


RESEARCH

Open Access



# The global prevalence of ADHD in children and adolescents: a systematic review and meta-analysis

Nader Salari<sup>1</sup>, Hooman Ghasemi<sup>2</sup>, Nasrin Abdoli<sup>3</sup>, Adibeh Rahmani<sup>4</sup>, Mohammad Hossain Shiri<sup>2</sup>, Amir Hossein Hashemian<sup>5</sup>, Hakimeh Akbari<sup>6</sup> and Masoud Mohammadi<sup>6\*</sup> 

## Abstract

**Background** Attention-Deficit / Hyperactivity Disorder is a developmental neurological disorder that has three basic characteristics: Attention Deficit, Hyperactivity, and impulsivity. This study aimed to investigate the prevalence of ADHD in children and adolescents.

**Methods** This investigation was carried out using the meta-analysis method under PRISMA guidelines. Until October 2020, the articles were gathered by scanning PubMed, Scopus, WOS, and Science Direct databases. The second version of Comprehensive Meta-Analysis software was used to run analyses after extracting data from chosen papers. At a significance level of 0.05, the  $I^2$  test was used to analyze study heterogeneity, and the Egger test was used to assess publication bias.

**Results** This analysis includes 61 cross-sectional research, with 53 research used to determine the prevalence of ADHD in children, 7.6% of 96,907 children aged 3 to 12 years had ADHD (95% confidence interval: 6.1–9.4%), and 5.6% of teenagers aged 12 to 18 years have ADHD (95% confidence interval: 4.8–7%). The prevalence of ADHD in children and adolescents according to the DSM-V criterion is also higher than previous diagnostic criteria, according to studies.

**Conclusion** The findings of this study based on meta-analysis show the high prevalence of attention deficit hyperactivity disorder (ADHD). The findings of this study demonstrate the importance of management and policy in the treatment and control of ADHD in children and adolescents.

**Keywords** Attention deficit hyperactivity disorder, Children, Adolescents, Psychiatric disorder

\*Correspondence:

Masoud Mohammadi  
Masoud.mohammadi1989@yahoo.com

<sup>1</sup>Department of Biostatistics, School of Health, Kermanshah University of Medical Sciences, Kermanshah, Iran

<sup>2</sup>Student Research Committee, Kermanshah University of Medical Sciences, Kermanshah, Iran

<sup>3</sup>Department of Psychiatry, Substance Abuse Prevention Research Center, Kermanshah University of Medical Sciences, Kermanshah, Iran

<sup>4</sup>Julius Wolff Institute (JWI) - Charité, Berlin, Germany

<sup>5</sup>Research Center for Environmental Determinants of Health (RCEDH), Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran

<sup>6</sup>Cellular and Molecular Research Center, Gerash University of Medical Sciences, Gerash, Iran



© The Author(s) 2023. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

## Background

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most frequent neurodevelopmental disorders in childhood and adolescence, which is typically first, diagnosed in childhood and often persists into adulthood. It is one of the most prevalent causes of children being sent to psychology and psychiatric clinics [1, 2]. Children with ADHD may struggle to focus, lack self-control and impulsive behaviors, or exhibit excessive activity [1–3]. Hyperactivity, one of the main symptoms of ADHD, can lead to a child's psychological and social incompatibility at home, school, and community [2]. The fundamental aspect of Attention Deficit Hyperactivity Disorder ADHD, according to the Fifth Diagnostic and Statistical Manual of Mental Disorders (DSM5), is a set of behaviors that disturb social status. Increased motor activity in inappropriate contexts, excessive wobbling, finger play, and talkativeness are examples of these social circumstances, which can interfere with personal and educational life [3].

Attention deficit disorder affects children differently depending on their age and gender, and it is more common in boys than in girls [2]. The initial signs of hyperactivity are frequently hard to detect until a child reaches the age of four, and it is most evident in elementary school. In early adolescence, the condition normally follows a predictable pattern. Yet, studies demonstrate that the main characteristics of ADHD change with age, so regardless of classification, ADHD seems to reduce in adulthood. Throughout this age range, hyperactivity in particular, though still present, is less evident (Ramtekkar et al. 2010). As a result, a thorough history is required for the diagnosis of ADHD which then leads to the identification of specific symptoms [5].

Symptoms of ADHD are frequent in school-aged children and can last far into adulthood. In general, ADHD is usually characterized by impulsivity, attention deficit, and hyperactivity. A person with inattention may have trouble remaining on task, maintaining focus, and maintaining organization. A hyperactive person may appear to move around frequently or fidget excessively. An impulsive person may behave without thinking or struggle with self-control. [2–6]. Patients may be unable to pay close attention to detail or may be careless when performing tasks such as schoolwork, job, or other activities.

As previously mentioned, boys are more likely to manifest ADHD symptoms [6] with three times more likely to receive an ADHD diagnosis than girls [9]. Based on a study by Rucklidge, there are significant differences in how the condition reveals in boys and girls. Boys with ADHD usually show externalized symptoms, such as running and impulsivity. Girls with ADHD, on the other hand, typically show internalized symptoms [9]. These symptoms include inattentiveness and low self-esteem.

Boys also tend to be more physically aggressive and externalize their frustrations, while girls tend to be more verbally aggressive and turn their pain and anger inward, putting them at an increased risk for depression, anxiety, and eating disorders [9]. ADHD in children is caused by several factors, including genetics and environment, premature birth, preeclampsia, hypertension, overweight, and obesity in pregnant women, as well as maternal smoking exposure [7, 8]. Family history studies have also shown that drug abuse plays a significant role in the development of ADHD [9]. Identifying whether a child has ADHD is a multi-step process. There is no single test that can detect ADHD. To diagnose ADHD a checklist for rating the symptoms is provided and a history of the child from parents, teachers, and sometimes, the child is taken [3–9].

Guardiola et al. carried out a study in which they assessed the prevalence of ADHD in 484 pupils using two criteria: DSM-IV and neuropsychological criteria. The results showed that the incidence of ADHD using the DSM-IV criterion and the neuropsychological criterion were 18% and 3.5%, respectively [10]. Shabani et al. conducted another research wherein 428 elementary pupils were studied. According to the findings of this study, 4.9% of students (or 21 persons) have ADHD [11].

According to a survey conducted by Adonna et al., 8.7% of Nigerian students aged 7 to 12 had ADHD. In addition, the prevalence of attention-deficit subtypes was determined to be 4.9%, hyperactivity/impulsivity subtype 1.2%, and hyperactivity and attention deficit subtype 2.6% in this study [12]. According to research by Mahala et al., 18.1% of Tunisian youngsters suffer from ADHD [13]. ADHD was identified as the most common disorder among teenagers in another study by Oes Borg et al., which looked into the prevalence of chronic diseases among adolescents with mental disabilities aged 18–12 [14].

Another study on the prevalence of ADHD was undertaken by Maulov et al. A total of 210 Lebanese teenagers between the ages of 11 and 17 were studied. 10.2% of persons have ADHD, according to the findings of this study [15].

There are several inconsistencies across research on the prevalence of ADHD in children and adolescents, which are influenced by a variety of factors including diagnostic criteria variances. As a result, this study was conducted to determine the prevalence of ADHD in children and adolescents based on various diagnostic criteria and age groups.

## Method

This research looked at the prevalence of ADHD in children and adolescents by a systematic review and meta-analysis of cross-sectional data. The technique for

carrying out the various stages of this study following the criteria of Guideline [16] was created and implemented.

