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Exploring Attention Deficits in Healthcare Workers Experiencing Non-Clinical Burnout

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Abstract

Burnout syndrome is characterized by fatigue, cynicism toward work, and reduced productivity. Staff members who score high on burnout measures but continue working are considered to have non-clinical burnout (NCB). This covers the early phases in which burnout symptoms (BNS) occur, but have not reached a level that requires taking leave. The present research sought to determine the influence of BNS on attentional abilities among healthcare workers (HCWs) in a COVID-19-designated hospital during the ongoing pandemic. Researchers used the Maslach Burnout Inventory (MBI) to evaluate the three core aspects of burnout. Attention was measured through the Continuous Visual Attention Test (CVAT), which analyzed four distinct subdomains. All participants were assigned to one of two categories depending on MBI results: a control group and an NCB group. Thirteen individuals from the control group were matched to 13 NCB participants by age, gender, and professional HCW role. The overall sample (n = 26; 65% male) comprised 11 physicians and 15 nurses, with a mean age of 35.3 years (SD = 5.47). Individuals in the NCB group exhibited noticeably higher impulsivity than those in the control group. The remaining attention subdomains revealed no important differences between the groups. Strong links were observed between impulsivity and all burnout dimensions, with elevated absolute BNS scores associated with greater impulsivity. In conclusion, NCB impairs executive attention.

Keywords: Burnout, Healthcare professionals, Attention deficits, Impulsivity, Executive functions

Introduction

Burnout develops from persistent job-related stress and poses a significant health hazard to workers [1]. The condition involves three primary dimensions: exhaustion, cynicism, and lowered personal accomplishment. Schaufeli and Salanova [2] describe exhaustion as the wearing down of one's emotional energy, cynicism as the creation of mental distance from job tasks, and reduced personal efficacy as a drop in confidence in work performance. Several studies have also reported cognitive problems among employees diagnosed with full clinical burnout [3-7]. Addressing this, Deligkaris *et al*. [8] advocated including a cognitive component in the standard definition of burnout, given its clear influence on mental functioning at work.

One previous report [9] explained that people experiencing burnout are typically identified by high exhaustion scores and strongly unfavorable ratings on at least one of the other two key elements. Workers who register high burnout levels but continue their regular employment are often referred to as non-clinical burnout (NCB) employees [10].

NCB reflects the initial stage of burnout, characterized by exhaustion and detachment while continuing to perform duties [11]. Early on, it mainly presents through exhaustion and depersonalization; ongoing pressure from stressors gradually intensifies the condition [10]. Eventually, these issues grow stronger, interfere with normal functioning, and can progress to clinical burnout [10]. When fully clinical, the syndrome features both

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emotional and bodily fatigue, depersonalization, plus a reduced perception of personal or career success [10]. In addition, those with clinical burnout are expected to stop working for a period [11].

Healthcare workers (HCWs) frequently encounter intense workplace pressure [12, 13]. Before the pandemic, many already had high levels of exhaustion [14, 15]. While the COVID-19 pandemic unfolded, HCWs dealt with constant infection dangers in addition to patient care responsibilities. Recent papers, therefore, documented a major rise in exhaustion levels among HCWs during this period [16-21]. Research conducted in Brazil found that emotional exhaustion and depersonalization had the greatest impact on medical staff who remained on duty during the crisis [22]. Consequently, the broad appearance of burnout symptoms in multiple HCW positions made this group particularly appropriate for investigating cognitive functioning among employees who persist in their roles despite substantial burnout (NCB).

Although cognitive deficits have been reported in people with clinical burnout, whether cognitive impairment exists in NCB groups remains under debate. Certain studies have identified cognitive deficits [10], whereas others have not [23, 24]. While information on cognitive impairments in NCB is scarce, it is scarcer still when NCB occurs specifically among HCWs.

Nonetheless, investigating cognitive performance among HCWs who maintained their roles despite burnout symptoms is of both practical and theoretical importance. Practically speaking, cognitive issues contribute to workplace mistakes. These issues can immediately harm job output and heighten sensations of distress, depression, and anxiety [4, 25, 26].

