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Attention-Deficit/Hyperactivity Disorder: prevalence of risk in the scholastic scope of the Canary islands

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Objective. To obtain data of prevalence of risk of the disorder attention deficit (ADHD) in the child and adolescent population of the Canary Islands.

Subjects and method. The sample used is 4858 participants of whom 2553 are girls (52.55%) and 2305 boys (47.45%) with a range of age between 6 and 16 years. Also of the total sample 2500 participants belong to primary while 2358 come from. These samples detected those participants exceeding the cut-off points in the EDAH scale versions validated for the Canary Islands.

Results and conclusions. Analysis of the data gives us a global risk of 11.52% prevalence, which is why one of every seven school children could manifest this disorder. We explore the possible differences by sex and age, both in primary and secondary.

Keywords: Prevalence of risk, ADHD, EDAH, Childhood, Adolescence

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Trastorno por Déficit de Atención con Hiperactividad: prevalencia de riesgo en el ámbito escolar de Canarias

Objetivo. Obtener datos de prevalencia de riesgo del trastorno por déficit de atención con hiperactividad (TDAH) en la población infanto-juvenil de Canarias.

Sujetos y método. La muestra utilizada es de 4858 participantes de los cuales 2553 son chicas (52,55%) y 2305 chicos (47,45%) con un rango de edad entre 6 y 16 años. Del total de la muestra 2500 participantes pertenecen a primaria (51,46%) mientras que 2358 (48,54%) proceden de secundaria. A partir de dichas muestras se detectan aquellos participantes que superen los puntos de corte en la escala EDAH en sus versiones validadas para Canarias.

Resultados y conclusiones. El análisis de los datos nos aporta una prevalencia de riesgo global de un 11,52% por lo que uno de cada siete escolares podría manifestar este trastorno. Se estudian las posibles diferencias por sexo y edad, tanto en primaria como en secundaria.

Palabras clave: Prevalencia de riesgo, TDAH, EDAH, Infancia, Adolescencia

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INTRODUCTION

Attention Deficit Hyperactivity Disorder (ADHD) is characterized by a persistent pattern of inattention and/or hyperactivity-impulsiveness that is more frequent and severe than that usually observed in children with a similar development level. In order to make a differential diagnosis, the clinical manifestations must occur in two or more settings, prior to the age of 7 and be accompanied by significant clinical deterioration. Furthermore, its presence should not be limited to the course of a generalized developmental disorder, of schizophrenia or any other psychotic disorder.[1]

It is a frequent disorder that is sufficiently important due to its morbidity and dysfunctionality that is more intensely present in childhood, but that continues in adolescence.[2,3] It is a chronic disorder, whose symptoms may be accompanied by learning problems, low self-esteem, emotional and behavioral disorders and problems interacting with peers. The above may be worsened by social and cultural precariety.[4-8]

The DSM-IV-TR considers the existence of subtypes for those cases in which only signs of only one element predominate[1] giving rise to four subcategories. These are a) type with hyperactive-impulsive predominance, whose fundamental characteristics are related with hyperkinesis and impulse control problems; b) type having a predominance of attention deficit, in which the difficulties are focused on concentration problems; c) Combined Type, which shares symptoms of the two above types and d) Attention deficit with hyperactivity, unspecified type, which occurs when all the criteria mentioned are fulfilled but the subject has symptoms of inattention or hyperactivity-impulsiveness.

Variations between 3% and 15% have been observed regarding the prevalence of the disorder and in accordance with different studies.[9-12] At this point, the meta-analysis performed on 102 publications from different geographic zones, including Spain, and that explains this variability, should be mentioned. This variability is accounted for, not because of the differences in the sites analyzed, but rather due to the methodological characteristics of the works.[13] On its part, the DSM-IV-TR offers an estimated prevalence of 3-7%. In our country, prevalence indexes between 4% and 14.4% have appeared more recently, although it must be stated that these results arise from different objectives.[14-16] In the first work, only one source of information (teachers) was used and the work followed a strategy only based on psychometrics and whose objective was to obtain risk prevalences. The second study used psychometry for the detection and clinical evaluation for the case confirmation. The third and most recent one considered information from fathers, mothers and teachers. The results obtained in the latter two are close to the rates indicated by the DSM-IV, while the risk prevalence in the first one differs from the prevalence estimated according to the classification systems in use.

