Burnout is related to executive dysfunction in primary healthcare professionals working in rural areas

Irene Cano-López, Mariola I. Pérez, Sara Puig-Pérez

Introduction. Healthcare professionals are especially vulnerable to burnout, which implies a hypothalamus-pituitary-adrenal dysregulation that could impact the integrity of brain structures needed for cognitive processing. However, a scarce number of studies have analyzed the relationship between burnout and executive functions in this population, and possible modulator factors have not been clarified. This study aims to characterize the burnout level of primary healthcare professionals working in rural areas, and to analyze its relationship with executive functioning, considering the possible modulating role of optimism.

Subjects and methods. In this cross-sectional study, 32 primary healthcare professionals were recruited from the Carcastillo Health Center (Spain) and underwent an assessment in which burnout was assessed using the Maslach Burnout Inventory – Human Services Survey. Optimism and executive functions were also evaluated.

Results. 43.8%, 59.4%, and 56.3% of participants experienced high levels of burnout via emotional exhaustion, depersonalization, and personal accomplishment. The path analysis showed that emotional exhaustion was associated with poorer Trail Making Test scores (β = –0.37, SE –standard error– = 0.17, p = 0.024, Cohen's f^2 = 0.15), but optimism was not a significant moderator of this relationship (p = 0.24). The proposed model yielded excellent fit (CFI = 1.00, RMSEA = 0.0001, SRMR = 0.0001, and $\chi^2(3) = 6.07$, p = 0.11).

Conclusions. These results suggest that burnout in healthcare professionals could have a detrimental effect on the efficiency of health systems. This has relevant implications, especially for professionals characterized by both work pressure and high cognitive demands, and highlights a need to implement occupation-specific approaches for prevention.

Key words. Burnout. Cognition. Executive function. Optimism. Primary health care. Stress.

VIU-NED Chair of Global Neuroscience and Social Change (I. Cano-López, S. Puig-Pérez). Faculty of Health Sciences. Universidad Internacional de Valencia. Valencia, Spain (I. Cano-López, M.I. Pérez, S. Puig-Pérez).

Correspondence:
Dr. Irene Cano-López. Universidad Internacional de Valencia. Calle Pintor Sorolla, 21. E-46002 Valencia.

E-mail:
irene.cano@campusviu.es

ORCID:
orcid.org/0000-0001-9447-3244 (I.C.L.).

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Introduction

Primary healthcare professionals face precarious working conditions and increased workloads, which may favours burnout [1], a psychological syndrome characterized by emotional exhaustion, depersonalization, and reduced personal accomplishment [2]. The pro-urban uneven distribution of the health workforce and the poor social amenities in rural areas may lead to a greater vulnerability to burnout [1,3-6].

The 'allostatic load' refers to the price that individuals pay to adapt to chronic stressors [7]. The hypothalamus-pituitary-adrenal (HPA) axis regulates long-term stress adaptation, which requires the efficient termination of stress response through a negative feedback mechanism in which cortisol act on limbic circuits (e.g., prefrontal cortex, hippocampus and amygdala), and burnout has a great impact on these neural networks, resulting in a reduction in the efficacy of this mechanism and, consequently, in the hypersecretion of baseline cortisol [8]. Prolonged cortisol hypersecretion can injure these neural networks, by sculpting dendrites and synapsis [9]. The integrity of these areas is needed for cognitive processing [7], and stress may influence executive functions through cortisol upregulation [10], so it is reasonable to expect that the alteration of the HPA axis that can occur as a consequence of burnout may be associated with executive function impairments in healthcare professionals.

Executive functions are especially relevant in workforce populations, but scarce studies have analysed their association with burnout in healthcare

professionals [11]. These preliminary studies have been conducted with professionals working at hospitals in urban areas, showing mixed results. Diestel et al [12] revealed that nurses with high exhaustion performed worse than those with low exhaustion only when tasks put high demands on their executive control. Fernández-Sánchez et al [13] also showed poorer performance in executive function tasks in professionals with burnout compared to those without burnout. Orena et al [14] found a significant association between burnout scores and attentional deficits in anesthesia practitioners. On the contrary, McInerney et al [15] showed no significant relationship between burnout and cognition in nurses and physicians.

