

Neurocognitive Impairments in Adults with Chronic Migraine: An Exploratory Cross-Sectional Study

Deterioro Neurocognitivo en Adultos con Migraña Crónica: Un Estudio Transversal Exploratorio

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Abstract

Background: Chronic migraine is a major cause of disability, often associated with cognitive impairments affecting memory, attention, and executive functions. While such alterations have been described internationally, evidence in Latin America is limited. This study aimed to exploratorily characterize neurocognitive alterations in Colombian patients with chronic migraine. **Methods:** A cross-sectional study including adults diagnosed with chronic migraine according to the International Classification of Headache Disorders (2019). Patients were consecutively recruited at the Primary Headache Centre of Excellence between July 2023 and December 2024. Sociodemographic data and cognitive performance were assessed using validated instruments, including the Visual Analogue Scale, migraine disability and headache impact measures, Beck Depression Inventory-II, State-Trait Anxiety Inventory, Pittsburgh Sleep Quality Index, Montreal Cognitive Assessment, D2 Test of Attention, Rey Auditory Verbal Learning Test, Five Digits Test, Letter-Number Sequencing, Tower of Hanoi, Trail Making Test, and Rey–Osterrieth Complex Figure. **Results:** Thirty-two participants were included (96.9% female; mean age 43.4 years). Most reported severe pain and high migraine-related disability, with 68.8% showing severe headache impact. Depressive symptoms were mild to moderate, and anxiety levels were elevated. Cognitive assessment revealed scores below the cutoff of 26 in the Montreal Cognitive Assessment, with moderate deficits in memory, attention, and executive functions, while recognition remained preserved. Pain intensity showed a positive correlation with the D2 Variation Index and negative correlations with verbal learning and executive function tasks. **Conclusion:** Adults with chronic migraine present significant neurocognitive impairments, particularly in verbal learning and executive functions, with pain intensity playing a central role.

Keywords: Migraine Disorders, Cognition Disorders, Executive Function, Memory Disorders, Neuropsychological Tests

Resumen

Antecedentes: La migraña crónica es una causa importante de discapacidad y con frecuencia se asocia con alteraciones cognitivas que afectan la memoria, la atención y las funciones ejecutivas. Aunque estas alteraciones han sido descritas a nivel internacional, la evidencia en América Latina es limitada. Este estudio tuvo como objetivo caracterizar, de manera exploratoria, las alteraciones neurocognitivas en pacientes colombianos con migraña crónica. **Métodos:** Se realizó un estudio transversal que incluyó adultos diagnosticados con migraña crónica de acuerdo con la Clasificación Internacional de las Cefaleas (2019). Los pacientes fueron reclutados consecutivamente en el Centro de Excelencia en Cefaleas Primarias entre julio de 2023 y diciembre de 2024. Se recopilieron datos sociodemográficos y se evaluó el rendimiento cognitivo mediante instrumentos validados, entre ellos la Escala Visual Analógica, medidas de discapacidad por migraña e impacto de la cefalea, el Inventario de Depresión de Beck-II, el Inventario de Ansiedad Estado-Rasgo, el Índice de Calidad del Sueño de Pittsburgh, la Evaluación Cognitiva de Montreal (MoCA), el Test de Atención D2, el Test de Aprendizaje Auditivo-Verbal de Rey, el Test de los Cinco Dígitos, la prueba de Secuenciación de Letras y Números, la Torre de Hanói, el Trail Making Test y la Figura Compleja de Rey-Osterrieth. **Resultados:** Se incluyeron 32 participantes (96,9 % mujeres; edad media: 43,4 años). La mayoría refirió dolor intenso y un alto grado de discapacidad relacionada con la migraña; el 68,8 % presentó un impacto grave de la cefalea. Los síntomas depresivos fueron de leves a moderados y los niveles de ansiedad estuvieron elevados. La evaluación cognitiva mostró puntuaciones inferiores al punto de corte de 26 en la Evaluación Cognitiva de Montreal, con déficits moderados en memoria, atención y funciones ejecutivas, mientras que la capacidad de reconocimiento se mantuvo preservada. La intensidad del dolor mostró una correlación positiva con el Índice de Variación del D2 y correlaciones negativas con las pruebas de aprendizaje verbal y funciones ejecutivas. **Conclusión:** Los adultos con migraña crónica presentan alteraciones neurocognitivas significativas, particularmente en el aprendizaje verbal y las funciones ejecutivas, y la intensidad del dolor desempeña un papel central.

