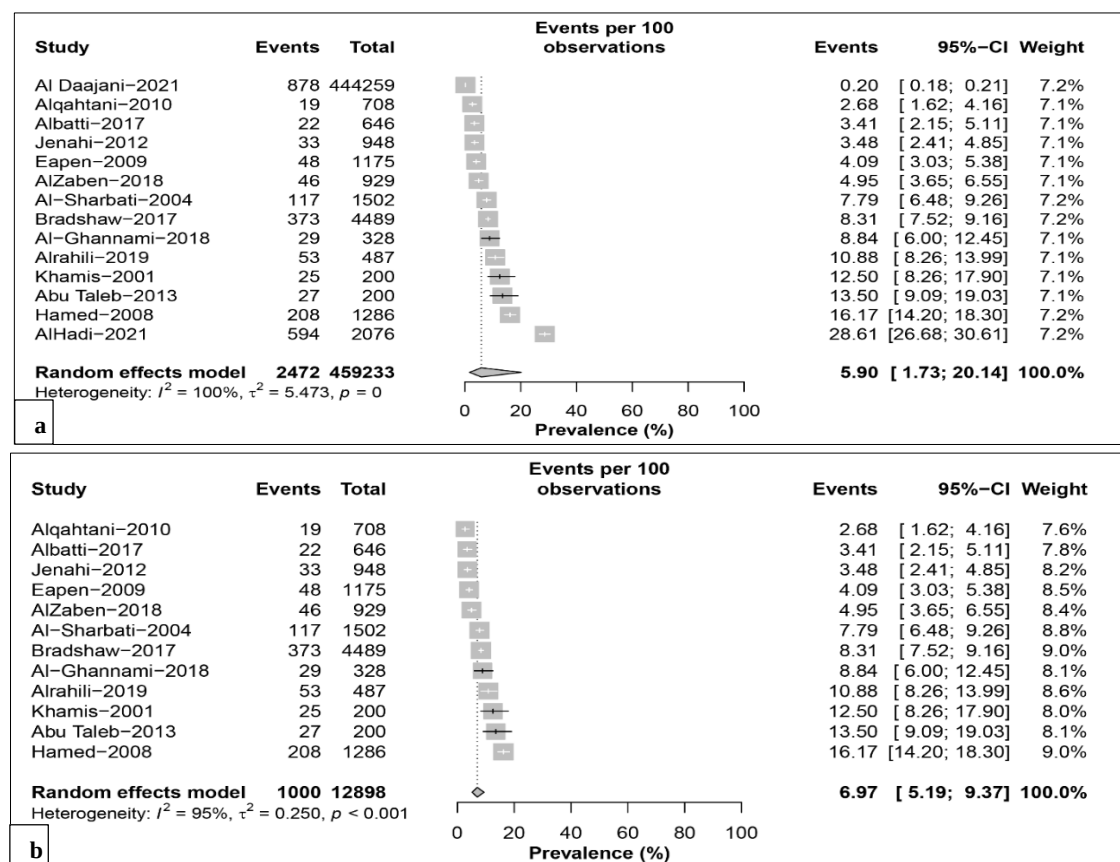


Figure 2: Results for the studies reported the prevalence of ADHD among the Arab Gulf population (a) Egger's regression test, and (b) Baujat plot.

Using the Baujat plot, we identified Alhadi et al and Al Daajani et al as the most significant contribution to heterogeneity.^{39,40} For that, we performed a sensitivity analysis by removing these studies, which minimally reduced heterogeneity but had a noticeable effect on the pooled prevalence rate to be 6.97% (95% CI=5.19-9.37) (Figure 2b).

Gender differences

On further exploration of prevalence disparities, we compared the prevalence of ADHD in males to that in females. Nine studies of 2,070 individuals stratified the prevalence by gender, with no statistically significant difference among both sexes (OR=1.48; 95% CI=0.53-4.14; p value=0.456). The leave-one-out sensitivity analysis did not change the statistical significance proving that the pooled effect size was not driven by a single study (Figure 3a and b).

Effect of parents' educational level

As another trial to explore sources of heterogeneity, we tested the effect of parents' educational level on the detected ADHD prevalence. On one hand, the prevalence was the highest among children born to fathers with at least a secondary education (prevalence= 51.49; 95% CI=22.97-100.00), while the prevalence rate was comparable among those with primary school education (prevalence=16.63; 95% CI=1.28-100.00) and illiterate fathers (prevalence=17.03; 95% CI=12.84-22.59). The difference between different education subgroups was statistically significant (p value=0.040); however, there was a significant heterogeneity on various levels (Figure 4).

