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Relationship between executive function alterations and academic performance in university students at risk of ADHD

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Abstract

Objective: *This study aims to identify executive function (EF) deficits associated with attention deficit hyperactivity disorder (ADHD) risk and their impact on academic performance (AP) among Mexican university students.* **Methods:** *The adult ADHD self-report scale v1.1 was administered to 200 university students. A total of 103 students scored within the high-risk range for ADHD. In the second phase of the study, students at high risk for ADHD were invited to undergo a neuropsychological evaluation. Forty-four students (18 men and 26 women) completed the Neuropsychological Battery of Frontal and EF to assess EF. AP was determined based on the average high school and university scores, verified through official school records. Statistical analyses included analysis of variance and correlation tests to explore relationships among the variables.* **Results:** *Over 50% of the evaluated participants met the criteria for high ADHD risk, highlighting a high prevalence of undiagnosed symptoms. EF impairments were observed, particularly in the dorsolateral prefrontal cortex. Despite achieving higher AP, women scored significantly lower on EF tasks compared to men. A positive correlation was found between orbitofrontal cortex functioning and AP. In men, higher ADHD risk was negatively associated with EF efficiency.* **Conclusions:** *These findings underscore the importance of implementing systematic ADHD screening strategies in university settings. They also suggest the potential presence of compensatory mechanisms in women at high risk for ADHD. Further research is needed to develop targeted interventions aimed at enhancing EFs and supporting academic success in this population.*

Keywords: *Executive functions. Attention deficit hyperactivity disorder. University students. Sex differences. Academic performance.*

Relación entre alteraciones en la función ejecutiva y el rendimiento académico en universitarios con riesgo de TDAH

Resumen

Objetivo: *Este estudio tiene como propósito identificar los déficits en funciones ejecutivas asociados al riesgo de TDAH y su impacto en el desempeño académico de jóvenes universitarios mexicanos.* **Métodos:** *Se aplicó la Escala de Autoinforme para el TDAH en Adultos (ASRS v1.1) a 200 estudiantes universitarios. Un total de 103 estudiantes obtuvieron un puntaje indicativo de alto riesgo para TDAH. En la segunda fase del estudio, los estudiantes con alto riego para TDAH fueron invitados a*

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una evaluación neuropsicológica, 44 estudiantes (18 hombres y 26 mujeres) completaron la Batería Neuropsicológica de Funciones Frontales y Ejecutivas (BANFE-3), con el objetivo de evaluar su desempeño en funciones ejecutivas. Asimismo, el rendimiento académico se determinó a partir del promedio de calificaciones en educación media superior y universitaria, verificado mediante documentos escolares oficiales. Se realizaron análisis estadísticos mediante ANOVA y pruebas de correlación para explorar las relaciones entre las variables. **Resultados:** *Más del 50% de los participantes evaluados cumplieron con los criterios de alto riesgo para TDAH, lo que evidencia una alta prevalencia de síntomas no diagnosticados. Se observaron alteraciones en funciones ejecutivas, particularmente en la corteza prefrontal dorsolateral (CPFDL). A pesar de registrar un mejor rendimiento académico, las mujeres obtuvieron puntajes significativamente más bajos en funciones ejecutivas en comparación con los hombres. Además, se identificó una correlación positiva entre el funcionamiento de la corteza orbitofrontal y el rendimiento académico. En los hombres, un mayor riesgo de TDAH se asoció negativamente con la eficiencia en funciones ejecutivas.* **Conclusiones:** *Los hallazgos subrayan la relevancia de implementar estrategias de detección sistemática del TDAH en el ámbito universitario. Asimismo, sugieren la posible existencia de mecanismos compensatorios en mujeres con alto riesgo de TDAH. Se requiere investigación adicional para diseñar intervenciones dirigidas a fortalecer las funciones ejecutivas y favorecer el desempeño académico en esta población.*

Palabras clave: *Funciones ejecutivas. Trastorno por déficit de atención e hiperactividad. Estudiantes universitarios. Diferencias por sexo. Rendimiento académico.*

Introduction

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental condition characterized by a persistent pattern of inattention and/or hyperactivity-impulsivity that significantly interferes with daily functioning. Inattention symptoms typically include difficulty concentrating, disorganization, and forgetfulness, whereas hyperactivity-impulsivity is marked by excessive fidgeting, constant talking, and frequent interruptions of others[1]. According to diagnostic criteria, these symptoms must appear before age 12, occur in at least two distinct settings, and result in substantial impairment in social, academic, or occupational domains. ADHD is classified into three presentations: predominantly inattentive, predominantly hyperactive-impulsive, and combined. Globally, prevalence estimates range from 5% to 7.2% in youth and from 2.5% to 6.7% in adults[2].

