Estimation of the prevalence of attention deficit/hyperactivity disorder among the standard population on the island of Majorca

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ESTIMATION OF THE PREVALENCE OF ATTENTION DEFICIT/HYPERACTIVITY DISORDER AMONG THE STANDARD POPULATION ON THE ISLAND OF MAJORCA

Summary. Aim. *To determine the rate of prevalence of attention-deficit/hyperactivity disorder (ADHD) in children of school age (6-11 years) in the Island of Mallorca.* Subjects and methods. *The epidemiological study was conducted using a community sample extracted by means of multi-stage stratified sampling according to areas (rural, city and touristy) and schooling (public, private and concerted) and consisted in 1,509 children of both sexes. The ADHD Rating Scales-IV (ADHD RS-IV) for home and school setting were used to collect data. The optimal approach to do a diagnostic evaluation, according with the literature, was using a cut-off point of 90 centil.* Results. *The estimated prevalence of ADHD was 4.57% (confidence interval at 99%: 3.0-5.8%) and we also obtained 1.26% for the hyperactive subtype, 1.06% for the disattentional subtype, and 2.25% for the combined subtype. Contrary to what was expected, prevalence was higher for females but no statistically significant. There were no statistically significant differences between levels, schools or areas.* Conclusions. *The estimates for prevalence found in this study are consistent with those reported in the literature (between 3-5%). Using the ADHD RS-IV which has different cut-off point regarding age, sex and setting and the fact that it was a poblational based study could explain the higher prevalence in the females. We propose a normalization of the scales in our area in other to confirm our findings. [REV NEUROL 2007; 44: 10-4]*

Key words. *Attention-deficit/hiperactivity disorder (ADHD). Childhood. Prevalence.*

INTRODUCTION

Attention deficit/hyperactivity disorder (ADHD) is a behavioural disorder, with genetic basis where diverse neuropsychological factors affect attention, impulsivity and motor hyperactivity in children leading to lack of self-control with far reaching consequences [1,2]. The *Diagnostic and Statistical Manual of Mental Disorders* IV edition (DSM-IV) [3] distinguishes three subtypes of ADHD: combined, predominantly inattentive, and predominantly hyperactive/impulsive and requires that symptoms be present in two or more settings. The rate of prevalence of ADHD is a controversial [4]. Even though DSM-IV criteria establish a range between 3% and 5%, as the most widely accepted value, in reality, variability is very high. Du Paul et al [5] suggest a range from 2% to 30% in the general population, while Buitelaar et al [6] in a comprehensive review place the range between 4% and 17% with a high degree of variability with respect to strategies used, clinical criteria, cut-off points, age range, gender, socio-demographic characteristics, ADHD subtypes and co-morbidity. Recent research presents discrepant results: Brown et al [7] place the rate in the general population between 4% and 12%; Barbaresi et al [8] in a study done on cohorts in a hospital environment estimate a range of 7% to 16%; and Cornejo et al [9] obtain a 16% rate in a sample of Colombian children. Roche et al [10] obtain a rate of 5.8% using a very complete methodology on a sample of 1013 children between 12 and 14 years of age. Gender differences indicate a higher prevalence rate in males than in females: according to DSM-IV criteria, 9:1 in the clinical population and 4:1 in a normal population. Du Paul et al [5] and Buitelaar et al [6] show less dramatic differences yet still favour a higher prevalence rate in males. Regardless, some authors [1] have indicated that not using different criteria for gender leads to an underdiagnosis for girls. On the other hand, Montiel-Nava et al [11] with a sample of 1411 children in Maracaibo and using Conners CRS-R scales for parents and teachers obtained a total prevalence rate of 7.19%, with a higher rate in girls (8.26%) than in boys (6.20%), attributed partially to 'cultural factors'.

