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Review Article

# The global prevalence of attention deficit hyperactivity disorder in children and adolescents: An umbrella review of meta-analyses

Getinet Ayano [a,*], Sileshi Demelash [b,f], Yitbarek Gizachew [c], Light Tsegay [d,1], Rosa Alati [a,e,1]

[a] School of Population Health, Curtin University, Australia
[b] Ethiopian Public Health Institute, Addis Ababa, Ethiopia
[c] Bethel Medical College, Addis Ababa, Ethiopia
[d] Aksum University, Aksum, Ethiopia
[e] Institute for Social Science Research, The University of Queensland, Brisbane, QLD, Australia
[f] Department of Family Medicine, CAPHRI School for Public Health and Primary Care, Maastricht University, Maastricht, The Netherlands

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ABSTRACT

*Background:* Emerging epidemiological data suggest that hundreds of primary studies have examined the prevalence of ADHD in children and adolescents and dozens of systematic view and meta-analyses studies have been conducted on the subject. The purpose of this umbrella review is to provide a robust synthesis of evidence from these systematic reviews and meta-analyses.

*Methods:* We systematically searched PubMed, Web of Science, PsychINFO, and Scopus to find pertinent studies. The study was preregistered with PROSPERO (CRD42023389704). The quality of the studies was assessed using a Measurement Tool to Assess Systematic Reviews (AMSTAR). Prevalence estimates from the included studies were pooled using invariance variance weighted random-effect meta-analysis.

*Results:* Thirteen meta-analytic systematic reviews (588 primary studies) with 3,277,590 participants were included in the final analysis. A random effect meta-analysis of these studies showed that the global prevalence of ADHD in children and adolescents was 8.0 % (95%CI 6.0–10 %). The prevalence estimate was twice higher in boys (10 %) compared to girls (5 %). Of the three subtypes of ADHD, the inattentive type of ADHD (ADHD-I) was found to be the most common type of ADHD followed by the hyperactive (ADHD-HI) and the combined types (ADHD-C).

*Conclusion:* Findings from our compressive umbrella review suggest that ADHD is highly prevalent in children and adolescents with boys twice more likely to experience the disorder than girls. Our results underpin that priority should be given to preventing, early identifying, and treating ADHD in children and adolescents.

## 1. Introduction

Attention deficit hyperactivity disorder (ADHD) is a complex neurodevelopmental disorder that can affect individuals across the lifespan (APA, 2013; Ayano et al., 2020; Berger, 2011; Cortese et al., 2012). It is associated with widespread heterogeneity in terms of causes, clinical presentations, and treatment outcomes (APA, 2013; Ayano et al., 2021; Berger, 2011; Cortese et al., 2012). ADHD is primarily characterized by developmentally inappropriate, persistent, and impaired levels of inattention, hyperactivity, and impulsivity resulting from a widespread and subtle alteration of gene expressions in multiple brain regions affecting brain function (APA, 2013; Berger, 2011; Cortese et al., 2012). ADHD has been most commonly diagnosed in school-age children, but it can occur in any age group (Ayano et al., 2020; Montano, 2004). Emerging evidence also suggests that ADHD is among the biggest contributors to the global burden of disease in children and adolescents and evidence suggests that the cost of raising children with ADHD is considerably high when compared with raising children without such disorder (Chan et al., 2002; Doshi et al., 2012). For example, a 2019 study by Zhao and colleagues found that the economic burden of raising children and adolescents with DAHD was five times higher than raising children without ADHD, with the excess economic burden primarily being driven by the indirect cost associated with losing their jobs or missed workdays (Zhao et al., 2019). ADHD in children and adolescents has also a significant

* Corresponding author at: School of Population Health, Curtin University, WA, Australia.
*E-mail addresses:* babiget2015@gmail.com, g.yaya@curtin.edu.au (G. Ayano), rosa.alati@curtin.edu.au (R. Alati).
[1] Joint last authors.

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impact on academic performance as well as physical and mental health (Ayano et al., 2023; Ayano et al., 2022; Pang et al., 2021). According to the World Federation of ADHD International Consensus Statement that offered 208 evidence-based conclusions about the disorder, there are widespread misconceptions and stigma regrading ADHD and the prevalence of ADHD in children and adolescent ranged from 5.9 to 14 % (Faraone et al., 2021).

