

## Systematic review of the epidemiology of attention deficit hyperactivity disorder in Arab countries

Najla J. Alhraiwil, Anna Ali, Mowafa S. Househ, Ali M. Al-Shehri, Ashraf A. El-Metwally

### ABSTRACT

**Objectives:** To assess the epidemiology of attention deficit hyperactivity disorder (ADHD) in Arab countries, and identify gaps for future research.

**Methods:** We searched PubMed from July 1978 to July 2014 and reviewed local journals with cross-referencing. The keywords we used were ADHD, diagnosis, prevalence, incidence, factor, diagnosis, rate, risk, and each of the names of the 22 Arab countries (Jordan, Egypt, Lebanon, Saudi Arabia, and so on). Studies were eligible for inclusion if they investigated the epidemiology of ADHD in any Arab country, and were published in English. The search was conducted from 2nd to 5th August 2014 in King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia.

**Results:** A total of 22 articles were included in the review. Twenty studies were cross-sectional and found the prevalence of ADHD ranged between 1.3-16%, prevalence of hyperactive type ADHD between 1.4-7.8%, and the prevalence of inattention type between 2.1-2.7%. Only 2 case-control studies investigated potential risk factors. Evidence extracted from these studies shows a significant association between ADHD and male gender, previous psychiatric illness in the family, vitamin D deficiency, poor school performance, sleep problems, and nocturnal enuresis.

**Conclusions:** The prevalence of ADHD in Arab countries is comparable to reports in North America, Africa, and other countries of the Middle East. Longitudinal studies are needed to investigate the prognosis and determinants of this condition in the Arab world.

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According to the Diagnostic and Manual of Mental Disorder (DSM-IV), attention deficit hyperactivity disorder (ADHD) is a neurobehavioral disorder characterized by pervasive and impairing symptoms of inattention, hyperactivity, and impulsivity.<sup>1</sup> It is a condition that occurs primarily in childhood, and presents profound impairments impacting every aspect of life.<sup>2</sup> The ADHD symptoms are caused by a neurological dysfunction within the brain. The physiological mechanism of ADHD is still under study.<sup>1,2</sup> This disorder has been associated with a broad range of negative outcomes for affected subjects,<sup>3</sup> and with a significant financial burden.<sup>4</sup> The prevalence of ADHD varies from 0.2-28%.<sup>5</sup> Reported differences in prevalence across countries might be related to differences in diagnostic criteria used, but also might be related to biological, cultural, and family factors.<sup>6</sup> A comprehensive systemic review conducted in 2007 documented the worldwide-pooled prevalence at 5.3% (95% confidence interval [CI]=5.01-5.56).<sup>6</sup> The National Survey of Children's Health in 2011 reported 11% prevalence of ADHD in children aged between 4 and 17 years of age.<sup>7</sup> Attention deficit hyperactivity disorder is more common in boys than girls (ratio 4:1 for the predominantly hyperactive type, and 2:1 for the predominantly inattentive type).<sup>8</sup> Accordingly, the DSM-IV proposed 3 subtypes of ADHD that are the inattentive type, hyperactive/impulsive type, and combined type.<sup>9</sup>

During the past decade, evidence has accumulated indicating that symptoms of ADHD persist into adulthood for 30-70% of children diagnosed with the disorder.<sup>10</sup> Many studies have demonstrated conclusively that genetic and environmental influences play a role in the etiology of ADHD, as is true for virtually all psychological traits and disorders.<sup>11</sup> Attention deficit hyperactivity disorder is 6-8 times higher among first-degree relatives with ADHD, where 30-35% of full siblings meet the ADHD criteria.<sup>12</sup> Prenatal or perinatal complications significantly predicted the later development of ADHD.<sup>13</sup> Virus infections, meningitis, encephalitis, head injury, epilepsy, toxins, and drugs, were among the childhood illnesses associated with ADHD. Furthermore, diet-related sensitivities and mineral deficiencies have always been controversial factors.<sup>14</sup> Worldwide, several systematic reviews have been conducted to summarize the epidemiological evidence with respect to the occurrence and determinants of ADHD. In the Arab region only one systematic review was completed in 2009.<sup>15</sup> However, with increased interest in research on ADHD, several new studies have been conducted in the Arab world. This systematic review provides an update on the current state of knowledge with respect to ADHD literature in the Arab world.

