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Birth month influences the likelihood of attention-deficit/hyperactivity disorder diagnosis in young boys – Evidence from Portugal

*Rui Sampaio** and *João Caseiro*

Serviço de Psiquiatria da Infância e da Adolescência, Departamento de Psiquiatria e Saúde Mental, Unidade Local de Saúde do Tâmega e Sousa, Penafiel, Portugal

Abstract

Introduction and objectives: Studies carried out worldwide concluded that children born in the last months of the school year are more likely to be diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD), in what is known as the relative age effect. The likeliest explanation for this phenomenon is that these children are the youngest in their class and therefore exhibit relative immaturity when compared to their older classmates, which might be misinterpreted as inattention and hyperactivity-impulsivity. Our aim is to find evidence of this phenomenon in the Portuguese population. We hypothesize that children born in the second semester of the year have an increased prevalence of ADHD diagnosis. **Methods:** Retrospective cohort study of patients followed in a child and adolescent psychiatry outpatient clinic between December 2011 and December 2021. **Results:** The relative risk of ADHD diagnosis under the age of 11 for patients born in the second semester of the year was only significantly elevated in boys (RR = 1.280, 95% CI of 1.007 – 1.628, p = 0.044). **Discussion:** The results demonstrate the relative age effect in the diagnosis of ADHD in the male subset of a Portuguese population sample. Differences in gender may be attributable to the small size of the female population sample. This is the first evidence of the relative age effect in the diagnosis of ADHD in Portugal in young boys. Clinicians should be mindful of this phenomenon when performing this diagnosis.

Keywords: ADHD. Diagnosis. Child development.

O mês de nascimento influencia a probabilidade de diagnóstico de perturbação de hiperatividade e défice de atenção em crianças do sexo masculino – Evidência em Portugal

Resumo

Introdução e objetivos: Estudos realizados em vários países concluíram que as crianças nascidas nos últimos meses do ano escolar têm uma maior probabilidade de serem diagnosticadas com perturbação de hiperatividade e défice de atenção, de acordo com o chamado efeito de idade relativa. A explicação mais provável para este fenómeno é que essas crianças são as mais novas da sua turma e por esse motivo exibem imaturidade relativa quando comparadas com os seus colegas mais velhos, o que pode ser erradamente interpretado como desatenção e hiperatividade/impulsividade. O nosso objetivo é encontrar evidência deste fenómeno na população portuguesa. A nossa hipótese é que crianças nascidas no segundo semestre

***Correspondence:**
Rui Sampaio
E-mail: rui.pires95@gmail.com

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do ano têm uma prevalência aumentada de diagnóstico de PHDA. **Métodos:** Estudo restrospetivo de coorte de pacientes seguidos num serviço de consulta externa de Psiquiatria da Infância e da Adolescência entre dezembro de 2011 e dezembro de 2021. **Resultados:** O risco relativo de ter um diagnóstico de PHDA antes dos 11 anos de idade para pacientes nascidos no segundo semestre do ano é significativamente elevado apenas em rapazes (RR = 1.280, 95% CI of 1.007-1.628, p = 0,044). **Discussão:** Os resultados demonstram o efeito de idade relativa no diagnóstico de perturbação de hiperatividade e défice de atenção no subconjunto masculino de uma amostra da população portuguesa. As diferenças de género observadas poderão ser atribuíveis à pequena dimensão da amostra de população feminina. Esta é a primeira evidência do efeito de idade relativa no diagnóstico de perturbação de hiperatividade e défice de atenção em crianças do sexo masculino em Portugal. Este fenómeno deve ser tido em conta na realização deste diagnóstico.

Palavras-chave: PHDA. Diagnóstico. Desenvolvimento infantil.

Keypoints

What is known
- Younger children in a classroom are more likely to be diagnosed with ADHD (a phenomenon known as "relative age effect").
- Clinicians should be mindful of this phenomenon when diagnosing ADHD.

What is added
- First evidence of the relative age effect for the diagnosis of ADHD in young boys in Portugal.