From a theoretical standpoint, some researchers maintain that cognitive deficits occur in NCB. Others, however, argue that compensatory processes may hide differences in cognitive performance between NCB cases and controls [27]. Supporters of cognitive deficits in NCB link the harmful effects of burnout on cognition to reduced brain-derived neurotrophic factor, which may disrupt brain function and lead to cognitive deficits even during the initial phases of burnout [28]. In opposition, two prominent theories are often cited to account for how NCB workers might handle cognitive challenges in the workplace: cognitive reserve and self-regulation theories [29, 30]. Cognitive reserve theory posits that when NCB individuals tackle difficult assignments, they activate alternative brain pathways, drawing on their cognitive reserve to apply varied cognitive tactics [29]. Self-regulation theory asserts that NCB employees retain the capacity to manage themselves and engage cognitive reserve to achieve peak performance, as they preserve the ability to restrain dominant responses and channel cognitive resources toward objectives [30].

Various elements, such as the diversity of tools used to measure cognition, can account for the mixed outcomes concerning cognitive performance and burnout symptoms in NCB subjects. Within this framework, the attention domain occupies a pivotal place in cognition. Attention is the capacity to select and maintain focus on pertinent stimuli [31]. In everyday life, attention is indispensable for activities such as operating vehicles, acquiring knowledge, and performing multiple professional tasks [32, 33]. Consequently, diminished attentional performance may increase the risk of occupational accidents because workers are more susceptible to errors [33]. Additionally, attention serves as a foundation for effective operation in other cognitive spheres [31, 34]. Nevertheless, attentional performance has not been systematically investigated in NCB subjects.

Converging findings indicate that the attention system may be partitioned into four subdomains: alertness, behavioral inhibition, focused attention, and sustained attention [35, 36]. Intrinsic alertness concerns the internal management of arousal in the absence of external signals, while behavioral inhibition denotes the capacity to restrain unsuitable responses. Focused attention denotes the ability to respond appropriately to target stimuli, and sustained attention is generally characterized as the capacity to maintain concentration over time to identify relevant occurrences [31]. These attention subdomains can be dependably quantified via Continuous Performance Tests, including the Continuous Visual Attention Test (CVAT) [37-41].

Although earlier studies have recognized the cognitive repercussions of clinical burnout, the current work examines attention subdomains more closely within NCB. Hence, we performed an exploratory evaluation of CVAT performance among HCWs who continued their duties throughout the COVID-19 pandemic. More precisely, we explored whether performance across each attention subdomain was compromised in persons showing NCB. We hypothesized that NCB generates attention deficits in HCWs.

Materials and Methods

Participants

Volunteers were recruited from a tertiary university hospital in Rio de Janeiro, Brazil, from April to December 2020, during the COVID-19 pandemic. HCWs encompassed medical doctors, nurses, and nursing assistants. Initially, a brief clinical interview was conducted with HCWs aged 25 to 45 years. The minimum age threshold (25 years) was derived from a prior meta-analysis that revealed elevated rates of emotional exhaustion and depersonalization in younger nurses [42]. Therefore, younger age could exacerbate burnout symptoms, whereas greater age might act as a buffer against burnout. The maximum age cutoff of 45 years stemmed from earlier research documenting reduced processing speed beyond 45 years old [43-45]. Consequently, individuals aged 45 or older exhibit greater score variability on the CVAT [46], which may reduce the likelihood of detecting group differences and necessitate larger sample sizes. Following this, we enforced these exclusion criteria: consumption of antipsychotic or antiepileptic drugs capable of altering CVAT results, prior head injury involving loss of consciousness, ongoing alcohol or illegal substance use, existing neurological or psychiatric disorders, involvement in shift work, and any prior diagnosis of COVID-19. Participants with a history of COVID-19 were excluded, as the infection alone can cause attention deficits [39-41]. Every participant was assessed at the commencement of their work shift to minimize fatigue influences. Using responses from the Maslach Burnout Inventory (MBI), we created two groups: controls and non-clinical burnout. Detailed classification standards for these groups appear in the classification subsection (Section 2.2) and are drawn upon the three dimensions from the Portuguese-adapted version of the MBI (Section 2.2 and Section 2.4.2). Lastly, chosen participants completed the attention task. The examiner conducting the attention assessment remained unaware of each participant's assigned group.