Several systematic reviews and meta-analyses have been published exploring the prevalence of ADHD in children and adolescents (Cénat et al., 2022; Polanczyk et al., 2007; Thomas et al., 2015; Vasileva et al., 2021). These studies examined the prevalence rates in children and adolescents across a wide rages countries including China, Spain, India, Africa, the USA, and other countries (Cénat et al., 2022; Chan et al., 2021; Polanczyk et al., 2007; Thomas et al., 2015; Vasileva et al., 2021; Wang et al., 2017; Yadegari et al., 2018). In addition, the reviews reported inconsistent findings ranging from 3.4 to 14 % (Cénat et al., 2022; Polanczyk et al., 2007; Thomas et al., 2015; Vasileva et al., 2021). For example, a meta-analytic study by Polanczyk and colleagues in 2015 including 13 studies with 20,125 participants the prevalence of ADHD was 3 % (Polanczyk et al., 2015). Another meta-analysis with relatively few of studies (n = 15) involving 201,765 participants the prevalence of ADHD was 4.4 % (Vasileva et al., 2021). In the contrary, in 2015 meta-analytic studies involving 175 studies with 1,023,071 children and adolescents a prevalence of 7.2 % which was considerably higher that the above studies with few numbers of identified articles and participants (Thomas et al., 2015). Other similar studies reported consistent findings (Ayano et al., 2020). Another meta-analytic review in the USA found that 14 % of children and adolescents in America had ADHD (Cénat et al., 2021). The main reasons for the difference could be geographic variations in the prevalence. For example, in two meta-analytic systematic reviews conducted in America by Cenat and colleagues, the prevalence estimates of ADHD were 15.9 % in Black American children and adolescents, 16.6 % among Whites, and 12.4 % among Asians (Cénat et al., 2021; Cénat et al., 2022). These estimates are 1.5 to 2.5 times higher than shown in studies conducted in other countries such as Africa, India, and China (Ayano et al., 2020; Catalá-López et al., 2012; Cénat et al., 2021; Cénat et al., 2022; Chan et al., 2021; Chauhan et al., 2022; Polanczyk et al., 2007; Polanczyk et al., 2015; Thomas et al., 2015; Vasileva et al., 2021; Wang et al., 2017; Willcutt, 2012; Yadegari et al., 2018). The other possible reasons for the observed differences in prevalence rates could be the methodological differences across the studies, the year where the studies were conducted (ranging from 2007 to 2021), and the scope of the meta-analysis. For example, some reviews estimated the prevalence rates in a single country, some in the continent, and some internationally (Ayano et al., 2020; Catalá-López et al., 2012; Cénat et al., 2021; Cénat et al., 2022; Chan et al., 2021; Chauhan et al., 2022; Polanczyk et al., 2007; Polanczyk et al., 2015; Thomas et al., 2015; Vasileva et al., 2021; Wang et al., 2017; Willcutt, 2012; Yadegari et al., 2018).

Umbrella reviews—a systematic collection and assessment of multiple systematic reviews and meta-analyses done on a specific research topic can address these limitations by appraising the quality and the methodological rigor of the studies, as well as conducting a robust synthesis of the evidence reporting a wide range of mixed results (Slim and Marquillier, 2022).

Therefore, the purpose of this umbrella review is to provide a robust synthesis of evidence from these systematic reviews and meta-analyses. Specifically, we aimed to consolidate: (1) the global prevalence estimates of ADHD in children and adolescents; (2) the prevalence estimates specifically in boys and girls; and (3) the prevalence estimates for the three subtypes of ADHD. We hoped to provide clinicians, researchers, and policymakers with robust data on the global burden of ADHD in children and adolescents.

## 2. Methods

### 2.1. Research design and methods

Following the preferred reporting items for systematic review and meta-analysis guideline (Moher et al., 2009), we conducted umbrella review of systematic review and meta-analysis of observational studies that examined the prevalence of ADHD in children and adolescents. The protocol for this review has been preregistered in the International Prospective Register of Systematic Reviews (PROSPERO) (CRD42023389704).