## Methods

An electronic search was conducted to identify articles in PubMed that met our inclusion criteria. The following keywords were searched ADHD, diagnosis, prevalence, incidence, factor, diagnosis, rate, risk, and each of the names of the 22 Arab countries (Jordan, Egypt, Lebanon, Saudi Arabia, and so on). The study was conducted from 2nd to 5th August 2014 in King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia.

Inclusion criteria were publications in the English language, publication in a peer-reviewed journal, and a study focusing on the epidemiological impacts of ADHD in the Arab world. Case reports/series, randomized clinical trials regarding treatment comparison and studies on the impact of ADHD on different aspects of life were excluded. This search was supplemented with searching local peer-reviewed journals (not indexed in PubMed) in Arab countries and cross-referencing. The search generated a total 43 articles. One case report, one review article, and 2 treatment-based articles were excluded. Out of 43 articles, we found 14 articles that were not relevant to the epidemiology of ADHD, and thus we further excluded 14 articles. The full text of 20 articles was retrieved and out of these, we further excluded 5 articles that did not meet the inclusion criteria. Searches in local peer-reviewed medical and health-related journals in Arab countries identified an additional 7 articles. The full texts of the 22 articles were retrieved and reviewed. A flow chart for the research strategy is shown in [Figure 1](#).

**Figure 1-** A flow chart for the 22 articles retrieved and reviewed for this research strategy into the epidemiology of attention deficit hyperactivity disorder in Arab countries.