The fact that not all studies have observed executive function deficits among healthcare professionals suffering from burnout could be due to the lack of consideration of possible modulating factors. The behavioral self-regulation theory [16] states that the way people deal with challenges influences stress coping [17]. Thus, psychological factors such as optimism may modulate the way people deal with stressors [18]. Therefore, it is reasonable to expect that the relationship of burnout with executive functioning may be more pronounced in less optimistic individuals. Nevertheless, as far as we know, no studies have examined the association between burnout and executive functions in primary healthcare professionals from rural areas nor the modulating role of optimism. This study aims to characterize the burnout level of primary healthcare professionals working in rural areas, and to analyse its relationship with executive functioning, considering the possible modulating role of optimism.

Subjects and methods

Participants

Participants were recruited from the Carcastillo Health Center (Navarra, Spain), a rural and public health center that provides 24-hour service to five municipalities with a total of 5,000 inhabitants.

The inclusion criteria were: a) to be a health professional; b) at least, 18 years old; c) to sign an informed consent. Excluded were participants who: a) had any diagnosed mental disorder (e.g., anxiety, mood disorders, psychotic disorders, obsessive-compulsive disorders); b) used central nervous system medications; and c) were not fluent Spanish speakers.

Procedure

This is a cross-sectional study conducted between April 2018 and March 2019. Our reporting followed the STROBE guidelines [19]. The procedure followed the Declaration of Helsinki and was approved by the Ethics Committee of the Valencian International University (CEID2022_10). All participants provided written informed consent. An individual neuropsychological assessment was performed.

Instruments

The Spanish version [20] of the Maslach Burnout Inventory – Human Services Survey [2] was used to evaluate burnout. It consists of 22 items rated on a seven-point scale, to identify the frequency and intensity of symptoms of the three burnout dimensions. Total score for each dimension was computed. Higher emotional exhaustion and depersonalization scores were indicative of higher burnout levels, whereas a higher personal accomplishment score was indicative of lower burnout levels. Cutting scores were as follows: a) emotional exhaustion: low (≤ 18), moderate (19-26), and high (≥ 27); b) depersonalization: low (≤ 5), moderate (6-9), and high (≥ 10); c) personal accomplishment: low (≥ 40), moderate (39-34), and high (≤ 33) [21]. Cronbach's alpha in this sample was 0.90 for emotional exhaustion, 0.79 for depersonalization, and 0.71 for personal accomplishment.

The Spanish version [22] of the Life Orientation Test-Revised [23] was used to evaluate dispositional optimism. It is composed of 10 items rated on a five-point scale and provides a total score, higher scores indicating greater optimism. Cronbach's alpha was 0.79.

The Trail Making Test – part A (TMT-A) [24] was used to evaluate visual search, scanning, speed of processing, and mental flexibility. Participants were requested to draw a line to successively connect 25 circles with numbers and in the correct order. The total time employed to finish the task was computed as a percentile score.

The Wisconsin Card Sorting Test (WCST) [25] was used to assess cognitive flexibility and set shifting. It contains 128 response cards and four stimulus cards changing in three criteria. Participants were instructed to match the response cards with one of the stimulus cards, without any instruction. In each trial, participants received feedback. Each time that participants had correctly classified 10 consecutive cards, the classification criterion chang-

ed. The number of perseverative errors was computed as a percentile score.

The Stroop Color-Word Task [26] was used to evaluate cognitive interference. It consists of three trials with a limit time of 45 seconds. Participants were told to read a list of 100 color words printed in black ink (W trial), to name the color of 100 'XXXX' printed in red, green, or blue ink (C trial), and to name the ink color of the printed words, with the color and meaning of each word producing interference (CW trial). The interference score was computed and transformed to a percentile score.

The total number of words generated in one minute for the letters F, A, and S was obtained to evaluate phonemic fluency [27], and transformed to a percentile score.

To evaluate semantic fluency, participants were asked to 'think of the names of as many animals as they could in 1 min' [28]. The total score was transformed to a percentile score.

Statistical analyses

The Shapiro–Wilk test was carried out to examine data normality. When data distribution was not normal, a logarithmic transformation was performed.

Univariate ANOVAs were performed to analyze differences in burnout and cognitive functioning depending on categorical demographic characteristics. Bonferroni tests were performed as post hoc analyses. When significant differences in these variables were found, they were included as covariates when examining the relationship between burnout and cognitive functioning.

Associations of quantitative demographical variables and optimism with burnout and cognitive functioning were examined using Pearson correlations. Pearson correlations or partial correlations (controlling for demographic characteristics) were performed to examine the relationship between burnout and cognitive functioning.