Palabras clave: Trastornos de migraña, trastornos cognitivos, función ejecutiva, trastornos de la memoria, pruebas neuropsicológicas

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Introduction

Chronic migraine (CM) not only manifests as recurrent and debilitating pain but is also strongly associated with significant cognitive impairments, affecting crucial domains such as memory, attention, and executive functions. These persistent dysfunctions severely impact the quality of life and productivity of those affected, positioning CM among the leading causes of disability worldwide.^{1,2} Globally, it is estimated that CM affects between 1% and 2% of the population. In Colombia, 13.8% of the population suffers from migraine, underscoring its relevance as a critical public health issue.³

Recent research highlights that patients with CM frequently struggle with impairments in sustained attention, working memory, and executive functions, accompanied by a notable decrease in information processing speed.^{4,5} These cognitive deficits are not only present during migraine attacks but are also observed during interictal periods, raising significant concerns. This persistent dysfunction suggests that cognitive decline in CM patients is a chronic feature rather than a symptom limited to acute episodes of pain. Such impairments can have far-reaching consequences, influencing daily activities, decision-making processes, and the ability to perform even routine tasks effectively.^{6,7}

The pathophysiology of CM involves abnormal activation of pain-modulating networks, including structures such as the hypothalamus and the periaqueductal gray (PAG). This activation is associated with central sensitization and allodynia.⁸ The resulting neurophysiological changes not only affect pain perception but also impact key cognitive areas such as the prefrontal cortex and the temporal lobe, critical regions for attention and memory.⁶ Furthermore, alterations in the brainstem and cholinergic system have been identified, contributing to cognitive overload in these patients, impairing their ability to perform complex tasks and process information efficiently.⁷

Given the high prevalence of migraine and its profound impact on cognitive functions, it is essential to identify and analyse the neurocognitive alterations in adults with CM. Although international studies have described these impairments, there is a scarcity of evidence in Latin American populations, particularly in Colombia, where the burden of migraine is significant. This study therefore aims to characterise neurocognitive alterations in a group of patients with CM treated at the Primary Headache Centre of Excellence in Colombia, providing evidence that may contribute to clinical management and public health strategies.

Methods

An analytical cross-sectional study was conducted. All patients aged 18 years or older with CM who attended

the neurology outpatient clinic at the Primary Headache Centre of Excellence in Colombia between July 1, 2023, and December 31, 2024, and who agreed to participate were included. Exclusion criteria comprised patients with systemic inflammatory disorders such as rheumatic and autoimmune inflammatory diseases, active chronic infections, pregnancy or breastfeeding, pre-existing neurological conditions (e.g., epilepsy, neuromuscular diseases, metabolic disorders), brain tumors, as well as those with terminal illnesses that precluded long-term follow-up. Patients were diagnosed with CM according to the International Classification of Headache Disorders (ICHD-3), using the diagnostic criteria updated through 2019.⁹

The variables collected included sociodemographic characteristics: sex, age, marital status, education level, occupation, place of origin, area of origin, health system; and regarding the cognitive and neuropsychiatric assessment questionnaires:

Self-reported pain intensity (PAIN): Self-reported pain perception was measured using the Visual Analogue Scale (VAS), which consists of a 10-cm continuous line between the anchors ‘no pain’ and ‘worst pain imaginable.’ Patients indicated the point that best represented their pain intensity, which was then translated into a quantitative measure in millimeters.¹⁰

Migraine Disability Assessment Scale (MIDAS): A self-administered 5-item questionnaire that quantifies disability attributable to migraine over the preceding 3 months. It measures days lost from work or school, household responsibilities, and social or leisure activities due to migraine. The total score categorizes disability from minimal to severe, making it a reliable instrument for evaluating functional burden and informing treatment decisions in both clinical and research settings.¹¹

Headache impact (HIT-6 score): It is a brief six-item questionnaire that measures the impact of headache on daily life, assessing dimensions such as pain, social functioning, cognitive capacity, fatigue, role performance, and psychological well-being.^{12,13}

Beck Depression Inventory-II (BDI-II): A self-report questionnaire designed to assess the severity of depressive symptoms. It contains items that evaluate cognitive, affective, and somatic dimensions of depression.¹⁴

