

Prevalence and epidemiological characteristics of ADHD in Spanish pre-school and school age children

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Abstract

Objective: To report the ADHD estimated prevalence in Spain, considering differences in sex, age, presentation and severity. *Methods:* This study has a two-phase design and forms part of the Neurodevelopmental Disorders Epidemiological Research Project (EPINED). The ADHD screening was performed through parent (N=3,727) and teacher (N=6894). To perform ADHD diagnosis (DSM-5), screen positive and a subsample of the screen negative children and their parents were assessed using neuropsychological tests and a semi-structured psychiatric interview. *Results:* The ADHD overall estimate prevalence was 5.5% (7.7% in school-age children; 3.0% in pre-schoolers) and 3.5% for subclinical conditions. The combined presentation and mild severity were the most common, while 18.2% were highly impaired. Previous diagnoses were found in 12% of pre-schoolers and 41% school-aged. *Conclusion:* The prevalence found in Spain is higher than other European reports. The low ratio of prior-diagnoses indicates a need to provide resources for assessment in school and clinical settings.

Keywords: ADHD; school-age children; pre-schoolers; presentation; severity

Introduction

Mental disorders in children and teenagers are one of today's biggest public health problems. Studies indicate that the prevalence of any DSM disorder is around 20-25% and that ADHD is the second most commonly diagnosed mental disorder in childhood and adolescence and the most frequent neurodevelopment disorder (Kessler et al., 2012; Merikangas et al., 2009, 2010; Polanczyk et al., 2014 or 15; Younger, 2017). ADHD has a negative impact on the child's daily activities, academic functioning and social relationships, causing lifelong impairment depending on its severity, comorbidity and detection time and the interventions carried out. All this means a substantial economic burden for patients, families and school, medical and social systems (Libutzki et al., 2019; Matza et al., 2005; Okumura et al., 2019; Quintero et al., 2018).

Systematic reviews indicate that the worldwide prevalence of ADHD among children and adolescents is between 2% and 7.2%, with an average of around 5% (Erskine et al., 2013; Polanczyk et al., 2007, 2015; Thomas et al., 2015; Sayal et al., 2018; Willcutt, 2012). The highest ADHD prevalence (7.2%) was presented in the meta-analysis by Thomas et al. (2015). Somewhat lower rates ranging from 5.9% to 7.1% were found by Willcutt (2012) in studies using DSM-IV diagnostic criteria. The meta-analytic results in Polanczyk et al. (2007) showed a prevalence rate of 5.3% in 2007 and 3.4% in 2015. The lowest rates (between 2% to 4%) were estimated by Erskine et al. (2013) in their systematic review. Data from these studies showed significant heterogeneity between prevalence estimates, but most did not identify geographical and cross-national variability or differences between study periods (Erskine et al., 2013; Polanczyk et al., 2014; Willcutt, 2012). Other recent studies that have covered the previous lack of data on ADHD prevalence in countries such as China (Liu et al., 2018, Wang et al., 2017), Korea (Kim et al., 2017), Nigeria (Umar et

al., 2018) and Arab regions (Alhraiwil et al., 2015; Yadegari et al., 2018) have provided similar (6.3%) or even higher (8.8%) prevalence rates.

Although for some authors ADHD has been relatively stable over the last few decades (Erskine et al., 2013; Polanczyk et al., 2014), others have found consistent increases in diagnostic prevalence in recent years (Atladdottir et al., 2015; Nyarko et al., 2017; Safer, 2018; Song et al., 2019; Vasiliadis et al., 2017; Xu et al., 2018) and some even report a decline (Sawyer et al., 2018). According to the US National Survey of Children's Health (NSCH), the estimated prevalence of ADHD in children and adolescents aged 4 to 17 increased from 6.1% in 1997-1998 to 10.2% in 2015-2016 (Danielson et al., 2018; Xu et al., 2018). Regarding the reasons for this apparent increase in diagnosis prevalence, Safer (2018) and Rydell et al. (2018) have suggested that the rates of ADHD found in the last two decades might reflect changes in diagnostic and treatment practices, since the prevalence of ADHD symptoms based on parent ratings have not varied over time. In contrast, Göbel et al. (2018) showed a reduction in lifetime ADHD diagnoses in Germany of almost one percentage point over the period between 2003-2006 (5.3%) and 2014-2017 (4.4%). Also in Europe, the weighted prevalence of ADHD from the Millennium Cohort Study was 3.9% (Russell et al., 2019), and the meta-analysis conducted in Italian children and adolescents reported a pooled prevalence of 2.9% (Reale & Maurizio, 2018). Thus, although several studies indicate that the difference in prevalence rates has more to do with methodological aspects than cultural or geographical differences (Polanczyk et al., 2014; Setyawan et al., 2018; Song et al. 2019), recent data have suggested that ADHD diagnosis estimates are lower in Europe than in the United States (Thomas et al., 2015), which points to a need to conduct epidemiological studies in other European countries and clarify whether or not a real increase in ADHD prevalence is currently taking place.

As regards the methodological differences between epidemiological studies, firstly it should be taken into account that there may be a discrepancy between the rates of clinical case identification and estimated prevalence (Song et al., 2019), and that even within each there are differences regarding the methodologies used. As Song et al. (2019) explain, "caseness" refers to how many children have been identified on the basis of nationwide parent surveys (e.g. NSCH) or by examining healthcare records, which provide data on children with a previous diagnosis or who have accessed care services but may not be representative of the whole population. Data from prevalence studies, on the other hand, provide information about those cases from community-representative samples that must meet diagnostic criteria according to standardized classification systems (DSM, ICD). Even so, great variability can also be found among these studies. While some researchers use two-phase designs taking into account multiple informants and confirm the diagnosis by carrying out structured interviews with families, others only provide data about risk symptoms reported by parents and teachers and do not provide enough information to determine compliance with diagnostic criteria. Heterogeneity can also be found in the use of different classification systems, temporal considerations – lifetime, 12-month or current prevalence – severity levels and age ranges. For some researchers the high ADHD prevalence rates and differences between studies suggest a potential over-diagnosis of ADHD (Kazda et al., 2019). In contrast, other authors believe that infra-diagnosis may be present, especially for some age groups – pre-schoolers and adolescents – children of low socioeconomic status, females or those living in certain regions of the country (Madsen

et al., 2018; Danielson et al., 2018; Nguyen et al., 2019; Göbel et al., 2018; Rowland et al., 2018; Sayal et al., 2018). The fact is that across cultures ADHD has been less frequently diagnosed in girls than in boys (Gobel et al., 2018; Lecendreux et al., 2011; Merikangas et al., 2009; Vasiliadis, 2017; Xu et al., 2018; Yadegari et al., 2018) and has been shown to increase with age, peaking at age 10 (Danielson et al., 2018; Göbel et al., 2018; Vasiliadis, 2017).

