Original Paper

Attention deficit hyperactivity disorder (ADHD) in schoolchildren aged 6 to 17 years

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Abstract

Objective: we aimed to establish the prevalence of attention-deficit hyperactivity disorder (ADHD) in schoolchildren aged 6 to 17 years in Barranquilla, to obtain an epidemiological perspective of this disorder in the Caribbean region of Colombia.

Materials and methods: we selected 383 children enrolled in a single school and administered screening tests (symptoms checklist and BASC). In children with scores that suggested the presence of abnormalities, we scheduled another assessment by means of a structured interview (MINI).

Results: of the 383 children that underwent the initial assessment, 178 exhibited abnormalities, of which 59 (15%) received a final diagnosis of ADHD (38 male and 21 women, corresponding to a 2:1 ratio). The distribution by subtypes was 7.3% combined, 5% inattentive and 3.1% hyperactive. Overall, 23% of the children in the sample had some form of neuropsychiatric disorder, and we found that the inattentive type was significantly associated with agoraphobia and episodes of depression and the hyperactive type with oppositional defiant disorder and anxiety disorder, while in the combined type, depression was associated with an increased risk of suicide.

Conclusions: the prevalence of ADHD in Barranquilla was similar to the prevalence reported in other regions of Colombia, both overall and for each of the subtypes, and in its distribution by sex or comorbidities. These proportions were not associated to psychosocial factors, which supports the hypothesis of a multifactorial aetiology of ADHD.

Key words:
- Attention-deficit hyperactivity disorder
- Behavioural disorders
- Childhood neurodevelopmental disorders
- Childhood neuropsychiatric disorders

Trastorno por déficit de atención e hiperactividad (TDAH) en niños escolarizados de 6 a 17 años

Resumen

Objetivo: se buscó determinar la prevalencia del trastorno por déficit de atención e hiperactividad (TDAH) en niños de entre 6 a 17 años escolarizados en Barranquilla, para hacer una caracterización epidemiológica del trastorno en la región Caribe colombiana.

Materiales y métodos: se tomaron 383 niños de una institución educativa a los que se les aplicaron pruebas de tamizaje (Checklist y BASC). Aquellos sujetos que registraron una puntuación sugestiva de alguna alteración fueron reprogramados para la realización de la evaluación por medio de la entrevista estructurada (MINI).

Resultados: de los 383 sujetos evaluados inicialmente, 178 resultaron ser casos de algún tipo de alteración, de estos se confirmó que 59 (15%) tenían diagnóstico de TDAH, con una proporción de 38 varones y 21 mujeres, lo que arroja una relación 2:1, la distribución por subtipos se dio en 7,3% combinado, 5% inatento y 3,1% hiperactivo. En total, el 23% de los sujetos evaluados presentaron algún trastorno neuropsiquiátrico y se encontró una relación estadísticamente significativa entre el subtipo inatento con la agorafobia y los episodios depresivos, entre el subtipo hiperactivo con el trastorno oposicionista desafiante y el trastorno de angustia y entre la depresión y el riesgo de suicidio con el subtipo combinado.

Conclusiones: la prevalencia del TDAH en Barranquilla presenta un comportamiento similar a otras regiones del país, tanto en la prevalencia como en la distribución por subtipos, relación por sexo, tipos de comorbilidades. Estos datos no están sujetos a factores psicosociales, lo que confirmaría la teoría de tener una etiología multifactorial.

Palabras clave:
- Trastorno por déficit de atención e hiperactividad
- Trastornos del comportamiento
- Trastornos del neurodesarrollo
- Trastornos neuropsiquiátricos en la infancia

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INTRODUCTION

Attention-deficit hyperactivity disorder (ADHD) is a prevalent neurologic syndrome characterised by a pattern of hyperactivity, impulsive behaviour and impaired attention considered abnormal for the developmental stage of the child.[1] It is one of the most frequent diagnosis in children and adolescents and it is the most common diagnosis in young adults.[2] There are no accurate data on its prevalence, but it is estimated at 2% to 12% in children[2-7] and 2.5% to 5% in adults.[5-11]

The regions with the broadest variability in prevalence are Africa and Latin America, which also have the greatest prevalences, usually high above the mean.[12] According to the Liga Latinoamericana para el Estudio del TDAH (Latin American League for the Study of ADHD), there are 36 million people affected by ADHD in Latin America, and less than one fourth are receiving adequate care.[13]