State-Trait Anxiety Inventory (STAI): A self-report measure that evaluates two distinct components of anxiety: state anxiety (temporary emotional status) and trait anxiety (general tendency to experience anxiety).¹⁵

The Pittsburgh Sleep Quality Index (PSQI): Is a self-administered questionnaire that evaluates subjective sleep quality and disturbances over one month. It includes 19 items across seven components, yielding a global score from 0 to 21, where higher scores indicate poorer sleep quality.¹⁶

Montreal Cognitive Assessment (MoCA): A brief cognitive screening tool developed to detect mild cognitive impairment and early dementia. It evaluates several domains including attention, memory, language, visuospatial abilities, executive functions, and orientation^{15,17}. Declaration of evaluation permission.

D2 Test of Attention: A paper-and-pencil test measuring selective attention and concentration. The task requires the subject to identify and cross out target letters among distractors within a time limit.¹⁸

Paced Auditory Serial Addition Test (PASAT): A test of sustained attention and working memory. Participants hear digits presented sequentially and must continuously add each new digit to the one immediately prior.¹⁹

Rey Auditory Verbal Learning Test (RAVLT): A test of verbal memory involving the learning and recall of a list of words over several trials and after different delay intervals.²⁰

Five Digits Test (FDT): A neuropsychological test assessing processing speed, attention, inhibition, and flexibility. It requires the subject to rapidly name digits while managing interference, similar to the Stroop paradigm.²¹

Letter-Number Sequencing – WAIS-V subtest: A working memory task in which individuals are presented with a mixed series of letters and numbers and must reorder them into numerical and alphabetical sequences. It evaluates sequencing, mental manipulation, and executive functions.²²

Tower of Hanoi – BANFE-II version: A problem-solving and executive function test that measures planning, inhibition, and reasoning. It involves moving disks of different sizes between pegs while following specific rules.²³

Trail Making Test (TMT): It is a neuropsychological test that assesses processing speed, visual attention, cognitive flexibility, and executive functions through the task of sequentially connecting numbers and letters in the correct order.¹²

Rey-Osterrieth Complex Figure: Is a neuropsychological test that assesses visuospatial abilities, visual memory, and executive functions through the copying and subsequent reproduction of a complex geometric figure.²⁴

All neuropsychological assessments were administered by trained psychology professionals with formal training in neuropsychological evaluation and prior experience in the application of standardized cognitive batteries. Before the start of the study, evaluators received specific training to ensure standardized administration and scoring procedures across participants.

All evaluations were conducted in a quiet room under controlled conditions, following standardized instructions for each instrument. The complete neuropsychological battery required approximately 90–120 minutes per participant. To minimize fatigue effects, short breaks were allowed between tests when needed, and the order of administration followed a fixed sequence designed to alternate tasks requiring high attentional demand with less demanding tasks. Participants were evaluated during interictal periods whenever possible, and testing was postponed if severe headache or significant discomfort was present at the time of assessment.

Statistical Analysis:

Data were collected from patients with CM who were treated at the Primary Headache Centre of Excellence, with their information recorded in the REDCap® (Research Electronic Data Capture) database, PID 458. For the descriptive analysis, categorical variables were presented as frequencies and percentages, while continuous variables were assessed for normality using the Shapiro–Wilk test. Variables with a normal distribution were expressed as means and standard deviations, whereas non-normally distributed variables were expressed as medians and interquartile ranges. Bivariate associations between pain intensity and neurocognitive test performance were evaluated using Spearman's rank correlation coefficient. A two-tailed p-value <0.05 was considered statistically significant. All analyses were performed using STATA, version 16.

Given the large number of neurocognitive outcomes evaluated and the exploratory nature of the study, no formal adjustment for multiple comparisons was applied. Therefore, the results should be interpreted with caution and considered hypothesis-generating. This approach was chosen due to the limited sample size and the aim of identifying potential associations to be confirmed in future studies with larger populations. In addition, no multivariable adjustment was performed due to the limited sample size; therefore, the results should be interpreted as exploratory.

Results

A total of 32 participants with chronic migraine were included in the study. Most participants were female and in the fourth decade of life. The majority had secondary education, were either employed or homemakers, and mainly came from urban areas within the Metropolitan Area of Bucaramanga. Detailed sociodemographic characteristics are presented in Table 1.