Epidemiological studies on ADHD are based on two strategies [1,5,6]: the clinical strategy based on evaluation by an expert, and the psychometric strategy based on scales for parents and/or teachers. The first has the advantage that it follows the criteria in diagnostic manuals closely and depends on a clinical expert. However it is more costly, time-consuming and more susceptible to variability inter observers (due to competence of the experts). The second strategy provides a more objective prediction with less cost and in faster time but with the limitations that the use of scales and self-evaluations carry. Buitelaar et al [6] suggest that the psychometric strategy would be improved if the scales used would meet the following requirements: information must come from more than one source, the items must match a clinical model for diagnosis, scores must be normalized by gender and age, and finally, the cut-off points must be derived from clinical studies (i.e., there must be accountability for sensitivity and specificity). Currently, the Attention Deficit Hyperactivity Disorder Rating Scale IV (ADHD RS-IV) by Du Paul et al [5,12-14] meets these criteria most closely, thus justifying its use in epidemiological studies that use a psychometric strategy. However, its use must take into account several factors; first, the direct scores used to obtain the cut-off point are lower for parents than from teachers

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Table I. Sample distribution by school year and by gender. The proportionality of the number of state funded and semi-privately funded institutions as well as the numbers of centers located in urban, rural or touristy zones in the initial population was maintained in the sample.

		First	Second	Third	Fourth	Total
Boys	*n*	201	185	205	212	803
	% year	25.0	23.0	25,5	26.4	100
	% total	51.7	51.8	55.0	54.4	53.2
Girls	*n*	188	172	168	178	706
	% year	26.6	24.4	23.8	25.2	100
	% total	48.3	48.2	45.0	45.6	46.8
Total		389	357	373	390	1509
% by school year		25.8	23.7	24.7	25.8	100

Table II. Multi-trait/multi-source correlation matrix. All correlations are significant with $p > 0.01$.

	Teachers			Parents	
	Inattention	H/I	Total	Inattention	H/I
Parents					
Inattention	0.52	0.33	0.47		
H/I	0.39	0.41	0.40	0.64	
Total	0.48	0.41	0.48	0.91	0.90
Teachers					
Inattention					
H/I	0.70				
Total	0.93	0.91			

H/I: hyperactivity/impulsivity scale.

and less for girls than from boys. The effect of over-diagnosis by parents is balanced with the direct scores provided by teachers. The effect of normalising the differences by gender is not considered a problem but a clinical necessity. Another factor to take into account is that in the study of the ADHD RS-IV [5,15] the results allows to support either a unifactorial or bi-factorial solution (the authors choose to follow a bi-factorial approach by adherence with the DSM-IV model). In practice this implies high correlation between the subscales of inattention and hyperactivity/impulsivity leading to higher incidence of the combined subtype.

The principal objective of this study is to estimate the prevalence of ADHD, using ADHD RS-IV scale, in children 6 to 11 years old. Our initial hypothesis is that the prevalence of ADHD, as is indicated by DSM-IV criteria, must be between 3 % and 5% of the children in the population. A second objective is to determine differences by gender. Our initial hypothesis states that the prevalence must be greater in boys than in girls, however by using a scale that has carefully established differential cut-off points we expect that the difference between genders could be reduced. A third objective is to establish differences between the subtypes: ADHD predominantly inattentive, predominantly hyperactive/ impulsive and combined. Our working hypothesis states that the combined subtype will be prevalent, although it is likely that correlation between the sources (parents and teachers) and traits (inattention, hyperactivity/ impulsivity) will determine the results. Lastly, we will look at possible differences between the type of school and demographic zone.

SUBJECTS AND METHODS

The initial population consisted of all the students between the first and fourth school year (6-12 year old) in state funded and partially state-funded schools in the island of Majorca. The total number of students was 29,435 from 215 schools (90% of schools in the island). Schools that were too small and consisted of mixed classes or those that were exclusively private were excluded from the study. The epidemiological study was conducted using a community sample extracted by means of multi-stage stratified sampling according to areas (rural, city and touristy) and schooling (state funded, private and partially private).

The sampling parameters were the following:

- Universe: *n* (approximate) = 30,000.
- Stratified sampling by school year (1-4 primary level), and by clusters (number of classes/year) proportional to the type of centre and socio-demographic zones.
- Sample size (*n*): 1509. Fraction of total: 1/20.
- Error type IZ $\alpha = 0.05$, for an expected prevalence rate of 5%.
- Precision level: ± 1.07%.