It should also be mentioned that the variability in the prevalence indexes found may be due to the influence of the diagnostic criteria, the detection instruments, gender of the population studied, sample type (clinical or community), communication source (parents, teachers, children) and sociocultural characteristics.[16-20]

The combined ones appear to be the most frequent[17-19,21] of the disorder subtypes, while other investigations point to the hyperactive-impulsive subtype as the one with the greatest prevalence.[11]

There is a predominance of males regarding gender. The ratio ranges from 2:1 to 9:1, depending on the sample.[21-25] There are also variations regarding gender in the ADHD subtypes. This is the case of some research that has stated that girls with ADHD have a greater tendency for attention problems,[26] while more recent studies have found that the hyperactive-impulsive subtype is the most frequent in this gender, versus males who have more attention problems.[9]

In line with the subjects dealt with up to now, and within a more extensive investigation, which included the evaluation of internalized and externalized behaviors in school children of the Regional Community of the Canary Islands,[27,28] the current work has aimed to study the presence of ADHD symptoms in the school setting in a child-adolescent sample that is representative of the general population, to detect the prevalence of risk by age and gender groups and to verify its relationship with behavioral problems and/or social interaction problems. A hypothesis that the symptoms will vary based on gender and age is also proposed.

METHOD

Subjects and methods

The data were obtained in two phases. Data from the secondary school were collected in the first phase and from primary school in the second phase. In both cases, sampling was performed by bi-stage clusters, the primary unit being the center (the public and charter centers of the Canary Island Community) and the classroom for the secondary unit. All the boys and girls from each classroom selected participated. Furthermore, because of the great disparity in the prevalence data found in the literature,[14-16] it was decided to consider the minimum size of the sample in both cases (n=2828), this resulting in an expected risk prevalence of 8% with 1% accuracy and 95% confidence interval. Furthermore, it was considered that this amount needed to be increased by 20% to control possible experimental

Table 1 Means (M) and Standard Deviations (SD) of the ADHD score in Primary School

Age	Gender	n	Hyperactivity (H)		Attention Deficit (DA)		H+AD		BP		SP	
			M	SD	M	SD	M	SD	M	SD	M	SD
6	B	101	2.13	2.41	2.90	3.80	5.04	5.60	2.11	3.76	0.76	1.71
	G	103	1.42	2.24	2.18	3.38	3.61	5.15	1.70	3.76	0.47	1.13
7	B	160	3.20	3.35	4.07	3.81	7.22	6.33	4.73	5.77	1.57	2.11
	G	177	2.07	2.57	3.31	3.65	5.39	5.59	3.0	4.30	1.14	1.86
8	B	209	3.30	3.80	4.34	4.04	7.66	6.59	5.07	5.84	1.76	2.35
	G	235	1.42	2.26	2.74	3.49	4.16	5.13	2.20	3.77	0.69	1.33
9	B	220	2.89	3.04	5.09	4.48	7.99	6.56	5.05	6.25	1.91	2.58
	G	218	1.69	2.20	3.60	3.71	5.30	4.92	2.65	3.91	0.97	1.69
10	B	202	2.89	2.86	4.71	4.26	7.57	6.18	4.33	5.44	1.49	2.15
	G	208	1.49	2.21	2.77	3.60	4.28	5.02	2.40	4.16	0.91	1.77
11	B	152	2.33	2.92	3.84	4.19	6.17	6.49	4.11	5.51	1.43	2.35
	G	177	1.49	2.04	3.18	3.79	4.68	5.10	2.62	4.11	0.99	1.99
12	B	168	2.60	3.06	5.05	4.28	7.68	6.59	4.66	6.11	1.57	2.04
	G	169	1.20	1.93	3.55	3.55	4.71	4.78	2.45	4.07	1.12	1.82

Table 2 Means (M) and Standard Deviations (SD) of the ADHD score in Secondary School

Age	Gender	n	Hyperactivity (H)		Attention Deficit (DA)		H+AD		BP		SP	
			M	SD	M	SD	M	SD	M	SD	M	SD
12	B	207	1.64	2.0	2.52	2.62	4.19	4.13	3.72	4.97	0.88	1.59
	G	235	1.09	1.71	2.25	2.48	3.37	3.75	3.16	4.71	0.93	1.54
13	B	259	2.86	2.47	4.06	3.22	6.91	4.75	5.81	6.24	1.34	1.83
	G	279	1.48	1.83	2.73	2.77	4.22	3.86	3.91	5.13	0.91	1.43
14	B	252	2.16	2.37	4.17	3.53	6.39	5.14	4.76	6.23	1.26	1.75
	G	312	1.23	1.76	2.91	3.15	4.17	4.27	3.66	5.59	0.97	1.39
15	B	274	2.21	2.20	3.73	3.67	5.94	5.22	4.55	5.82	1.04	1.59
	G	332	0.96	1.40	2.54	2.73	3.50	3.45	2.50	4.07	0.71	1.35
16	B	100	2.19	2.11	4.08	3.24	6.27	4.64	4.02	4.62	0.96	1.28
	G	108	1.03	1.26	2.87	2.76	3.92	3.25	2.5	4.78	0.50	0.95