Table 1. Sociodemographic characteristics of patients with chronic migraine.

Variable	Category	Frequency	Percentage
Sex	Female	31	96.88
	Male	1	3.13
Age (years)		43.4	(11.9)
Marital status	Single	10	31.25
	Married	6	18.75
	Common-law union	11	34.38
	Separated	3	9.38
	Widowed	1	3.13
	Not reported	1	3.13
Educational level	No formal education	2	6.25
	Primary education	8	25.00
	Secondary education	13	40.63
	Technical/technological	7	21.88
	University education	2	6.25
Occupation	Employee	15	46.88
	Student	1	3.13
	Homemaker	12	37.50
	Retired	1	3.13
	Self-employed	3	9.38
Place of origin	Metropolitan Area of Bucaramanga	22	68.75
	Other cities	10	31.25
Area of origin	Rural	7	21.88
	Urban	25	78.13
Health system	Contributory	8	25.00
	Subsidized	22	68.75
	Other	2	6.25

Data are presented as absolute frequencies and percentages. Age is reported as mean (Standard Deviation).

Participants reported high levels of pain intensity and migraine-related burden. Most patients were classified within the severe categories of headache impact and disability scales. Emotional assessment revealed the presence of depressive symptoms, elevated anxiety levels, and poor sleep quality in a substantial proportion of participants. Detailed results of clinical and psychosocial scales are shown in Table 2.

Global cognitive screening using the Montreal Cognitive Assessment revealed scores below the expected cutoff in several participants, particularly affecting delayed recall, executive functions, and attention, while orientation and language domains were relatively preserved.

Performance on attention tests showed variability, with increased omissions and fluctuations in concentration indices. Tasks evaluating working memory and processing speed also demonstrated reduced performance in part of the sample. In verbal learning assessment, participants showed progressive acquisition across trials, although lower performance was observed in initial encoding and delayed recall compared with expected values, while recognition remained relatively preserved. Detailed results of MoCA, D2, PASAT, and RAVLT are presented in Table 3.

Table 2. Clinical, disability, and psychosocial characteristics of patients with chronic migraine.

Variable / Scale	Median (IQR)	Category (range)	n (%)
VAS	10.00 (9.00-10.00)	1-3 (Mild) 4-6 (Moderate) 7-10 (Severe)	0 (0) 0 (0) 30 (93.75)
MIDAS score	8.00 (0.00-38.00)	0-5 (None or minimal) 6-10 (Mild) 11-20 (Moderate) ≥21 (Severe)	13 (40.63) 2 (6.25) 3 (9.38) 10 (31.25)
HIT-6 score	71.50 (60.50-78.00)	≤49 (Little to no impact) 50-55 (Mild impact) 56-59 (Moderate impact) ≥60 (Severe impact)	1 (3.13) 1 (3.13) 4 (12.5) 22 (68.75)
BDI II	20.00 (13.00-31.00)	-	26 (81.25)
STAI (direct score)	48.50 (29.00-53.00)	-	26 (81.25)
STAI (direct score)	50.50 (41.00-60.00)	-	26 (81.25)
PSQI (Global score)	8.50 (7.00-12.00)	-	26 (81.25)

Data are presented as median (interquartile range, IQR) and absolute frequencies with percentages, as appropriate. Abbreviations: VAS, Visual Analogue Scale; MIDAS, Migraine Disability Assessment Scale; HIT-6, Headache Impact Test; BDI-II, Beck Depression Inventory-II; STAI, State-Trait Anxiety Inventory; PSQI, Pittsburgh Sleep Quality Index.

Table 3. Neurocognitive performance of patients with chronic migraine across attention, memory, and executive function domains.