### Eligibility criteria

In general, the criteria for selecting documents in systematic review and meta-analysis are within the framework of PICOS (Population, Intervention, Comparison, Outcomes, Study) [17]. In this study, the eligibility criteria are based on these conditions. Population: All people under the age of 18 were examined in this study. Exposure: Affected children and adolescents. Outcomes: Because of the differences in diagnostic criteria for ADHD and the prevalence of ADHD in different age and gender subgroups, the prevalence of ADHD was evaluated using DSM-V, DSM-IV, DSM IV-TR, and ICD10 criteria. Type of study: Cross-sectional observational studies were utilized to establish the disease's prevalence. Other observational studies and methodologies, such as interventional review, were left out of the analysis.

### Data sources and search strategy

The authors reviewed four electronic bibliographic databases, including PubMed, Scopus, WOS, and science direct, as well as any electronic publications printed before October 2020. Mesh terms and keywords used in review studies and previously published studies were utilized to choose the relevant keywords, which were chosen by one of the authors (MSH) and confirmed by the first and second authors. All keywords were selected in English. The search strategy in this study was designed using the terms “prevalence OR outbreak OR Global prevalence AND ADHD OR ADDH OR “Attention Deficit Hyperactivity Disorder”.

### Selection of studies

After using Endnote software to remove duplicate articles, an author (MSH) examined the study's title and abstract. Excluded studies were those that did not meet the entry and exit criteria. The whole text of the paper was then examined by two writers (MSH and HGH) based on inclusion and exclusion criteria. These experiments were carried out independently and by blinding. Any comments given to affirm or reject the research were re-examined after the reviews were completed at this step. In the case of a disagreement, the study was confirmed using the third author's (MM) reviews. If the full text of the study was not available, an email or research gate request was submitted to the paper's lead author.

In this study, the STROBE checklist [17] was used as a tool to measure methodological quality in observational studies. According to the various criteria of this checklist, the title, abstract, introduction, method, and results of observational studies with a minimum score of 0 and a maximum score of 32 were considered separately. Studies

with a score less than 16 were considered at high risk for bias. However, none of the studies were omitted due to low-quality or high risk of bias, and all studies were analyzed.

### Data extraction

Information gathering was performed by two authors (MSH and HGH). This data was gathered using the methodology and findings of preliminary research. A form was created to extract information such as the first author's name, year of publication, country, population examined by gender, diagnostic criteria, and diagnostic instruments. Data were extracted by (MSH) and reviewed by (MM).

### Statistical analysis

The heterogeneity of the studies was assessed using the  $I^2$  test. The Egger test and its accompanying Funnel plot were used to analyze the publication bias due to the large number of samples included in the study. Comprehensive Meta-Analysis software (Version 2) was used to examine the data.

### Results

A systematic review and meta-analysis of information on research on the prevalence of ADHD in children and adolescents around the world was conducted in this study, with no time constraint until 2020 and following PRISMA principles. 1837 potentially related articles were found and transferred to the information management software based on an initial database search (EndNote). A total of 1837 studies were found, with 170 duplicate studies being eliminated. Out of 1667 papers, 1442 were eliminated during the screening phase after titles and abstracts were examined for inclusion and exclusion criteria. 164 articles were removed from the remaining 225 studies during the competency evaluation phase due to irrelevance after analyzing the full text of the article based on inclusion and exclusion criteria. All 61 articles were approved in the qualitative evaluation stage after reading the complete text of the article and calculating the STROBE score (Table 1).

### General prevalence of hyperactivity in children (under 12 years)

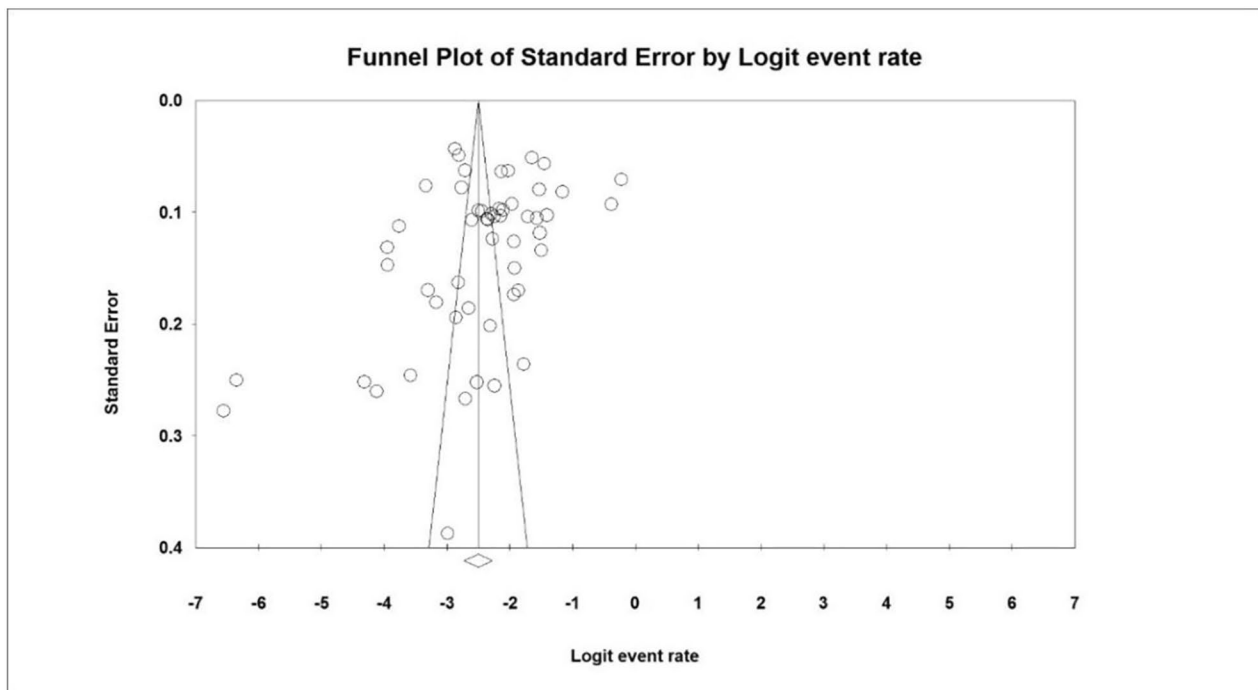
Based on the  $I^2$  test results (98.6) and the heterogeneity of the chosen research, a stochastic effects model was utilized to combine studies and estimate overall prevalence. Study heterogeneity can be caused by differences in sample size, sampling error, research year, and study location. The funnel diagram and Egger test at a significance level of 0.05 revealed that there was no publication bias in the distribution of data in the current investigation ( $P=0.107$ ). (Fig. 1).