As far as the situation in Spain is concerned, there is a gap in current data for ADHD prevalence in children and adolescents. A recent study from Pérez-Crespo et al. (2020) has presented administrative data of ADHD diagnoses for all children aged 4 to 17 years who were treated by the public Catalan public health system in 2009–2017. For 2017 they estimated a prevalence of 4.06% (5.81% for boys and 2.20% for girls). However, at the general population level, epidemiological studies carried out to date have mostly provided prevalence estimates at the level of ADHD risk symptoms on the basis of parent and teacher reports or DSM-III-R/DSM-IV data (Canals et al., 2018; Català-López et al., 2012; Cerrillo et al., 2018; Jiménez et al., 2015; Marín-Méndez et al., 2018). The meta-analysis by Català-López et al. (2012) estimated an overall pooled prevalence of ADHD of 6.8% in school-age children. In 3-year-old pre-schoolers, Ezpeleta et al. (2014) found a rate of ADHD of 3.7% using a two-phase design and a diagnostic semi-structured interview. Given the current situation in Spain and the variability of the data in Europe, the aim of this study is to provide data on ADHD epidemiology in Spain by studying a representative sample of pre-school and school-age children using a two-phase design including a standardized ADHD assessment methodology. We present data on the estimated prevalence of ADHD, taking into account both clinical and subclinical ADHD and differences in age, sex, severity level and presentation type. Educational outcomes, previous diagnosis and service use are also reported.

Method

Study design

The Neurodevelopmental Disorders Epidemiological Research Project (EPINED) is a two-phase cross-sectional study conducted between 2014 and 2019 in the province of Tarragona, Spain. Its aim was to estimate the prevalence of ADHD, autism spectrum disorder (ASD) and social communication disorder (SCD) in children from the school population in two different age groups (4-5 years old and 10-11 years old). Participants completed two different protocols at the same time, one for screening ASD/SCD and the other for ADHD. The ADHD screening and diagnostic assessment aimed to obtain a more realistic estimation of ADHD prevalence in Spain because of its potential to identify both newly- and previously-diagnosed children in a community setting. The study protocol was validated by the Ethics Committee at the Sant Joan University Hospital (13-10-31/10proj5).

Participants

Two age ranges were assessed: pre-school-age children (PRE) from 3 to 5 years old and primary school children (PRI) from 10 to 12 years old. Details regarding sample size estimation have previously been described in Morales-Hidalgo et al. (2018). The potential EPINED sample comprised 6921 children from 86 public and private schools randomly selected by area from mainstream schools in the entire province of Tarragona, Spain (see Figure 1). In the first phase, child behaviour questionnaires were collected from 6894 teachers (participation rate 99.6%) and 3727 parents (53.9%). An agreement with the Catalan Government's Department of Education allowed us to obtain anonymous information from teachers regarding the presence of ADHD risk symptoms in children from non-participating families (46.1%). However, only those children with the informed consent of their families were able to participate. In the second phase a total of 781 children were individually assessed.

Procedure

In the first phase, parents and teachers reported psychological and sociodemographic information. In order for participants to be classified as ADHD screen-positive or screen-negative, both sets of informants answered 10-item Conners indexes. We considered a screen-positive case to be when a child obtained high or very high scores ($T \geq 65$) in parent and teacher indexes (i.e. *parent and teacher* criteria). All screen-positive participants along with those with a previous ADHD diagnosis – even if they obtained a negative screening – were contacted so that an individual assessment could be performed in the second phase of the study. In addition, we invited the participation of a representative group of children with $T \geq 65$ scores in only one context (i.e. *parent or teacher* criteria) in order to prevent the presence of false negative ADHD diagnosis, and also a screen-negative group comprising children with scores of $T < 65$ in both indexes (parent and teacher criteria), matched by gender, age and school. As can be seen in Figure 1, the ADHD Risk Group was composed of 555 participants [$N = 332$ parent and teacher criteria and $N = 223$ parent or teacher criteria] and the Non-ADHD Risk Group of 226 participants.

The second phase was administered by specially trained clinicians in the schools. The protocol involved the assessment of nuclear ADHD symptoms from the entire specific ADHD scale of the Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS-PL, Kaufman et al., 1997), child neuropsychological performance using the Wechsler scales (WPPSI-IV, Wechsler Preschool and Primary Scales of Intelligence; WISC-IV, Wechsler Intelligence Scales for Children; Wechsler, 2003, 2012) and the Trail Making Test (Portellano et al., 2009). At the end of the study a full report of the results was given to parents and school psychologists. To ensure adequate data collection, in both phases of the study we provided specific support to families who had problems understanding the questionnaires due to lower linguistic competence in Spanish or other difficulties. This support was given by the teachers, other family members with greater linguistic competence or translators from the municipal government. To guarantee the quality of the research, inter-rater reliability was assessed in qualitative terms

throughout the project, with very high agreement being achieved. Once per school, two researchers carried out a complete assessment (one as examiner and the other as a non-participant observer) and independently scored the instruments. As for the K-SADS-PL results, these were compared between clinicians in order to determine high agreement (>95%) in symptom numbers and severity impairment contexts.