Beyond attentional deficits, individuals with ADHD commonly exhibit impairments in executive functions (EFs). EFs are cognitive processes essential for planning, organizing, controlling impulses, sustaining attention, and working memory (WM), collectively responsible for regulating behavior and guiding goal-directed actions. Deficits in these areas may manifest as difficulties maintaining attention over extended periods, managing time effectively, controlling impulses, and adapting flexibly to new demands[3,4]. As a result, executive dysfunction can significantly impact academic achievement, as affected individuals often struggle to follow instructions, organize tasks, and handle complex academic situations. These difficulties become particularly evident in educational contexts as academic demands increase.

Adult ADHD frequently remains underdiagnosed due to misconceptions that ADHD exclusively affects children or misinterpretations of symptoms such as personality traits or stress responses. Furthermore, symptoms often overlap with other disorders such as anxiety or depression, complicating accurate diagnosis[5]. Consequently, many adults with ADHD remain untreated, facing considerable challenges, especially within university settings that require heightened academic and social functioning.

As students transition to higher education, the demands for planning, organization, and self-regulation increase significantly. These heightened requirements often expose EF deficits that students may have previously compensated for or masked. Consequently, such deficits frequently lead to difficulties in task completion, adherence to deadlines, and adaptation to increased academic responsibilities, ultimately negatively impacting overall academic performance (AP)[6].

Effective screening tools, such as the adult ADHD self-report scale (ASRS), facilitate the identification of students at risk for ADHD, enabling timely symptom detection and prompt diagnostic intervention[7]. In addition, standardized instruments such as the Neuropsychological Battery of Frontal and EFs (BANFE-3) offer objective evaluation of specific EF deficits, supporting the development of targeted interventions to improve academic outcomes and student well-being.

This study aims to investigate the relationship among ADHD risk, EF impairments, and AP deficits within a university population. Understanding the specific executive challenges associated with ADHD symptoms is key for early identification, the implementation of effective interventions, and raising awareness about the importance of timely diagnosis and support. Ultimately, this approach seeks to enhance educational outcomes and improve the quality of life among university students facing ADHD-related challenges.

Methods

Participants

The initial sample consisted of undergraduate students aged 18-27 from health-related fields (Nutrition, Medicine, and Psychology). The ASRS was administered as a preliminary screening tool to identify students meeting the criteria for "high risk of ADHD." Participants included those who provided informed consent, had no previous diagnosis of ADHD or other psychopathologies (e.g., anxiety, depression, and bipolar disorder), and were not receiving psychopharmacological treatment. In the first phase, 200 responses were collected (153 women and 47 men). Of these, 143 students obtained a high-risk score for ADHD. However, 40 students were excluded due to previously reported psychopathological diagnoses, resulting in a final sample of 103 students who met the criteria for high ADHD risk. In the second phase, 31 students declined to participate, citing a lack of interest in the outcome of the neuropsychological evaluation as their primary reason for withdrawal. The remaining 72 students (men and women) were invited to undergo an EF assessment using the Spanish version of the Neuropsychological BANFE-3. Of these, 28 did not attend their scheduled appointment, reporting the length of the evaluation (approximately 60 min) as their main reason for non-participation. Ultimately, 44 students (18 men and 26 women) completed the neuropsychological assessment. AP was assessed through the review of official academic records from their institution.

Procedure

ADHD risk evaluation

The ASRS v1.1, developed collaboratively by the World Health Organization and the Adult ADHD Task Force, was employed in this study. This instrument is a validated and widely recognized screening tool for identifying adults at risk for ADHD. Developed by prominent experts in the field, including Dr. Lenard Adler (New York University Medical School), Dr. Ronald Kessler, and Dr. Thomas Spencer (both from Harvard Medical School), the ASRS v1.1 evaluates core ADHD symptoms and has demonstrated strong reliability aligned with DSM criteria. In this study, the ASRS v1.1 was administered online via Google Forms, and all participants provided informed consent before beginning the questionnaire. All procedures adhered to the ethical standards established by the Ethics Committee of the Faculty of Psychology at the University of Colima. Results from this scale indicate whether individuals exhibit symptoms that warrant further evaluation through a comprehensive clinical interview, serving as a basis for guiding subsequent diagnostic assessments and targeted therapeutic interventions.