In Colombia, based on the study by Hoai Danh Pham published in 2015, which cites a 2001 article by doctor Pineda, Colombia is the country with the highest prevalence of ADHD in the world, amounting to 17.1% of the population.[6,14] This was confirmed by Vélez in 2012, who described that the prevalence in Colombia was higher compared to other countries, and expressed the need to carry out more structured studies to standardise criteria in order to establish the actual prevalence in Colombia, as the figures reported by different studies conducted in different cities and with different methods vary widely.[15]

This disorder involves a disturbance of healthy development in affected individuals and is associated with significant problems in the family[13]; it is known that up to 50% of children with ADHD have poor relations with their peers and that up to 70% in the third grade do not have friends do to their severe limitations in participating harmoniously in the social interactions characteristic of this age.[16] When family members of individuals with ADHD have been asked about the difficulties and disabilities that may be associated with the disorder, they have described a negative impact of ADHD on school life, everyday activity, social interaction and family relationships, in addition to self-esteem.[17] These disturbances in social and academic development are among the main reasons why ADHD is associated with a higher prevalence of drug use and abuse in the ADHD population in comparison with controls without ADHD.[18]

Attention-deficit hyperactivity disorder is important because it manifests in childhood with a series of disturbances in individual, academic and social functioning that lead individuals at the stage when their personality and identity are being shaped to interact poorly with society, bringing a stigma that, without adequate management, may eventually result in marginalization.[16,19-24] While different studies have demonstrated that these patients exhibit multiple qualities in creative and artistic subject areas,[25] it is also important to highlight the role played by schools with standardised and rigid curricula in comparison to schools that are more specialised in a more progressive education with emphasis in the arts with more stimulating curricula and flexible classrooms and schedules that improve the adaptation of these children, an approach that is not common in our region.

Therefore, early intervention in these children and adolescents is of vital importance in order to decrease the negative repercussions in adolescence and adulthood, which manifest in the form of disorganization in school work, poor performance in school and work, difficulty completing tasks and working independently, high-risk behaviours, low self-esteem due to failure in several areas of life, increased risk of substance use or early sexual debut, among others.[1]

For this reason, we undertook an initial approximation to the epidemiology of ADHD at the local level, taking into account the social and cultural characteristics of our population, which differ significantly from those of populations in inland Colombia.[26,27] In addition, we used different diagnostic tests to try to identify probable cases, and made the final diagnosis by means of a structured clinical interview, the Mini-International Neuropsychiatric

Interview (MINI), thus increasing the validity and accuracy of diagnosis by not basing it exclusively on questionnaires and scales, which, as we already noted, are subject to interrater variability based on the application of different diagnostic criteria.

Our aim is for this first study to provide a local baseline allowing replication in similar studies conducted in other cities and to open the door for and justify broader studies with larger samples capable of detecting correlations with a greater number of more risk factors, associated disorders and comorbidities, with the ultimate purpose of developing specific guidelines for the population that could be included in the planning of public policies targeting early childhood so that the most vulnerable population can be managed from a multidisciplinary and therefore comprehensive approach, thus reducing the harm and negative impact on affected individuals.[15]

METHODS

We conducted a cross-sectional, prospective, quantitative analytical study. The setting of the study was a school in Barranquilla (Colombia). We selected the sample of children to be evaluated by simple randomization, obtaining a sample of 383 children, of who 178 exhibited neurobehavioural changes that justified assessment by MINI after obtaining the informed consent of parents and with agreement of the children. We excluded children with a previous diagnosis or undergoing treatment for any form of developmental or psychiatric disorder.

Once the parents had signed the informed consent and the children had assented to participation, the assessment was carried out as follows: to determine whether there was any form of neurodevelopmental or behavioural abnormality, children were assessed by the consecutive administration of the Behavior Assessment System for Children (BASC) and the ADHD symptom checklist.[14,28-31]

Children that exhibited abnormalities both in the BASC and the symptom checklist underwent a short structured diagnostic interview lasting an average of 15 minutes following the protocol of the MINI for children and adolescents (MINI KID), Spanish version 5.0.0, based on the DSM-IV.

We arranged the results of the BASC and ADHD symptom checklist and the results of the MINI in a table, calculating measures of central tendency (observed frequency, mean and standard deviation), by ADHD subtype. We also analysed the association between sex, age group and ADHD subtype by means of the χ^2 test, and performed a simple correspondence analysis comparing ADHD subtypes and the presence of comorbidities. The analysis was performed with the statistical package R-CRAN. The study was overseen by the Bioethics Committee.

RESULTS

We start by presenting the sociodemographic characteristics of the children that participated in the study. The mean age was 11 3 years, 52.75% were male (n = 91), 60.11% were aged 6 to 11 years (n = 107), and 15% (confidence interval [CI]: 12 to 18) met the criteria for diagnosis of ADHD, as can be seen in **Table 1**.