Assessment methods

ADHD symptoms were screened using the 10-item Conners Early Childhood Global Index (Conners ECGI; Conners, 2009) and the Conners 3 ADHD Index (Conners Hyperactivity Index; Conners, 2008) parent and teacher forms. The Conners ECGI assesses the presence of general psychopathology in children between 2 and 6 years old using the scales for *restless-impulsive*, *emotional lability* and *total problem*, while the Conners Hyperactivity Index assesses the most prominent symptoms of ADHD in children between 6 and 18 years old. Both scales inquire about symptoms and behavior over the previous month and provide a cut-off for high (T 65-69) and very high scores ($T \geq 70$). The Spanish validation of these indexes showed good psychometric properties, with internal reliability values ranging from .92 to .98 and a total scale inter-rater agreement of between .44 and .50 (Morales-Hidalgo et al., 2017).

The Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS-PL; Kaufman et al., 1997) semi-structured psychiatric interview was used to collect information on child ADHD symptomatology from parents in accordance with DSM diagnosis criteria. As for the ADHD scale, this has a sensitivity of 87.8% and a positive predictive value of 98.6% (Jarbin et al., 2017). The Spanish version showed high inter-rater reliability ($Kappa = .91$; Ulloa et al., 2006). As the interview was based on DSM-IV-TR criteria, diagnostic specifiers such as age of onset and severity classification were adapted by the clinicians to DSM-5 criteria. Although the ADHD diagnosis needs to be established in clinical terms, the assessment of cognitive performance and the specific profile of strengths and weaknesses in abilities is a valuable component of the diagnosis procedures. To this end we administered the Wechsler Scales of Intelligence for pre-school (WPPSI-IV; Wechsler, 2012) and school-age children (WISC-IV; 2003). These provide an estimation of global intelligence quotient and provide specific scores for verbal comprehension, perceptual reasoning, working memory and processing speed.

Sociodemographic information on the children, their families and schools was gathered in the first phase using an ad-hoc questionnaire that included details such as place of birth, ethnicity, age, current address, level of studies and occupation. In the second phase we collected more specific clinical information about personal and family psychopathological antecedents, the presence of previous diagnoses or problems, and psychiatric, psychological and educational service use. Academic performance was ascertained from school grade reports. School-age children's performance was expressed using a 5-point Likert scale ranging from failing to excellent results and including the child's ratings in language, maths, history and science, music/arts and physical education. Pre-school performance, on the other hand, was reported using a 3-point Likert scale ranging from low to high achievement and including the

child's development in language, maths, science, music, arts, psychomotricity, social interaction and school habits. Socioeconomic levels were estimated in accordance with Hollingshead (2011).

Case definition and prevalence estimates

Participants received a positive diagnosis of ADHD (i.e. "clinical ADHD") when the information in the K-SADS-PL interview met the DSM-5 criteria for any of the three presentations of ADHD (inattentive, hyperactive-impulsive and combined). Children with previous ADHD diagnoses provided by public mental health centres and those in partial remission due to pharmacological or psychological treatment were also considered as having "clinical ADHD". The K-SADS-PL information on the number of nuclear ADHD symptoms and impairments in social, school or occupational functioning was used to establish the current severity of the diagnosis. According to the DSM specification of current severity, mild ADHD severity was considered to be present in those children exhibiting 6 or 7 symptoms out of a maximum of 9 in one or both ADHD presentations along with low impairment in one or two functional contexts. High severity involved the presence of 8 or 9 symptoms out of a maximum of 9 or several particularly severe symptoms along with severe impairment in two or three functional contexts. Moderate impairment was identified when symptoms or functional impairment between "mild" and "severe" were present. Due to the presence of many children with subthreshold characteristics of ADHD but with these having a considerable impact on their overall development, we thought it appropriate to establish a "subclinical ADHD" level when participants presented four or five manifestations of ADHD on the K-SADS-PL for any of the ADHD presentations. Children without clinical and subclinical characteristics were classified as "non-ADHD". As regards prevalence, the results obtained in accordance with the case definitions described above were used to describe estimated clinical and subclinical prevalence.

Statistical analyses

Sample size was calculated using Ene 3.0 software, while statistical analyses were performed using IBM SPSS 25 and EPIDAT 4.2. Child demographic, psychological and cognitive characteristics were provided through descriptive statistics. Depending on the data characteristics, chi-squared and t-tests for independent samples were used to compare the scores between groups. The estimated prevalence analyses were weighted taking into account the diagnoses in the screen-positive and screen-negative groups. A 95% confidence interval was provided for all estimations. Agreement between informants and between ADHD risk symptoms and diagnoses were calculated using Cohen's kappa. Diagnosed severity and presentation was also described and compared by age and sex.

Results

Sociodemographic characteristics of the sample

The comparison of sociodemographic and psychological data between children from participating and non-participating families in the first phase is presented in *Table 1*. In proportionately greater numbers, participants were autochthonous, lived in urban environments and showed higher socioeconomic levels. As regards the second phase, *Table 1* also describes the characteristics of those children at risk (screen positive) of ADHD and controls (screen negative). No differences were found between the groups in terms of ethnicity, sex or environment. Only school-age children with ADHD risk belonged to lower socioeconomic levels. As expected, the mean scores for the ADHD indexes were significantly higher in the ADHD at-risk groups. These children scored lower on the intelligence tests, despite being in the average range. [Please insert *Table 1* around here]

Rates of ADHD risk symptoms and prevalence estimates of ADHD diagnosis

The rates of ADHD risk symptoms, ADHD diagnosis and subclinical ADHD diagnosis in the mainstream school-age population are shown in *Table 2*. Teachers reported ADHD risk symptoms (Conners indexes $T \geq 65$) in 7.5% of the pre-schoolers (3.8 in clinical range according to Conners $T \geq 70$) and 18.5% of the school-age children (14.4% in clinical range). Family reports were significantly higher, with 36.8% of pre-schoolers (26.2% in clinical range) and 38.5% of primary school children (34% in clinical range). Agreement between informants was low (Cohen's kappa, $k = 0.13$ PRE, 0.27 PRI), which leads to a joint ADHD symptom prevalence of 5.4% and 13.6% (2.61% and 10.4% in clinical range) among pre-school and school-age children respectively. Agreement between ADHD risk symptoms ($T \geq 65$ and $T \geq 70$) with final diagnosis ranged between 0.19 and 0.30 in family reports and 0.30-0.42 in teacher reports. As far as sex differences are concerned, boys of school age showed higher rates of symptoms than girls. However, in pre-schoolers no significant differences were found through teacher reports, and parents indicated a higher prevalence of symptoms in clinical range ($T \geq 70$) for girls.