**Table 1** Information table of studies entered into the systematic review

First author	Year	Country	Assessments	Range of age	Participants	Patient
Abdekhodaie, Zahra [18]	2012	Iran	DSM-IV-TR	5–6	1083	133
Aboul-ata, Mohammad A. [19]	2015	Egypt	DSM-V	6–12	371	68
				13–14	19	6
Adewuya, A. O. [12]	2007	Nigeria	DSM-IV	6–12	1112	97
adshaw, L. G. [20]	2017	Qatar	DSM-IV	6–12	2613	276
				13–19	1876	97
Afeti, K. [21]	2017	Ghana	DSM-IV	6–12	400	51
Al Azzam, Manar [22]	2017	Jordan		6–12	480	195
Alqahtani, Mohammed MJ [23]	2010	Saudi Arabia	DSM-IV	7–9	708	40
Ambuabunos, EA [24]	2011	Nigeria	DSM-IV	6–12	1473	112
Amiri, S. [25]	2019	Iran	DSM-V	6–9	298	40
				15–19	327	8
Anokye, R. [26]	2020	Ghana	DSM-IV	6–9	794	32
Baumgaertel, Anna [27]	1995	Germany	DSM-III	5–12	1077	103
			DSM-III-R	5–12	1077	117
			DSM-IV	5–12	1077	192
Bozkurt, Özlem Hekim [28]	2017	Turkey	DSM-IV	6–11	569	72
Bronsard, Guillaume [29]	2011	France	DSM-III-R	13–17	183	7
Canals, Josefa [30]	2018	Spain	DSM-IV	3–6	516	28
Catherine, T. G. Golden [31]	2019	India	DSM-V	8–11	2453	286
Cuffe, Steven P. [32]	2005	America	DSM-IV	4–8	3557	81
				14–17	2819	67
de la Barra, Flora Eloísa [33]	2013	Chili	DSM-IV	4–11	824	197
				12–18	734	39
Dodangi, N. [34]	2014	Iran	DSM-IV TR	6–11	145	21
				12–18	226	23
Egbochuku, EO [35]	2007	Nigeria	DSM-IV	6–12	1384	111
El-Nemr, Fathia Mohamed [36]	2015	Egypt	DSM-IV	5–12	600	118
Erşan, E Erdal [37]	2004	Turkey	DSM-IV	6–12	1169	107
				13–15	256	8
fAlyahri, A. [38]	2008	Yemen	DSM-IV	7–10	1210	16
Farahat, Taghreed [39]	2014	Egypt	DSM-IV	6–12	1362	94
Farbstein, Ilana [40]	2014	Israel	DSM-IV, ICD-10	14–17	957	26
Feiz, Pa [41]	2013	Tehran	DSM-IV	6–7	1000	105
Fleitlich-Bilyk, Bacy [42]	2004	Brazil	DSM-IV	7–10	627	17
Ford, T. [43]	2003	England	DSM-IV and ICD-10	5–12	7814	178
				13–15	2624	55
Froehlich, Tanya E. T. E. [44]	2007	America	DSM-IV	8–11	1160	119
				12–15	1922	103
Gallardo-Saavedra, G. A. [45]	2019	Mexico	DSM-IV	6–8	2832	458
Gau, Susan SF [46]	2005	Taiwan	DSM-IV	13–15	3156	179
Ghosh, Prosenjit [47]	2018	India	DSM-5	6–11	300	38
Gomez, Rapson [48]	2011	Malaysia	DSM-IV	6–12	934	15
Guardiola, A. [10]	2000	Brazil	DSM-IV	6–7	484	87
Gul, N. [49]	2010	Turkey	DSM-IV	6–12	1126	97
Heiervang, E. [50]	2007	Norway	DSM-IV ICD-10	7–9	9155	16
				7–9	9155	13
Hs, Ramya [51]	2017	India	DSM-5	5–12	3120	59
Huang, Yanhong [52]	2017	China	DSM-5	7–12	2959	175
Lecendreux, M. [53]	2011	America	DSM-IV	6–12	1012	36
Leib, Shiran [54]	2020	Israel	DSM-IV	13–19	84	24
Leung, Patrick W. L. [55]	2008	China	DSM-IV	ADO	541	24
Maalouf, Fadi T. [15]	2016	Lebanon	DSM-IV and ICD-10	11–12	177	17
				13–17	339	35
Mhalla, Ahmed [56]	2018	Tunis	DSM-IV	ADO	447	81

**Table 1 (continued)**

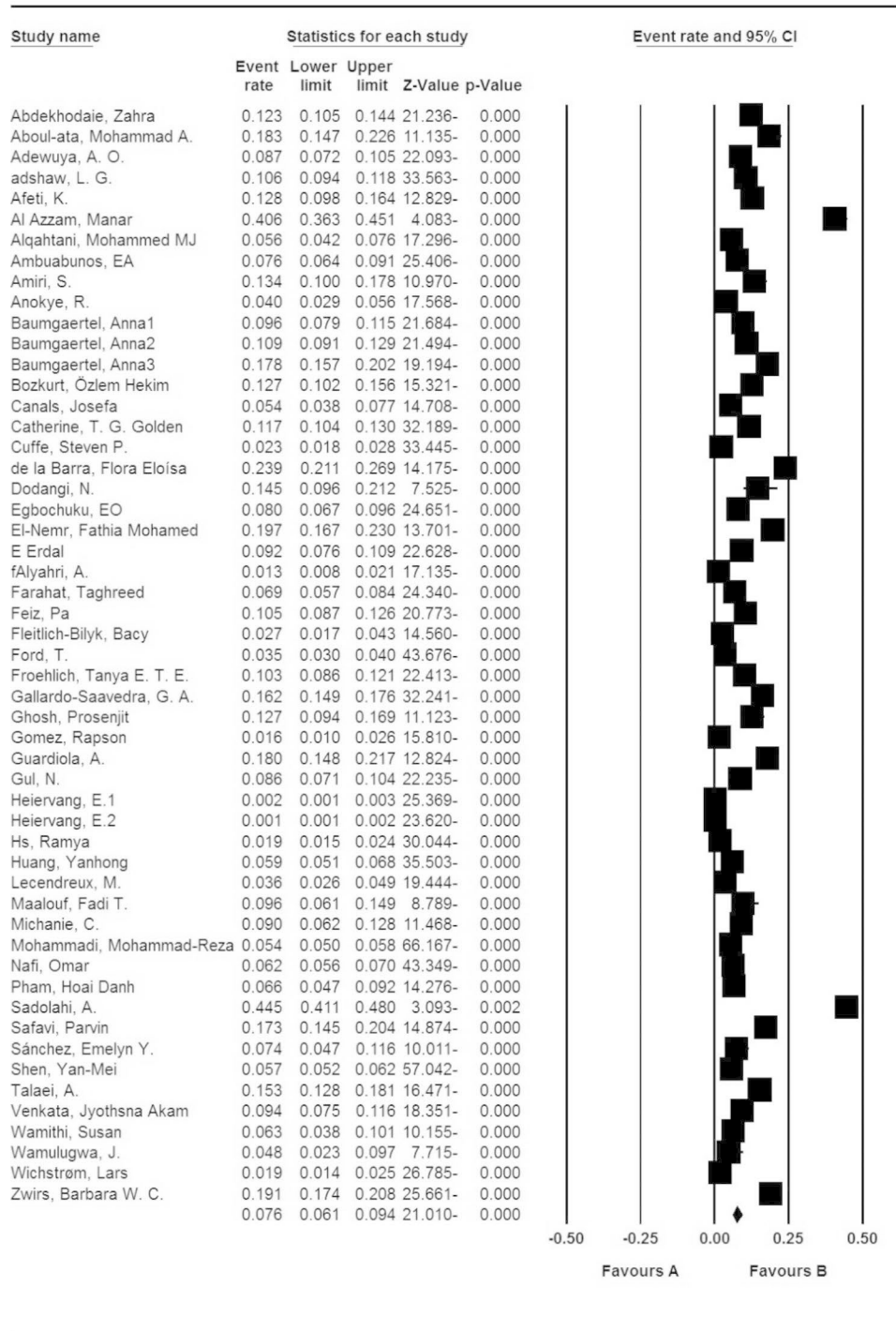
First author	Year	Country	Assessments	Range of age	Participants	Patient
Michanie, C. [57]	2007	Argentina	DSM III-R	6–12	300	27
Mohammadi, Mohammad-Reza [58]	2019	Iran	DSM-IV-TR	6–9 15–18	10,466 9409	562 210
Nafi, Omar [59]	2016	Jordan	DSM-IV	6–12	4374	273
Oeseburg, Barth [14]	2010	Netherlands		12–18	1083	229
Pham, Hoai Danh [60]	2015	Vietnam	DSM-IV	5–10	471	31
Pillai, Aravind [61]	2008	India	DSM-IV and ICD-10	12–16	2048	4
Rohde, L. A. [62]	1999	Brazil	DSM-IV	12–14	191	23
Sadolahi, A. [63]	2019	Iran	DSM-5	6–9	806	359
Safavi, Parvin [64]	2016	Iran	DSM-IV	6–12	631	109
Sánchez, Emelyn Y. [65]	2011	Panama	DSM-IV-TR	children	229	17
Shen, Yan-Mei [66]	2018	China	DSM-IV	6–11 12–16	7689 9382	438 409
Talaei, A. [67]	2010	Iran	DSM-IV	7–9	714	109
Umar, M. U. U. [68]	2018	Nigeria	DSM-IV	11–19	487	43
Venkata, Jyothsna Akam [69]	2013	India	DSM-5	6–11	770	72
Vreugdenhil, Coby [70]	2004	Netherlands	DISC-IV	12–18	198	8
Wamithi, Susan [71]	2015	Kenya	DSM-IV	6–12	240	15
Wamulugwa, J. [72]	2017	Uganda	DSM-IV-TR	4–10 10–18	146 186	7 32
Wichstrøm, Lars [73]	2012	Norway	DSM-IV	children	2475	47
Zwirs, Barbara W. C. [74]	2007	Netherlands	DSM-IV	6–10	2041	389