mortality. The final sample was n=3400 for secondary and n=3390 for the primary school because already formed groups were used.

Loss of participants occurred in both primary (n= 890) as well as in secondary school (n=1042). In the primary one, the parents had not signed the informed consent in 748 cases and the questionnaires were incomplete in 142 cases. In secondary, the parents had not signed the informed consent in 948 cases, the questionnaires were incomplete in 70 cases and the children were younger than 12 in 24 cases. Finally, the total study sample was made up of 4858 participants, 2358 (48.54%) of whom were doing studies in Obligatory Secondary School (ESO in Spanish) and 2500 (51.46%) were within the Primary Education (PE) in the Canary Island Community.

Distribution by gender in Secondary School was 1266 girls (53.7%) and 1092 boys (46.3%). Age ranged from 12 to 16 years with a mean of 13.83±1.24 years. Distribution by

Table 3 ADHD risk prevalence according to gender and education level

		PRIMARY (N=2500)		SECONDARY (N=2358)		TOTALS (N=4858)
		BOYS	GIRLS	BOYS	GIRLS	
H	N	31	55	37	37	160
	%	1.36%	2.2%	1.56%	1.56%	3.29%
	CI 95%	(0.90-1.81)	(1.17-3.22)	(1.05-2.06)	(1.05-2.06)	(2.78-3.79)
AD	N	34	38	40	40	152
	%	1.36%	1.52%	1.69%	1.69%	3.12%
	CI 95%	(0.90-1.81)	(1.04-1.99)	(1.16-2.21)	(1.16-2.21)	(2.63-3.60)
H+AD	N	65	68	59	56	248
	%	2.6%	2.72%	2.50%	2.37%	5.11%
	CI 95%	(1.97-3.22)	(2.08-3.35)	(1.86-3.13)	(1.75-2.98)	(4.48-5.71)
TOTALS	N	130	161	136	133	560
	%	5.2%	6.44%	5.64%	5.76%	11.52%
	CI 95%	(4.32-6.07)	(5.47-7.40)	(4.70-6.57)	(4.81-6.70)	(10.62-12.41)

gender in Primary School was de 1287 girls (51.5%) and 1213 boys (48.5%). Age ranged from 6 to 12 years, with a mean of 9.14±1.82 years.

Instrument

The instrument used, the EDAH[29] (evaluation of deficit of attention and hyperactivity) is a revised Spanish version of Conners' behavior scale for professors in the child population (6 to 12 years). It objective is to gather information on the usual behavior of the children in the classroom, with a structured observation method for the teacher. It is made up of 20 items. We used the versions validated for the child and adolescent population of the Canary Islands for this study,[30,31] made up of four subscales: Hyperactivity (H), Attention Deficit (AD), Social interaction problems (SP) and Behavioral Problems (BP). The sum of the scores of the H and AD factors made it possible to detect the so-called combined subtype. Each item was scored with 0 to 3 points. The highest scores are indicative of the presence of the symptom. The cutoffs used in primary education were obtained by adding two standard deviations to the mean of each factor in each age. In secondary school, the cutoffs of the scale for adolescents were used.[32] The reliability and validity indicators that the two validations have offer excellent values, the psychometric goodness of fit of the test being confirmed.

RESULTS

By considering all the factors measured by the test, we found that the mean in each one of them for the complete sample (N=4858) was M=3.66; SD=5.20 for the BP factor and M=3.45; SD=3.60 for the AD factor. For the SP factor it was M=1.1; SD=1.80 and for the H factor M=1.92; SD=2.43. In the combined H+AD, the mean was 5.37 (SD=5.31). The means obtained by the males were greater in every case than those obtained by the females, and the means obtained in Primary school were greater than those from Secondary, except for BP factor that showed higher means in Secondary school. The means and standard deviation by gender and age are shown in tables 1 and 2.