Table 1 shows the distribution of the sample by school year and gender (no significant differences in any of the variables).

Informed consent from the schools and the parents was obtained for evaluation of all the subjects. Children of school years 1 to 4 were randomly chosen with the exclusion of children with special educational needs, that have repeated year of schooling or that have any psychopathologic diagnostic illnesses.

Methods

Teachers and parents of the children in the sample completed DuPaul et al's [5] ADHD RS-IV questionnaire. The items in this rating scale match the diagnostic criteria for ADHD (criteria A) listed in the DSM-IV. It consists of a subscale for inattention (9 items) and one for hyperactivity/impulsivity (9 items) for a total of 18 items. Each item is scored 0 to 3 points, with the higher punctuation indicating presence of symptoms. In the DSM-IV this ADHD RS-IV has excellent indicators for reliability, validity, sensitivity, specificity and its use for clinical and prevalence studies on ADHD is recommended. The total points obtained are transformed to percentiles based on the evaluator (teacher or parent), age of the subject and gender.

Procedures

From the 215 schools 24 schools were chosen, 14 were state funded (5 urban, 5 touristy and 4 rural), and 10 were partially state-funded (7 urban, 3 rural) through a proportional cluster random sampling. Two schools refused participation and were substituted by other two, randomly chosen from their category. Fifteen to 20 students were chosen randomly from each of the four school years from the participating schools. An information letter was sent to the parents to obtain written consent (only 2 % of subjects had to be substituted). The rating scales were sent to parents and teachers and returned within 10 days.

Prevalence rate of ADHD was determined from a cut-off point of 90 percentile for all the scales (inattention, hyperactivity/impulsivity and total) and from two different sources (parents and teachers). The original parameters from USA were used to classify the subjects. Cases were defined in the following manner:

– A subject is considered to be of ADHD combined subtype if the cut-off point is equal to or greater than 90 percentile for both parents and teachers.
– A subject is considered to be of the inattentive ADHD type if:
  a) In the scale of inattention the cut-off point is equal to or greater than 90 % percentile for both parents and teachers.
  b) For one of the evaluators the above condition is met and for the other the cut-off point in the total scale is equal to or greater than the 90 percentile (but not in the hyperactivity/impulsivity scale).
– A subject is considered to be of the hyperactive/impulsive ADHD type when:
  a) For both evaluators (parents and teachers) the cut-off point for the hyperactivity impulsivity scale is equal to or above 90 percentile but not for the other scale.
  b) When for one of the evaluators the above condition is met and for the other the cut-off point in the total scale is equal to or greater than the 90 percentile (but not in the inattentive scale).

RESULTS

While is not the main objective of this research, it is important to consider the multi-trait (inattentive, hyperactive/impulsive) multi-source (parents, teachers) matrix correlation before determining the rate of prevalence of ADHD in the sample population since it may affect it. As shown on Table II the correlations are generally high and significant.

The matrix data show a moderate valid correlation between the two scales of parents and teachers, especially in the inattention scale and in the total scale with a correlation of 0.50, and less in the hyperactivity/impulsivity scale. On the other hand, the trend in the data does not favour the discriminating validity of the scales since the inattentive and hyperactive/impulsive scales correlate with a value of 0.70 for teachers and 0.64 for parents. Even in 'crossed' correlations significant values are maintained: 0.39 between teachers-inattentive and parents-hyperactivity/impulsivity scales and 0.33 between inattention-parents and hyperactivity/ impulsivity-teachers.

The total prevalence rate is 4.57% (± 1.39). It is noteworthy to observe a higher prevalence rate in girls than in boys; although considering the table as a whole the differences are not statistically significant: χ^2 (3) = 4.81; p = 0.19 (Table III).

The predominant ADHD subtype is combined (2.25%), in both boys (1.74%) and girls (2.83%). The ADHD hyperactive/impulsive subtype (1.26%) is more frequent than the inattentive subtype (1.06%) in both genders.