**Fig. 1** A funnel plot demonstrating the prevalence of hyperactivity in children under the age of 12 years

ADHD prevalence was found to be 7.6% (95% confidence interval: 6.1–9.4%) in 53 studies with a total sample size of 96,904 participants who looked at children under the age of 12. The shape of the Forrest plot depicts the overall prevalence in the studies under consideration,

with the midpoint of each line segment representing the prevalence in each study and the shape of a rhombus indicating population prevalence for the entire research (Fig. 2).

# Meta Analysis



## Meta Analysis

Fig. 2 Forest plot, the prevalence of hyperactivity in children under the age of 12 years old

**Table 2** Prevalence of hyperactivity in children under 12 years of age based on diagnostic criteria

Diagnostic criteria	N	Sample size	I <sup>2</sup>	Egger test	Prevalence (95%CI)
DSM-IV	33	56,186	98.5	0.052	7.7 (95%CI: 6-9.9)
DSM-IV TR	5	12,069	95.7	0.390	8.3 (95%CI: 4.9-13.6)
DSM-III	3	2454	0	0.572	10.1 (95%CI: 9-11.3)
DSM-IV and ICD-10	3	5963	89.1	0.664	4.4 (95%CI: 2.4-8.2)
DSM-V	8	11,077	99.2	0.509	11.3 (95%CI: 5.3-22.2)

**Table 3** Prevalence of hyperactivity in children under 12 years by type of hyperactivity

Diagnostic criteria	N	Sample size	I <sup>2</sup>	Egger test	Prevalence (95%CI)
Inattentive subtype	24	3040	90.5	0.052	33.2 (95%CI: 27.6-39.3)
Hyperactive impulsive subtype	24	3040	93.3	0.390	30.3 (95%CI: 23.8-37.7)
Combined	24	3040	93.1	0.572	31.4 (95%CI: 24.6-39.1)

Based on the results of Table 2 and the methods of diagnosing hyperactivity in children under the age of 12, the DSM-IV diagnostic criterion of ADHD prevalence was 7.7% (95% confidence interval: 6-9.9%).

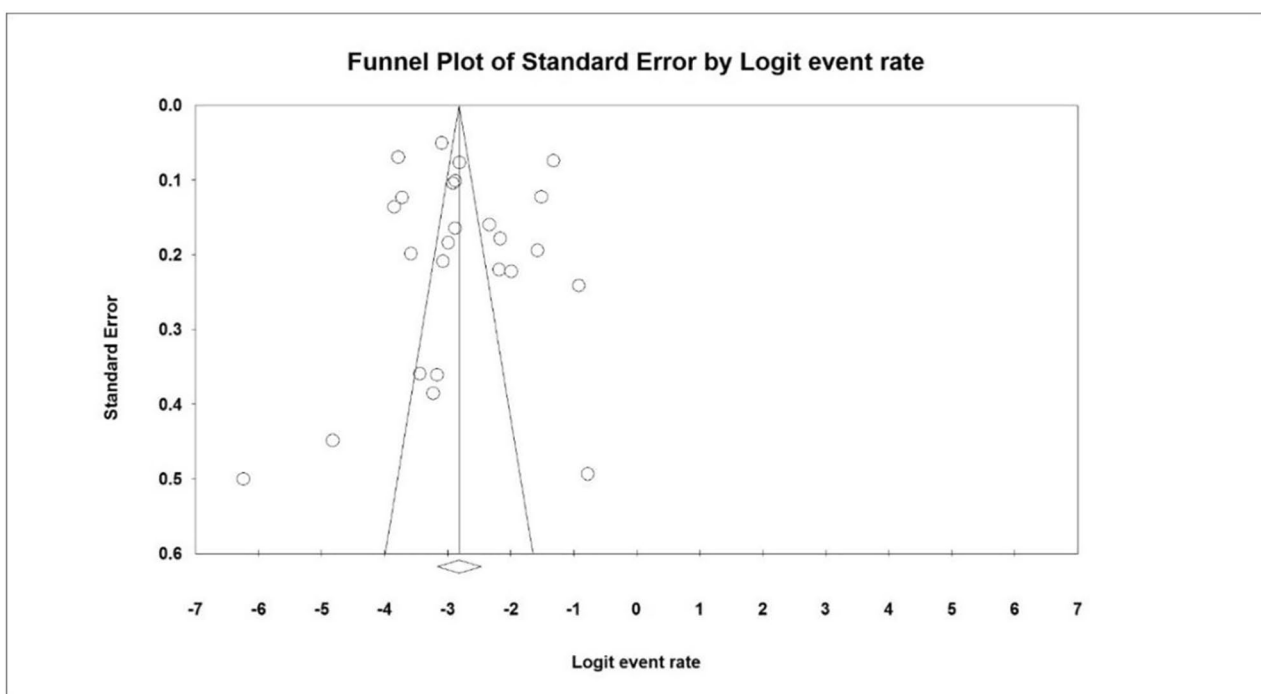
Other criteria used to determine the prevalence of ADHD in children were DSM-IV-TR, DSM-III, DSM-V, DSM-IV, and ICD10, which were: 8.3% (95% confidence interval: 4.9-13.9%); 10.1% (95% confidence interval: 9-11.3%); 11.3% (95% confidence interval: 5.3-22.2%); and 4.4% (95% confidence interval: 2.4-8.2%), respectively (Table 2).

The prevalence of ADHD was also studied in Table 3. According to the findings of 24 studies on ADHD in children under the age of 12, the prevalence of the Inattentive subtype was 33.2% (95% confidence interval: 27.6-39.3%), Hyperactive impulsive subtype was 30.3% (95% confidence interval: 23.8-37.7%), and Combined ADHD was 31.4% (95% confidence interval: 24.6-39.1%) (Table 3).