EF evaluation

The third edition of the Neuropsychological BANFE-3, a comprehensive instrument with high reliability and validity, was employed in this study. This battery evaluates cognitive processes, specifically EFs, primarily mediated by the prefrontal cortex. It is used with Spanish-speaking individuals aged 6-90 years, and the assessment typically takes approximately 50 min to administer. The BANFE-3 battery includes various tests, such as the Stroop test, which measures the inhibition of automatic responses and response selection, and the Iowa Gambling Task, which evaluates decision-making under conditions of uncertainty. The Mazes test assesses impulsivity control and planning, whereas tasks such as visuospatial WM, and self-directed pointing focus on cognitive strategies. In addition, the Tower of Hanoi is used to examine sequential planning abilities. The battery also incorporates verbal fluency, proverb interpretation, semantic classification, and the metamemory curve tests, which assess cognitive flexibility, abstract reasoning, and memory self-assessment.

The BANFE-3 selected the test based on anatomical and functional criteria, focusing on three main regions: the orbitofrontal cortex (OFC), anterior prefrontal cortex (APC), and dorsolateral prefrontal cortex (DLPFC) (Table 1). These tests help identify impairments in EF by offering a global performance index and specific scores for each targeted area. The battery is proven effective in detecting dysfunctions related to frontal lobe damage, such as those arising from traumatic brain injuries. Its specificity has been validated through research with individual brain injuries and supported by findings from functional neuroimaging studies, reinforcing its value as a reliable neuropsychological tool for evaluating EF in affected populations.

Table 1. Neuropsychological assessment by the BANFE-3: targeted brain structures and corresponding tests

Function and structures involved	Test for evaluation
Metafunctions (APC)	Metamemory Understanding figurative meaning Abstract attitude
Executive functions (DLPFC)	Verbal fluency Productivity Mental flexibility Visuospatial planning Sequential planning Reverse sequence Encoding control
Working memory (DLPFC)	Self-directed visual working memory Verbal working memory-ordering Visuospatial working memory-sequential
Functions basic (OFC)	Inhibitory control Rule following Risk-benefit processing

APC: anterior prefrontal cortex; DLPFC: dorsolateral prefrontal cortex; OFC: orbitofrontal cortex.

AP register

AP is commonly evaluated through grade point average, standardized test scores, educational aspirations, and educational attainment metrics. These indicators reflect an individual's academic abilities, providing measurable estimates of knowledge acquired through formal instruction or training. Furthermore, they represent the proficiency level achieved in specific academic subjects, as demonstrated by quantitative assessments. The students' AP was assessed based on the average of their high school and university scores. These grades were verified through official academic records, ensuring the accuracy of the reported data. Collectively, these measures provide a reliable representation of the participants' current academic achievement and capabilities.

Data analysis

Data were presented as means ± standard deviation or frequencies, depending on the nature of the variables. Statistical analyses were performed using the Statistical Package for the Social Sciences 26, and data visualization was conducted with GraphPad Prism 8. Quantitative variables were tested for normality before analysis. A one-way analysis of variance (ANOVA) was used to compare differences between men and women. For all statistically significant ANOVA results, effect sizes were calculated using eta squared (η^2) to assess the magnitude of group differences. In addition, Spearman's correlation analyses were conducted to examine the relationships between AP, EFs, and ADHD risk. A significance level of 95% ($p \leq 0.05$) was applied to all statistical tests.

Results

EF deficits associated with ADHD risk

In the initial phase, 200 students participated (153 women and 47 men), with women representing a significantly higher proportion of the sample. Of these, 143 students obtained a high-risk score for ADHD. However, 40 students were excluded due to previous psychopathological diagnoses, and 103 students (51.5% of the total sample) met the criteria for high ADHD risk, indicating that more than half of the eligible participants exhibited symptoms warranting further evaluation. Of these, 31 declined further participation citing a lack of interest in the outcome of the neuropsychological evaluation as their primary reason for withdrawal, leaving 72 students who were invited to undergo an EF assessment, 28 participants did not attend their scheduled appointment, reporting the length of the evaluation (approximately 60 min) as their main reason for non-participation. Ultimately, 44 students (26 women and 18 men) (Table 2) completed the neuropsychological evaluation, during which AP data were also collected.