Test / Subscale		n (%)	Median (IQR)
- Variable	Category		
MoCA	Visuospatial/Executive	32 (100)	4(3-5)
	Naming	32 (100)	3(2.5-3)
	Attention	32 (100)	5(5-6)
	Language	32 (100)	2(2-3)
	Abstraction	32 (100)	2(2-2)
	Delayed Recall	32 (100)	2(1-3.5)
	Orientation	32 (100)	6(6-6)
	Total Score	32 (100)	24.5(22-26)
D2 Test of Attention	Total responses (TR)	31 (96.87)	375(295-431)
	Total correct (TA)	31 (96.87)	127(95-156)
	Omissions (O)	31 (96.87)	20(4-65)
	Commissions (C)	30 (93.75)	6(1-31)
	Overall effectiveness (TOT)	31 (96.87)	320(238-366)
	Concentration index (CON)	31 (96.875)	95(58-138)
	Maximum line (TR+)	31 (96.875)	37(32-43)
	Minimum line (TR-)	31 (96.875)	14(8-19)
PASAT	Variation index (VAR)	31 (96.875)	21(16-24)
	Correct responses (3 s)	31 (96.875)	37(28-40)
	Incorrect responses (3 s)	31 (96.875)	6(3-10)
	Omissions (3 s)	31 (96.875)	12(6-23)
	Correct responses (2 s)	31 (96.875)	26(16-30)
	Incorrect responses (2 s)	31 (96.875)	6(3-7)
RAVLT	Omissions (2 s)	31 (96.875)	27(14-32)
	Trial 1	32 (100)	6(4-6)
	Trial 5	32 (100)	11(9-13)
	Total learning (1-5)	32 (100)	45(38-51)
	Short delay free recall	32 (100)	9.5 (8-12)
	Short delay cued recall	32 (100)	12(10-13)
	Long delay free recall	32 (100)	10(8-12)
	Long delay cued recall	32 (100)	11(9.5-13)
Recognition		32 (100)	14(12-15.5)

Data are presented as median (interquartile range, IQR). Percentages indicate the proportion of participants with valid data for each test. Abbreviations: MoCA, Montreal Cognitive Assessment; D2, D2 Test of Attention; PASAT, Paced Auditory Serial Addition Test; RAVLT, Rey Auditory Verbal Learning Test; TR, total responses; TA, total correct responses; O, omissions; C, commissions; TOT, overall effectiveness index; CON, concentration index; VAR, variation index.

Evaluation of executive functions and cognitive flexibility revealed longer execution times and increased errors in tasks requiring inhibition, alternation, and planning. Tests assessing working memory, visuospatial organization, and problem-solving also showed heterogeneous performance across participants. In visuospatial memory tasks, copy performance was relatively preserved, whereas recall scores were lower, suggesting difficulties in visual memory and organizational strategies. Detailed results of executive function and visuospatial tests are presented in Table 4.

Table 4. Executive function, attention, and visuospatial memory performance in patients with chronic migraine.

Test / Variable	Category	n (%)	Median (IQR)
FDT – Executive Functions	Reading (errors)	32 (100)	0.00 (0.00-0.00)
	Reading (time, s)	32 (100)	39.00 (33.00-54.50)
	Counting (errors)	32 (100)	0.00 (0.00-1.00)
	Counting (time, s)	32 (100)	43.50 (36.00-58.00)
	Choice (errors)	32 (100)	1.00 (0.00-2.00)
	Choice (time, s)	32 (100)	51.50 (43.50-65.00)
	Alternation (errors)	32 (100)	4.00 (1.00-7.00)
	Alternation (time, s)	32 (100)	69.00 (61.50-84.50)
	Inhibition Index	32 (100)	10.00 (5.00-17.00)
	Flexibility Index	32 (100)	28.5 (21.50-37.50)
WAIS-V – Letter-Number		32 (100)	
Sequencing	Total score		15.50 (14.00-17.00)
Tower of Hanoi	Total moves	30 (93.75)	18.00 (12.00-26.00)
	Total time (s)	30 (93.75)	95.00 (50.00-148.00)
TMT	TMT-A Attention (s)	32 (100)	48.50 (41.00-67.50)
	TMT-B Executive functions (s)	32 (100)	107.50 (83.50-135.50)
Rey–Osterrieth Complex Figure		28 (87.50)	
	Copy		32 (27.00-35.00)
	Recall	28 (87.50)	15.50 (11.00-19.00)

Data are presented as median (interquartile range, IQR). Percentages indicate the proportion of participants with valid data for each test. Abbreviations: FDT, Five Digits Test; WAIS-V, Wechsler Adult Intelligence Scale–Fifth Edition; TMT, Trail Making Test; IQR, interquartile range.

Correlation analysis showed a significant association between pain intensity and cognitive performance. Higher pain levels were associated with greater variability in attention tasks and poorer performance in verbal learning and executive function measures. Significant correlations were observed between pain intensity and the D2 variation index, verbal learning scores, short-term recall, and performance in the Tower of Hanoi task. These associations are illustrated in Figure 1.