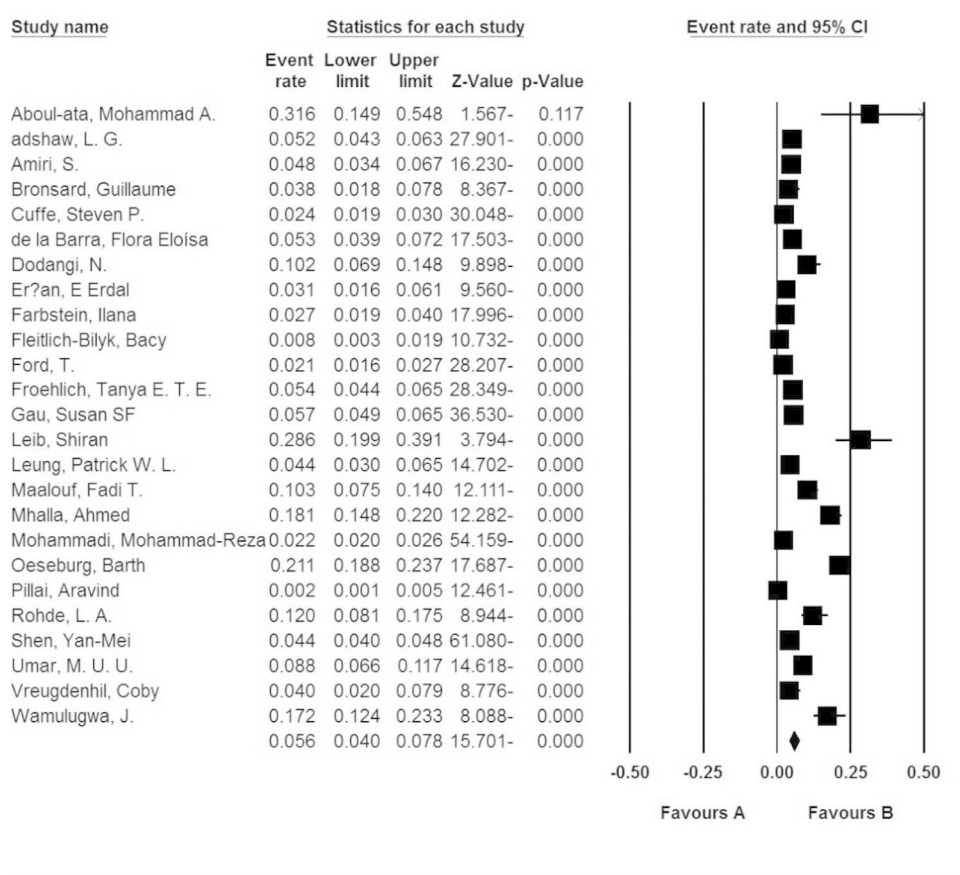
### General prevalence of hyperactivity in adolescents (12-18 years)

A random-effects model was used to integrate the studies and estimate the shared prevalence based on the test results (I<sup>2</sup>: 97.8) and the heterogeneity of the selected research. Differences in sample size, sampling error, year, or study location can all contribute to the study heterogeneity. The possibility of bias in the dissemination of data was determined using a funnel diagram and the Egger test at a significance level of 0.05 in the current study (P=0.774). (Fig. 3).

In 25 studies involving teenagers aged 12 to 18, the prevalence of ADHD was determined to be 5.6% (95%

**Fig. 3** A funnel plot demonstrating the prevalence of hyperactivity in children aged 12 to 18 years old

# Meta Analysis



## Meta Analysis

**Fig. 4** Overall Hyperactivity prevalence in adolescents aged 12 to 18 years

**Table 4** Hyperactivity prevalence in youth aged 12 to 18 years old depending on diagnostic criteria

Diagnostic criteria	N	Sample size	I <sup>2</sup>	Egger test	Prevalence (95%CI)
DSM-IV	14	23,170	97.5	0.537	7.1 (95%CI: 4.9–10.1)
DSM-IV TR	3	9821	98.6	0.174	7.5 (95%CI: 1.7–15.2)
DSM-V	2	665	94.3	-	12.7 (95%CI: 6.7–19.1)
DSM-IV and ICD-10	5	6592	96.04	0.406	1.7 (95%CI: 1.1–4.5)

confidence interval: 4-7.8%). The total prevalence in the studies examined is depicted in the Forrest plot, with the midpoint of each segment showing the prevalence in each study and the rhombus shape indicating the general population prevalence (Fig. 4).

Using the DSM-IV diagnostic criterion and based on the results of Table 4 and the methods of detecting

hyperactivity in children aged 12–18 years, the ADHD prevalence was 7.1% (95% confidence interval: 4.9–10.1%). Other criteria used to determine the prevalence of ADHD in children included DSM-IV-TR, DSM-V, DSM-IV, and ICD10 which reported to be: 7.5% (95% confidence interval: 1.7–15.2%), 12.7% (95% confidence interval: 6.7–19.1%), and 1.7% (95% confidence interval: 1.1–4.5%), respectively (Table 4).

Table 5 looked at the prevalence of different kinds of ADHD. According to the findings of five studies involving children aged 12 to 18, the prevalence of Inattentive Subtype was 37.3% (95% confidence interval: 30–45.4%), Hyperactive-Impulsive Subtype was 23.1% (95% confidence interval: 13.2- 38.2%), and Combined ADHD was 31.1% (95% confidence interval: 15.6 -42.3%) (Table 5).



**Table 5** Prevalence of hyperactivity in children 18–12 years according to the type of hyperactivity

Diagnostic criteria	N	Sam- ple size	I <sup>2</sup>	Egger test	Prevalence (95%CI)
Inattentive subtype	5	151	0	0.172	37.3 (95%CI: 30–45.4)
Hyperactive impul- sive subtype	5	151	80.7	0.322	23.1 (95%CI: 13.2–38.2)
Combined	5	151	79.3	0.311	31.1 (95%CI: 15.6–42.3)

## Discussion

The objective of this paper was to figure out how prevalent ADHD is in children and adolescents. According to the findings of this study, the prevalence of ADHD in children aged 3 to 12 years is higher than in adolescents aged 12 to 18. It was also shown that the prevalence of this condition varies depending on the diagnostic criteria used. According to studies, the prevalence of ADHD in children and adolescents diagnosed using the DSM-V criteria is higher than using alternative diagnostic criteria. The prevalence of several forms of ADHD was also measured in this study, and the results show that the percentage of ADHD-I, ADHD-H, and ADHD-C is nearly equal in children. Adolescents with ADHD-I, on the other hand, had a slightly higher prevalence of the disorder than those with other forms of ADHD.

ADHD is a neurodevelopmental disorder. Excessive motor activity, inattention, and impulsivity are all symptoms of this disease in children and adolescents [5]. According to the findings, the incidence of ADHD is 7.6% in children aged 3 to 12 years and 5.6% in teenagers aged 12 to 18. The findings of this study are nearly identical to those of earlier meta-analysis studies on the prevalence of ADHD. The prevalence of ADHD in children has been estimated to be between 2 and 7% in previous research [75].

Only one study [76] documented the prevalence of ADHD in teenagers other than children, which is consistent with our findings. According to the findings of a 2012 study, the prevalence of ADHD in children aged 6 to 12 years was 11.4%, and in youngsters aged 12 to 18 years was 8%, which was slightly higher than our findings. The discrepancy is understandable because this study only looked at the DSM-IV criterion. Another study, which looked at the incidence of ADHD in African children and adolescents in 2020, discovered that 7.47% of children and adolescents in Africa had the disorder. The prevalence of ADHD is higher in boys than in girls, according to this study [77]. People under the age of 18 were evaluated in another meta-analysis study conducted in Spain. The prevalence of ADHD in children and adolescents was 6.6% in this study, and 7% in children (participants under 12 years old), which is similar to the current study [78]. Another study looked at the prevalence of ADHD in

Chinese children and youths, finding that 5.74% of children and 6.72% of children and adolescents had ADHD [79].

Another analysis carried out in this study was to determine the prevalence of ADHD using various diagnostic criteria. The prevalence of ADHD was higher when using the DSM-V diagnostic criterion than when using other criteria, according to the findings. The DSM-V diagnostic criteria were very similar to the DSM-IV. However, the prevalence and disorder definitions in DSM-V differ from those in DSM-IV. Previously, the spread of the disease was determined by reviewing the symptoms of the disorder, which in the DSM-V is defined as the presence of two or more symptoms of the stated criteria. In light of these circumstances, the rise in the number of patients diagnosed with ADHD based on DSM-V diagnostic criteria is reasonable [80].