[Please insert *Table 2* around here]

The overall estimated prevalence of ADHD in our sample was 5.5% (95% CI 4.75-6.23). Significant age and sex differences were observed. The prevalence in 4 to 5-year-old children was 3.0% (95% CI 2.18-3.74) and in 10 to 11-year-olds 7.7% (95% CI 6.50-8.88). The male-to-female ratio was 2.4:1 and 3.0:1 respectively. The highest prevalence was 11.9% in school-age boys. Between 3.0% and 3.9% of the children exhibited subclinical level ADHD, with a male-to-female ratio of around 2.3:1 in pre-schoolers and 1.6:1 in school-age children.

ADHD severity level and clinical presentation

As can be seen in Table 3, mild ADHD profiles of severity were the most prevalent in the present sample. We found that 52.1% of the children with ADHD were at mild level and 18.2% with high severity. As regards sex, significant differences ($p = .017$) were found in school-age children, with boys presenting higher severity than girls (21.5% *versus* 2.4% at a high level). As for age, a similar ratio of children with mild symptoms was observed in both age groups. Although the difference was not significant, there were more highly-impaired children among pre-school than school-age children (25% *versus* 16.2%).

[Please insert *Table 3* around here].

Different distributions of ADHD presentation were found according to age ($p \leq .001$), while sex differences were only found among school-age children ($p \leq .042$). Combined presentation was the most salient in both age groups (61.4% and 51.4%), followed by hyperactive-impulsive among pre-schoolers (31.8%) and inattentive among school-age children (40.5%). As regards sex, pre-school girls showed mostly combined presentation (73.3%), while boys showed mostly combined (55.2%) and hyperactive-impulsive (41.4%) presentations. Among school-age children, boys also showed more combined (57.0%) and hyperactive-impulsive (37.4%) presentations, while girls more frequently exhibited an inattentive pattern (48.8%) followed by the hyperactive-impulsive (36.6%). Among children with subclinical ADHD conditions, different patterns of presentation were also found with regard to age ($p \leq .001$) but not sex. In this respect, pre-schoolers tended to exhibit more hyperactive-impulsive presentations, while school-age children showed more inattentive symptomatology.

Previous diagnoses, interventions and educational outcomes

Considering the entire sample, families and teachers reported a prior ADHD diagnosis at a ratio of 0.30% (95% CI 0.14-0.54) in pre-schoolers and 2.93% (95% CI 2.40-3.54) in schoolers, of which 93% were validated in the present study. Of these children, 61.95% had a positive screen by both informants, 23% a positive screen by one informant and 15.04% a negative screen. Thus, of the children who received an ADHD diagnosis in the present study, a previous clinical diagnosis from a mental health professional was reported for 11.4% of pre-schoolers (only 10% of the ADHD with high severity had a diagnosis) and 41.2% of school-age children (only 49% of the ADHD with high severity had a diagnosis). Previous diagnoses were significantly lower in girls than in boys for both age groups (pre-school: 6.7% *versus* 13.8% and school age 29.3% *versus* 45.8%).

[Please insert *Table 4* around here].

Psychological intervention had taken place among 34.1% of pre-schoolers and 45.3% of school-age children, with no differences being found as regards sex (see Table 4). Educational support was provided for 34.1% and 31.1% respectively by age group. In this regard it is important to note that between 33.8% and 38.6% of the children with

ADHD were receiving no educational or psychological support. In addition, significant differences were observed ($p \leq .001$) in the support received by previously diagnosed children with ADHD (84.9%) and by those newly diagnosed with ADHD (54.8%). Pharmacological treatment (mainly stimulant medication) was being undertaken in 28.4% of the school-age children with ADHD (32.7% boys and 17.1% girls). As for those with subclinical ADHD, 53.5% of the children were not receiving any specific support. The rate of education support was 16.7% in pre-school and 26.7% in school-age children, while psychological intervention was 13.9% and 18.7% respectively.

The prevalence of learning problems in school-age children reported by parents and/or teachers was 15.5% (of which only 8.8% had a confirmed diagnosis of learning disorders) in the ADHD group and 18.6% (9.3% confirmed) in the subclinical ADHD group. However, the average intelligent quotient (IQ) in children with clinical and subclinical conditions of ADHD was within the normal range, with ADHD groups showing the lowest performance. In comparison with their peers without ADHD, children with ADHD showed more school failure in both age groups (4.5% and 10.1% respectively repeated a year). Taking into account school grade reports, children with ADHD performed significantly worse than their peers, with a mean of 1.9 points (1 to 3 Likert scale) in pre-school and 2.6 (1 to 5 Likert scale) in school-age children. Performance was lower among school-age children than pre-schoolers with ADHD. Children with subclinical ADHD also scored lower than children without ADHD, despite significant differences only being found in the older group.

Discussion

In the present study we report data on the estimated prevalence of ADHD in Tarragona, a Mediterranean region located in the north of Spain (Catalonia). We assessed a school population of two age groups to observe clinical and epidemiological differences by age and sex. The overall estimated prevalence of ADHD in our sample was 5.5%, which is in agreement with the 5.3% reported in the meta-analysis by Polanczyk et al. (2007) and the 5.5% identified by the NSCH among US children (Song et al., 2019). Our estimate is higher than the latest meta-analyses by Polanczyk et al. (2015) and Erskine et al. (2013), which estimated rates of around 3%, and other European studies conducted in France, Italy, the UK and Germany that reported ADHD prevalence rates of between 1.4% and 4.4% (Göbel et al., 2018; Lecendreux et al., 2011; Reale & Bonati, 2018; Russell et al., 2019). However, the high heterogeneity between prevalence estimates leads us to consult other studies that report even higher values, such as 6.3% in China (Liu et al., 2018; Wang et al., 2017), between 7.8% and 8.8% in Australia, Nigeria and Korea (Kim et al., 2017; Sawyer et al., 2018; Umar et al., 2018) and 10.2% in the US (Xu et al., 2018). One characteristic of our sample is that it looks at two clearly differentiated ages. In this respect we found a prevalence of 7.7% in schoolchildren of 11 years, an age that has previously been established as a peak of diagnosis (Danielson et al., 2018; Göbel et al., 2018; Russell et al., 2019; Vasiliadis et al., 2017). Meanwhile the estimated prevalence in pre-schoolers was 3%, similar to the rate estimated by Ezpeleta et al. (2014) for Spain, but higher than the 0.2% calculated by Göbel et al. (2018) for Germany or the 1.5-2.1% calculated by Danielson et al. (2017; 2018) for the US. In comparison with the prevalence reported in the Catalan