To analyze the moderating effect of optimism on those significant relationships found between burnout and cognitive functioning, a path analysis was performed using the lavaan (version 0.6-5) package [29]. Before the path analysis, variables were standardized. The model included emotional exhaustion, optimism, and 'emotional exhaustion x optimism' as endogenous variables. Attention was included as an exogenous variable. A comparative fit index (CFI) > 0.95, a root mean square error of approximation (RMSEA) < 0.06, a standardized root mean square residual (SRMR) < 0.08, and a nonsignificant χ^2 statistic were considered indicators of excellent model fit [30]. Cohen's f^2 was calculated as a local effect size measure to quantify the contribution of each predictor to the exogenous variables, with values near 0.02, 0.15, and 0.35 indicating small, medium, and large effect sizes, respectively [31].

Statistical analyses were carried out using RStudio.

Results

Demographic characteristics

Fifty professionals were eligible for participation in the study (Table I). Among them, 32 decided to participate (16 nurses and 16 physicians). No missing data were detected.

Burnout scores: relationships with demographic factors and optimism

Burnout scores are shown in Table II. Using Maslach's categorization of burnout, 43.8%, 59.4%, and 56.3% of participants experienced high levels of burnout via emotional exhaustion, depersonalization, and personal accomplishment. According to Maslach's high burnout category, 9.4% of participants registered burned out in only one of the dimensions, 46.9% in two dimensions, and 18.8% in all three dimensions, whereas 25.0% showed no high levels in any of the dimensions. In sum, 75.1% of participants were classified as experiencing a high level of burnout in at least one of the dimensions (considering the percentage of patients with high levels of burnout in one, two, or all three dimensions).

Personal accomplishment tended to be related to age ($r(32) = 0.33$, $p = 0.07$), but not to the rest of the burnout dimensions (for all, $p > 0.10$). Burnout dimensions did not differ depending on sex, educational level, marital status, working hours, or annual salary (for all, $p > 0.10$). However, depersonalization tended to differ depending on professional seniority ($F(1.31) = 3.06$, $p = 0.06$, $\eta^2_p = 0.17$), participants with less than 5 years of seniority having higher depersonalization than those with 5 to 10 years.

Optimism was not significantly associated with emotional exhaustion ($r = -0.18$, $p = 0.33$), depersonalization ($r = 0.18$, $p = 0.92$), or personal accomplishment ($r = -0.04$, $p = 0.84$).

Table I. Participant characteristics and cognitive scores.

		Mean ± SD or *n* (%)
Age (years)		44.66 ± 10.40
Sex	Female	25 (78.1%)
	Male	7 (21.9%)
Educational level	University studies	32 (100.0%)
Marital status	Single	12 (37.5%)
	Married	15 (46.9%)
	Separated/divorced	5 (15.6%)
	Widowed	0 (0.0%)
Working hours	Full-time	23 (71.9%)
	Part-time	9 (28.1%)
Work schedule	Morning shift	19 (59.4%)
	Evening shift	13 (40.6%)
Professional seniority	Less than 5 years	15 (46.9%)
	5 to 10 years	5 (15.6%)
	More than 10 years	12 (37.5%)
Annual salary (€)	Less than 20,000	8 (25.0%)
	20,000 to 40,000	12 (37.5%)
	More than 40,000	12 (37.5%)
Optimism		22.44 ± 4.47
Cognitive scores (percentiles)	TMT-A	70.59 ± 24.57
	Wisconsin cards sorting test	22.44 ± 20.56
	Stroop Color Word Task	52.41 ± 19.63
	Phonemic fluency	42.50 ± 28.40
	Semantic fluency (animals)	96.91 ± 2.67

SD: standard deviation.

Cognitive functioning: relationships with demographic factors and burnout

Cognitive scores are shown in Table I. Cognitive functioning was not related to age, and did not differ depending on sex, educational level, work schedule, or professional seniority (for all, $p > 0.11$). However, phonemic fluency differed depending on marital status ($F(1.31)= 5.57$, $p = 0.009$, $\eta^2_p = 0.28$), married participants having better scores than those separated or divorced ($p = 0.008$). Additionally, semantic fluency differed depending on working hours ($F(1.31)= 4.27$, $p = 0.047$, $\eta^2_p = 0.13$), participants working full-time performing better than those working part-time. Moreover, WCST scores tended to differ depending on annual salary ($F(1.31)= 3.16$, $p = 0.057$, $\eta^2_p = 0.18$), participants with a salary between 20,000 and 40,000 € performing better than those with a salary lower than 20,000 € ($p = 0.069$). Optimism was not related to cognitive functioning (for all, $p > 0.10$). Consequently, marital status, working hours, and annual salary were controlled to study the association of burnout with phonemic fluency, semantic fluency, and cognitive flexibility, respectively.