Among the evaluated students, the results of neuropsychological evaluation indicated an average total score of 82.18 on the complete battery assessment, corresponding to a diagnosis of mild functional impairment. When analyzing the results by structure, the DLPFC associated with EF showed an average score of 81.36, indicating mild impairment. However, the DLPFC-associated WM function was preserved, with an average score of 105, corresponding to normal functioning. Nevertheless, overall functionality (WM + EF) demonstrated mild impairment, with an average score of 83.90. Regarding the APC, the data also indicated mild impairment (82.18), while the OFC functions were preserved, with an average score of 93.88 (Table 2).

Sex differences in EF among students at risk for ADHD

Comparisons between sexes indicated no significant differences in the average risk of ADHD between men

Table 2. Neuropsychological performance and ADHD risk in university students

Variable	Total (n = 44)			
	Mean (SD)			
Age	21.15 (2.31)			
ADHD risk	42.63 (12)			
BANFE				
Orbitofrontal	93.88 (16.50)			
Anterior prefrontal	82.18 (16.47)			
Dorsolateral (memory)	105.09 (10.65)			
Dorsolateral (EF)	81.36 (18.35)			
Total dorsolateral	83.90 (12.66)			
Total score	80.95 (13.60)			
BANFE diagnostic	**High normal**	**Normal**	**Mild impairment**	**Severe impairment**
	% (n)			
Orbitofrontal	2.3 (1)	77.3 (34)	6.8 (3)	13.6 (6)
Anterior prefrontal	2.3 (1)	43.2 (19)	25 (11)	29.5 (13)
Dorsolateral	-	45.5 (20)	43.2 (19)	11.4 (5)
Total	-	50 (22)	45.5 (20)	13.6 (6)

ADHD: attention deficit hyperactivity disorder; SD: standard deviation; BANFE: Batería Neuropsicológica de Funciones Ejecutivas y Lóbulos Frontales; EF: executive function.

and women. However, in the analysis of EF efficiency, women demonstrated lower performance in tasks associated with the DLPFC (WM + EF), $F(1, 42) = 16.43$, $p < 0.0001$. The effect size was large ($\eta^2 = 0.281$), suggesting that sex accounted for 28.1% of the variance in total dorsolateral performance.

When analyzed separately, men exhibited scores corresponding to a normal diagnosis, whereas women showed mild impairment. Similarly, for EF related to the DLPFC, women displayed significantly lower scores, indicating mild impairment, $F(1, 42) = 7.34$, $p = 0.01$, whereas men remained within the normal range. A moderate-to-large effect size was observed ($\eta^2 = 0.149$), indicating meaningful sex-related differences in EF tasks.

Finally, although WM functions related to the dorsolateral cortex were preserved in both men and women, the latter obtained significantly lower scores, $F(1, 42) = 13.8$, $p = 0.00$ (Table 3). The effect size was large ($\eta^2 = 0.247$), meaning that almost a quarter of the variance in WM performance could be explained by sex.

Similarly, although women obtained lower scores in the APC, the difference was not statistically significant, $F(1, 42) = 3.73$, $p = 0.06$. Finally, in terms of overall test efficiency, women exhibited significantly lower performance compared to men, $F(1, 42) = 11.93$, $p = 0.001$ (Table 3). This difference was accompanied by a large effect size ($\eta^2 = 0.221$), indicating robust sex-related differences in overall EF.

EF and ADHD risk: a predictor of AP

Regarding AP averages, the evaluated students had a general mean score of 9.12 on a 1-10 scale, which falls within the parameters of good performance. However, data analysis revealed that women exhibited significantly better AP compared to men, $F(1, 42) = 4.74$, $p = 0.03$, despite their lower efficiency in EFs. The effect size was moderate ($\eta^2 = 0.101$), indicating that sex accounted for approximately 10% of the variance in AP.