### 2.2. Data source and searches

We systematically searched PubMed, Web of Science, PsychINFO, and Scopus to find pertinent studies using a structured search strategy. No date and language restrictions were applied. Two authors (GA and LT) independently screened and reviewed full-text articles according to predefined inclusion and exclusion criteria. The search was performed using the following relevant search terms: (i) ADHD, attention deficit hyeractivity disorders; (ii) prevalence, epidemiology, rates; (iii) adolescent, children; and (iv) Systematic review, meta-analyses, quantitative synthesis, systematic literature review. Details of the search strategy are available as Supplementary material (Supplementary material 1). We also hand searched the references of the included article to detect studies that may not have been included in the above three e; electronic databases.

### 2.3. Eligibility criteria

The eligibility criteria included: (1) meta-analytic systematic reviews; (2) if they reported the prevalence of ADHD; (3) conducted in children and adolescents; and (4) whether they were published in the English language. Narrative reviews, commentaries, qualitative systematic reviews, and studies conducted in adults were excluded.

### 2.4. Data abstraction

From each eligible meta-analysis, we extracted the first author's name, publication year, database searched, number of primary studies, number of ADHD cases, geographic location, total sample size, ADHD prevalence in boys and girls, and the rates for the different subtypes of ADHD.

### 2.5. Study quality

The methodologic quality of the included articles was appraised by two independent authors (GA and LT) using the Assessment of Multiple systematic reviews (AMSTAR) tool (Shea et al., 2007). The tool consists of 11 items designed to evaluate the methodologic quality of meta-analyses (Shea et al., 2007). In agreement with previous umbrella reviews, we used three standard scoring categories: low quality (Scores 0–3) moderate quality (scored 4–7), and high quality (scored 8–11) (Chesney et al., 2014).

### 2.6. Data synthesis and analysis

Stata Version 16.1 was used to conduct meta-analyses. Considering the heterogeneity of the reported rates into account, prevalence estimates from the included studies were pooled using invariance variance weighted random-effect meta-analysis. Cochrane's Q and $I^2$ test were conducted to evaluate the heterogeneity across the studies (Borenstein et al., 2010). The heterogeneity was categorized into three: low ($I^2$ values of 25), moderate ($I^2$ values of 50), and high ($I^2$ values of 75) (Higgins et al., 2003). The presence of potential publication bias was assessed graphically using a funnel plot and statistically using Egger's

test (Egger et al., 1997). Subgroup analyses were conducted by the by gender (boys and girls) and the subtype of ADHD [the inattentive type of ADHD (ADHD-I) the hyperactive (ADHD-HI)] and the combined types (ADHD-C). A p-value of $<0.05$ was considered as statistically significant.

## 3. Results

### 3.1. Study selection

The PRISMA flow diagram shows the study selection and inclusion process (Fig. 1). A total of 1148 studies were detected by our initial electronic search. Through a manual search of other sources, we found additional 2 papers. After duplicate removal (263 citations), 887 papers were assessed at the title/abstract level. Consequently, 19 papers that met the eligibility criteria were preserved to be read in full. Finally, 13 meta-analytic reviews were included in this umbrella review (Ayano et al., 2020; Catalá-López et al., 2012; Cénat et al., 2021; Cénat et al., 2022; Chan et al., 2021; Chauhan et al., 2022; Polanczyk et al., 2007; Polanczyk et al., 2015; Thomas et al., 2015; Vasileva et al., 2021; Wang et al., 2017; Willcutt, 2012; Yadegari et al., 2018) (Table 1).

### 3.2. Characteristics of included studies

Table 1 presents the characteristics of the included articles. Thirteen systematic review and meta-analytic studies including 588 primary studies and 478,146 ADHD cases were included in this analysis. Selected reviews were published between 2007 (Polanczyk et al., 2007) and 2022 (Chauhan et al., 2022). The average number of databases searched in the included reviews was 4 ranging from 2 to 7. PubMed/Medline (n = 11) was the commonest most common source of information followed by PsychInfo (n = 7) and ERIC/Embase (via Ovid) (n = 6). The median number of studies included in meta-analyses was 21 (ranged 5–175); whereas the median number of participants was 43,972 0 (ranged 5499–1,613,780) and the median number of ADHD cases was 2595 (ranged 527–221,088).