We found that 8% (CI: 6 to 10) of individuals that required assessment by means of the MINI exhibited criteria for other neuropsychiatric disorders. Children with ADHD or other diagnoses added up to 23%, which means that nearly one fourth of the children evaluated had a mental health diagnosis.

Of the group that met the criteria for ADHD, 62.7% (n = 37) were aged 6 to 11 years, with a statistically significant difference in age ($p < 0.01$). We also found a significant predominance of the male sex (64.4%; $p < 0.01$).

As for the distribution of diagnoses by subtype, we found that in the group of children diagnosed with ADHD (n = 59), the prevalence of the hyperactive type was 20%, the prevalence of inattentive type 32% and the prevalence of combined type 47%. We did not find a significant association between

Table 1. Prevalence of ADHD in the sample

	Absolute frequency	Relative frequency	Confidence interval
Healthy	205	54%	49-59%
Healthy in MINI	87	23%	IC 19-27%
ADHD	59	15%	IC 12-19%
Another diagnosis	32	8%	IC 6-11%
Total	383	100%	-

Healthy: participants that did not require assessment by means of the MINI; **Healthy in MINI:** participants that exhibited some neurobehavioural abnormality and underwent the full evaluation but did not meet the criteria for a neuropsychiatric diagnosis; **ADHD:** participants who met the criteria for diagnosis of attention-deficit hyperactivity disorder; **Other diagnosis:** participants that met the criteria for diagnosis of other neuropsychiatric disorders.

sex and ADHD subtype (χ^2: 1.38; $p > 0.05$) or age group and ADHD subtype (χ^2: 0.71; $p > 0.05$).

The comorbidities associated to the hyperactive type were anxiety and oppositional defiant disorder, while the inattentive type was mainly associated with episodes of depression and agoraphobia. We ought to note that the combined type appeared in the middle of the scatter plot, evincing a clear combination of the other 2 subtypes (hyperactive and inattentive). In children with combined type, we found that depression was associated with an increased risk of suicide.

We evaluated other characteristics that ought to be highlighted: none of the students reported having intentionally set fires, deceived other people to steal their money or get their belongings, robbed others using weapons or intimidation, forced or coerced anyone to have sex, or being cruel to animals or enjoying causing them suffering.

DISCUSSION

Prevalence studies are very important, especially in areas where there are gaps in knowledge. Although ADHD is one of the most frequent neurodevelopmental disorders in childhood, the epidemiological data in the medical literature is insufficient to establish the prevalence with certainty, which is why our study focused on this aspect.[1,2] In Colombia, few studies have analysed the prevalence of ADHD, and those published focused on the inland population of the country; there are still no data on the Caribbean region of Colombia allowing us to assess the epidemiology of this disorder and to make comparisons with the findings of other authors domestically and abroad, so with our study we aimed at making an initial approximation to estimate the prevalence of ADHD in schoolchildren in Barranquilla and to spur future research on this subject.

The prevalence of ADHD varies across the world, with some authors estimating it at approximately 7.2%[32] and other studies ranges as broad as 4% to 13.3%.[3,33] In Colombia, the prevalence diverges from what has been generally reported worldwide, as the evidence published to date shows a prevalence of 15% to 17%.[1,14] Our findings were consistent with those of studies performed previously in Colombia, which corroborates the 15% prevalence found in the sample under study, evidence that is indicative of a high risk of mental health disorders in school children in the city of Barranquilla and in Colombia overall.

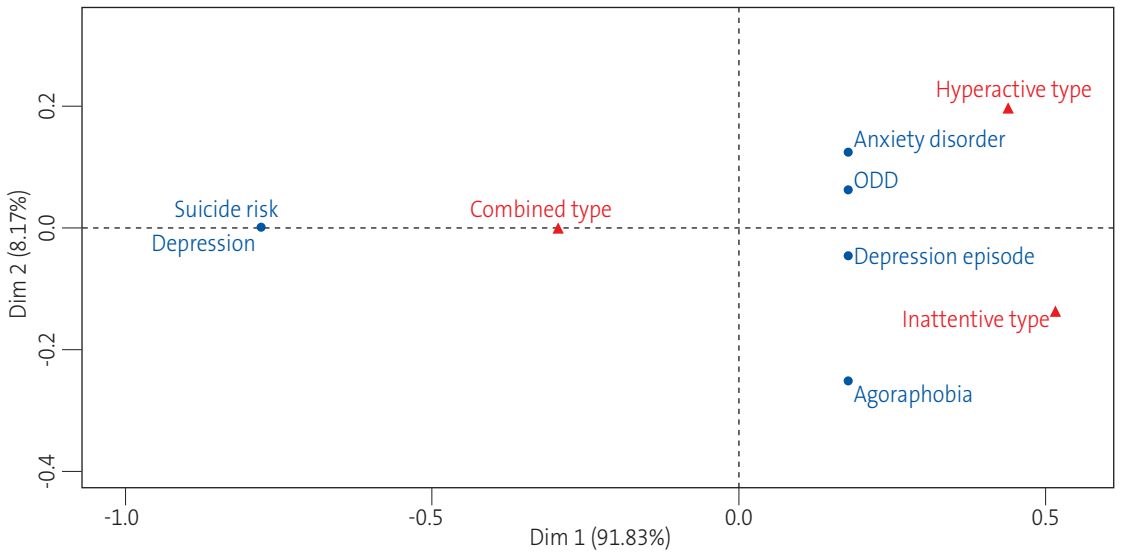
When it came to the sex distribution, we found that ADHD was more frequent in male than female students, with a ratio of 2:1, which was con-