As earlier researchers had also observed [7], it proved quite difficult to enroll healthcare workers (HCWs) with pronounced burnout symptoms who agreed to participate in the study. Thirteen individuals exhibiting high burnout symptoms (non-clinical burnout group) finished the attention assessment. Among the other 24 participants who showed no burnout symptoms, we selected 13 control subjects carefully matched for age, sex, educational level, and professional HCW role. The smallest acceptable sample size had been calculated in advance using a power analysis (Section 2.3).

All participation was voluntary and was conducted in accordance with the ethical standards set by the Research and Ethics Committee of the Federal University of the State of Rio de Janeiro, Brazil (CAAE: 69406817.1.0000.5258), in line with the Declaration of Helsinki. Every participant provided written informed consent.

Classification of the participants based on their maslach burnout inventory (MBI) scores

Burnout should be understood as a gradual continuum extending from mild to intense manifestations. Greater burnout is reflected in higher scores on emotional exhaustion and depersonalization, coupled with lower scores on personal accomplishment [47, 48]. While some authors restrict burnout diagnosis to the emotional exhaustion and cynicism subscales alone — claiming that the ineffectiveness (or personal accomplishment) subscale mainly captures personality characteristics [49, 50] — others prefer a single-dimension model based only on emotional exhaustion, regarding cynicism and reduced personal achievement as independent processes [51].

To determine whether participants showed significant burnout symptoms (yes or no), we employed the strictest classification rule recommended by Brenninkmeijer and co-workers [9], requiring the simultaneous presence of high exhaustion, high cynicism, and low personal efficacy. Cutoff scores were drawn from the third edition of the MBI manual that had been validated for Brazilian samples: average EX $\geq$ 3.2, average CY $\geq$ 2.2, and average PE $\leq$ 4.0 [52-55].

Burnout was additionally examined as a continuous measure by using the scores of its three separate dimensions. For each individual, the item scores within a given dimension were totaled and then divided by the exact number of items belonging to that dimension.

Power analysis

Minimum sample size estimation was conducted through power analysis that considered the two statistical strategies illustrated in **Figure 1**: (1) group comparisons of mean attentional performance between participants dichotomized by burnout symptom presence, and (2) correlational analyses linking burnout dimensions to attentional performance. As a result, two independent analyses were carried out. For both, the parameters applied were α = Type I error = 0.05 and β = Type II error = 0.20 (statistical power = 1 − β = 0.80).