Of the 11 studies, three studies reported prevalence rates in both

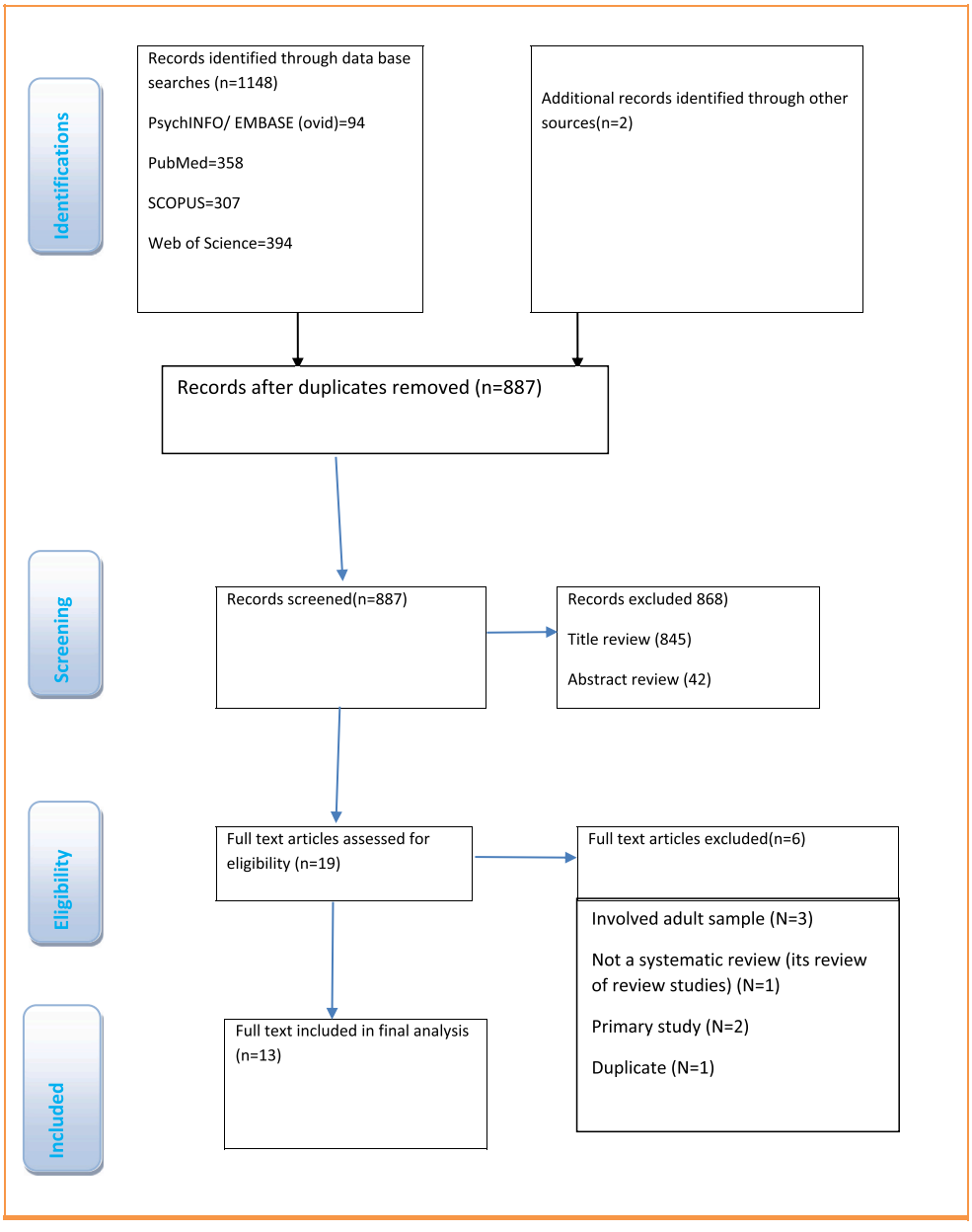


**Fig. 1.** PRISMA flowchart of review search.

**Table 1**
Characteristics of the included studies.

| Author year | Database searched | Number of primary studies | Case | Sample size | Prevalence rates | Type of ADHD | Prevalence by gender | Regions |
|---|---|---|---|---|---|---|---|---|
| Ayano et al., 2020 | PubMed, Embase, and Scopus | 12 | 856 | 11,465 | 7.47 | (ADHD-I) 2.95 % (ADHD-HI) 2.77 % (ADHD-C) 2.44 % | Boys (10.60 %), 425/4008 Girls (5.28 %) 199/3769 | Africa |
| Willcutt, 2012 | Pubmed, PsycINFO, Educational Resources Information Center (ERIC), and Social Sciences Citation Index databases | 20 | 2595 | 43,972 | 5.9 | (ADHD-I) 4.3 (ADHD-HI) 2.6 (ADHD-C) 2.27 % | – | Global |
| Wang et al., 2017 | PubMed, Web of Science, MEDLINE, CNKI, Wanfang, Weipu and CBM databases | 67 | 17,247 | 275,502 | 6.26 | (ADHD-I) 3.24, 3183/ 103132 (ADHD-HI) 1.16, 1223/ 103132 (ADHD-C) 1.71 %, 1952/ 10132 | Boys (8.17 %), 10,913/ 132,904 Girls (6.22 %), 8519/124,391 | China |
| Polanczyk et al., 2015 | PubMed, PsycINFO, and EMBASE | 33 | 2629 | 77,297 | 3.4 | – | – | Global |
| Chauhan et al., 2022 | Pub-Med, EMBASE | 19 | 1846 | 29,200 | 6.32 | – | – | India |
| Thomas et al., 2015 | Medline, PsycINFO, CINAHL, Embase, and Web of Science | 175 | 73,662 | 1,023,071 | 7.2 | – | – | Global |
| Cénat et al., 2021 | APA PsycInfo, MEDLINE, Embase, Cochrane CENTRAL, CINAHL, ERIC, and Education Source databases. | 21 | 145,855 | 20,230 | 13.87 | – | – | Black US individuals |
| Cénat et al., 2021 | Seven databases, including APA PsycInfo (Ovid), Medline (Ovid), Embase (Ovid), Cochrane CENTRAL (Ovid), CINAHL (Ebsco), ERIC (Ovid), and Education Source (Ebsco). | 82 | 221,088 | 1,613,780 | 13.7 | – | | Black, White, Latino, and Asian in United States and, Canada |