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by a persistent pattern of inattention, hyperactivity, and impulsivity that interferes with functioning or development[1]. Clinicians rely on the observation of the child or adolescent as well as on reports and rating scales completed by parents and teachers to diagnose ADHD[2]. The diagnostic process and its accuracy has been a subject of debate[3,4], and systematic reviews of studies conducted around the world concluded that the youngest children within a class are more likely to be diagnosed with ADHD, in what is known as the relative age effect[5-7]. The most accepted explanation for this phenomenon is that teacher ratings of ADHD symptoms rely on the comparisons of children within the classroom, where relative younger age and thus relative immaturity may be misinterpreted as inattention or hyperactivity-impulsivity, suggesting that classroom comparisons drive the relative age effect[8,9]. In an effort to quantify the increased likelihood of relatively younger children to receive an ADHD diagnosis, a recent meta-analysis yielded a relative risk (RR) of 1.34 for children born in the last four months of the school year[5].

To the best of our knowledge, the relative age effect in ADHD diagnosis has never been studied in Portugal. Our hypothesis is that children born in the second semester of the year have an increased likelihood of having an ADHD diagnosis.

The aim of this study was to find evidence of the relative age effect in ADHD diagnosis in a cohort of patients followed in a child and adolescent psychiatry outpatient clinic in Portugal.

Methods

We conducted a retrospective cohort study of all the children and adolescents up to 18 years of age followed in a child and adolescent psychiatry outpatient clinic between December 2011 and December 2021 with at least one electronically-recorded diagnosis of a mental and behavioral disorder, defined as diagnostic codes 290-319 in the International Classification of Diseases, 9th Revision [ICD-9] and codes F00-F99 in the International Classification of Diseases, 10th Revision [ICD-10] (n = 1876).

We collected data regarding the birth month and clinical diagnosis. ADHD cases were defined as having a diagnosis of 314 (Hyperkinetic syndrome of childhood) in ICD-9 or F90 (attention-deficit/hyperactivity disorders) in ICD-10. ICD-9 was used in this medical institution from the beginning of the study period until June 2020 and ICD-10 was used from July 2020 onwards. All data was collected from the patients' electronic medical records.

Because the birth month is more relevant to the age difference between younger children than between older children or adolescents, we restricted our analysis to children who received an ADHD diagnosis before they completed 11 years of age (the term "ADHD<11y"

Table 1. Descriptive statistics and relative risk of ADHD diagnosis under the age of 11 for patients born in the second semester of the year and for male patients born between August and October

Date of birth	Total	ADHD<11y (%)	RR (95% CI)	p-value
First semester	845	113 (13.4%)		
Male	500	87 (17.4%)		
Female	345	26 (7.5%)		
Second semester	1031	170 (16.5%)	1.233 (0.990-1.536)	0.069
Male	633	141 (22.2%)	1.280 (1.007-1.628)	0.044
Female	398	29 (7.3%)	0.983 (0.590-1.635)	0.528
August-October	546	97 (17.7%)		
Male	330	82 (24.8%)	1.347 (1.092-1.731)	0.021
Female	216	15 (6.9%)		
Total	1876	283 (15.1%)		

RR: relative risk; CI: confidence interval.

is used from this point onwards for simplicity). We grouped patients into two categories: those born in the first semester (relatively older) and those born in the second semester (relatively younger) and calculated the relative risk of ADHD<11y diagnosis for the relatively younger patients. No patients were excluded from the analysis on account of other medical diagnoses.

We also calculated the proportion of patients with a diagnosis of ADHD<11y for each birth month.

All data analysis was conducted in IBM SPSS Statistics Version 28.0.0.0. Associations were tested for significance using the chi-square test of independence. Statistical significance was set at $p < 0.05$.

The study was approved by the institution's ethics committee and board.