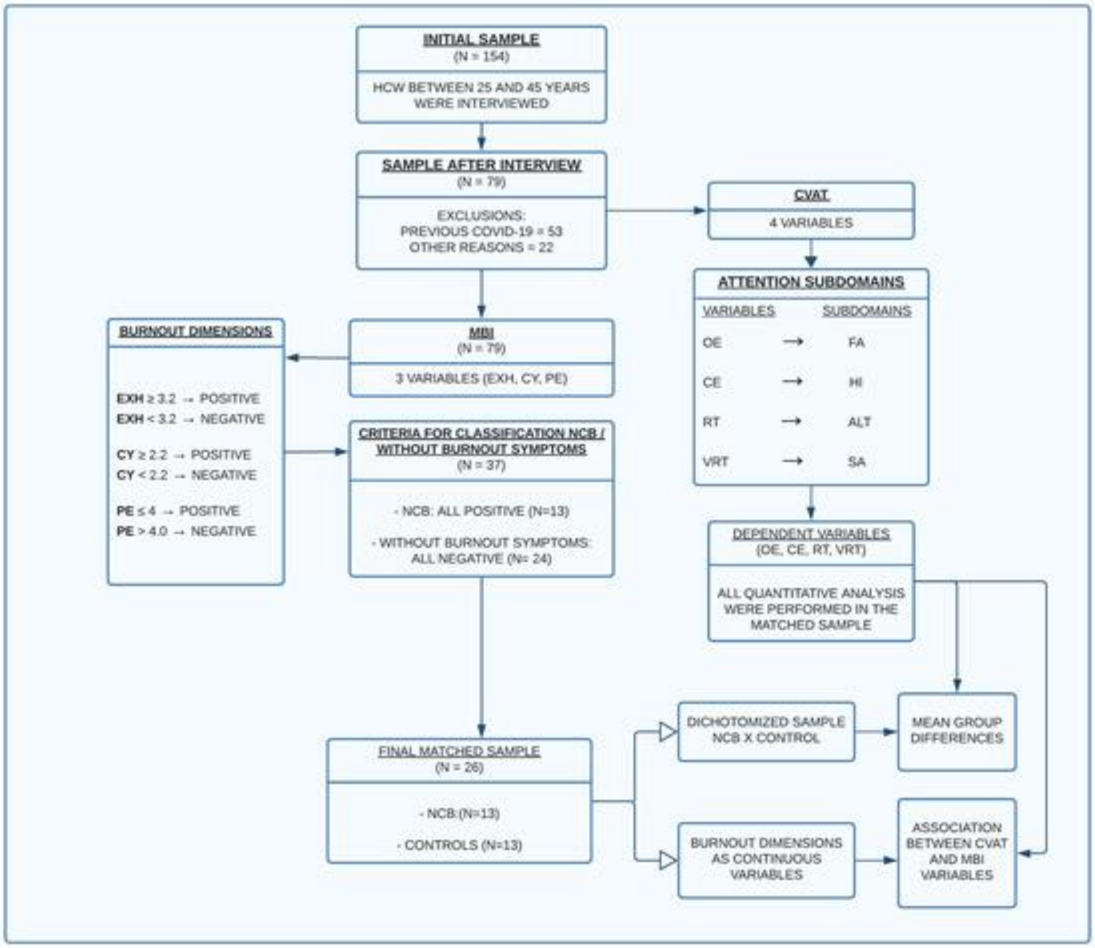


Figure 1. Flowchart explaining the study design. Abbreviations: CVAT = Computerized Visual Attention Test; MBI = Maslach Burnout Inventory; OE = omission errors; FA = focused attention; CE = commission errors; HI = hyperactivity/impulsivity factor; RT = reaction time; ALT = alertness; VRT = intraindividual reaction time variability; SA = sustained attention; EX = mean exhaustion; CY = mean cynicism; PE = mean personal efficacy; HCW = healthcare workers; NCB = non-clinical burnout.

Participants were divided into two groups based on whether they showed burnout symptoms. In this situation, MANCOVAs were conducted to properly account for potential dependencies among the dependent variables, which represented the different attention subdomains. This multivariate method could reveal overall differences in group means even when separate ANCOVAs or unpaired t-tests failed to reach significance. Still, we conducted post hoc t-tests in every case to pinpoint exactly which aspects of attention performance differed between the groups. Because these follow-up comparisons were all based on t-test variations, the power calculations relied on independent t-tests. We calculated the smallest differences (Δ) that would carry real clinical importance. Population standard deviations and clinically meaningful mean differences for each measure in the brief attention test (1.5-min version) were drawn from prior, larger-scale studies comparing healthy individuals with patients diagnosed with attention deficits. Moreover, objective impairment in a cognitive domain is frequently defined as scores at least 1.5 standard deviations (SD) below the normative average [56]. After weighing all these factors, we based the power analysis on the smallest Cohen's d value among the four CVAT measures. For an allocation ratio of 1 and a 1.5 SD difference above the normative mean (where higher CVAT scores indicate worse performance), the analysis indicated that 18 participants total (9 per group) would be the minimum needed. Given $\alpha = 0.05$, $\beta = 0.20$, power = 0.80, and d = 1.5, our actual sample of 26 individuals (13 per group) proved adequate for detecting mean differences in attentional performance between the groups.

When burnout was examined as a continuous measure, associations between each of the three burnout dimensions and the CVAT attention subdomains were evaluated through Pearson correlation coefficients (R). In regression-based work, R^2 (the squared Pearson correlation) serves as the standard effect size. This value helps researchers decide in advance which relationships are practically important. The first step in determining sample size for correlation studies is therefore estimating the expected population correlation strength (ρ). Since no relevant empirical data existed for this population, we had no clear basis for ρ. In such situations, Schafer [57] advises treating $R^2 = 0.25$ as a sensible maximum. Cohen [58] similarly views $R^2 = 0.26$ as a large effect. We therefore selected ρ values between 0.50 and 0.55. These large effects yielded minimum sample sizes of 23-29 participants. Our final sample of 26 fell well inside this interval.