| Catalá-López et al., 2012 | PubMed/MEDLINE, IME, IBECS and TESEO | 16 | 898 | 13,026 | 6.8 | – | – | Spain |
| Vasileva et al., 2021 | Web of Science, PsycINFO, PSYNDEX, MEDLINE, and Embase. | 8 | 742 | 17,243 | 4.3 | – | – | Global |
| Polanczyk et al., 2007 | MEDLINE and PsycINFO | 102 | 9086 | 171,756 | 5.29 | – | Boys (10 %), 171,756/ 171,756 Girls (4.7 %) 199/3769 | Global |
| Chan et al., 2021 | Scopus, Pro-Quest, Pubmed | 5 | 527 | 5499 | 11.56 | – | – | The Gulf Cooperation Council (GCC), |
| Yadegari et al., 2018 | Magiran, SID, Google Scholar | 27 | 1815 | 15,124 | 12.0 | – | – | Iran |

male and female participants and three studies reported a separate data for the various categories of ADHD — ADHD-I, ADHD-H, and ADHD-C.

Six reviews investigated the global prevalence of ADHD; three studies examined the prevalence in the USA, one study in China, one study in Spain, and one in Africa.

### 3.3. Quality assessment

The AMSTAR tool was used to examine the methodological quality of the included systematic review and meta-analytic studies. Three reviews (23.08 %) had a medium quality score, 10 (76.92 %) reviews had high quality, and no review had low quality (Supplementary material 2). Notably, the vast majority of the included systematic reviews failed to search for grey literature (2/13 systematic reviews achieved this) and the prespecified study protocol (1/13 reviews achieved this).

### 3.4. Prevalence of ADHD

The reported prevalence of ADHD ranged from 3.4 % to 14 % in the presence of high heterogeneity. A random effect meta-analysis based on 588 original studies derived from 13 meta-analyses resulted in a pooled prevalence of ADHD of 8.0 % (95%CI 6.0–10 %). The heterogeneity across the studies was significant ($Q = 55{,}944.61$; $I^2 = 99.98$; $p < 0.0001$) (Fig. 2). There is no evidence for publication bias ($\beta = 7.48$; $SE = 8.736$; $p = 0.3916$) (Fig. 3).