A Pearson correlation analysis was conducted to examine the relationship between AP and EF efficiency. A positive correlation was found between OFC functions and AP, indicating that better OFC function was associated with higher AP, $r(44) = 0.481$, $p < 0.001$ (Fig. 1A). When the data were analyzed by sex, a positive correlation was observed between OFC functions and AP in men (Fig. 1B), $r(18) = 0.649$, $p = 0.004$, as well as with overall performance on the BANFE (Fig. 1C), $r(18) = 0.490$, $p = 0.03$.

Furthermore, in men, a negative correlation was identified between EF efficiency and ADHD risk level, as measured by the ASRS. Higher ASRS scores were associated with lower EF efficiency (Fig. 1D), $r(18) = -0.469$, $p = 0.04$. Similarly, a negative correlation was found between dorsolateral cortex efficiency and higher ASRS scores (Fig. 1E), $r(18) = -0.468$, $p = 0.05$, indicating that greater ADHD risk was related to poorer performance in tasks associated with dorsolateral cortex functions.

Table 3. Comparison of executive function performance and ADHD risk by sex

Variable	Male (n = 18)	Female (n = 26)	p
	Mean (SD)	Mean (SD)	
Age	21.72 (2.80)	20.76 (1.86)	0.182
Academic performance	8.97 (0.43)	9.22 (0.32)	0.036
ADHD risk	44.66 (11.67)	41.23 (12.24)	0.357
BANFE			
Orbitofrontal	93.72 (17.53)	94 (16.10)	0.957
Anterior prefrontal	87.77 (16.81)	78.30 (15.37)	0.060
Dorsolateral (memory)	111.38 (4.67)	100.73 (11.49)	**0.001**
Dorsolateral (EF)	89.77 (12.61)	75.53 (19.62)	**0.010**
Total dorsolateral	91.88 (9.38)	78.38 (11.76)	**< 0.001**
Total score	88.55 (12.01)	75.69 (12.23)	**0.001**

BANFE diagnosis	High normal		Normal		Mild impairment		Severe impairment	
	% (n)							
	M	F	M	F	M	F	M	F
Orbitofrontal	5.6 (1)	-	66.7 (12)	84.6 (22)	5.6 (1)	7.7 (2)	22.2 (4)	7.7 (2)
Anterior prefrontal	5.6 (1)	-	55.6 (10)	34.6 (9)	27.8 (5)	23.1 (6)	11.1 (2)	42.3 (11)
Dorsolateral	-	-	77.8 (14)	23.1 (6)	22.2 (4)	57.7 (15)	-	19.2 (5)
Total	-	-	55.6 (10)	23.1 (6)	44.4 (8)	53.8 (14)	-	23.1 (6)

F: female; M: male; ADHD: attention deficit hyperactivity disorder; SD: standard deviation; BANFE: *Batería Neuropsicológica de Funciones Ejecutivas y Lóbulos Frontales*; EF: executive function.
Bold data represents statistically significant difference.

Discussion

This study identified a high prevalence of ADHD risk among university students, accompanied by EF impairments, especially in domains linked to the DLPFC. In addition, relevant differences between sexes and associations between OFC functioning and AP were observed. These results provide a comprehensive view of the cognitive challenges faced by students at risk of ADHD and highlight the importance of tailored academic support.

More than half of the participants met the criteria for high ADHD risk, highlighting the prevalence of undiagnosed symptoms in university students. ADHD often goes unnoticed in young adults due to reliance on self-reports, lack of childhood records, and symptom overlap with other conditions[8]. Many students only seek evaluation when faced with increased academic demands, which can exacerbate EF deficits[9]. Accurate diagnosis in university populations is challenging, with cases frequently missed or misattributed to other conditions[8]. These challenges, combined with the limitations of subjective screening tools, underscore the need for objective neuropsychological assessments and systematic screening in universities to enable early detection and intervention.

Our neuropsychological findings, based on BANFE-3 performance, indicate that students at risk for ADHD show reduced performance in tasks typically associated with DLPFC functions, such as WM, cognitive flexibility, and planning. While our study did not directly assess brain function, previous neuroimaging studies have reported reduced functional connectivity and hypoactivation in the DLPFC among individuals with ADHD[10,11]. Similarly, transcranial magnetic stimulation research has shown that enhancing DLPFC activation can improve EF[12]. These external findings provide a plausible neurobiological context for interpreting the behavioral patterns observed in our sample. The impairments identified, particularly in cognitive flexibility, verbal fluency, and planning, may hinder students' ability to manage academic responsibilities. Therefore, although our data are limited to cognitive performance, these results support the potential benefit of targeted cognitive interventions or neuromodulation strategies for students at risk of ADHD.