public mental health system in pre-schoolers (0.28%) (Pérez-Crespo et al., 2020), and the prevalence of prior diagnosis reported in the present sample (0.30%), our estimates (3%) are much higher. Probably, these children have no diagnosis because they are not yet cared for in public mental health services, although some could receive assistance in early stimulation centers. For school-age children, the 3.47% (7-12 years) reported by Pérez-Crespo et al. (2020) was also very close to the 2.93% previously reported in the present sample and may coincide with the moderate-severe cases found in our study (48% of ADHD diagnoses in the 11 years old), suggesting that milder cases may not be referred to public clinical services.

As widely found by other researchers (Danielson et al., 2018; Ezpeleta et al., 2014; Göbel et al., 2018; Umar et al., 2018; Vasiliadis et al., 2017; Xu et al., 2018), our results also indicated that regardless of age boys were more likely to have ADHD than girls, with a sex ratio in the range of 2-3:1, as reported in the review by Sayal et al. (2018) and the administrative data by Pérez-Crespo et al (2020) in Spain. The prevalence in school-age boys was very high (11.9%), but not very far from the 11.7% found by Danielson et al. (2018) and Kim et al. (2017) in 7 to 12-year-old children. However, this preponderance was not observed as regards ADHD risk symptoms in pre-school children, for whom teachers reported similar rates for both sexes and parents reported more symptoms in girls. This could be due to the fact that Conners ECGI includes not only items about restlessness-impulsivity but also emotional lability, which may be more observable or higher in girls. There was a notably high rate of symptoms in the clinical range (Conners T ≥ 70) reported by parents in both pre-school (26.2%) and school-age children (34%, reaching a value of 42% in boys), which is clearly higher than the rates reported by other authors (Aboul-ata & Amin, 2015; Canals et al., 2018; Cao et al., 2018; Cerrillo et al., 2018; Joshi & Angolkas, 2018; Yadegari et al., 2018). Although the high rate of symptoms detected in boys will be related to the high prevalence of ADHD in males (4% in pre-schoolers and 11.9% in school-age children), it could also be due to the characteristics of the screening test used to assess the risk symptoms (Conners ECGI and Conners 3 ADHD Index). These tests show good psychometric properties (Morales et al., 2017) for detecting ADHD, but they register symptoms of low duration (previous month) and may also detect other unspecified learning problems. Comparing data on symptoms among Spanish pre-school children we found disparities between studies depending on the use of different screening tests. Thus rates of 23.9% and 12.9% were reported by parents and teachers respectively using the ADHD-Rating Scale IV (Cerrillo et al., 2018), while Canals et al. (2018) estimated 12.9% and 8.7% respectively using the Early Childhood Inventory. Only the study by Soma et al. (2009) on Japanese pre-schoolers, using a questionnaire based on DSM-III-R, found a 4.3% prevalence of risk symptoms reported by teachers and 31.1% by parents, which is similar to our data although the cultural environment is very different. Regardless of methodological differences, teachers tend to report lower ratings than parents, and this may be due to subjective judgments about severity, frequency, the impact of symptoms and ADHD clinical manifestations (Du Paul, 2020; Murray et al., 2018). Although agreement between parents and teachers is low, prevalence of ADHD risk symptoms reported by both informants in pre-schoolers (2.6%) coincides with that reported in Marín-Méndez et al. (2018) among Spanish pre-school children (2.5-4.1%).

In addition to the prevalence of ADHD, we found 3.5% of children to be showing subclinical ADHD (3.9% in school-age children), a rate comparable to that reported by Sayal et al. (2018), which would indicate that a substantial number of children have problems with overactivity, inattention and impulsivity just under the threshold of meeting the full diagnostic criteria for ADHD. This prevalence was quite similar between age groups, was again higher in boys than girls, and showed a profile involving lower academic achievement than in the non-ADHD group but less than with children with ADHD. The follow-up of this population could provide information about the course of ADHD symptoms and other psychosocial outcomes throughout their development. This would be especially worthwhile, bearing in mind that a recent meta-analysis reported that children with subthreshold ADHD have rates of comorbid psychopathology and functional impairment in cognitive, interpersonal and school areas that are even higher than those for children meeting ADHD criteria (Kirova et al., 2019). These authors suggest that this may be due to a lack of educational and psychological support, an aspect that was also found in our sample.

According to ADHD severity and regardless of age, 52% of the sample exhibit mild profiles, a higher rate than that reported by Danielson et al. (2018), who estimated 41.8% mild, 43.7% moderate and 14.5% severe cases. In our study the distribution of moderate and high severity was different among pre-schoolers and school-age children, with pre-schoolers having a greater proportion of high severity cases (25%) than school-age children (16.2%). We believe this may be due to the fact that milder cases are more likely to be identified later, when academic requirements increase, or that these young children were not taking medication and the symptoms led to greater impairment, in contrast to other countries. Danielson et al. (2017), for example, reported that 43.7% of US children between ages 2 and 5 were taking medication for ADHD. On the other hand, 28.4% of school-age children in the present study were receiving pharmacological treatment (psychostimulants), which is also lower than the 45-48% overall rates found in Europe (Russell et al., 2019; Setyawan et al., 2018) and the 62% in the US (Danielson et al., 2018) but higher than the 15% described in Canada (Leung et al., 2019). In this context, the data show big differences in the prescription of medication in several countries (Raman et al., 2018; Russell et al., 2019; Setyawan et al., 2018) according to sex. In our sample more boys than girls took medication, probably because boys presented higher rates of both high severity and ADHD-C, which may give rise to more interference than ADHD-I, which was the presentation most common in girls at age 11. Mowlem et al. (2019) suggested that females with ADHD were less likely to be prescribed medication unless they had prominent externalizing problems. It may also be related to the fact that more boys with ADHD had been previously recognized by the public health services