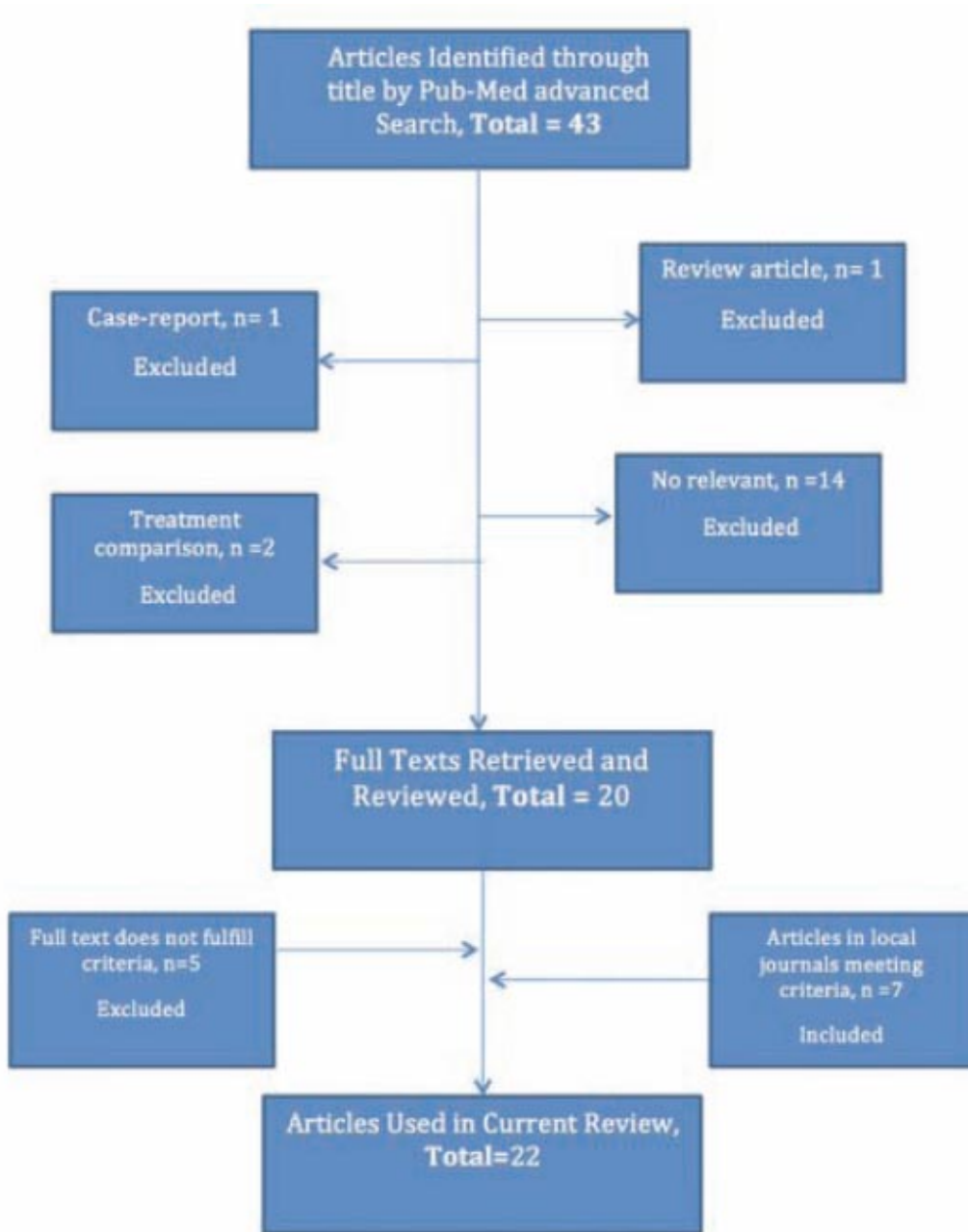
## Results

Studies were identified from 11 out of the 22 Arab countries: Saudi Arabia, Egypt, United Arab Emirates (UAE), Iraq, Qatar, Palestine, Yemen, Oman, Tunisia, Jordan, and Lebanon. From the 22 included articles, 7 articles discussed potential risk factors for ADHD in patients from Arab countries, and the remaining were prevalence studies.

Prevalence studies. The prevalence studies were conducted in Egypt, Palestine, Oman, Qatar, Saudi Arab, Tunisia, Lebanon, Tunisia, and Iraq. The prevalence range was as high as 19.6% and as low as 0.5% in different studies ([Table 1](#)). The prevalence of DSM-IV disorders among 3278 UAE's children, in 1997/1998 was 10.4% with 0.5% for ADHD.<sup>22</sup> In 2003, another study<sup>23</sup> in the UAE documented a prevalence of 0.9% (almost double) among a sample of 329 children. Another study<sup>24</sup> conducted in UAE and published in the same year (2004) reported an ADHD prevalence of 3% among 278 surveyed children, also suggesting an increasing trend of ADHD prevalence in the UAE. Studies conducted in Palestine revealed an ADHD prevalence of 10% in 6-11 years old children,<sup>32</sup> in Egypt 7.48% in 3-5 years old,<sup>18</sup> in Jordan 6.2% in 6-12 years old, and in Lebanon 3.2% in 6-10 years old. All these studies showed that male gender was significantly associated with ADHD prevalence. The study from Palestine<sup>32</sup> also documented a higher prevalence of ADHD among adolescents between the ages of 12-16 (11.8%) compared with that among 6-11 years old (10%). An Iraqi study<sup>27</sup> conducted in 1048 adolescent aged 12-18 years revealed an ADHD prevalence of 2.6% ([Table 1](#)). The prevalence of the hyperactive type of ADHD was reported in studies conducted in Oman (7.8%),<sup>33</sup> Saudi Arabia (1.4%<sup>16</sup> and 3.5%<sup>17</sup>), Tunisia (1.9%),<sup>35</sup> and Egypt (6.5%).<sup>21</sup> The prevalence of inattention type ADHD was consistent in studies conducted in Saudi Arabia in 2010,<sup>16</sup> and 2012,<sup>17</sup> and in Tunisia<sup>35</sup> ([Table 1](#)).

**Table 1-** Summary of epidemiological studies on attention deficit hyperactivity disorder (ADHD) in Arab countries.

Risk factors studies. The included studies were conducted in Yemen, Iraq, Qatar, Egypt, and UAE. Only 2 studies, one conducted in Iraq, and another in Qatar, employed a case-control study design. Samples size varied between 40-42<sup>23</sup> children (Table 1). The associated factors investigated were: daily injuries, poor school performance, sleep problems, nocturnal enuresis, low socioeconomic conditions, poor family relationship, bigger family size, single parent, bottle fed, age, gender, vitamin D, and smoking. A case-control study conducted in Iraq in 2006,<sup>26</sup> documented that ADHD was associated with daily injuries, poor school performance, sleep problems, and nocturnal