Table IV shows the prevalence rate by school year. Prevalence rates are very similar between all the age levels, for each subtype and for all the ADHD candidates. The differences are not statistically significant: χ^2 (9) = 10.24; p = 0.33. A trend for a higher prevalence rate is observed in the younger two school years (5.36% for subjects with any ADHD subtype) than in the older two (3.8%), but the difference in this case is also not statistically significant: χ^2 (1) = 2.11; p = 0.15.

Finally, we must note that for the other two variables studied, type of school and socio-demographic zones there were no differences detected in the percentage of ADHD potential cases. In the fully state-funded schools, 4.77 % (± 1.99) of a population of 818 students present some type of ADHD and in the partially private schools 4.34% (± 2.00) of the 691 students do. In the case of socio-demographic zone, the prevalence rates are as follows: urban, 3.82% (± 1.80) of 759 students; rural, 6.17% (± 2.91); and touristy, 4.05% (± 2.96). As there were no apparent significant differences interactive statistical analyses were not performed.

Table III. Prevalence rate of ADHD candidates by subtype and gender.

		ADHD subtype (pc 90)				
	Negative [a]	Combined	Inattentive	Hyperactive/ impulsive	Total	Total ADHD [c]
Total						
n	1440	34	16	19	1509	69
% total	95.43	2.25	1.06	1.26	100	4.57
Precision [b]	1.39	0.99	0.68	0.74		1.39
Boys						
n	775	14	7	7	803	28
% total	96.51	1.74	0.87	0.87	100	3.49
Precision [b]	1.67	1.19	0.85	0.85		1.67
Girls						
n	665	20	9	12	706	41
% total	94.19	2.83	1.27	1.70	100	5.81
Precision [b]	2.27	1.61	1.09	1.26		2.27

[a] Subjects below the cut-off point. [b] Value to calculate the interval of confidence at 99%. [c] Sum of all the ADHD subtypes.

Tabla IV. Prevalence rate of ADHD candidates by subtype and school year.

		ADHD subtype (pc 90)				
	Negative [a]	Combined	Inattentive	Hyperactive/ impulsive	Total	Total ADHD [c]
School year 1						
n	370	10	6	3	389	19
% total	95.12	2.57	1.54	0.77	100	4.88
Precision [b]	2.82	2.07	1.61	1.14		2.82
School year 2						
n	336	9	6	6	357	21
% total	94.12	2.52	1.68	1.68	100	5.88
Precision [b]	3.21	2.14	1.76	1.76		3.21
School year 3						
n	357	10	0	6	373	16
% total	95.71	2.68	0.00	1.61	100	4.29
Precision [b]	2.71	2.16		1.68		2.71
School year 4						
n	377	5	4	4	390	13
% total	96.67	1.28	1.03	1.03	100	3.33
Precision [b]	2.35	1.47	1.32	1.32		2.35

[a] Subjects below the cut-off point. [b] Value to calculate the interval of confidence at 99%. [c] Sum of all the ADHD subtypes.

DISCUSSION

We conclude that the prevalence rate of ADHD falls exactly at the expected level, 4.6% (with a confidence interval between 3% and 6%).

It is important to note that the data presented here arises from a very representative sample, since one out of 20 subjects of the target population was evaluated. We would also like to mention that the parameters used are the original ones used to classify the subjects in the USA. Even though it would be desirable to have our own normalized score, our data supports the use of the ADHD RS-IV in our population.

The gender differences in the ADHD rate were not as expected: there were no significant differences in the prevalence rate between genders and there was even a slight trend for girls to present a higher ADHD prevalence rate. Whether or not 'cultural factors' could play a role, in our case, the scoring adjustment applied by the rating scale may explain this result. For example to be in the 90 percentile of the rating scale a 7 year old boy must attain 39 points in the teacher's score and 29 in the parent's score, while a girl only needs 36 points in the teachers rating and 20 points in the parent's rating score. Therefore, and aside of the fact that it would be desirable to have our own scoring adjustments, the data supports that using the ADHD RS-IV gender differences are lessened in an important manner. 'Same frequency' of ADHD however must not be interpreted as 'same severity' of ADHD. It is assumed that boys' scores are much higher than girls' scores. In general for both parents and teachers the disorder is more worrisome when it is a boy than a girl that has it. It follows then that in clinical studies both in hospital environment or outpatient situations the prevalence rate is higher in boys.