Regarding clinical presentation, 53.6% of children presented ADHD-C, which is similar to the 59.1% reported for Spain but lower than the rates reported for other European countries (Setyawan et al., 2018). In pre-schoolers the combined presentation and hyperactive-impulsive were higher than in school-age children, which supports data from follow-up studies that found that hyperactivity and impulsive behaviors decreased with age (Molina et al., 2009). The ADHD-I presentation increased with age and was the most frequent in school-age girls (48.8%), as also shown by various authors (Biederman et al., 2005; Molina et al., 2009; Umar et al., 2018). Likewise, ADHD-C was overall the most frequent presentation in agreement with most studies (Kim et al., 2017; Setyawan et al., 2018). In

the subclinical ADHD group, the distribution of clinical presentations was different in comparison with the ADHD group. In pre-schoolers, hyperactive-impulsive manifestations were present in half the cases (66.7% in girls) and declined at school age. In contrast, inattentive manifestations were the most frequent in school-age children of both sexes and a high co-occurrence with learning problems was also found, which leads us to believe that these children could later be diagnosed with ADHD-I and/or specific learning disorders.

We also found that the ratio of previously reported ADHD diagnosis was very low compared to the estimated prevalence (0.30% versus 3% in pre-school and 2.93% versus 7.69% in school-age) which suggests an under-diagnosis in the population. These figures agree with administrative prevalence shown by Pérez-Crespo et al. (2020) in our health system. The lack of early diagnosis may lead to the absence of early intervention and could lead to a more negative prognosis and worse psychosocial functioning (Okumura et al., 2019). In our education system, if the child does not have a clinical diagnosis it is very unlikely that the school will provide psychoeducational support. In our sample around 31-34% of the children with ADHD received educational support, with no differences according to age. In contrast, psychological support was reported in 45.3% of school-age children and 31.1% of pre-schoolers. Our rates are similar to those reported by Danielson et al. (2018) for the older group (46.7%) but lower than the rate found in children under age 6 (52%), despite pre-schoolers showing higher severity of symptoms. Finally, the probability of having greater learning difficulties and repeating a school year indicated in other studies in children with ADHD (Lecendreux et al., 2011) is supported in the current research. Although a lower percentage of school-age children repeated in comparison with Lecendreux et al. (2011), 4.5% of pre-schoolers did not advance a year, indicating impairment even from early ages.

The results presented in this study have several limitations that should be taken into account. Firstly, we have studied the representative population of a Spanish province, but we do not know if this is representative of the overall Spanish population. Also, although the difference in assessment of children aged 4-5 and 10-11 is very interesting, we have no results for children between 5 and 10 years or for adolescents. Nevertheless, our study has strengths that include the updating of data on ADHD prevalence in Europe, and it is the only study in Spain that has produced estimates using a two-phase design and structured interview (rather than just parent and teacher reports) for the DSM-5 diagnosis of ADHD in children. We also provide results of subclinical ADHD (non-compliance of full criteria) and compare it with ADHD as regards age, sex and educational outcomes.

Conclusion

The estimated prevalence of ADHD was 7.7% in school-age children and 3% in pre-school children, with a male-to-female ratio of 3:1 and 2.4:1 respectively. The estimated prevalence of ADHD at subclinical level was 3.5% without age differences. The ADHD of combined presentation and mild severity level ADHD were the most common. The lack of a previous ADHD diagnosis in a large number of children – about 90% and 60% for pre-school and school-age children respectively – suggests less engagement with early interventions and consequently a greater probability of

negative outcomes. These results highlight the need to provide more resources to school psychologists and mental health services in order for them to identify at-risk children carry out accurate diagnostic assessment and perform specific intervention programmes.