Author	Year of publication	Country	Study design	Population	Sample size	Diagnostic criteria	Main findings
Alqahtani <sup>16</sup>	2010	KSA	Cross-sectional	Primary school pupils attending grades 1-3 (7-9 years old)	708	Teachers and parents questionnaire follows the DSM-IV criteria	Overall prevalence of ADHD was 2.7%, inattention type was 2%, hyperactive type was 1.4%, and combined type was 0.7%
Jenahi et al <sup>17</sup>	2012	KSA	Cross-sectional	Female primary schoolchildren (6-15 years old)	1009	Attention deficit disorders evaluation scale, school version	Prevalence of ADHD was 3.5%, inattentive type was 2.1%, and hyperactive type was 5.6%
Attia et al <sup>18</sup>	2000	Egypt	Cross-sectional	Primary school children in grades 3-5	1350	Conner's rating scale	Prevalence of ADHD symptoms: 7.48%, higher in boys (11.7%) than girls (3.6%)
Al Hamed et al <sup>19</sup>	2008	KSA	Cross-sectional	Male school children aged (6-13 years old)	1287	Modified Arabic version of (ADDES-3) school version, and parents' questionnaire	Prevalence of ADHD was 6.5%, showing a higher prevalence in males than in females for the hyperactive-impulsive and combined types (4% males, 2.5% females), ADHD related to birth order (6 <sup>th</sup> child in the family), hyperactivity type higher among children living with single parents, inattention type more common among children who were bottle-fed
EL Koumi et al <sup>20</sup>	2012	Egypt	Cross-sectional	6-12 year old children	265	Children were clinically interviewed and	Prevalence of behavioral disturbances was 64.5% among those in institutional care and ADHD was one of the most

						diagnosed based on DSM-IV criteria	prominent psychiatric disorders detected with a prevalence of 19.6%
Yehia et al <sup>21</sup>	2010	Egypt	Cross-sectional	Preschool and school children (4-12 years)	4223	The Conner's ADHD Index DSM-IV Complete physical, mental and behavioral assessment	Prevalence of ADHD was 6.5%, showing a higher prevalence in males than in females for the hyperactive-impulsive and combined types (4.01% males, 2.48% females), ADHD related to birth order (6 <sup>th</sup> child in the family), hyperactivity type higher among children living with single parents, inattention type more common among children who were bottle fed
Eapen et al <sup>22</sup>	1998	UAE	Cross-sectional	Schoolchildren aged 6 to 15 years	3278	Rutter A2 parent questionnaire and clinical interview	Weighted prevalence of all DSM-IV disorders: 10.4% with 0.5% for ADHD
Eapen et al <sup>23</sup>	2003	UAE	Cross-sectional	Children and adolescents age 6-18 years	329	Rutter parent questionnaire K-SADS CGAS	The overall prevalence rate of psychiatric morbidity found to be 22.2%, 0.9% diagnosed as ADHD
Eapen et al <sup>24</sup>	2004	UAE	Cross-sectional	Children age 6-18 years visiting the primary care doctors	278	Systematic psychiatry evaluation	43% were diagnosed with DSM-IV psychiatric disorder; 3% were considered as ADHD
Eapen et al <sup>25</sup>	2009	UAE	Cross-sectional	School children age 5-16 years	1175	Conner's scale	Prevalence rate was 4.1% as per the parents and 3.4% as per teachers. As per parent score the rate of boys (5.3%) were higher than girls (2.9%) and as per teachers score: boys were 3.9% and girls were 2.8%. ADHD in this study was found to be decreasing as age increased, with a rate of 5% for elementary, 4.2% for preparatory, and 2.7% for secondary school children
Al-Karagully <sup>26</sup>	2006	Iraq	Case-control	7-14 year old children	42 cases & 40 controls	Parents questionnaire follows the DSM-IV criteria	The study showed that males (67%) were affected twice as the females (33%). Attention deficit hyperactivity disorder was associated with daily injuries, poor school performance, sleep problems, and nocturnal enuresis
Suhail <sup>27</sup>	2012	Iraq	Cross-sectional	Adolescent pupils aged 12-18 years	1048	SRQ 20 CIDI	Out of 1048, 183 adolescents have positive mental disorders with a point prevalence of 17.5%. ADHD cases represents 14.75% of those, with approximately 2.6% of the total sample
Ashor <sup>28</sup>	2012	Iraq	Cross-sectional	University students, mean age: 21 years	361	ADHD adult self-report scale	16.6% reported ADHD symptoms, more among males. ADHD was related to smoking
Bener et al <sup>29</sup>	2006	Qatar	Cross-sectional	School-age children 6-12 years	2000	Conner's classroom rating scale	The study showed an overall prevalence of 9.4%
Bener et al <sup>30</sup>	2007	Qatar	Cross-sectional	Primary school students aged 6-12 years	1869	Conner's classroom rating scale	Overall prevalence of 11.1%, more among 6-9-year-old. ADHD had poorer school performance. Associated factors were: low socioeconomic conditions, poor relations with parents and bigger family size
Bener and Kamal <sup>31</sup>	2013	Qatar	Case-control	Children <18 years of age	1331 cases & 1331 controls	Conner's teacher scale	8.1% of ADHD had sufficient serum vitamin D levels. A significant difference found in the mean values of vitamin D between ADHD (16.6±7.8) and control children (23.5±9.9) ( $p<0.0001$ )
Miller et al <sup>32</sup>	1999	Palestine	Cross-sectional	School-aged Palestinian children	669	OCHS CPTS-RI	Prevalence of ADHD was 10% among children age 6-11 years; 11.8% among adolescents age 12-16 years. In both categories boys were higher than girls
Al-Sharbati et al <sup>33</sup>	2008	Oman	Cross-sectional	School boys of age 6-13 years	1502	Short version of Conner's teacher rating scale semi structured interview using the style	7.8% exhibited hyperactive type of ADHD
Alyahri and Goodman <sup>34</sup>	2008	Yemen	Cross-sectional	7-10-year-old children	1210	Strengths a weakness questionnaire, the DSM-IV criteria	Overall prevalence of DSM-IV psychiatric disorders was 15.7%, ADHD ranked as the third most common disorder with a prevalence: 1.3%, 95% CI: 0.1-2.5%. Significantly higher among boys. ADHD was associated with daily injuries