Discussion

This study comprehensively explored the relationship between pain, disability, emotional variables, and neurocognitive performance in patients with migraine. The findings reveal a consistent pattern in which pain and its impact were associated with cognitive alterations and greater emotional burden, supporting the multidimensional nature of this disorder. However, given the cross-sectional and exploratory design, these associations should not be interpreted as causal relationships but rather as hypothesis-generating observations. Disability levels related to migraine (MIDAS) and the perceived impact on daily life (HIT-6) were correlated with impairment in various cognitive functions, particularly attention, memory, and executive functions. These results are consistent with previous reports describing how high attack frequency and its functional consequences negatively affect neuropsychological performance and quality of life.^{5,25}

The association between higher MIDAS/HIT-6 scores and poorer performance on attentional tests (D2, PASAT) further highlights that the clinical burden of pain translates into reduced cognitive efficiency, which may have important implications for patients' occupational and academic functioning. Emotional status also played a key role. The

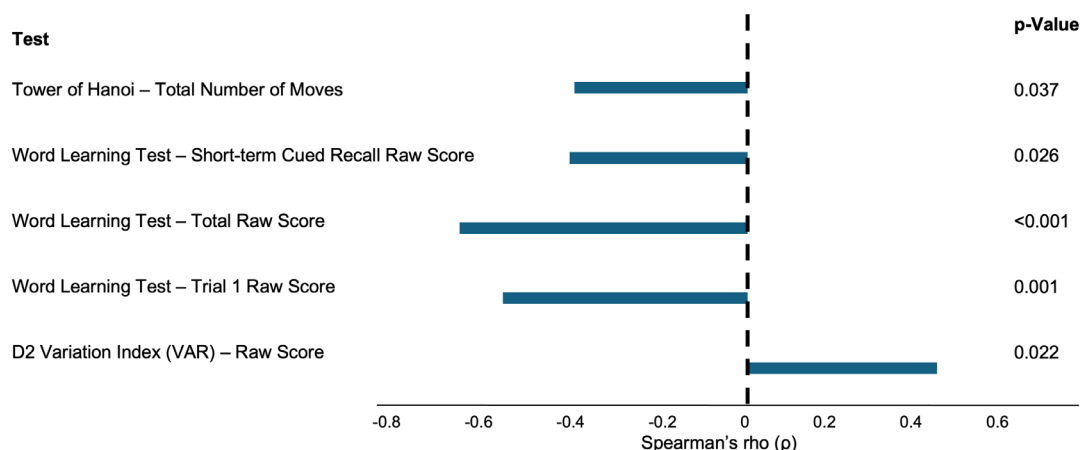


Figure 1. Correlations between pain intensity and selected neurocognitive measures.

The horizontal bars represent Spearman's rank correlation coefficients (ρ) between pain intensity (Visual Analogue Scale) and performance on neurocognitive tests. Negative values indicate worse cognitive performance with increasing pain, whereas positive values indicate higher scores with greater pain intensity. The dashed vertical line denotes no correlation ($\rho = 0$). Statistically significant correlations are shown with corresponding p-values.

presence of depressive symptoms (BDI-II) and both state and trait anxiety (STAI) were linked to poorer overall performance in verbal memory (RAVLT), sustained attention (D2), and cognitive flexibility tests (TMT-B, FDT). These findings are consistent with previous literature showing that depression and anxiety common comorbidities in migraine exacerbate cognitive impairment by increasing rumination and emotional overload, thereby interfering with information encoding and retrieval processes.^{26,27}

Global cognitive assessment using the MoCA revealed selective impairments in domains such as delayed memory, attention, and executive functions, whereas language and orientation remained relatively preserved. These findings suggest that migraine is not associated with diffuse cognitive decline but rather with a specific neuropsychological profile that primarily affects executive control and working memory processes in the evaluated sample. The preservation of basic domains may explain why many patients do not report generalized deficits in daily life, although they do experience difficulties in tasks requiring sustained concentration and planning.²⁸

The results of the specific tests complement this pattern. In the D2 test, patients exhibited greater variability in performance and more omission and commission errors, reflecting difficulties in attentional control. The PASAT confirmed this trend, with fewer correct responses and an increased number of omissions, indicating deficits in working memory and processing speed. In the RAVLT, alterations were observed in progressive learning as well as in short- and long-term recall, reinforcing the hypothesis of impairments in initial encoding and information consolidation.²⁹