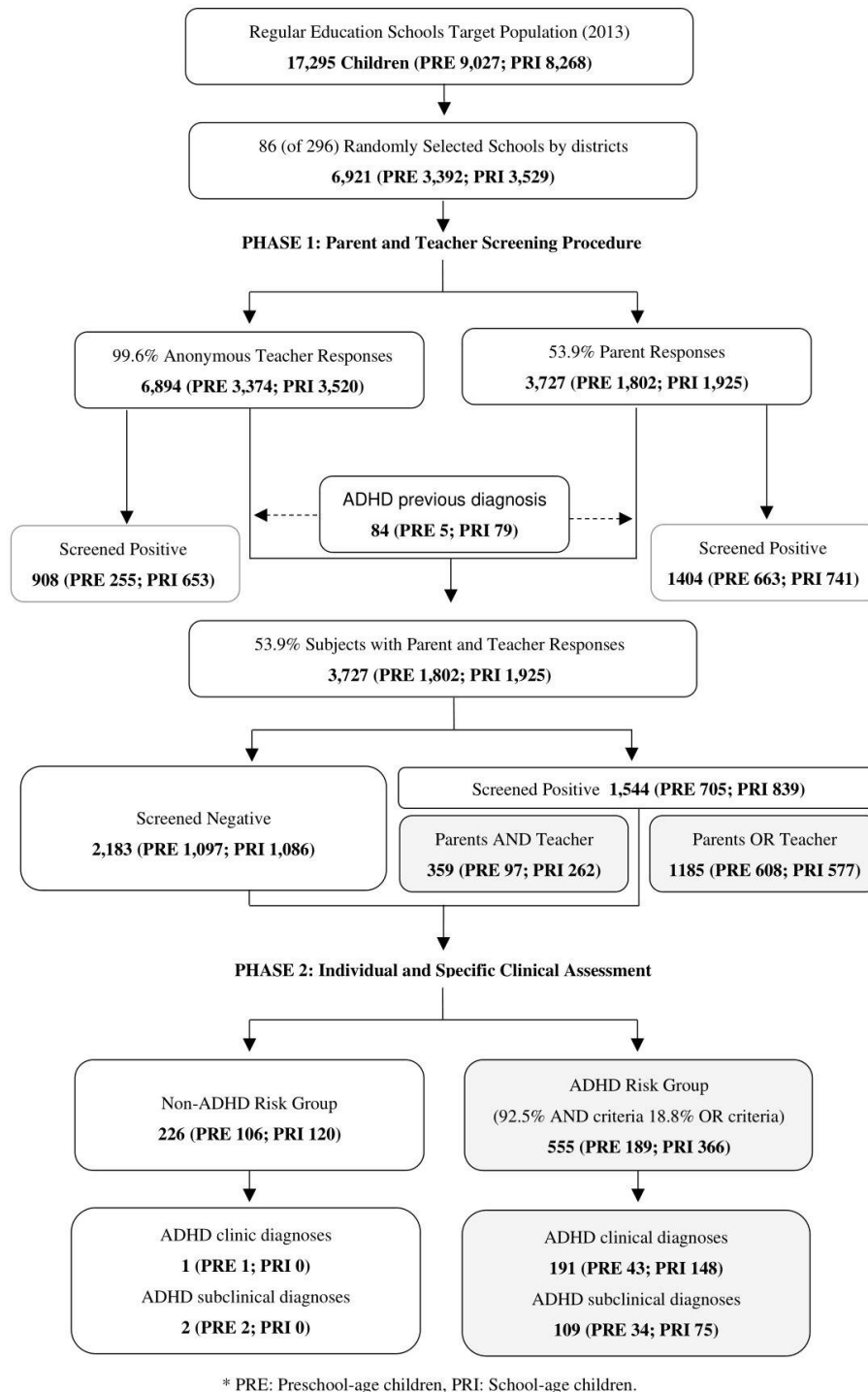


Figure 1. Study design flow chart.

Table 1. Sociodemographic and psychological characteristics of the sample according to phase of the study, age and participation level

	PHASE 1: SCREENING PROCEDURE						PHASE 2: CLINICAL ASSESSMENT					
	Preschool-age children			School-age children			Preschool-age children			School-age children		
	Non-participants <i>n</i> = 1572	Participants <i>n</i> = 1802	<i>p</i>	Non-participants <i>n</i> = 1595	Participants <i>n</i> = 1925	<i>p</i>	ADHD risk <i>n</i> = 189	Controls <i>n</i> = 106	<i>p</i>	ADHD risk <i>n</i> = 366	Controls <i>n</i> = 120	<i>p</i>
Sex, male	797 (50.69)	900 (49.94)	.679	879 (55.11)	898 (46.65)	.001	108 (57.14)	71 (66.98)	.097	239 (65.30)	69 (57.50)	.124
Age, years	4.70 (.44)	4.66 (.50)	.015	10.75 (.57)	10.63 (.46)	.001	5.08 (.71)	5.10 (.49)	.827	11.06 (.54)	11.12 (.51)	.323
Ethnicity, autochthonous	1093 (69.52)	1483 (82.30)	.001	1261 (79.06)	1622 (84.26)	.001	145 (76.72)	84 (79.25)	.617	304 (83.06)	106 (88.33)	.168
School classification, public	1213 (77.16)	1350 (74.92)	.135	1173 (73.54)	1478 (76.78)	.027	145 (76.72)	97 (91.51)	.001	302 (82.51)	103 (85.83)	.397
Environment, urban	1330 (84.61)	1466 (81.35)	.012	1365 (69.68)	1561 (81.09)	.001	148 (73.31)	80 (75.47)	.577	294 (80.33)	96 (80.00)	.938
Socioeconomic status												
Low	235 (27.71)	278 (15.62)		234 (29.73)	338 (17.92)		40 (21.17)	16 (15.09)		80 (21.86)	11 (9.17)	
Medium	455 (53.66)	1041 (58.52)	.001	454 (57.69)	1131 (59.97)	.001	119 (62.96)	65 (61.32)	.173	230 (62.84)	74 (61.66)	.001
High	158 (18.63)	460 (25.86)		99 (12.58)	417 (22.11)		30 (15.87)	25 (23.59)		56 (15.30)	35 (29.17)	
Conners parents' T score	-	61.55 (12.84)		-	61.68 (18.01)		75.64 (10.26)	54.10 (6.79)	.001	81.45 (12.69)	48.57 (5.56)	.001
Conners teacher' T score	48.21 (9.21)	48.60 (9.48)	.232	53.83 (15.00)	52.71 (14.27)	.023	64.40 (13.53)	47.76 (8.82)	.001	71.77 (17.67)	45.98 (3.38)	.001
Total intelligence quotient	-	-		-	-		95.04 (15.78)	100.31 (15.83)	.007	97.60 (14.12)	107.67 (15.76)	.001

Data presented in frequencies (N) and percentages (%) in dichotomic variables and mean (M) and standard deviation (SD) in continuous variables, significant differences in bold ($p \leq .05$). Data for NSE in the first phase are provided from the following number of subjects: Preschool non-participants ($n = 848$) and participants ($n = 1779$); Primary non-participants ($n = 787$) and participants ($n = 1886$). School classification: public *versus* private. Environment: urban *versus* rural ($> 5,000$ habitants).

Table 2. Estimated prevalence of ADHD, subclinical ADHD and rates of risk symptoms by age and sex