Building on these findings, sex differences in EF performance further highlight the complexity of ADHD-related cognitive impairments. In our sample, women showed significantly lower scores in DLPFC-related tasks compared to men, despite exhibiting similar levels of ADHD risk. These behavioral findings are

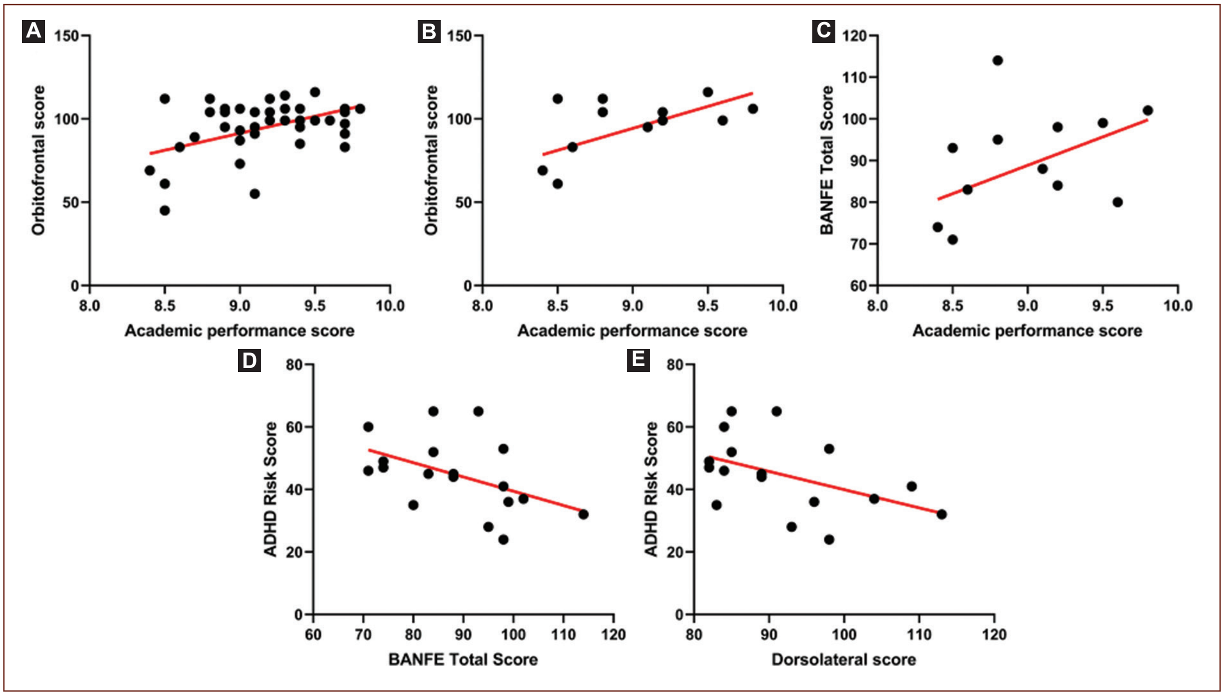

Figure 1. Correlations between academic performance, executive function efficiency, and attention deficit hyperactivity disorder (ADHD) risk. **A:** a positive correlation was found between the function of the orbitofrontal cortex and academic performance ($p < 0.001$). **B:** when analyzed by sex, a positive correlation was observed between orbitofrontal cortex function and academic performance in men ($p = 0.004$). **C:** in addition, overall BANFE-3 performance was positively correlated with academic performance in men ($p = 0.03$). **D:** a negative correlation was found between executive function efficiency and ADHD risk level, with higher adult ADHD self-report scale scores associated with lower executive function performance ($p = 0.04$). Similarly, **E:** a negative correlation was identified between dorsolateral cortex efficiency and ADHD risk, where greater ADHD risk was linked to poorer dorsolateral prefrontal cortex function ($p = 0.05$).

consistent with previous neuroimaging research suggesting that women with ADHD may show greater deficits in cognitive flexibility and WM, potentially due to differences in functional connectivity and compensatory mechanisms[13,14]. The observed differences were not only statistically significant but also moderate in effect size, reinforcing their relevance for both research and clinical practice. These neural models provide a useful framework for contextualizing the sex-related performance differences we observed.