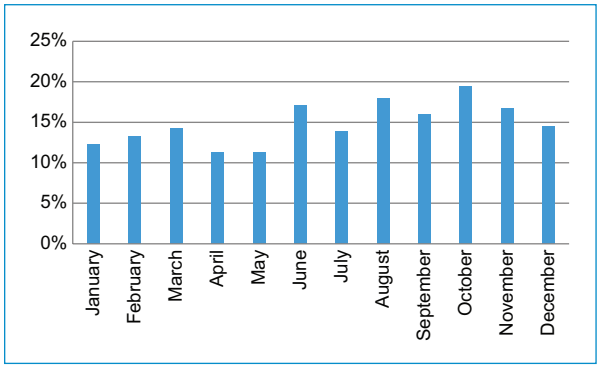

Figure 1. Percentage of patients with an ADHD<11y diagnosis by birth month.

Results

The clinical sample consisted of 1876 patients, 283 of which had a diagnosis of ADHD<11y (Table 1).

The relative risk of ADHD<11y diagnosis for patients born in the second semester of the year was not significantly elevated (RR = 1.233 with a 95% confidence interval [CI] of 0.990 – 1.536, p = 0.069). However, a stratified analysis by gender revealed a significantly elevated relative risk for male patients (RR = 1.280, 95% CI of 1.007 - 1.628, p = 0.044) but not for female patients (RR = 0.983, 95% CI of 0.590 - 1.635, p = 0.528) (Table 1).

Figure 1 shows the rate of ADHD<11y diagnosis by birth month for the total study sample, while figures 2 and 3 show the diagnosis rate for male and female patients, respectively.

The three-month period between August and October revealed a particularly high ADHD<11y diagnosis rate for boys (24.8%) (Fig. 2 and Table 1). The relative risk of ADHD<11y diagnosis for boys was also calculated for the period between August and October (RR = 1.347, 95% CI 1.092-1.731, p = 0.021).

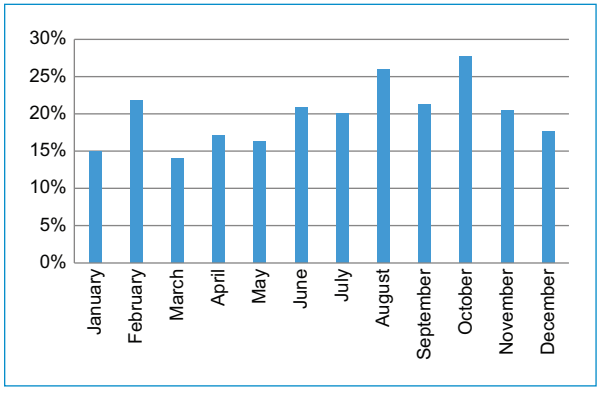

Figure 2. Percentage of male patients with an ADHD<11y diagnosis by birth month.

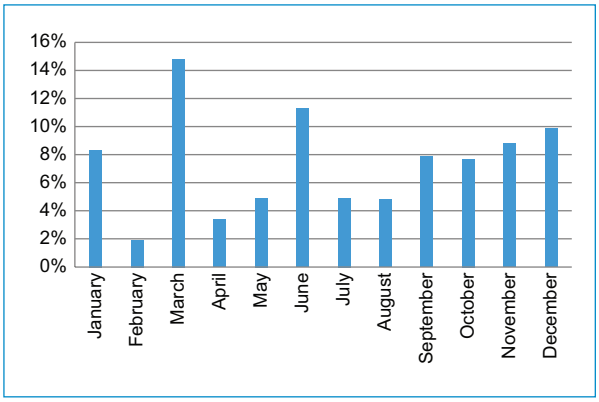

Figure 3. Percentage of female patients with an ADHD<11y diagnosis by birth month.

Discussion

The relative age effect in ADHD diagnosis has been extensively studied and reviewed[5-7]. Our goal was to study and quantify this effect in a clinical sample from a Portuguese child and adolescent psychiatry outpatient clinic.

Although we could not find any evidence for a significantly elevated relative risk of ADHD diagnosis under the age of 11 in patients born in the second semester of the year when both male and female patients were included, a stratified analysis by gender revealed a significantly elevated relative risk for male patients, with a RR of 1.28, which is similar to the relative risks found in two recent meta-analyses (RR = 1.34 and RR = 1.27)[5,6].