According to the results obtained in this study, at adult ages and as people get older ADHD appears to be less common. However, because no follow-up investigations have been conducted, this issue cannot be definitively addressed. Adults have lower rates of ADHD than children, according to previous research [77].

Song P., et al. research was done as a meta-analysis in 2021. The prevalence of ADHD in adults with persistent (childhood ADHD) and symptomatic (not include childhood ADHD) ADHD was investigated in this study. Around 140 million persons were evaluated for persistent ADHD in this study, with only 2.58% having the disease. The study also looked at symptomatic ADHD in a population of 370 million individuals, with 6.76% of people over the age of 18 having the disorder. On the other hand, the findings of this study demonstrated that when participants' ages increase in both groups, the prevalence of ADHD decreases, which is consistent with our findings [81]. Another study indicated that the prevalence of ADHD was lower in adults over the age of 18 than in teenagers [76]. Even though the prevalence of ADHD in adults is decreasing, it is nevertheless recognized as a risk factor for issues such as academic failure, workplace challenges, and criminality [75]. Adults with ADHD are more likely to commit crimes. As a result, the number of people in prison with ADHD is on the rise [82]. Furthermore, because the onset of ADHD symptoms in adults is socially problematic, many of these people will be admitted to psychiatric hospitals, affecting the prevalence of ADHD in adults in the general population [82, 83].

## Limitation

One of the limitations of this study is the high heterogeneity of studies in terms of age group. Since the purpose of this study was to measure the prevalence of children and adolescents separately, studies that report the prevalence of ADHD in children and adolescents combined

were removed. Furthermore, because this study only looked at cross-sectional papers, it was impossible to track the participants and measure their symptoms over time.

## Conclusion

The findings of this study based on meta-analysis demonstrate the significant prevalence of attention deficit hyperactivity disorder (ADHD). The results of this investigation corroborate prior research and highlight the importance of planning and policy-making in the treatment and control of ADHD in children and adolescents. Future research should look into the prevalence of ADHD in different age groups and how it affects their personal and social lives.

## Abbreviations

ADHD	Attention-Deficit / Hyperactivity Disorder
ADHD-I	ADHD Inattentive type
ADHD-H	ADHD Hyperactive and Impulsive type
ADHD-C	ADHD Combined type
DSM	Diagnostic and Statistical Manual
MESH	Medical Subject Headings
WoS	Web of Science
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analysis
STROBE	Strengthening the reporting of observational studies in epidemiology for cross-sectional study

## Supplementary Information

The online version contains supplementary material available at <https://doi.org/10.1186/s13052-023-01456-1>.

Supplementary Material 1

## Acknowledgements

This study is the result of research project No. 3011572 approved by the Student Research Committee of Kermanshah University of Medical Sciences. We would like to thank the esteemed officials of the center for the financial affords of this study.

## Author Contribution

NS and HGH and MM and MSH contributed to the design, MM statistical analysis, participated in most of the study steps. MM and NA and AR and HGH prepared the manuscript. MM and HA and AHH and HG and MSH assisted in designing the study, and helped in the, interpretation of the study. All authors have read and approved the content of the manuscript.

## Funding

By Deputy for Research and Technology, Kermanshah University of Medical Sciences (IR) (3011572). This deputy has no role in the study process.

## Data Availability

Datasets are available through the corresponding author upon reasonable request.

## Declarations

### Ethics approval and consent to participate

Ethics approval was received from the ethics committee of deputy of research and technology, Kermanshah University of Medical Sciences (3011572). All the methods of the present study have been carried out in accordance with the ethical standards set out in the Helsinki Declaration. This study did not include human samples and did not require informed consent.

## Consent for publication

Not applicable.

## Competing interests

Authors declare that they have no conflict of interest.

Received: 21 June 2022 / Accepted: 12 April 2023

Published online: 20 April 2023

## References

1. DO AUSTERMAN J. ADHD and behavioral disorders: assessment, management, and an update from DSM-5. *Cleve Clin J Med*. 2015;82:3.
2. Kaplan BJ. Kaplan and sadock's synopsis of psychiatry. *Behavioral sciences/clinical psychiatry*. *Tijdschrift voor Psychiatrie*. 2016;58(1):78–9.
3. Sharma A, Couture J. A review of the pathophysiology, etiology, and treatment of attention-deficit hyperactivity disorder (ADHD). *Ann Pharmacother*. 2014;48(2):209–25.
4. Liu A, Xu Y, Yan Q, Tong L. The prevalence of attention deficit/hyperactivity disorder among chinese children and adolescents. *Sci Rep*. 2018;8(1):1–15.
5. Rappley MD. Attention deficit–hyperactivity disorder. *N Engl J Med*. 2005;352(2):165–73.
6. Reale L, Bartoli B, Cartabia M, Zanetti M, Costantino MA, Canevini MP, et al. Comorbidity prevalence and treatment outcome in children and adolescents with ADHD. *Eur Child Adolesc Psychiatry*. 2017;26(12):1443–57.
7. Ngan M, Tsang B, Kwong K. Prevalence. Risk factors and impact of ADHD on children with recent Onset Epilepsy. *HK J Paediatr (new series)*. 2019;24(2):65–9.
8. Kim JH, Kim JY, Lee J, Jeong GH, Lee E, Lee S, et al. Environmental risk factors, protective factors, and peripheral biomarkers for ADHD: an umbrella review. *The Lancet Psychiatry*. 2020;7(11):955–70.
9. Rucklidge JJ. Gender differences in attention-deficit/hyperactivity disorder. *Psychiatr Clin North Am*. 2010 Jun;33(2):357–73.
10. Guardiola A, Fuchs FD, Rotta NT. Prevalence of attention-deficit hyperactivity disorders in students: comparison between DSM-IV and neuropsychological criteria. *Arq Neuropsiquiatr*. 2000;58:401–7.
11. Shaabani M, Yadegari A. Prevalence of attention deficit hyperactivity disorder (ADHD) in elementary school children in Zanjan 2004–2005. *J Adv Med Biomedical Res*. 2005;13(51):42–8.
12. Adewuya AO, Famuyiwa OO. Attention deficit hyperactivity disorder among nigerian primary school children prevalence and co-morbid conditions. *Eur Child Adolesc Psychiatry*. 2007;16(1):10–5.
13. Mhalla A, Guedria A, Brahem T, Amamou B, Sboui W, Gaddour N, et al. ADHD in tunisian adolescents: prevalence and associated factors. *J Atten Disord*. 2018;22(2):154–62.
14. Oeseburg B, Jansen D, Dijkstra G, Groothoff J, Reijneveld S. Prevalence of chronic diseases in adolescents with intellectual disability. *Res Dev Disabil*. 2010;31(3):698–704.
15. Maalouf FT, Ghandour LA, Halabi F, Zeinoun P, Tavitian L. Psychiatric disorders among adolescents from Lebanon: prevalence, correlates, and treatment gap. *Soc Psychiatry Psychiatr Epidemiol*. 2016;51(8):1105–16.
16. Moher D, Liberati A, Tetzlaff J, Altman DG, Group P. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med*. 2009;6(7):e1000097.
17. Eriksen MB, Frandsen TF. The impact of patient, intervention, comparison, outcome (PICO) as a search strategy tool on literature search quality: a systematic review. *J Med Libr Association: JMLA*. 2018;106(4):420.
18. Abdekhoodaie Z, Tabatabaei SM, Gholizadeh M. The investigation of ADHD prevalence in kindergarten children in northeast Iran and a determination of the criterion validity of Conners' questionnaire via clinical interview. *Res Dev Disabil*. 2012;33(2):357–61.
19. Aboul-Ata MA, Amin FA. The prevalence of ADHD in Fayoum City (Egypt) among school-age children: depending on a DSM-5-based rating scale. *J Atten Disord*. 2018;22(2):127–33.
20. Bradshaw LG, Kamal M. Prevalence of ADHD in qatari school-age children. *J Atten Disord*. 2017;21(5):442–9.
21. Afeti K, Nyarko SH. Prevalence and effect of attention-deficit/hyperactivity disorder on school performance among primary school pupils in the Hohoe Municipality. *Ghana Annals of general psychiatry*. 2017;16(1):1–7.