A stratified meta-analysis based on gender revealed that the prevalence of ADHD was twice higher in boys (10 %; 95 % CI 8–11 %) than in girls (5 %; 95 % CI 4–7). Our subgroup analyses by the type of ADHD showed that the inattentive type of ADHD was the commonest type of ADHD (ADHD-I) [3 % (95%CI 2.0–4 %)] followed by hyperactive type (ADHD-HI) [2.95 % (95%CI 1.8–4 %)] and the combined type (ADHD-C) [2.44 %, (95 % CI: 1.5–3.5 %)].

In terms of gender, ADHD-I was found to be the most common subtype of ADHD in both males and females (4.05 %; 95 % CI 3.11–5.27 % in males and (2.21 %; 95 % CI 1.61–3.03 %) in females) when compared with the other ADHD subtypes such as ADHD-C (3.63 %; 95 % CI 2.87–5.87 %) in males and (1.52 %; 95 % CI 1.11–2.08 %) in females and ADHD-HI (3.61 %; 95 % CI 1.88–6.82 %) in males and (1.50 %; 95 % CI

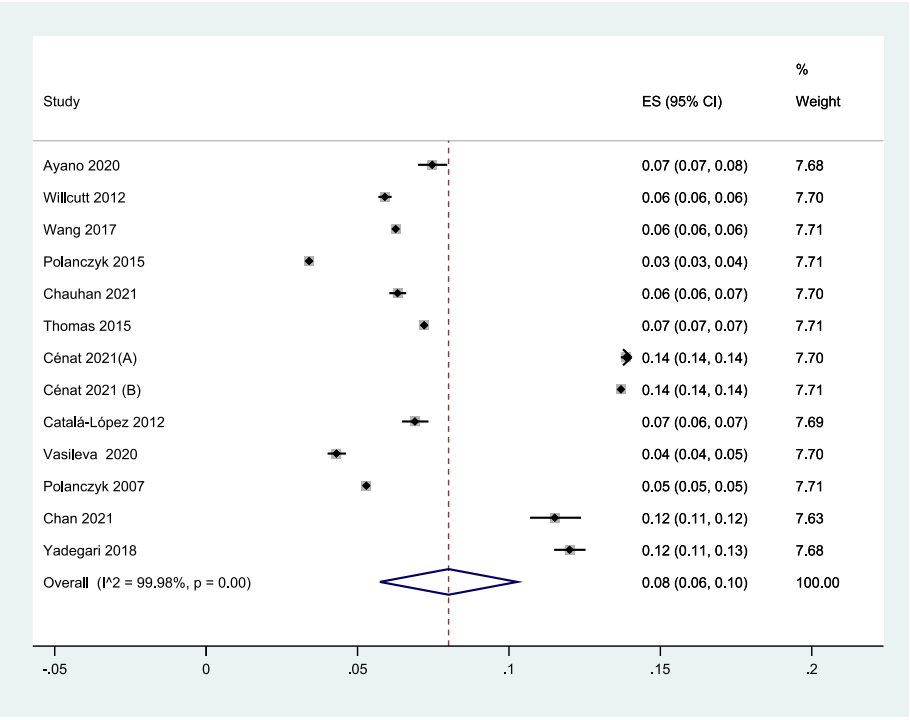


**Fig. 2.** Forest plot for the prevalence estimate of ADHD in children and adolescents.
"In this forest plot, we summarized data from the included studies in a single image. ES denotes estimates, which indicate prevalence rates/proportions with their 95% confidence intervals (95% CI). Each horizontal line on a forest plot represents an individual study with the result plotted as a box (prevalence estimates) and the 95% confidence interval of the result displayed as the line. ***The diamond at the bottom of the forest plot shows*** the result when all the individual studies are combined together and averaged. The horizontal points of the diamond are the limits of the 95% confidence intervals and are subject to the same interpretation as any of the other individual studies on the plot".