Despite these EF challenges, women in this study demonstrated higher AP than men, suggesting alternative compensatory strategies that allow them to mitigate cognitive deficits through structured study habits and increased effort[15]. This paradox highlights a disconnect between executive performance and academic outcomes, raising questions about how effectively traditional assessments capture cognitive functioning[16]. These findings emphasize the need for individualized intervention strategies, considering both cognitive impairments and behavioral adaptations. Future research should explore how EF training, academic support systems, and flexible learning strategies can enhance AP in students at risk for ADHD, with particular attention to sex-specific patterns.

Although neural activity was not directly measured, our findings align with studies linking OFC to adaptive behavior and AP, especially in men. While our study evaluated OFC functions using neuropsychological tests, not direct neural measures, prior research has linked the OFC to adaptive behaviors in dynamic environments like academic settings[17]. In animal studies, it has been demonstrated that the OFC plays a crucial role in meta-reinforcement learning. This suggests that its conserved functions may regulate distinct mechanisms and timescales, providing additional flexibility and stability in cognition and learning[18], which could ultimately enhance AP.

EF has been consistently associated with academic outcomes from early education[19] to university-level studies[20,21]. It has been observed that EF was an even stronger predictor in the early years of education. This suggests that during the 1st years of school, other factors such as socioeconomic status, cultural background, rural or urban origin, and academic history are not yet as influential[19]. However, at the university level, sex differences in predictors of academic success have been documented. For instance, self-control and self-monitoring are better predictors of study progress in women than in men[22]. In our findings, EF was associated with AP only in men. This discrepancy may reflect the influence of additional non-cognitive factors in women. For example, conscientiousness and course-taking patterns have been identified as strong predictors of academic achievement in women, particularly in less cognitively demanding academic tasks, such as participation and coursework[23].

Finally, it is important to highlight that a higher risk of ADHD in men is associated with lower EF and DLPFC function. Previous studies have reported impairments in EF and attentional skills in patients with ADHD[24,25]. Furthermore, the DLPFC is associated with decision-making and impulse control[26]. Both of which are altered in ADHD patients, especially those with impulsive symptoms. In our findings, only men exhibited a relationship between ADHD risk, EF deficits, and DLPFC dysfunctions. This may be attributed to gender differences as reported in the literature. Men tend to show more pronounced hyperactivity symptoms, whereas girls more commonly present inattentive and emotional symptoms[27]. Furthermore, compared to women, men with ADHD tend to show greater impairments in WM, and educational functioning, as well as more severe deficits in social functioning and mood regulation[28], highlighting the importance of more extensive and complete studies to identify gender differences in the EF of university students with ADHD risk.

Conclusion

The results of this study indicate a notable presence of undiagnosed ADHD symptoms among university students, accompanied by measurable EF deficits. Neuropsychological assessment revealed reduced performance in tasks associated with the DLPFC, particularly affecting WM, planning, and cognitive flexibility. These difficulties were more pronounced in women, who nonetheless demonstrated higher AP than men, suggesting the use of compensatory strategies that merit further exploration. In contrast, men showed a stronger association between ADHD risk, DLPFC dysfunction, and lower academic achievement. Moreover, OFC functioning was positively related to AP, especially among male students, pointing to its possible role in adaptive learning and behavioral regulation. These findings reinforce the value of early ADHD screening and comprehensive EF assessment in higher education settings. Future research should further investigate sex-specific cognitive profiles and the interaction between neuropsychological performance and academic adaptation to guide the development of targeted and effective support strategies for students at risk.

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Conflicts of interest

The authors declare that they have no conflicts of interest. The authors declare that D. Romero-Zavala and Y. Sánchez-Cervantes contributed equally to this work and share first authorship.

Ethical considerations

Protection of human subjects and animals. The authors declare that the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the World Medical Association and the Declaration of Helsinki. The procedures were authorized by the Institutional Ethics Committee.

Confidentiality, informed consent, and ethical approval. The authors have followed their institution's confidentiality protocols, obtained informed consent from all patients, and secured approval from the Ethics Committee. SAGER guidelines have been followed as applicable to the nature of the study.

Declaration on the use of artificial intelligence (AI). The authors declare that no generative artificial intelligence was used in the writing or creation of the content of this manuscript.

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