On the other hand, there were no statistically significant differences in ADHD prevalence when comparing different mothers' educational levels (p value=0.260). Again, heterogeneity among the included studies was observed on multiple levels (Figure 5).

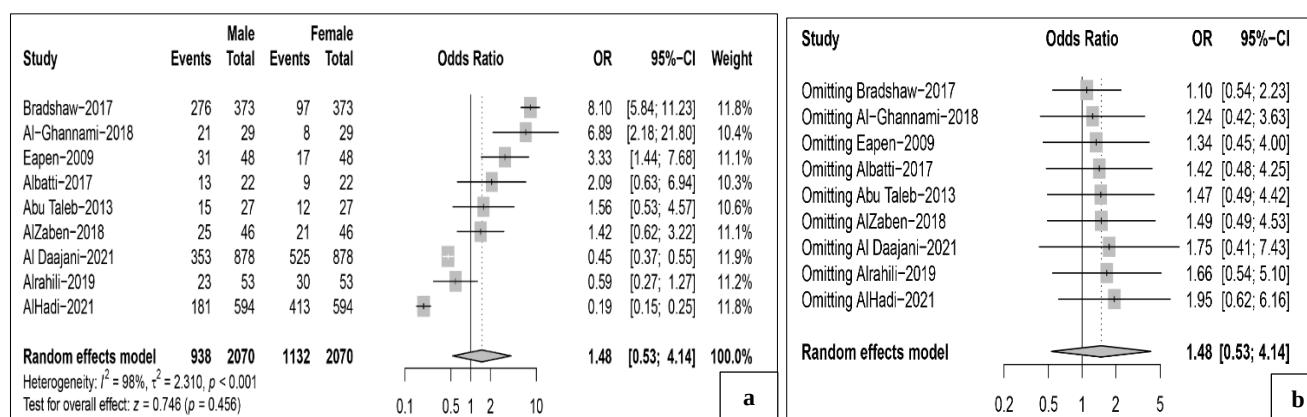


Figure 3: (a) Main analysis for gender differences in the prevalence of ADHD, and (b) leave-one-out sensitivity analysis for gender differences in the prevalence of ADHD by excluding one study at each analysis.

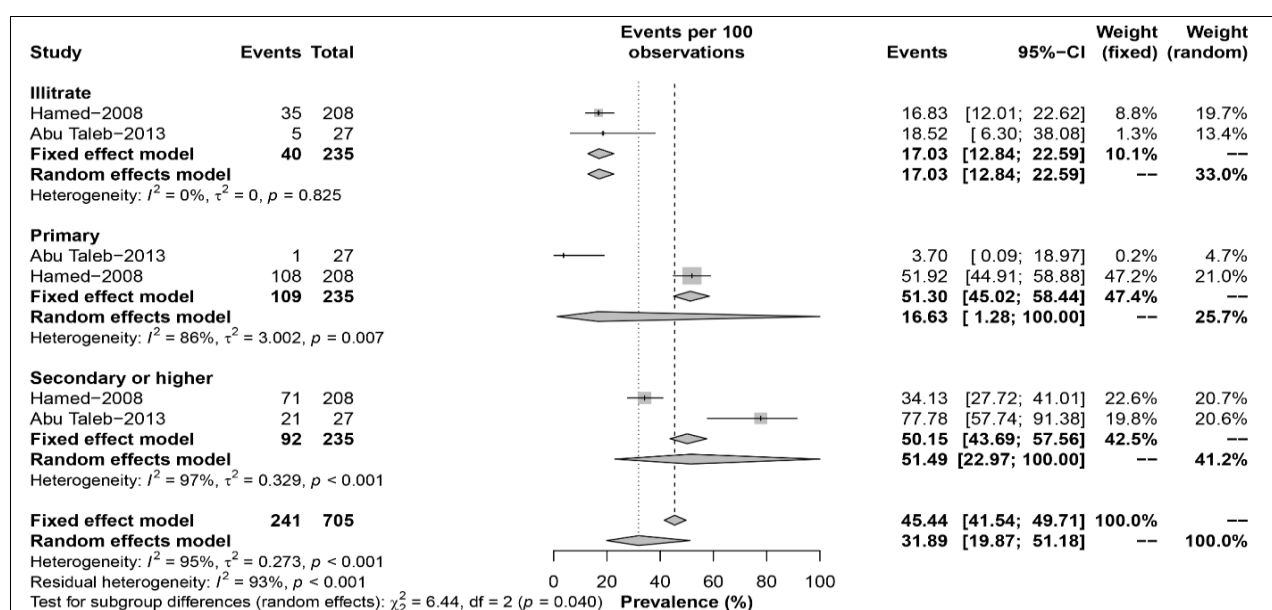


Figure 4: Fathers' education level and the prevalence of ADHD.