The differences by age group were also not significant. This was more predictable given that the whole sample can be considered a 'children's population' and that the rating scale also has differential cut-off points. Even though the trend showed a higher ADHD prevalence rate in the younger children the differences are not particularly relevant.

No significant differences were found in two of the variables, schooling type and socio-demographic zone. The same ADHD prevalence rate in the two types of school suggests, even though indirectly, that neurobiological basis for the disorder is more important than the environmental effect. This conclusion would depend on whether there are real socio-economic differences between the families who take their children to one type of school or another, a variable that has not been controlled in our study. In terms of socio-demographic differences the conclusion are limited since Majorca is a small island with a small population and the type of differences normally associated with urban, rural, and touristy that can be established in a large country, like the United States are not present here. However, ADHD rate has been shown to be uniformly distributed in terms of this population variable in Majorca.

Finally, the differences by subtype of ADHD have not been apparent in any of the variables that were analyzed. It is evident that the psychometric strategy used does not allow us to differentiate the subjects clearly without further interviews, clinical studies and laboratory tests. However, independent of the necessity to confirm the ADHD diagnosis with further tests, our data show that in the ADHD RS-IV parents and teachers only weakly agree when evaluating the same trait, either inattention or hyperactivity/impulsivity and both tend not to distinguish between them. In other words, a priori in our results we observe that the parent and teacher measures show convergent validity but fail to show discriminant validity with respect to trait using ADHD RS-IV. In practice this implies that only subjects who have met criteria in both scales (approx 2.25% of population) can theoretically be classified in a subtype (combined), while for the other two subtypes the classification is much more difficult.

Our data suggest that is possible to use a psychometric strategy to establish, with reasonable degree of accuracy, the total prevalence rate of potential ADHD cases and the ADHD RS-IV is a good tool to use in our area. However, to establish prevalence rates for the different subtypes it is necessary to complement with a 'clinical' strategy. In spite of the good functionality of the rating scale in general it appears necessary to have more studies to validate the scales scoring according to our own population, sensitivity levels and specificity in order to facilitate clinical decisions. It is also important to have multi-trait and multi-source confirmatory factor analysis to determine the scales ability to adjust to the three-subtype model of ADHD, which, in spite of doubts still prevails.