ADHD was associated with daily injuries, poor school performance, sleep problems and nocturnal enuresis

Khemakhem et al <sup>35</sup>	2012	Tunisia	Cross-sectional	School population (grade 1-5)	513	Conner's scale of teachers and parents DSM-IV-TR	Prevalence of ADHD was 9.94%, mixed-type was 5.3%, inattention was 2.7%, and hyperactivity was 1.9%
Nafi et al <sup>36</sup>	2013	Jordan	Cross-sectional	School children aged 6-12 years	4374	Teachers questionnaire follows the DSM-IV criteria	Prevalence of ADHD was 6.2%, 9% in boys, 3.7% in girls, with a male to female ratio of 2.4:1
Richa et al <sup>37</sup>	2014	Lebanon	Cross-sectional	6-10 year old children	1000	ADHD-rating scale-IV school version	Prevalence of ADHD = 3.2%, significantly more prevalent in boys (4.5%) than in girls (1.8%)

ADDES-3 - Attention Deficit Disorders Evaluation Scale-3rd edition, DSM-IV - Diagnostic And Statistical Manual Of Mental Disorders-4th edition, ADHD - attention deficit hyperactivity disorder, K-SADS - Kiddie-Schedule For Affective Disorders And Schizophrenia, CGAS - Children's Global Assessment Scale, SRQ 20 - Self-Reporting Questionnaire-20 items, CPTS-RI - Child Posttraumatic Stress Reaction Index, KSA - Kingdom of Saudi Arabia, CI - confidence interval, CIDI - Composite International Diagnostic Interview, OCHS - Ontario Child Health Scale



enuresis. These findings were also documented in a cross-sectional study conducted in Yemen.<sup>34</sup> The Qatar study,<sup>30</sup> in addition, identified factors such as low socioeconomic status, poor relationship with parents and bigger family size associated with ADHD. Two cross-sectional studies conducted in Saudi Arabia in 2008<sup>19</sup> and in Egypt in 2010,<sup>21</sup> documented that higher birth order was related with ADHD. Hyperactive type ADHD was prevalent among children with a single parent, and inattention type ADHD was more prevalent among children who were bottle-fed.<sup>19,21</sup> Another cross-sectional study conducted in UAE in 2009<sup>25</sup> documented that the prevalence of ADHD decreases with increasing age with a rate of 5% for elementary, 4.7% for preparatory, and 2.7% for secondary school children. In 2012, a study conducted in Iraq documented a significant relationship between ADHD prevalence and smoking among university students with a mean age of 21.<sup>27</sup> More recently, a large case-control study conducted in Qatar in 2014<sup>31</sup> on 1331 cases and 1331 controls, documented a significant association between low vitamin D serums levels and ADHD. A significant difference in the mean values of vitamin D between ADHD (16.6±7.8) and control children (23.5±9.9) ( $p<0.0001$ ) was found. This is the only study that documented a biomarker related with ADHD in Arab countries.