22. Al Azzam M, Al Bashtawy M, Tubaishat A, Batiha A-M, Tawalbeh L. Prevalence of attention deficit hyperactivity disorder among school-aged children in Jordan. *East Mediterr Health J*. 2017;23(7):486–91.
23. Alqahtani MM. Attention-deficit hyperactive disorder in school-aged children in Saudi Arabia. *Eur J Pediatrics*. 2010;169(9):1113–7.
24. Ambuabunos E, Ofewe E, Ibadin M. Community survey of attention-deficit/hyperactivity disorder among primary school pupils in Benin City, Nigeria. *Annals of African Medicine*. 2011;10(2).
25. Amiri S, Mohammadi MR, Ahmadi N, Khaleghi A, Nourouzi S, Asl Rahimi V et al. Prevalence of Psychiatric Disorders Among Children and Adolescents in the East Azerbaijan Province, Tabriz, Iran in 2017. *Iranian Journal of Psychiatry and Behavioral Sciences*. 2019;13(4).
26. Anokye R, Acheampong E, Edusei A, Owusu I, Mprah WK. Prevalence of attention-deficit/hyperactivity disorder among primary school children in Oforikrom, Ghana based on the disruptive behavior disorders rating scale. *East Asian Archives of Psychiatry*. 2020;30(3):88–90.
27. Baumgaertel A, Wolraich ML, Dietrich M. Comparison of diagnostic criteria for attention deficit disorders in a german elementary school sample. *J Am Acad Child Adolesc Psychiatry*. 1995;34(5):629–38.
28. Bozkurt ÖH, Dirik E, Üneri ÖŞ. Prevalence of ADHD in Northern Cyprus. *Anadolu Psikiyatri Dergisi*. 2017;18(5):478.
29. Bronsard G, Lançon C, Loundou A, Auquier P, Rufo M, Siméoni M-C. Prevalence rate of DSM mental disorders among adolescents living in residential group homes of the french child Welfare System. *Child Youth Serv Rev*. 2011;33(10):1886–90.
30. Canals J, Morales-Hidalgo P, Jané MC, Domènech E. ADHD prevalence in spanish preschoolers: comorbidity, socio-demographic factors, and functional consequences. *J Atten Disord*. 2018;22(2):143–53.
31. Catherine TG, Robert NG, Mala KK, Kanniammal C, Arullapan J. Assessment of prevalence of attention deficit hyperactivity disorder among schoolchildren in selected schools. *Indian J psychiatry*. 2019;61(3):232.
32. Cuffe SP, Moore CG, McKeown RE. Prevalence and correlates of ADHD symptoms in the national health interview survey. *J Atten Disord*. 2005;9(2):392–401.
33. de la Barra FE, Vicente B, Saldivia S, Melipillan R. Epidemiology of ADHD in Chilean children and adolescents. *ADHD Atten Deficit Hyperactivity Disorders*. 2013;5(1):1–8.
34. Dodangi N, Ashtiani NH, Valadbeigi B. Prevalence of DSM-IV TR psychiatric disorders in children and adolescents of Paveh, a western city of Iran. *Iranian Red Crescent Medical Journal*. 2014;16(7).
35. Egbochuku E, Abikwi M. The prevalence of attention deficit/hyperactivity disorder (ADHD) among primary school pupils of Benin Metropolis, Nigeria. *J Hum Ecol*. 2007;22(4):317–22.
36. El-Nemr FM, Badr HS, Salem MS. Prevalence of attention deficit hyperactivity disorder in children. *Sci J Public Health*. 2015;3(2):274–80.
37. Erşan EE, Doğan O, Doğan S, Sümer H. The distribution of symptoms of attention-deficit/hyperactivity disorder and oppositional defiant disorder in school age children in Turkey. *Eur Child Adolesc Psychiatry*. 2004;13(6):354–61.
38. Alyahri A, Goodman R. The prevalence of DSM-IV psychiatric disorders among 7–10 year old Yemeni schoolchildren. *Soc Psychiatry Psychiatr Epidemiol*. 2008;43(3):224–30.
39. Farahat T, Alkot M, Rajab A, Anbar R. Attention-deficit hyperactive disorder among primary school children in Menoufia Governorate, Egypt. *International journal of family medicine*. 2014;2014.
40. Farbstein I, Mansbach-Kleinfeld I, Auerbach JG, Ponizovsky AM, Apter A. The Israel Survey of Mental Health among adolescents: prevalence of attention-deficit/hyperactivity disorder, comorbidity, methylphenidate use, and help-seeking patterns. *Isr Med Association journal: IMAJ*. 2014;16(9):568–73.
41. Feiz P, Emamipour S. A survey on prevalence rate of attention-deficit hyperactivity disorder among elementary school students (6–7 years old) in Tehran. *Procedia-Social and Behavioral Sciences*. 2013;84:1732–5.
42. Fleitlich-Bilyk B, Goodman R. Prevalence of child and adolescent psychiatric disorders in southeast Brazil. *J Am Acad Child Adolesc Psychiatry*. 2004;43(6):727–34.
43. Ford T, Goodman R, Meltzer H. The British child and adolescent mental health survey 1999: the prevalence of DSM-IV disorders. *J Am Acad Child Adolesc Psychiatry*. 2003;42(10):1203–11.
44. Froehlich TE, Lanphear BP, Epstein JN, Barbaresi WJ, Katusic SK, Kahn RS. Prevalence, recognition, and treatment of attention-deficit/hyperactivity disorder in a national sample of US children. *Arch Pediatr Adolesc Med*. 2007;161(9):857–64.
45. Gallardo-Saavedra GA, del Consuelo Martínez-Wbaldo M, Padrón-García AL. Prevalence of ADHD in Mexican schoolchildren through screening with Conners scales 3. *Actas Esp Psiquiatr*. 2019;47(2):45–53.
46. Gau SS, Chong M-Y, Chen TH, Cheng AT. A 3-year panel study of mental disorders among adolescents in Taiwan. *Am J Psychiatry*. 2005;162(7):1344–50.
47. Ghosh P, Choudhury HA, Victor R. Prevalence of attention deficit hyperactivity disorder among primary school children in Cachar, Assam, North-East India. *Open J Psychiatry Allied Sci*. 2018;9(2):130–5.
48. Gomez R, Hafetz N, DSM-IV ADHD. Prevalence based on parent and teacher ratings of Malaysian primary school children. *Asian J Psychiatry*. 2011;4(1):41–4.
49. Gul N, Tiryaki A, Kultur SEC, Topbas M, Ak I. Prevalence of attention deficit hyperactivity disorder and comorbid disruptive behavior disorders among school age children in Trabzon. *Klinik Psikofarmakoloji Bülteni-Bulletin of Clinical Psychopharmacology*. 2010;20(1):50–6.
50. Heiervang E, Stormark KM, Lundervold AJ, Heimann M, Goodman R, Posserud M-B, et al. Psychiatric disorders in Norwegian 8- to 10-year-olds: an epidemiological survey of prevalence, risk factors, and service use. *J Am Acad Child Adolesc Psychiatry*. 2007;46(4):438–47.
51. Ramya H, Goutham A, Lakshmi VP. Prevalence of attention deficit hyperactivity disorder in school going children aged between 5–12 years in Bengaluru. *Curr Pediatr Res*. 2017;21(2):321–6.
52. Huang Y, Zheng S, Xu C, Lin K, Wu K, Zheng M, et al. Attention-deficit hyperactivity disorder in elementary school students in Shantou, China: prevalence, subtypes, and influencing factors. *Neuropsychiatr Dis Treat*. 2017;13:785.
53. Lecendreux M, Konofal E, Faraone SV. Prevalence of attention deficit hyperactivity disorder and associated features among children in France. *J Atten Disord*. 2011;15(6):516–24.
54. Leib S, Gilon Mann T, Stein D, Vusiker I, Tokatly Latzer I, Ben-Ami M, et al. High prevalence of attention - deficit/hyperactivity disorder in adolescents with severe obesity seeking bariatric surgery. *Acta Paediatr*. 2020;109(3):581–6.
55. Leung PW, Hung S-f, Ho T-p, Lee C-c, Liu W-s, Tang C-p, et al. Prevalence of DSM-IV disorders in Chinese adolescents and the effects of an impairment criterion. *Eur Child Adolesc Psychiatry*. 2008;17(7):452–61.
56. Mhalla A, Guedria A, Brahem T, Amamou B, Sbouui W, Gaddour N et al. ADHD in Tunisian Adolescents: Prevalence and Associated Factors. *JOURNAL OF ATTENTION DISORDERS*. 2018;22(2, SI):154 – 62.
57. Michanie C, Kunst G, Margulies DS, Yakhkind A. Symptom prevalence of ADHD and ODD in a pediatric population in Argentina. *J Atten Disord*. 2007;11(3):363–7.
58. Mohammadi M-R, Zarafshan H, Khaleghi A, Ahmadi N, Hooshyari Z, Mostafavi S-A, et al. Prevalence of ADHD and its comorbidities in a population-based sample. *J Atten Disord*. 2021;25(8):1058–67.
59. Nafi OA, Shaheen AM. Prevalence of attention deficit hyperactive disorder (ADHD) in school children in Al-Qaser district Jordan. *Jordan Med J*. 2011;45(1):37–43.
60. Pham HD, Nguyen HBH, Tran DT. Prevalence of ADHD in primary school children in Vinh Long. *Vietnam Pediatr Int*. 2015;57(5):856–9.
61. Pillai A, Patel V, Cardozo P, Goodman R, Weiss HA, Andrew G. Non-traditional lifestyles and prevalence of mental disorders in adolescents in Goa, India. *Br J Psychiatry*. 2008;192(1):45–51.
62. Rohde LA, Biederman J, Busnello EA, Zimmermann H, Schmitz M, Martins S, et al. ADHD in a school sample of Brazilian adolescents: a study of prevalence, comorbid conditions, and impairments. *J Am Acad Child Adolesc Psychiatry*. 1999;38(6):716–22.
63. Sadollahi A, Ghorbani R, Bakhtiyari J, Salmani M, Khademi A, Mohammadi N et al. Prevalence of attention deficit hyperactivity disorders in first to third grades primary school students in Semnan, Iran. *Koomesh*. 2019;21(2).
64. Safavi P, Ganji F, Bidad A. Prevalence of attention-deficit hyperactivity disorder in students and needs modification of mental health services in Shahrekord, Iran in 2013. *J Clin Diagn research: JCDR*. 2016;10(4):LC25.
65. Sánchez EY, Velarde S, Britton GB. Estimated prevalence of attention-deficit/hyperactivity disorder in a sample of Panamanian school-aged children. *Child Psychiatry & Human Development*. 2011;42(2):243–55.
66. Shen Y-M, Chan BSM, Liu J-B, Zhou Y-Y, Cui X-L, He Y-Q, et al. The prevalence of psychiatric disorders among students aged 6 ~ 16 years old in central Hunan, China. *BMC Psychiatry*. 2018;18(1):1–9.
67. Talaei A, Mokhber N, Abdollahian E, Bordbar MRF, Salari E. Attention deficit/hyperactivity disorder: a survey on prevalence rate among male subjects in elementary school (7 to 9 years old) in Iran. *J Atten Disord*. 2010;13(4):386–90.