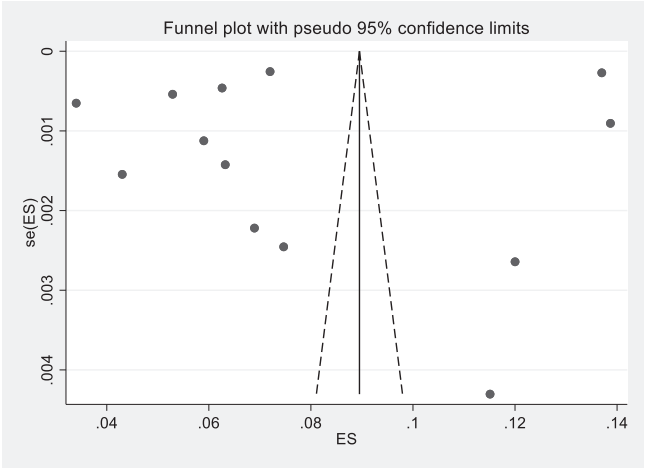


**Fig. 3.** Funnel plot for the prevalence of ADHD in children and adolescents.
"The horizontal axis of the figure (X-axis) represents the mean result (mean prevalence estimates denoted by ES) and the Y-axis shows the sample size or an index of precision The solid vertical line represents the summary estimate of the treatment effect, derived using from the random-effect meta-analysis (8.0%; 95%CI 6.0-10%) and the prevalence estimate of 4 % (0.04) and 14% (0.14) are the same distance from the summary effect estimate (average). The funnel plot assumes that studies with high precision will be plotted near the average, and studies with low precision will be spread evenly on both sides of the average, creating a roughly funnel-shaped distribution. Deviation from this shape can indicate publication bias. There is no evidence of significant publication bias (β=7.48; SE=8.736; p = 0.3916). That means the observed deviation is not significant and the effect of missed studies (if any) do not cause a significant variation on the reported prevalence estimates".

0.78–2.87 %) in females.

In a stratified analysis based on study setting, the epidemiological prevalence of ADHD in children and adolescents was slightly higher in the clinical setting (8.74 %; 95 % CI 5.66–13.27 %) when compared to the estimate in the community setting (7.19 %; 95 % CI 5.59–9.19 %) even though the difference was not statistically significant (p-value = 0.439).

Moreover, based on analysis stratified by age, Polanczyk and colleagues found that the prevalence estimate of ADHD was 2.3 times higher in children aged 6–11 years (7 %) when compared with adolescents aged 12–18 years (3 %) ($p < 0.001$) (Polanczyk et al., 2007).

## 4. Discussion

This umbrella review, to the best of our knowledge, is the first quantitative meta-synthesis on the global burden of ADHD in children and adolescents. The review pooled evidence from thirteen systematic review and meta-analytic studies including 588 primary studies, 478, 146 ADHD cases, and 3,277,590 participants. The included studies selected samples across the globe including Arica, China, Spain, India, Iran, the USA, and other developed as well as developing countries. The review estimated the overall prevalence of ADHD in children and adolescents, the prevalence for the specific subtypes of ADHD, as well as the prevalence specifically for boys and girls.

Overall, there were four key findings: First, the international prevalence of ADHD is high in children and adolescents (8 %) with relatively comparable prevalence across the globe except in Black, White, and Asian Americans as well as in India and the Middle East countries. For example, meta-analytic reviews conducted in Africa, China, Spain, and another study that pooled the global prevalence of ADHD reported consistent findings ranging from 6 % to 7.5 % (Ayano et al., 2020; Catalá-López et al., 2012; Chauhan et al., 2022; Thomas et al., 2015). However, two recent meta-analytic reviews by Cenat and colleagues that examined the prevalence of ADHD in America found that the prevalence of ADHD was 15.9 % in Black children and Adolescents, 16.6 % among Whites, and 12.4 % among Asians which was 1.5 to 2.5 times as prevalent as other population groups (Cénat et al., 2021; Cénat et al., 2022). The exact reasons for the higher prevalence of ADHD in American children and adolescents when compared with other countries were not well known. The difference may be due to the inclusion of children and adolescents at risk of ADHD (i.e., comorbid medical conditions, low socioeconomic status, higher rates of parental mental health and

substance use) (Alvidrez, 1999; Ayano et al., 2023; Ayano et al., 2021; Ayano et al., 2019a). The other reasons may be the impact of trauma and racial discrimination (Ayano et al., 2019b; Kirkinis et al., 2021; Meng et al., 2018; Wei et al., 2010). The exact reasons for the considerably higher rates of ADHD in Black, White, and Asian Americans needs investigation.