Procedures

A full description of every component of the study was prepared in accordance with the STROBE initiative recommendations [59]. After applying inclusion and exclusion criteria during interviews, eligible participants completed the MBI questionnaire. They were subsequently assigned to one of two groups based on their scores across the three inventory dimensions: a healthy control group or a group displaying notable burnout symptoms (referred to from this point as the non-clinical burnout or NCB group). All participants then completed the continuous visual attention test (CVAT). Examiners administering the CVAT were unaware of participants' burnout status. Statistical analyses used the matched-pairs groups.

The CVAT measured four separate attention subdomains, whereas the Maslach Burnout Inventory assessed three burnout dimensions. Group differences in attentional performance were analyzed using the dichotomized groups (controls versus NCB). In parallel, burnout dimensions were handled as continuous variables within the sample, allowing us to investigate links between each dimension and performance on the attention subdomains.

Computerized visual attention test (CVAT)

The CVAT **(Figure 2)** presented a steady sequence of visual items on a computer display at consistent time intervals. Subjects were directed to press the spacebar using their dominant hand as rapidly as possible upon seeing the designated target stimulus and to avoid pressing for any non-target items. Stimuli appeared for 250 ms each, separated by a 750-ms interstimulus gap. The full test included 90 trials, of which 72 (80%) were targets, and 18 (20%) were non-targets. It yielded data on reaction time (RT) and accuracy for both stimulus types, along with a variability metric reflecting the steadiness of attention and related to sustained attention capacity [60].

a)

b)

c)

Figure 2. Schematic overview of the CVAT showing the target (star) and non-target (diamond). The

CVAT begins with on-screen instructions (a): "In this test, the computer alternately displays the indicated figures in the center of the screen. You must press the spacebar using your dominant hand as fast as you can whenever the star appears in the center of the screen. If the other figure appears, you should not press the space bar". Both the target (b) and the non-target (c) remained on the screen for 250 milliseconds (ms). The test consists of 90 trials, with either of the two figures presented in each trial. The interstimulus interval is 1 s, resulting in a total test duration of 1.5 min. Key variables include omission errors (OE), commission errors (CE), average reaction time for correct responses (RT), and intraindividual variability of reaction time (VRT; the standard deviation of the RTs during the test). The CVAT [46] is available for research and clinical use by licensed psychologists. Access requests can be made to the corresponding author, Prof. Sergio L. Schmidt. There are versions in English, Spanish, and Portuguese.
CVAT: Continuous Visual Attention Test.

Average reaction time for correct responses (RT) was computed individually for each participant. Intraindividual reaction time variability (VRT) was also derived as the standard deviation (SD) of all correct RTs to targets. Accuracy levels were established by recording omission errors (failure to respond to targets) and commission errors (responses to non-targets).

Maslach burnout inventory (MBI)

The MBI [61] is a self-administered questionnaire that requires roughly 10 to 15 minutes to finish. It contains 16 items designed to evaluate the three core features of burnout: exhaustion (example item: 'I feel used up at the end of the work-day'), cynicism (example item: 'I have become less enthusiastic about my work'), and reduced personal efficacy (example item: 'In my opinion, I am good at my job'). Respondents rated how often they experienced each statement on a 7-point Likert scale ranging from "never" to "every day." Dimension scores were obtained by summing responses to the relevant items and calculating the mean for each dimension.

Statistical analysis

Mean differences in attention performance between two groups dichotomized according to the presence of burnout symptoms

To examine whether HCWs with pronounced burnout symptoms differed from those without such symptoms, we ran a MANCOVA with RT, VRT, OE, and CE serving as the dependent variables and group membership (high non-clinical burnout versus no burnout) as the independent factor. Box's M-test checked the equality of covariance matrices across groups. A significant MANCOVA result would indicate that at least one attention measure differed between groups, justifying follow-up univariate ANCOVAs. This MANCOVA/ANCOVA strategy was selected because it produces reliable outcomes even with non-normal data distributions [62]. In addition, we conducted independent t-tests on each CVAT variable to directly compare group means.