68. Umar M, Obindo J, Omigbodun O. Prevalence and correlates of ADHD among adolescent students in Nigeria. *J Atten Disord*. 2018;22(2):116–26.
69. Venkata JA, Panicker AS. Prevalence of attention deficit hyperactivity disorder in primary school children. *Indian J psychiatry*. 2013;55(4):338.
70. Vreugdenhil C, Doreleijers TA, Vermeiren R, Wouters LF, Van Den Brink W. Psychiatric disorders in a representative sample of incarcerated boys in the Netherlands. *J Am Acad Child Adolesc Psychiatry*. 2004;43(1):97–104.
71. Wamithi S, Ochieng R, Njenga F, Akech S, Macharia WM. Cross-sectional survey on prevalence of attention deficit hyperactivity disorder symptoms at a tertiary care health facility in Nairobi. *Child Adolesc Psychiatry Mental Health*. 2015;9(1):1–7.
72. Wamulugwa J, Kakooza A, Kitaka SB, Nalugya J, Kaddumukasa M, Moore S, et al. Prevalence and associated factors of attention deficit hyperactivity disorder (ADHD) among ugandan children; a cross-sectional study. *Child Adolesc Psychiatry Mental Health*. 2017;11(1):1–7.
73. Wichstrøm L, Berg-Nielsen TS, Angold A, Egger HL, Solheim E, Sveen TH. Prevalence of psychiatric disorders in preschoolers. *J Child Psychol Psychiatry*. 2012;53(6):695–705.
74. Zwirns BW, Burger H, Schulpen TW, Wiznitzer M, Fedder H, Buitelaar JK. Prevalence of psychiatric disorders among children of different ethnic origin. *J Abnorm Child Psychol*. 2007;35(4):556–66.
75. Sayal K, Prasad V, Daley D, Ford T, Coghill D. ADHD in children and young people: prevalence, care pathways, and service provision. *The Lancet Psychiatry*. 2018;5(2):175–86.
76. Willcutt EG. The prevalence of DSM-IV attention-deficit/hyperactivity disorder: a meta-analytic review. *Neurotherapeutics*. 2012;9(3):490–9.
77. Ayano G, Yohannes K, Abraha M. Epidemiology of attention-deficit/hyperactivity disorder (ADHD) in children and adolescents in Africa: a systematic review and meta-analysis. *Ann Gen Psychiatry*. 2020;19(1):1–10.
78. Catalá-López F, Peiró S, Ridaio M, Sanfélix-Gimeno G, Gènova-Maleras R, Catalá MA. Prevalence of attention deficit hyperactivity disorder among children and adolescents in Spain: a systematic review and meta-analysis of epidemiological studies. *BMC Psychiatry*. 2012;12(1):1–13.
79. Wang T, Liu K, Li Z, Xu Y, Liu Y, Shi W, et al. Prevalence of attention deficit/hyperactivity disorder among children and adolescents in China: a systematic review and meta-analysis. *BMC Psychiatry*. 2017;17(1):1–11.
80. Epstein JN, Loren RE. Changes in the definition of ADHD in DSM-5: subtle but important. *Neuropsychiatry*. 2013;3(5):455.
81. Song P, Zha M, Yang Q, Zhang Y, Li X, Rudan I. The prevalence of adult attention-deficit hyperactivity disorder: a global systematic review and meta-analysis. *Journal of global health*. 2021;11.
82. Baggio S, Fructuoso A, Guimaraes M, Fois E, Golay D, Heller P, et al. Prevalence of attention deficit hyperactivity disorder in detention settings: a systematic review and meta-analysis. *Front Psychiatry*. 2018;9:331.
83. Young S, Moss D, Sedgwick O, Fridman M, Hodgkins P. A meta-analysis of the prevalence of attention deficit hyperactivity disorder in incarcerated populations. *Psychol Med*. 2015;45(2):247–58.

### Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.