Regarding the relationships between burnout and cognitive functioning, emotional exhaustion was related to worse TMT-A scores, and no other significant relationships were found (Table III).

When a path analysis was performed to examine the relationships between emotional exhaustion and attention, as well as the possible moderating role of optimism, we obtained a model that yielded an excellent model fit (CFI = 1.00, RMSEA = 0.0001, 95% CI 0.0001-0.0001, SRMR = 0.0001, and $\chi^2(3) = 6.07$, $p = 0.11$) (Figure).

Emotional exhaustion was associated with worse TMT-A score ($\beta = -0.37$, SE = 0.17, $p = 0.024$, Cohen's $f^2 = 0.15$). However, neither optimism nor the interaction between emotional exhaustion and optimism predicted TMT-A score (for both, $p > 0.24$). The model explained 18% of the variance in TMT-A score.

Discussion

This study aimed to characterize the burnout level of primary healthcare professionals working in rural areas, and to analyze its relationship with executive functioning, considering the possible modulating role of optimism. Results revealed a high prevalence of burnout. Emotional exhaustion was related to worse scores in TMT-A, and this relationship was not modulated by optimism.

Regarding burnout, 44% of participants scored high for emotional exhaustion and 59% for depersonalization, and 56% experienced low accomplishment, with 19% experiencing burnout in all three dimensions. These percentages are higher than those found in a recent meta-analysis focused on primary healthcare professionals from urban and rural contexts [1]. In this meta-analysis, working in a rural or economically deprived setting was identified as a factor associated with higher burnout prevalence [1]. The fact that our study focused specifically on a rural population could explain these discrepancies in the prevalence of burnout. In fact, in another empirical study with Spanish primary healthcare professionals from urban and rural contexts. Navarro-González et al [32] also found lower percentages of burnout prevalence than in our study. Primary healthcare professionals from rural areas are often exposed to less availability of health workforce and social services [3], and a busy schedule that includes attending approximately 50 patients per day, covering night shifts, doing home visits, and attending patients from other family practices [6]. Furthermore, the hospitals closest to rural areas are often quite far away, so primary healthcare professionals from rural areas are expected to handle a variety of health conditions, including emergency care, which may imply additional burdens, especially if they are not prepared to cope with these demands [6]. Additionally, physicians and nurses have been found to have higher prevalence rates of burnout compared to other specialties [33], which could also justify the differences between our percentages and those of Navarro-González et al [32].

Concerning individual risk factors associated with burnout, younger age and less seniority tended to be related to burnout. The early years of the career may be the most difficult ones, requiring physical and mental effort, and implying a low sense of control over one's own decisions [34].

Over the past decade, primary care systems worldwide faced a crisis provoked by the COVID-19 pandemic, which has led to higher levels of burnout among healthcare professionals [35]. The pandemic has placed a high level of demand on these professionals, who have a fundamental role in the early detection of cases and the tracing of their contacts [36]. This has put primary care professionals in the spotlight, especially in rural areas, which have risks associated with their mobility, heightened population needs, socio-economic disadvantage, and access and health service infrastructure challenges [37]. Consequently, the COVID-19 pandemic has

Figure. Model assessing the associations between emotional exhaustion. optimism. emotional exhaustion x optimism. and Trail Making Test-A score.

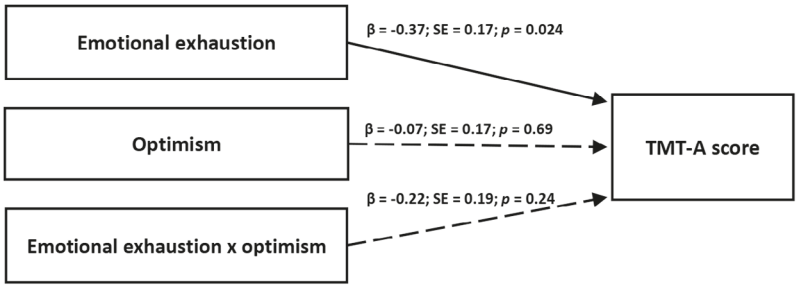

Table II. Burnout scores and levels according to Maslach's categorization of burnout [22].