	PRESCHOOL-AGE CHILDREN				SCHOOL-AGE CHILDREN				<i>p</i> _b	TOTAL SAMPLE
	Boys	Girls	<i>p</i> _a	Total	Boys	Girls	<i>p</i> _a	Total		
ADHD diagnosis	4.00 (2.74-5.31)	1.66 (.83-2.50)	.003	3.00 (2.18-3.74)	11.92 (9.80-14.03)	3.99 (2.79-5.19)	.001	7.69 (6.50-8.88)	.001	5.49 (4.75-6.23)
ADHD subclinical	3.90 (2.67-5.22)	1.66 (.83-2.50)	.004	3.00 (2.24-3.83)	4.90 (3.49-6.31)	3.02 (1.97-4.06)	.036	3.90 (3.03-4.76)	.133	3.51 (2.91-4.10)
ADHD risk symptoms reported by teachers										
Conners T 65-69	4.42 (3.49-5.51)	3.10 (.32-4.05)	.044	3.76 (3.15-4.46)	5.18 (4.20-6.32)	3.10 (2.33-4.02)	.002	4.15 (3.51-4.86)	.414	3.96 (3.51-4.46)
Conners T ≥ 70	3.77 (2.92-4.79)	3.82 (2. 295-4.85)	.945	3.79 (3.18-4.49)	17.29 (15.55-19.13)	11.47 (10.01-13.06)	.001	14.40 (13.26-15.61)	.001	9.21 (8.54-9.92)
ADHD risk symptoms reported by parents										
Conners T 65-69	10.78 (8.83-12.99)	10.42 (8.50-12.60)	.806	10.60 (9.22-12.11)	4.79 (3.49-6.40)	4.18 (3.04-5.59)	.518	4.47 (3.59-5.49)	.001	7.43 (6.61-8.32)
Conners T ≥ 70	20.89 (18.28-23.69)	31.49 (28.46-34.63)	.001	26.19 (24.18-28.29)	42.14 (38.88-45-45)	26.95 (24.25-29.77)	.001	34.03 (31.91-36.19)	.001	30.24 (28.77-31.74)
ADHD risk symptoms reported by both informants										
Conners T 65-69	2.89 (1.90-4.20)	2.77 (1.80-4.06)	.881	2.83 (2.11-3.71)	3.79 (2.64-5.26)	3.60 (2.55-4.93)	.824	3.17 (2.43-4.05)	.545	3.01 (2.48-3.61)
Conners T ≥ 70	3.00 (1.99-4.34)	2.22 (1.36-3.40)	.297	2.61 (1.92-3.45)	14.60 (12.36-17.09)	6.81 (5.35-8.53)	.001	10.44 (9.11-11.89)	.001	6.65 (5.88-7.50)

Data presented in percentages (%) and 95% confidence interval (CI). Estimates or rates have been compared by sex (*p*_a) and age (*p*_b), significant differences in bold (*p* ≤ .05)

Table 3. ADHD current severity and clinical presentation by age and sex

	PRESCHOOL-AGE CHILDREN,				SCHOOL-AGE CHILDREN				<i>p</i> _{<i>b</i>}	TOTAL SAMPLE
	Boys	Girls	<i>p</i> _{<i>a</i>}	Total	Boys	Girls	<i>p</i> _{<i>a</i>}	Total		
ADHD diagnosis severity										
Mild	16 (55.17)	7 (46.67)	.475	23 (52.27)	51 (47.66)	26 (63.41)	.017	77 (52.03)	.360	100 (52.08)
Moderate	5 (17.24)	5 (33.33)		10 (22.73)	33 (30.84)	14 (34.15)		47 (31.75)		57 (29.69)
High	8 (27.59)	3 (20.00)		11 (25.00)	23 (21.50)	1 (2.44)		24 (16.22)		35 (18.23)
ADHD diagnosis presentation										
Inattentive	1 (3.45)	2 (13.33)	.111	3 (6.82)	40 (37.38)	20 (48.78)	.042	60 (40.54)	.001	63 (32.81)
Hyperactive-impulsive	12 (41.38)	2 (13.33)		14 (31.82)	6 (5.61)	6 (14.63)		12 (8.11)		26 (13.54)
Combined	16 (55.17)	11 (73.34)		27 (61.36)	61 (57.01)	15 (36.59)		76 (51.35)		103 (53.65)
ADHD subclinical presentation										
Inattentive	2 (9.52)	2 (13.33)	.142	4 (11.11)	27 (61.36)	17 (54.84)	.625	44 (58.67)	.001	48 (43.24)
Hyperactive-impulsive	8 (38.10)	10 (66.67)		18 (50.00)	5 (11.36)	6 (19.35)		11 (14.67)		29 (26.13)
Combined	11 (52.38)	3 (20.00)		14 (38.89)	12 (27.27)	8 (25.81)		20 (26.67)		34 (30.63)

Data presented in frequencies (N) and percentages (%). Rates have been compared by sex (p_a) and age (p_b), significant differences in bold ($p \leq .05$)

Table 4. Service use, interventions and educational outcomes in ADHD groups by age

	PRESCHOOL-AGE CHILDREN				SCHOOL-AGE CHILDREN				ADHD
	ADHD _a	ADHD subclinical _b	Non-ADHD _c	<i>p</i>	ADHD _a	ADHD subclinical _b	Non-ADHD _c	<i>p</i>	<i>P_{age}</i>
Psychological intervention	15 (34.09)	5 (13.89)	31 (14.42)	.006	67 (45.27)	14 (18.67)	36 (13.69)	.001	.188
Medication use	0 (0.00)	0 (0.00)	0 (0.00)	-	42 (28.38)	1 (1.33)	0 (0.00)	.001	.001
Educational supports	15 (34.09)	6 (16.67)	33 (15.35)	.013	46 (31.08)	20 (26.67)	29 (11.03)	.001	.707
Educational outcomes									
Learning problems	0 (.00)	0 (.00)	1 (.47)	.830	23 (15.54)	14 (18.67)	14 (5.32)	.001	.006
Repetition of year	2 (4.55)	0 (.00)	2 (.93)	.127	15 (10.14)	4 (5.33)	20 (7.60)	.429	.158
Academic performance	1.93 (.46)	2.12 (.50)	2.33 (.55)	.001 _{ac} .273 _{ab} .102 _{bc}	2.58 (.80)	2.91 (.84)	3.50 (.89)	.001 _{ac} .022 _{ab} .001 _{bc}	.001
Total intelligence quotient	89.73 (14.86)	96.79 (14.57)	98.43 (16.06)	.001 _{ac} .158 _{ab} .913 _{bc}	95.34 (13.38)	99.95 (13.58)	103.28 (16.06)	.001 _{ac} .092 _{ab} .267 _{bc}	.019

Data presented in frequencies (N) and percentages (%) in dichotomic variables and mean (M) and standard deviation (SD) in continuous variables. Rates have been compared by groups (*p*) and age only in the ADHD group (*p_{age}*), significant differences in bold (*p* ≤ .05). Academic performance was rated in a 3-point Likert scale in preschool and a 5-point Likert scale in school-age children (from low to high performance). Data were transformed to the same scale in order to make comparison between age groups.

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