Second, the prevalence of ADHD was twice higher in boys (10 %) than in girls (5 %). There are several explanations as to why ADHD is more commonly diagnosed in boys when compared with girls. First, girls are protected against the development of ADHD (Mahone and Wodka, 2008). Second, evidence suggests ADHD in girls is more likely to be missed as compared to boys due to the presenting symptoms (Berry et al., 1985).

Third, in terms of the subtypes of ADHD, the review showed that the inattentive type of ADHD was the commonest type of ADHD (ADHD-I) (3 %) followed by the hyperactive type (ADHD-HI) (2.95 %) and the combined type (ADHD-C) (2.44). One of the possible reasons for the highest prevalence rates of ADHD-I compared with other subtypes could be due to the consistent nature of this subtype of ADHD (Weyandt et al., 2003). In support of this, emerging epidemiological evidence suggests that inattentive symptoms of ADHD remain relatively consistent over time (Weyandt et al., 2003) whereas the other symptoms of ADHD such as hyperactive-impulsive symptoms are developmentally sensitive and tend to decline over time (while the feeling of restlessness can persist) (Weyandt et al., 2003).

Fourth, some of the included reviews detected a small number of studies compared with the existing data according to other similar studies. Notably, the prevalence of ADHD in those studies that involved a small number of primary studies was relatively small when compared with studies that involved a higher number of primary studies. For example, in a meta-analytic study by Polynzyx and colleagues in 2015 including 13 studies with 20, 125 participants the prevalence of ADHD was 3 % (Polanczyk et al., 2015). Another meta-analysis with relatively few studies (n = 15) involving 20, 1765 participants the prevalence of ADHD was 4.4 %. On contrary, in 2015 meta-analytic studies involving 175 studies with 1,023,071 children and adolescents the prevalence was 7.2 % which was considerably higher than the above studies with a few numbers of identified articles and participants (Thomas et al., 2015). Other similar studies reported consistent findings (Ayano et al., 2020) which is also in line with the prevalence in the current meta-analytic view (8.0 %). The main reason for detecting a small number of studies in some systematic review and meta- analyses could be the methodological difference (i.e., the search strategy, search terms/keywords, as well as databases searched). For instance, in the forementioned two meta-analytic review with a small number of participants ADHD was assessed under the umbrella of mental disorders whereby the search strategy was not specifically designed to detect studies on ADHD in children and adolescents (Polanczyk et al., 2015).

There are several strengths of this umbrella review: (1) the strength of this umbrella review is being the first to quantitatively synthesize evidence on the global prevalence of ADHD in children and adolescents involving meta-analytic review across the global globe. (2) It strictly followed the PRISMA guideline and used robust tools to appraise the methodological quality of the included studies; (3) It estimated the prevalence of ADHD specifically in boys and girls as well as for each subtype of ADHD. (4), the quality of the studies was high for the majority of the included studies. No study had scored low quality and only three studies scored medium quality because they did not register their protocol, and/or reported the details of their methodology for the review. However, it is noteworthy to motional that the appraisal was partly based on subjective judgment and therefore considerably impacted by the reporting of the reviews, rather than exclusively by the actual methodological quality of the article.

This umbrella review has some limitations. First, it relied on data reported by the included systematic review and meta-analysis studies to estimate the global prevalence of ADHD in children and adolescents. Thus, other published unpublished studies could be missed. Second, as expected, we found significant heterogeneity across studies.

## 5. Conclusions

Data from our compressive umbrella review suggest that ADHD is highly prevalent in children and adolescents with boys twice more likely to experience the disorder than girls. Of the three subtypes of ADHD, ADHD-I was found to be the most common subtype followed by ADHD-H and ADHD-C. Our results underpin that priority should be given to preventing, identifying and treating ADHD in children and adolescents.

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## CRediT authorship contribution statement

GA, LT and RA conceived the study, developed the methodology, abstracted the data and evaluate the quality of the studies. GA involved in identification of the studies, conducted the analyses and drafted the manuscript. YG, LT, RA, and SD reviewed the draft of the manuscript and analyses. All author dead and approved the final manuscript.

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None.

## Declaration of competing interest

None.

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