Executive tests revealed clear impairments. The Tower of Hanoi and TMT-B indicated difficulties in planning, flexibility, and problem-solving. Complementarily, the FDT showed increased errors and longer times in alternating and inhibitory conditions, with a reduced flexibility index. These findings are consistent with neuroimaging studies that have demonstrated dysfunction in frontoparietal networks in patients with migraine, particularly in those with greater pain burden and comorbid anxiety and depression.³⁰ The finding of a positive association between pain and variability in the D2 test suggests that pain may increase attentional instability, impairing the ability to maintain consistent performance in sustained attention tasks. These results are consistent with the hypothesis that pain acts as an internal distractor, consuming cognitive resources that would otherwise be available for task performance.³¹

Conversely, negative scores in verbal learning and memory suggest a broader impact of pain on processes of information encoding and consolidation. In the RAVLT, patients showed poorer performance in both initial acquisition and total scores, as well as in short-term recall, indicating that pain interferes from the earliest stages of learning

through immediate retention. Previous studies have reported similar results in patients with chronic pain, who exhibit alterations in the hippocampus and working memory networks, supporting the neurobiological plausibility of these findings.³²

Performance on the Tower of Hanoi task showed a negative association with pain intensity. Because a lower number of moves in this test reflects better performance, this finding indicates that higher pain levels were associated with fewer moves, and therefore better performance in this specific measure. This result should be interpreted with caution given the exploratory nature of the study and the small sample size. The complexity of this task requires the coordination of multiple cognitive processes, and the observed association may reflect variability related to the limited sample rather than a true improvement in executive functioning.³³ Finally, the assessment of visuospatial memory using the Rey–Osterrieth Complex Figure revealed reduced performance in both copy and recall, reflecting not only difficulties in visual memory but also in perceptual organization and planning. This finding complements the profile observed in verbal tasks, suggesting that migraine exerts a global impact on memory processes, albeit with differential expression depending on the type of stimulus.³²

Taken together, these results demonstrate that migraine impacts multiple cognitive and emotional domains, with a pattern characterized by greater disability, heightened emotional burden, attentional impairment, difficulties in both immediate and delayed memory, and deficits in executive functions. From a clinical perspective, these findings underscore the importance of a multidisciplinary approach that addresses not only pain management but also the assessment of emotional status and the implementation of cognitive training. Moreover, they suggest that effective migraine treatment may yield indirect benefits on cognitive and emotional functioning, thereby improving quality of life and reducing the overall disease burden.³⁴

This study has several limitations that should be considered when interpreting the results. The absence of a control group does not allow direct comparison with individuals without migraine, which limits the ability to determine whether the observed neurocognitive performance differs from that expected in the general population. This limitation is particularly relevant for screening measures such as the Montreal Cognitive Assessment, where scores below the traditional cutoff may reflect sample characteristics rather than true impairment. Due to the exploratory nature of the study and the limited sample size, no multivariable statistical adjustment was performed. Therefore, potentially confounding factors such as sleep quality, depressive symptoms, and anxiety levels, all of which showed high prevalence in the sample, may have

influenced cognitive performance and should be considered when interpreting the observed associations.

The cross-sectional design precludes establishing temporal or causal relationships between pain, emotional variables, and cognitive outcomes. The results should therefore be interpreted as exploratory and hypothesis-generating rather than confirmatory. Finally, the high proportion of female participants reflects the epidemiology of chronic migraine but may limit the generalizability of the findings to male patients. Future studies including control groups, larger samples, and multivariable models will be necessary to clarify these relationships.

Conclusion

This study describes an association between pain intensity, perceived disability, emotional burden, and performance in several neurocognitive domains in adults with chronic migraine. The results suggest a pattern involving attention, memory, and executive functions; however, given the absence of a control group, the limited sample size, and the exploratory cross-sectional design, these findings should be interpreted with caution and cannot establish causal relationships. The identification of possible cognitive alterations highlights the importance of considering neuropsychological and emotional assessment in the clinical evaluation of patients with chronic migraine. Future studies including control groups, larger samples, and multivariable analyses are needed to confirm these observations and to clarify the role of clinical and emotional variables on cognitive outcomes.

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