Emotional exhaustion	
Mean (SD)	23.34 (11.67)
Range	5 - 44
Burnout level	
Low (≤ 18)	12 (37.5%)
Moderate (19-26)	6 (18.8%)
High (≥ 27)	14 (43.8%)
Despersonalization	
Mean (SD)	15.16 (11.91)
Range	1 - 42
Burnout level	
Low (≤ 5)	7 (21.9%)
Moderate (6-9)	6 (18.8%)
High (≥ 10)	19 (59.4%)
Personal accomplishment	
Mean (SD)	28.16 (11.84)
Range	5 - 45
Burnout level	
Low (≥ 40)	8 (25.0%)
Moderate (39-34)	6 (18.8%)
High (≤ 33)	18 (56.3%)
n (%) of patients with high burnout	
In one of the dimensions	3 (9.4%)
In two of the dimensions	15 (46.9%)
In three of the dimensions	6 (18.8%)
In any of the dimensions	8 (25.0%)

SD: standard deviation.

Table III. Correlations between burnout dimensions and cognitive functioning.

	Emotional exhaustion	Depersonalization	Reduced personal accomplishment
TMT-A	$r(32) = -0.36$, $p = 0.04$[a]	$r(32) = -0.24$, $p = 0.18$	$r(32) = -0.04$, $p = 0.82$
WCST	$r(29) = 0.02$, $p = 0.91$[b]	$r(29) = 0.23$, $p = 0.22$[b]	$r(29) = 0.19$, $p = 0.32$[b]
Stroop Color Word Task	$r(32) = -0.13$, $p = 0.48$	$r(32) = 0.32$, $p = 0.08$	$r(32) = -0.26$, $p = 0.15$
Phonemic fluency	$r(29) = -0.25$, $p = 0.17$[c]	$r(29) = 0.16$, $p = 0.38$[c]	$r(29) = -0.08$, $p = 0.68$[c]
Semantic fluency (animals)	$r(29) = -0.08$, $p = 0.68$[d]	$r(29) = 0.02$, $p = 0.90$[d]	$r(29) = 0.03$, $p = 0.85$[d]

[a] $p < 0.05$; [b] Partial correlations controlling for annual salary (less than 20,000 €/more than 20,000 €); [c] Partial correlations controlling for marital status (married/unmarried); [d] Partial correlations controlling for working hours (full-time/part-time).

significantly increased workload, limited resources, strained personal relationships [38], as well as burnout in primary healthcare professionals from rural areas [39]. To respond to this situation, it has been recommended to establish a quick locum supply system, ensuring rural representation in decision-making processes, and adopting an organizational perspective to support the mental health of these professionals [38].

Regarding the relationship between burnout and executive functioning, participants experiencing burnout performed worse in the TMT-A, emotional exhaustion having a medium effect size on TMT-A performance. Emotional exhaustion has been considered the core burnout component which manifests itself before cynicism and inefficacy [40]. Our results are congruent with those found by Diestel et al [12] with nurses in residential elderly care, and by Orena et al [14] with anesthesia practitioners working at a hospital. One possible explanation for this is that HPA dysregulation in individuals who suffer from burnout could affect the functioning of neural networks (e.g., orbitofrontal cortex, medial prefrontal cortex, and hippocampus) [7,8]. In fact, burnout has been proposed as an exponent of inadequate brain plasticity caused by stress-induced decreased neurogenesis [41]. Considering that these structures are main sites in the negative feedback circuit of the HPA axis, decreased neurogenesis may lead to less efficient inhibitory control of this axis, resulting in an increase of glucocorticoids [42]. Thus, executive functions would be affected, given that they are subordinated to the same neural networks [7]. Executive dysfunction could influence the quality of care for healthcare professionals, where clinical reasoning and problem-solving is a core competency [43].

Our findings showed that the relationship between burnout and TMT-A was not modulated by optimism. These results are not in agreement with those found with other populations [18]. However, it has been underlined that personality variables had a weak relationship with burnout in healthcare professionals (without considering cognitive variables) [44]. Consequently, we may not have been able to detect the possible modulating effect of optimism due to the limited sample size. Future studies that include a wide range of personality traits with large samples are needed.