## Discussion

The prevalence of ADHD was investigated in different age categories among the Arab countries making it difficult to provide a reliable comparison between the countries. However, results of this systematic review shows that the prevalence of ADHD in Arab countries among schoolchildren aged 6-12 years ranges between 7.8-11.1%, while it was higher, at 16%, in the studies that included younger aged children between 3 and 15 years of age. Although this prevalence rate variability could be explained by the methodological differences, it is important to note that these prevalence estimates stratified by age are comparable in range reports in North America and Africa.<sup>6</sup>

Population prevalence studies of ADHD in the Arab countries were conducted mostly in schools, which facilitates access to participants; however, this may not reflect the prevalence of ADHD at the population level, as it might overlook a large number of children who are carrying the symptoms but are not enrolled in the schools or studying in schools for "special needs" children. Not including these children can lead to underestimation of the true burden of ADHD in Arab countries. Most studies reviewed were cross-sectional studies, which could account for the low number of predicted risk factors (gender and family history of psychiatric illness) (Table 1). Genetic causes that have been linked to the incidence of ADHD were not examined in the reviewed studies.

Results of a worldwide systematic review showed a large variability of the prevalence of ADHD.<sup>6</sup> This review extracted information from 71 studies published from January 1997 to June 2007, and showed a prevalence ranging from 0.2-26.8%.<sup>6</sup> This variation was explained mainly from methodological differences across the studies. The current review in Arab countries showed a similar level of variability across studies with prevalence ranges between 0.46-19.6%. Similar to this worldwide review, our review in Arab countries documented male predominance with a male to female ration ranging from 1.61:1 to 5:2.

Several explanations can account for the higher prevalence estimates found in a few studies in this review. The use of clinical interviews for children in Egypt,<sup>20</sup> and the Self-Reported Questionnaire in Iraq between 2006 and 2012,<sup>26,38</sup> as diagnostic tools, reported a prevalence of ranging between 14.75% and 19.6%. On the other hand,

studies that used Conner's Rating Scale for teachers, or parents, or both, show very similar estimates of prevalence ranging from 3.4% and 9.9%. Other studies yielded lower prevalence when using a different measurement tool. For example, the study conducted in Saudi Arabia by Alqahtani in 2010<sup>16</sup> used teachers and parents' questionnaire and reported a prevalence of 2.7%. Other studies have examined the prevalence of ADHD among samples going under a general psychiatric evaluation for several mental and behavioral disorders,<sup>22,24,31</sup> and resulted in the lowest prevalence's of ADHD in Arab countries (1.3%, 0.9% and 0.46%) (Table 1). Eapen et al<sup>25</sup> however, believed that the low rates of ADHD in both of their studies (the school and community samples in Al Ain study, UAE) were due to a culturally shared higher threshold for behavioral problems.

As reviewed by Gillberg et al in 2004,<sup>39</sup> children and adolescents with ADHD show significant comorbidity with other psychiatric disorders, such as oppositional defiant disorder, conduct disorder, mood, and anxiety disorders, tic disorders, obsessive compulsive disorder, substance use disorders, as well as learning and language disorders. Four studies reviewed in this article found a similar pattern both in epidemiological and clinical samples.<sup>20,22-24</sup> Biederman in 2005<sup>41</sup> and Barkley in 2005<sup>38</sup> reported on the impact of ADHD on poor school performance, career related outcomes, aggression, and financial crises. Our review also suggested similar findings to Arab countries.