Analysis of prevalences

Only those factors that form the disorder per se, that is, hyperactivity, attention deficit and the combined H+AD were considered for the analysis of prevalences. All the confidence intervals shown were calculated with a 95% confidence level. A total of 11.52% (10.62-12.41) of the sample (N=4858) were at risk of ADHD. Globally, we can say that one out of every seven schoolchildren could present this disorder. Of these, 5.98% (4.41-6.64) are in primary school while 5.53% (5.32-5.73) were in secondary school. Regarding gender, we found a greater percentage for girls 6.05% (5.37-6.72) than for boys 5.47% (4.83-6.11). However, this difference was not significant ($z=0.899$; $p=0.368$; $\alpha=0.01$). Table 3 shows the ADHD risk prevalence by gender and educational level. It is stressed that significant differences were not found between the risk prevalences by gender, except in H+AD in primary school ($z=3.427$; $p=0.000$; $\alpha=0.01$), where there was a higher risk prevalence in girls.

It was found that boys obtained higher mean scores than the girls in both primary and secondary school. We performed an analysis of the variance (MANOVA) to detect possible significant differences in age, gender and their interaction. Wilks' Lambda and Pillai's Criterion were used to interpret the results. Both criteria showed a significant

Table 4 Results for a posteriori multiple comparisons between age of the different ADHD subtypes in Secondary School

	Age	Difference between means	Standard error	Significance	95% Confidence Interval	
					Lower limit	Upper limit
AD						
	12-14	1.9883	0.53518	0.009	0.3221	3.6544
H						
	13-16	1.9887	0.54222	0.011	0.3062	3.6712
	14-16	1.6825	0.53601	0.046	0.0193	3.3457
H+AD						
	12-14	-2.2867	0.58967	0.005	-4.1164	-0.4571
	13-16	2.2748	0.66093	0.020	0.2240	4.3256
	14-16	3.0173	0.65336	0.000	0.9900	5.0446
	15-16	2.2353	0.65160	0.021	0.2134	4.2572

general difference in primary school only for the gender variable [Wilks' Lamba =0.734 [$F_{(2.274)}$=24.51; p=0.000] and Pillai's criterion =0.266 [$F_{(2.274)}$=24.51; p=0.000], the mean being greater in all the factors for the males. The mean obtained for the H factor for the girls was 5.41 (SD=2.93) and for the boys M=7.88 (SD=3.18) [$F_{(1.274)}$=41.14; p=0.000]; in the AD factor, (M=8.96; SD=3.86) for the girls (M=11.41; SD=3.60) and for the boys [$F_{(1.274)}$=27.15; p=0.000]. In the H+AD, the girls obtained a mean of =14.38; SD=4.04 and the boys obtained a mean of =19.30 and SD=3.99 [$F_{(1.274)}$=94.14; p=0.000]. In the BP factor, the mean for the girls was 8.99 (SD=0.51) and for the boys, it was =13.27; (SD=0.50) [$F_{(1.274)}$=30.23; p=0.000]. In the SP factor, the mean for the girls was =3.35; SD=0.22 and for the boys, it was =4.98; SD=0.25[$F_{(1.274)}$=23.17; p=0.000].

In secondary school children, the criteria used indicated that there was a significant general difference for both gender and age. However, the same did not occur for their interaction. In relation to gender, the Wilks' Lambda was =0.699 [$F_{(2-250)}$=26.96; p=0.000] and Pillai's criteria =0.301 [$F_{(2.250)}$=26-96; p=0.000] and as occurred in the primary school children, the means were greater in boys than in girls for all the factors. The differences obtained were as follows: in the H factor, the mean for the girls was 3.79; SD=2.51 and for the boys M=5.66; SD=2.55, [$F_{(1.263)}$=35.87; p=0.000]. In the AD factor, the mean for the girls was 7.33; SD=2.96, while the mean for the boys was 9.05; SD=2.66 [$F_{(1.263)}$=25.07; p=0.000]. For the H+AD, the girls showed a M=11.12; SD=3.39 and the boys M=14.69; SD=3.0 [$F_{(1.263)}$=81.87; p=0.000]. In SP, the girls obtained a mean of 10.38; SD=0.65 and the boys a mean of 12.26; SD=0.66 [$F_{(1.263)}$=4.05; p=0.016] . Finally, in the SP factor, the girls reached a mean of 2.11; SD=0.19 and the boys a mean of 2.70, SD=0.19 [$F_{(1.263)}$=4.60; p=0.003]. Regarding age, Wilks' Lambda was=0.869 [$F_{(8.508)}$=4.62; p=0.000] and Pillai's criterion=0.134 [$F_{(8.510)}$=4.59; p=0.000]. We used the Scheffé method for *a posteriori* multiple comparisons to determine in which ages these differences occurred. In the AD subtype, we found that this occurred between 12 and 14 years, with the mean greater at 14 years. In the H subtype, the differences appear between those who were 13 and 16 years and 14 and 16 years, the means being greater at 13 and 14 years. In the H subtype, the differences appeared between the 13 and 16 year and 14 and 16 year olds, the mean being greater at the 13 and 14 year olds, respectively. The greater number of significant differences between ages occurred in the combined subtype. We found differences between the 12 and 14 year olds and between the 13, 14, 15 and 16 year olds, with means being greater for the 13, 14 and 15 years. Thus, it was observed that in the age interval of 13-14 years, there were higher scores on the three subtypes of ADHD. (See table 4)