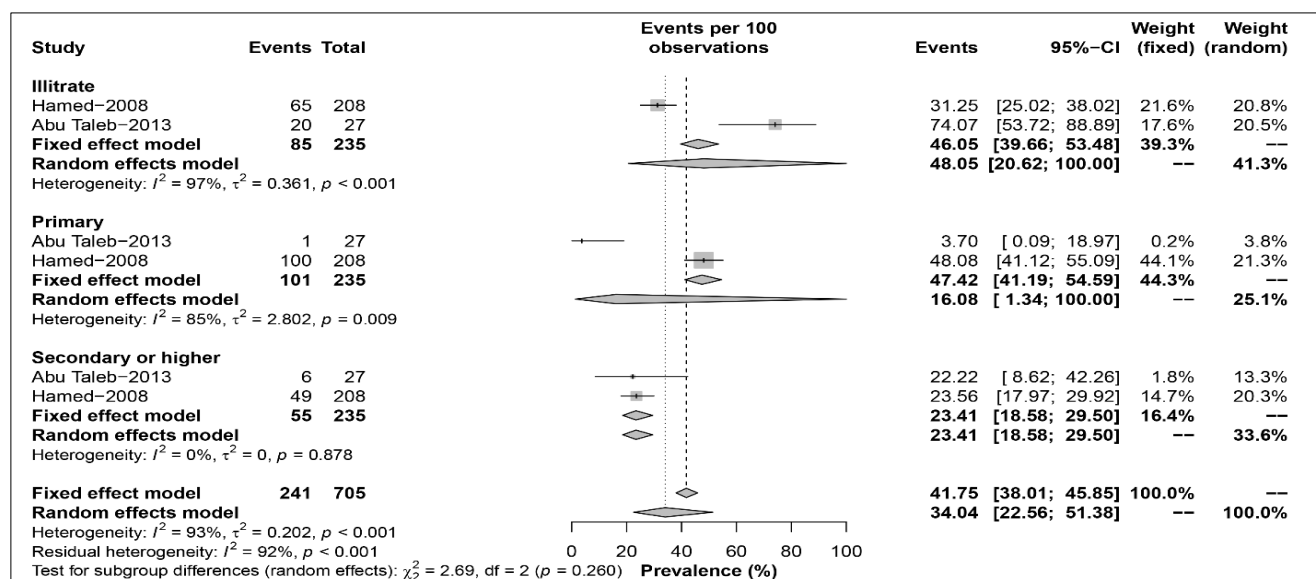


Figure 5: Mothers' education level and the prevalence of ADHD.

DISCUSSION

In the present systematic review and meta-analysis, we aimed to formulate evidence regarding the cumulative prevalence of ADHD in the Arab Gulf population based on evidence from the relevant studies in the literature. In addition, we aimed to identify whether gender or parenteral educational levels impacted the prevalence of ADHD in this population or not. Our findings indicate that the overall prevalence of ADHD in the Arab Gulf is 5.9%. However, it should be noted that significant heterogeneity was found among the results of the analyzed studies. When adjusting the analysis to minimize heterogeneity among studies, the estimated prevalence rate was even higher, being 6.97%.

Previous systematic reviews in Arab countries and international studies reported variable rates for the prevalence of ADHD in their populations. For instance, a previous systematic review by Alhraiwil et al reported that the prevalence of ADHD among 22 included studies ranged between 1.3-16% among Arabic populations.¹⁷ The authors also concluded that the prevalence of ADHD was related to the age of included participants in their studies, showing that the prevalence decreases with older ages. Another Arab-based systematic review also concluded that the prevalence of ADHD in their population is hugely variable, ranging between 1.3% and 34.5%.¹⁸ Although these rates are remarkably inconsistent, which might be attributed to the different methodological assessments of different studies, it should be noted that these rates are comparable with the reported rates within similar international investigations.^{8,41} For instance, a previous large-scale systematic review that analyzed data from 71 studies concluded that the prevalence of ADHD ranged between 0.2% and 26.8%.⁴² A previous worldwide meta-analysis by Polanczyk et al reported that the prevalence of ADHD among 171,756 participants from 102 studies was 5.29%.⁴³ Another meta-analysis by Thomas et al analyzed

the results of 175 relevant studies, and reported that the cumulative prevalence of ADHD is 7.2%.⁸ When interpreting and comparing the finding of this study with other worldwide investigations, one should consider the epidemiology of ADHD is different between developing (like Arab) and developed communities because of the different diagnostic criteria in these studies and epidemiology of ADHD is significantly associated with familial, cultural, and biological factors.⁴⁴⁻⁴⁶