With the increasing number of studies regarding ADHD in children and adolescents in Arab countries, there are still a small number of studies conducted in adult populations with most of them were limited by a small sample size.<sup>43</sup> One of the studies addressing the issue of adult ADHD was carried out in Lebanon,<sup>37</sup> but only as part of an international World Health Organization study, in which the prevalence of adult ADHD was estimated at 1.8%.<sup>44</sup> The authors explained that the low rate of adult ADHD reported in this study was attributed to the use of a structural interview (associated with low rates), and respondents under-reporting their symptoms in interviews due to the stigma of mental illnesses in the Arab world. The second study that explored adult ADHD in the review was conducted on a sample size of 361 Iraqi college students with a mean age of 21 years old.<sup>28</sup> The findings of the study showed a total prevalence of 16.6% with a significant indication of heavy nicotine intake ( $p=0.0001$ ), a finding which has to be interpreted with caution due to its cross-sectional design, making it impossible to predict whether smoking was a risk factor or a consequence of ADHD.

Cultural factors may play a significant role in the identification of ADHD. Indeed, there may be a misperception in some Arab cultures for what is identified as a behavioral problem. Conversely, given that ADHD impairs academic performance, which is culturally highly valued in the Arab world, it may be specifically the inattention symptoms of ADHD (and not hyperactivity/impulsivity) that draws parents' attention for early identification and treatment.<sup>42</sup>

We believe that the findings of this review have significant implications for health care planning as well as for service delivery and awareness campaigns in the Arab region. In many Arab countries, families may not accept their children's mental health problems and their need for treatment for fear of labelling and stigma. It is important to fight stigma and increase awareness of child mental health, and ADHD in particular. Physicians also need to educate parents regarding symptoms of ADHD, possible causes or risk factors, and the importance of early intervention medically and behaviorally.

The negative impact of ADHD on adult's daily-life performance was well investigated by Spencer et al in 2014.<sup>45</sup> Researchers on Arab countries should consider looking into this area, which may contribute to form good medical practice regarding this issue, resulting in improvement in functioning with a positive investment on adults in Arab countries.

Several methodological issues need to be addressed. We limited our search to articles in this review those published in English, while articles in Arabic or French languages were not considered. Although most studies by research institutes and universities in the Arab world are published in English, we could have missed some articles, particularly articles in French (and not indexed in PubMed) from Morocco, Algeria, and Tunisia where most publications are in French, rather than the English language. In addition, our search was limited to publications in peer-reviewed journals, but not dissertations from Arab universities. However, we have searched local journals along with our PubMed search to be as inclusive as possible. Cross-referencing was also performed and no missed studies were identified.

In conclusion, the prevalence of ADHD in Arab countries is comparable with those reported in North America, Africa, and other countries of the Middle East. A significant association between ADHD and the following factors were reported in the Arab region: male gender, previous psychiatric illness in the family, vitamin D deficiency, poor school performance, sleep problems, and nocturnal enuresis. However, 20 out of the 22 studies retrieved were cross-sectional and thus, we cannot infer causality. Longitudinal studies are needed to investigate determinants and

prognosis of this condition in the Arab world.

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## ***ETHICAL CONSENT***

All manuscripts reporting the results of experimental investigations involving human subjects should include a statement confirming that informed consent was obtained from each subject or subject's guardian, after receiving approval of the experimental protocol by a local human ethics committee, or institutional review board. When reporting experiments on animals, authors should indicate whether the institutional and national guide for the care and use of laboratory animals was followed. Research papers not involving human or animal studies should also include a statement that approval/no objection for the study protocol was obtained from the institutional review board, or research ethics committee.

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From the College of Public Health and Health Informatics (Alhraiwil, Ali, Al-Shehri, Househ, El-Metwally), King Saud Bin Abdulaziz University for Health Sciences, Riyadh, Kingdom of Saudi Arabia, and from the Institute of Applied Health Sciences (El-Metwally), University of Aberdeen, Aberdeen, Scotland, United Kingdom.

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Address correspondence and reprint request to: Dr. Ashraf A. El-Metwally, Assistant Professor of Epidemiology, Epidemiology & Biostatistics Department, College of Public Health & Health Informatics, King Saud Bin Abdulaziz University for Health Sciences, Internal Mail Code 2350, PO Box 22490, Riyadh 11426, Kingdom of Saudi Arabia. Tel. +966 (11) 8011111 Ext. 95414. Fax. +966 (11) 8011111 Ext. 43734. E-mail: ashraf.elmetwally@gmail.com

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