Analysis of correlations

In regards to the SP and BP factors, it was found that 177 [60.82% (58-61.9)] out of the 291 possible cases of ADHD detected in primary school had high scores in these factors. In secondary school, 126 [46.84% (43.9-48)] of the 269 possible cases detected had high score for the BP and/or SP factors. The difference between primary and secondary school was significant (z=3.292; p=0.000; α=0.05).

In primary school, for the girls (n=161), 89 cases also had high scores in said factors. This accounted for 55.27% (53.2-57.1). For the boys (n=130), there were 88 cases with behavioral and/or social interaction problems [67.68% (65.1-68.6)]. These differences are significant (z=-2.153; p=0.031; α=0.05).

For the girls in secondary school (n=133), 65 cases [48.86% (44.1-51.8)] showed behavioral and/or social interaction problems. For the boy, (n=136), 61 cases [44.84% (41.9-46)] presented these problems. The difference between genders was not significant in this stage.

We obtained significant differences between the two educational levels in the percentage of boys with high scores in BP and/or SP (z=3.744; p=0.000; α=0.05). Significant differences were not found for the girls.

CONCLUSIONS

This work was carried out within the framework of a larger study[28] in which there was an initial phase of detection of risk prevalence (which was carried out in two different points in time) and a second phase of case confirmation. It should be mentioned that there was high sample mortality in this second phase that made it impossible to obtain the rates of estimated prevalence.

The risk prevalence found in our study (11.52%) was only similar to that of another Spanish investigation that also used ADHD as screening test and whose result was 12%.[14]

It is clear that the use of only one informer determines the data found, which, in our case, were higher than those found in other investigations with several informers (parents and teachers)[15,33] and applying the DSM-IV criteria. However, it also needs to be mentioned that fluctuations were found in the prevalence rates among studies that used tests based on the DSM-IV criteria, above all in reference to subtypes.[18]

In accordance with our data, we can state on a general level that the ADHD signs are clearer in primary schools than in secondary school as higher mean scores are obtained in childhood than in adolescents. Boys have higher mean scores than girls both in the childhood and adolescent stage.[16]

However, although boys have higher mean scores thing girls, the risk prevalence found in primary school is greater in girls than boys, although these differences are not significant.

If we compare the risk prevalences on the two educational levels, we observe that they are similar. There are also no significant differences between genders, except for the type with hyperactive-impulsive predominance in primary school where the prevalence in girls is significantly greater than in boys.

In the cases detected, we found that:

- The difference is maintained in the mean scores, this being greater in boys than in girls in both primary and secondary school.
- Age does not affect the scores obtained in childhood but it does affect those achieved in adolescents, the mean scores being higher between 13-14 years in all the subtypes.
- Social interaction (SP) and behavioral problems (BP) are associated in a high percentage to the ADHD signs.[34] This association is clearer in primary school than in secondary school and greater in boys than in girls.

When it is taken into account that the results obtained refer to risk prevalence reported by teachers, a future clinical study is necessary to carry out a valid and reliable diagnosis. This study should include the evaluation through other informers (teachers and/or guardians and the children themselves) as well as direct observation of the clinician in natural context, that is, in the family and school setting, in order to confirm said diagnosis.

Finally, these symptoms should always be understood and analyzed within a bio-psychosocial model that considers the interaction and combination of a wide diversity of variables.

Achieving a correct diagnosis of ADHD is essential to lessen the impact that this psychological disorder may have on a personal, family and social level.

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