It should be noted that assessing the epidemiology and prevalence of ADHD in the Arab Gulf region is mostly conducted in schools. Although this facilitates access to these populations, it primarily does not provide a precise estimate of the true prevalence of ADHD on populational and regional levels. This is because many children with ADHD that might have the symptoms are not usually enrolled in a school or participate in schools designated for children with special needs. Accordingly, the actual prevalence rate of ADHD is most likely underestimated secondary to the data collection method of different studies in the literature. It should also be noted that most of the included studies are cross-sectional. Although these studies provide the best evidence regarding the prevalence of the condition, they do not adequately study the associated risk factors of the condition, necessary to identify the epidemiology and plan the best management and interventional approaches.

Furthermore, it is worth mentioning that the genetic predisposition of ADHD and its impact on the epidemiology of the condition were not investigated in these studies. In addition, minimal studies assessed the social and psychoeducational concerns of ADHD. Besides, most of the current studies were conducted by medical researchers, and we did not find relevant experimental investigations and randomized controlled trials, indicating the severe lack of interventional approaches aiming at

improving the quality of life and care for adolescents and children with ADHD and enhancing awareness levels of the importance of parenteral roles in dealing with their affected children. Finally, most studies included adolescents and children only, while the epidemiology of ADHD was not adequately investigated in adults.

The current study results also indicate no significant differences between the two genders regarding the prevalence of ADHD. This is not consistent with the previous systematic reviews that assessed the epidemiology of ADHD in Arab countries. These reviews reported that the prevalence is higher among males than females.^{17,18} Moreover, worldwide investigations also indicated that the prevalence of ADHD is higher among males.^{43,47,48} We also found that the highest prevalence of ADHD was found among children to fathers with at least a secondary education, indicating the significant impact of the father's education on the prevalence and development of ADHD. On the other hand, maternal education did not significantly impact the prevalence of ADHD. Parenteral perception and reporting of ADHD and seeking treatment of their children is a significant factor that might impact the prevalence of ADHD, which might be the reason for the inconsistency of reported prevalence rates of the condition.^{49,50} St Sauver et al reported that the prevalence and development of ADHD are significantly associated with maternal education while parenteral education is not.⁵¹ This has been attributed to the fact that mothers are usually more involved in educating their children and have more impact on their psychosocial patterns and behaviors.⁵²⁻⁵⁴

Different risk factors were also reported in the literature for ADHD among Arab and non-Arab studies. These include obesity, history of acquired brain injury, vitamin D deficiency, monoamine oxidase A genotypes, and having abnormal serum levels of main elements like phosphorus, potassium, magnesium, and iron.^{18,55-57} It should also be noted that several studies also indicated the significant association between ADHD and other comorbid disorders, including autistic spectrum disorder and posttraumatic stress disorder, intellectual disability, epilepsy, delayed language development, mood disorders, oppositional defiant disorder, anxiety disorder, learning disabilities, sleep problems, and central auditory processing disorder. These comorbidities were similar among studies conducted in Arab and non-Arab regions.^{18,58}

However, it should be noted that studies investigating these factors in Arab countries are scarce. Therefore, further investigations are still needed to provide additional evidence regarding the psychosocial and biological risk factors of ADHD in these countries and provide better insight into the impact of different comorbid conditions, socioeconomic status, familial factors, parenteral mental health, alcohol and smoking use during pregnancy, and prematurity over the epidemiology of ADHD in these countries.^{55-57,59,60}

Some limitations should be considered in this systematic review. These include the different diagnostic criteria and assessment tools used by each investigation, which might have contributed to the different prevalence rates in this study. Moreover, some studies included their populations from limited regions within their countries, which might jeopardize the results for selection bias. Moreover, the cross-sectional design of many of the included studies limited our ability to adequately decide the relevant risk factors associated with ADHD in Arab Gulf countries. Therefore, further future studies are needed with better sampling and enhanced methodology.

CONCLUSION

The present meta-analysis provides evidence regarding the prevalence of ADHD in Arab Gulf countries. The estimated cumulative evidence is high but comparable with the previously reported worldwide rates of different communities. Unlike these studies, the prevalence of ADHD was not associated with gender or maternal education. On the other hand, the highest prevalence of ADHD was found among children to fathers with at least a secondary education. Therefore, healthcare authorities should adopt interventional campaigns based on the relevant risk factors and enhance the management outcomes.

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Ethical approval: Not required

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