Table 2. Frequency distribution of ADHD subtypes by sex and age group

Sociodemographic variables		ADHD subtype			Total
		Hyperactive	Inattentive	Combined	
Sex	Male	8	14	16	38
	Female	4	5	12	21
Age group	6-11 years	8	13	16	37
	12-18 years	4	6	12	22

ADHD: attention-deficit hyperactivity disorder.

Figure 1. Simple correspondence analysis of the association between attention-deficit hyperactivity disorder subtypes and comorbidities



ADHD: attention-deficit hyperactivity disorder; **ODD:** oppositional-defiant disorder.

sistent with the findings worldwide and in other Colombian populations.[1,14,34] Similarly, the prevalence by age group found in our study found a higher proportion of ADHD in younger children (6 to 11 years), which reached 62.7% compared to the prevalence of 37.3% in children aged more than 12 years. These findings are similar to those reported by other authors,[7] and some researchers have attributed them to changes in brain maturation, for according to the experts patients with ADHD have levels of cortical maturation and thickening that are delayed by 2 to 3 years compared to children without ADHD.[35]

In a study of the population of Sabaneta in Antioquía in 2005, Cornejo JW *et al*. described that the most frequent subtype was the combined type, followed by the inattentive type and then the hyperactive type, which was consistent with the findings of our study, with a similar distribution and proportions (7.3%, 5.0% and 3.1%, respectively).[1]

Of the 16 psychiatric disorders included in the analysis as comorbidities, based on the selection of the structured interview (MINI), we found that the most prevalent was oppositional defiant disorder, corresponding to a proportion of 44.06%, which we found was a common feature in our review of the medical literature[21,36] and has a significant impact, as it is one of the most important factors associated with poor outcomes in ADHD. This disorder is characterised by hostility toward authority figures, disobedience and confrontational attitudes that result in a series of disturbances in the family, school and social life at large that may ultimately lead to criminal and high-risk behaviours.

Mood disorders were the second most frequent comorbidity in children with ADHD, present in 30.5% of the total, which was similar to the findings of the study conducted by Artigas-Pallares in 2003. In an article published in 2007, Birmaher described that ADHD is frequently associated with mood disorders. The causes of the association of these disorders and ADHD has not been elucidated. Some authors propose that problems in the family, school and social relationships, such as arguments with parents and other relatives, difficul-

ties interacting with peers and poor academic performance, are associated with decreases in self-esteem.[13] Other authors consider that it is the genetic and molecular changes characteristic of ADHD that underlie the association with mood disorders, with the possible contribution of environmental factors.[37]

Considering that the most frequent psychiatric disorders in the paediatric population are anxiety disorders, we ought to highlight that in our study we found a prevalence of anxiety as a comorbidity of ADHD of 20.3%, a high percentage that could be partly explained, in addition to what we just mentioned, by the genetic hypothesis that while these 2 disorders are inherited separately, they do potentiate one another.[1]

At present there are no known biological markers that can be used to diagnose ADHD with certainty, and the use of clinical tests or evaluations is not considered objective enough, as there is a risk of error or inaccuracy in making the diagnosis, all of which makes it difficult to compare the prevalences of ADHD reported by different studies conducted at the national and international levels.[1,22,38]

CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare in relation to the preparation and publication of this article. This article is part of the dissertation for the degree in the specialty of Psychiatry of Leónidas José Llanos Lizcano and Darwin José García Ruiz. It was funded with the authors' own resources.

ABBREVIATIONS

ADHD: attention-deficit hyperactivity disorder • **BASC:** Behavior Assessment System for Children • **CI:** confidence interval • **MINI:** Mini-International Neuropsychiatric Interview.

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