Despite burnout was related to TMT-A performance, it was not associated with performance in other neuropsychological tests. This suggests that commonly used measures of executive functioning are differentially sensitive to chronic stress, TMT being the most sensitive in our study. These differences between tests may be attributed to their characteristics in terms of stimulus complexity, self- versus externally-paced responding, or processing type [45]. TMT has certain advantages in the assessment of executive dysfunction such as its short administration time and simplicity [46], which could explain its clinical usefulness in healthcare professionals suffering from burnout. Mizuno and Watanabe [47] found that TMT was useful for measuring the extent of work efficiency during mental fatigue. Knowledge about the sensitivity of executive functions measures should improve neuropsychological assessment in professionals with burnout.

The strengths of the study include the use of various measures of executive function, the consideration of the relationship between burnout and executive function in healthcare professionals, along with the moderation effect of optimism in this rela-

tionship, and the study context (i.e., primary care in a rural area), so it represents an advancement over previous studies. Despite these strengths, some limitations should be considered. First, the sample size is limited, so results should be taken with caution. Second, given the cross-sectional design of our study, it is not possible to establish causal relationships, so longitudinal studies are needed. Third, TMT-A was included in the neuropsychological assessment instead of TMT-B, due to its simplicity, the need to adjust the protocol to time constraints, and the availability of other instruments assessing similar processes to TMT-B (i.e., WCST, Stroop test). Although TMT-B correlates significantly with the percentage of perseverative errors on the WCST [48] and the Stroop interference condition [49], the inclusion of TMT-B in future studies may provide additional information about the relationships between burnout and executive functions, allowing comparison of the results obtained with both parts of TMT. In fact, compared to TMT-A, TMT-B requires greater demands on visual search and motor speed [50], so differences between the two parts may not be necessarily attributed to the individual's cognitive efficiency, but also may reflect these discrepancies in task demands. Finally, we have not evaluated the possible modulating role of other personality traits (e.g., self-esteem) in the relationship between burnout and executive functioning.

Conclusions

This study shows that burnout is related to poor executive functioning in primary healthcare professionals working in rural areas. Primary care is at the forefront of global healthcare, so burnout in this population could have a detrimental effect on the efficiency of health systems, and, consequently, on patient care. This has relevant implications, especially for professionals characterized by both work pressure and high cognitive demands and highlights a need to implement occupation-specific approaches for prevention.

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El *burnout* se asocia con la disfunción ejecutiva en profesionales de atención primaria que trabajan en zonas rurales

Introducción. Los profesionales sanitarios son especialmente vulnerables al *burnout,* lo que implica una desregulación hipotalámico-hipófiso-suprarrenal que podría impactar en la integridad de estructuras cerebrales necesarias para el procesamiento cognitivo. Escasos estudios han analizado la relación entre el *burnout* y las funciones ejecutivas en esta población, y no se han esclarecido sus posibles factores moduladores. Este estudio pretende caracterizar el nivel de *burnout* de profesionales de atención primaria de zonas rurales y analizar su relación con el funcionamiento ejecutivo, considerando el posible papel modulador del optimismo.

Sujetos y métodos. En este estudio transversal, 32 profesionales de atención primaria fueron reclutados en el centro de salud de Carcastillo (España) y sometidos a una evaluación en la que se valoró el *burnout* mediante el *Maslach Burnout Inventory-Human Services Survey,* y el optimismo y las funciones ejecutivas.

Resultados. El 43,8, el 59,4 y el 56,3% de los participantes experimentaron alto *burnout* a través del agotamiento emocional, la despersonalización y la desrealización personal. El *path analysis* mostró que el agotamiento emocional se asoció con peores puntuaciones en el *Trail Making Test* (beta = –0,37, SE –error estándar– = 0,17, p = 0,024, f^2 de Cohen = 0,15), pero el optimismo no fue un moderador significativo (p = 0,24). El modelo mostró un ajuste excelente (índice de

ajuste comparativo = 1, error cuadrático medio de aproximación = 0,0001, residuo cuadrático medio estandarizado = 0,0001, y chi cuadrado(3) = 6,07, *p* = 0,11).

Conclusiones. Estos resultados sugieren que el *burnout* en profesionales sanitarios podría tener un efecto perjudicial sobre la eficiencia del sistema sanitario. Esto tiene implicaciones relevantes, especialmente para profesionales caracterizados tanto por la presión laboral como por las altas demandas cognitivas, y pone de manifiesto la necesidad de implementar enfoques específicos para su prevención.

Palabras clave. Atención primaria. *Burnout*. Cognición. Estrés. Función ejecutiva. Optimismo.