These results could raise the hypothesis that the relative age effect is more pronounced in boys than in girls due to developmental differences, but both meta-analyses mentioned above[5,6] found no difference between male and female populations in regards to the relative age effect, leading us to believe that these differential results regarding gender are more likely to be explained by the low number of female patients with an ADHD<11y diagnosis in our study population (n = 55, representing just 19% of all ADHD<11y patients), which may limit the statistical power of the analysis.

Analyzing ADHD<11y diagnosis rates by birth month revealed high diagnosis rates in boys born between August and October (Fig. 2 and Table 1). This prompted further analysis by calculating the relative risk of having an ADHD<11y diagnosis for boys born in this three-month period, which yielded a RR of 1.347 (95% CI 1.092-1.731, p = 0.021) (Table 1), which is even higher than the RR for boys born in the second semester of the year. One possible explanation is that parents may request early enrollment for children who complete six years of age between September 15 (the national school-entry cut-off date) and December 31, and these children would therefore be some of the youngest in their class. We suspect that the likelihood of opting for early enrollment decreases the further the child's birth date is from the September 15 cut-off date, despite having no data to support this. This could, however, help explain the lower diagnosis rates of ADHD<11y observed in the months of November and December, as boys who were born in these months and did not opt for early enrollment would be the oldest in class. In fact, Whitely and colleagues argue that the practice of "redshirting" (i.e. delaying school entry for children judged as immature, such as those born in the last months of the year) might disguise late birthdate effects[7].

Our study design has some limitations. We gathered data from a clinical sample, which may not be representative of the general population. All data refers to a single child and adolescent psychiatry outpatient clinic and may not be representative of other regions in the country. In addition, the female population sample was relatively small, which may have limited the statistical power of the analysis. The fact that parents may opt for early school enrollment for children born between September 15 and December 31 means that there is some flexibility in school entry, and we could not find data regarding the prevalence of early enrollment.

Our findings have relevant clinical implications. The relative age effect implies that some relatively younger children are being misdiagnosed and offered unnecessary medication. Clinicians should therefore be mindful of the relative age effect when diagnosing children who are relatively younger than their classmates, particularly with regards to young boys, by checking their birth month and whether they enrolled in school before they turned six years of age. Clinicians should also be mindful of this effect when analyzing teacher ratings of ADHD.

There are also educational implications to our study. When it comes to deciding whether or not to opt for early school enrollment, both parents and teachers should consider whether each particular child is sufficiently mature to face the academic challenges ahead, and whether they will stand out among their classmates as relatively immature, increasing the risk of an ADHD misdiagnosis.

To the best of our knowledge, this is the first evidence of the relative age effect for ADHD diagnosis in male children in Portugal.

In conclusion, clinicians should be mindful of the relative age effect when diagnosing ADHD in young boys and when analyzing teacher ratings of ADHD behavior. Parents and teachers should also consider the relative age effect when deciding whether or not a child should enroll in school ahead of schedule.

Further research on the relative age effect for ADHD diagnosis is needed, namely with studies conducted with samples from the general population and from across the country rather than limited to clinically-referred individuals to a single clinic.

Authors' contribution

Rui Sampaio: Idea behind, and design of, the study, report, review or other type of paper. Data acquisition from patients, research studies, or literature. Analysis or interpretation of data from patients, research studies, or literature. Drafting the article. Final approval of the version to be published. Agreement to be held accountable for the accuracy or integrity of the paper. João Caseiro: Idea behind, and design of, the study, report, review or other type of paper. Critical review of the article for important intellectual content. Final approval of the version to be published. Agreement to be held accountable for the accuracy or integrity of the paper.

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Conflicts of interest

None.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article. Furthermore, they have acknowledged and followed the recommendations as per the SAGER guidelines depending on the type and nature of the study.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Use of artificial intelligence for generating text. The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript, nor for the creation of images, graphics, tables, or their corresponding captions.

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