REFERENCES

1. Barkley RA. Attention deficit hyperactivity disorders: A handbook for diagnosis and treatment. 2 ed. New York: Guilford Press; 1998.
2. Barkley RA. Attention-deficit/hyperactivity disorder. In Mash E, Barkley RA, eds. Treatment of childhood disorders. 2 ed. New York: Guilford Press; 1998. p. 55-111.
3. American Psychiatric Association (APA). Manual diagnóstico y estadístico de los trastornos mentales (DSM-IV). Barcelona: Masson; 1994/2000.
4. Cardo E, Servera M. Prevalencia del trastorno por déficit de atención e hiperactividad. Rev Neurol 2005; 40 (Supl 1): S11-5.
5. DuPaul G, Power JT, Anastopoulos AD, Reid R. ADHD-Rating Scales DSM-IV for parents and teachers. New York: Guilford Press; 1998.
6. Buitelaar JK, Van Engeland H. Epidemiological approaches. In Sandberg S, ed. Hyperactivity disorders of childhood. Cambridge: Cambridge University Press; 1996. p. 26-68.
7. Brown RT, Freeman WS, Perrin JM, Stein MT, Amler RW, Feldman HM, et al. Prevalence and assessment of attention-deficit/hyperactivity disorder in primary care settings. Pediatrics 2001; 107: 1-11.
8. Barbaresi WJ, Katusic SK, Colligan RC, Pankratz S, Weaver AL, Weber KJ, et al. How common is attention-deficit/hyperactivity disorder? Arch Pediatr Adolesc Med 2002; 156 (271-224): 271-24.
9. Cornejo JW, Osío O, Sánchez Y, Carrizosa J, Sánchez G, Grisales H, et al. Prevalencia del trastorno por déficit de atención-hiperactividad en niños y adolescentes colombianos. Rev Neurol 2005; 40: 716-22.
10. Rhode LA, Biederman J, Busnello EA, Zimmerman H, Schmitz M, Martins S, et al. ADHD in a school sample of Brazilian adolescents. J Am Acad Child Adolesc Psychiatry 1999; 38: 716-22.
11. Montiel-Nava C, Peña JA, López M, Salas M, Zurga JR, Montiel-Barbero I, et al. Estimaciones de la prevalencia del trastorno por déficit de atención-hiperactividad en niños marabinos. Rev Neurol 2002; 35: 1019-24.
12. DuPaul G, Anastopoulos AD, Power JT, Reid R, Ikeda M, McGoey K. Parent ratings of attention-deficit/hyperactivity disorder symptom: factor structure and normative data. J Psychopathol Behav Assess 1998; 20: 83-102.
13. DuPaul G, Power JT, Anastopoulos AD, Reid R, McGoey K, Ikeda M. Teacher ratings of attention-deficit/hyperactivity disorder symtom: Factor structure and normative data. Psychol Assess 1997; 9: 436-44.
14. DuPaul G, Power JT, McGoey K, Ikeda M, Anastopoulos AD. Reliability and validity of parent and teacher ratings of attention-deficit/hyperactivity disorder symptoms. J Psychoeduc Assess 1998; 16: 55-8.
15. Gómez R, Burns GL, Walsh JA, De Moura MA. A multitrait-multisource confirmatory factor analytic approach to the construct validity of ADHD. Psychol Assess 2003; 15: 3-16.

ESTIMACIÓN DE LA PREVALENCIA DEL TRASTORNO POR DÉFICIT DE ATENCIÓN E HIPERACTIVIDAD EN POBLACIÓN NORMAL DE LA ISLA DE MALLORCA

Resumen. Objetivo. *Determinar la tasa de prevalencia del trastorno por déficit de atención con o sin hiperactividad (TDAH) en escolares de 6 a 11 años de la isla de Mallorca.* Sujetos y métodos. *Estudio poblacional en el que se aplicó diseño de la muestra polietápico estratificado (por cursos), proporcional (para el tipo de centro y por zonas sociodemográficas) por conglomerados (número de vías por curso en cada centro). A partir de una población diana de aproximadamente 30.000 sujetos se obtuvo una muestra de 1.509 niños. Se utilizaron las* Attention-Deficit/Hiperactivity Disorder Rating Scales IV *(ADHD RS-IV) para padres y maestros. Los casos se definieron a partir del percentil 90 en las escalas de inatención, hiperactividad/impulsividad y total de maestros y padres.* Resultados. *Indican una tasa global de prevalencia en el nivel esperado el 4,6% (intervalo de confianza al 99%: 3,0-5,8%), de los cuales el 1,26% fueron del subtipo hiperactivo, el 1,06% del subtipo inatento y el 2,25% del subtipo combinado. Contrariamente a lo esperado la incidencia fue ligeramente superior en niñas. No aparecen diferencias significativas ni por sexo, ni por cursos, ni por tipo de centro, ni por zona.* Conclusiones. *Las ADHD RS-IV han demostrado ser útiles en una población no anglosajona para estimar la prevalencia del TDAH en los valores esperados; sus puntos de corte diferenciados inciden en que desaparezcan las diferencias por sexo. Se propone normalizar la escala con muestras de nuestro entorno para poder confirmar los datos hallados. [REV NEUROL 2007; 44: 10-4]*

Palabras clave. *Infancia. Prevalencia. Trastorno por déficit de atención e hiperactividad (TDAH).*