In this investigation, the groups were balanced for key potential confounders (age and sex) through matching. However, the matched design allowed MANCOVA and ANCOVA models to be run without including covariates; matching alone does not fully replace statistical control. Some authors [63] argue that adjusting for confounders in the model captures more explanatory variance in the outcomes than simply omitting them to boost statistical power. For this reason, we performed the MANCOVAs and ANCOVAs both with and without covariates. Age and sex were entered as covariates. We also tested models using OE, CE, and VRT as dependent variables while treating RT, age, and sex as covariates. The inclusion of RT as a covariate followed the approach suggested by Linden *et al*. [7], who noted that commission errors tend to be inversely associated with reaction times so that unadjusted RT values could mask true differences in CE and VRT.

Fatigue was not treated as a confounding factor for two main reasons: the study excluded shift workers, and the CVAT duration is only 1.5 min.

Correlation between burnout dimensions and attention subdomains

We evaluated every possible relationship between the three burnout dimensions and the CVAT measures using Pearson correlation coefficients. Before interpretation, we verified that the data met all core assumptions for linear correlation analysis. These included linearity (straight-line relationships between predictors and outcomes), normality of residuals, homoscedasticity (consistent residual variance across predicted values), and independence of errors (no correlation between residuals from different observations). We further inspected the data for outliers and influential cases that might unduly affect the correlation values.

Results and Discussion

During the recruitment phase, 154 healthcare workers (HCWs) were screened through interviews. Among them, 53 were ruled out due to prior COVID-19 infection, and another 22 were excluded for various other health-related issues. Of the 79 individuals who remained eligible, 13 met the criteria for the non-clinical burnout (NCB) group, while 24 showed no notable symptoms across the three burnout dimensions. Control participants were carefully matched to the 13 NCB cases by age, sex, and specific HCW role. Once matching was completed, 13 suitable burnout-free participants were included for direct comparison with the NCB group.

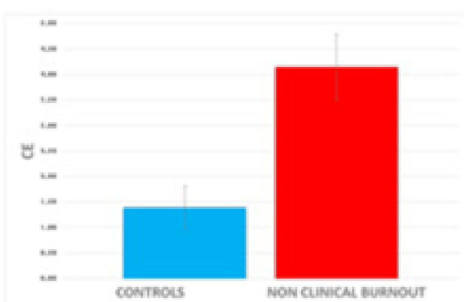
The final study sample consisted of 26 participants. Their ages spanned 25 to 44 years (mean = 35.31; standard deviation = 5.47), with 17 males and 9 females. Professionally, the group included 11 physicians and 15 nursing staff members. **Table 1** provides an overview of demographic characteristics and MBI scores. Despite minor imbalances, statistical comparisons revealed no meaningful differences in any demographic variables between the groups. As anticipated by the NCB classification criteria, clear and significant differences appeared across all three burnout dimensions when comparing the NCB group to controls.

Table 1. Demographics and MBI data (n = 26).

Demographics and burnout dimensions	Controls (n = 13)	Non-clinical burnout (n = 13)	Group diff (P)
Female (n (%))	4 (30.76%)	5 (38.46%)	ns
Age (years (mean ± SD))	36.38 ± 3.2	34.23 ± 7.0	ns
Physicians (n (%))	6 (46.15%)	5 (38.46%)	ns
Nurses and nurse aides (n (%))	7 (53.38%)	8 (61.15%)	ns
Average EXH (mean ± SD)	0.73 ± 0.43	5.11 ± 0.59	< 0.01
Average CY (mean ± SD)	0.14 ± 0.25	4.49 ± 1.12	< 0.01
Average PE (mean ± SD)	5.53 ± 0.56	3.23 ± 0.32	< 0.01

Each continuous variable is expressed as the mean ± standard deviation. Abbreviations: EXH = Exhaustion; CY = Cynicism; PE = Personal efficacy; ns (non-significant); P = proof value. Significant group differences are indicated in BOLD.

Figure 3 illustrates the unadjusted scores for the four CVAT measures in both groups. A visual review highlighted noticeably elevated commission errors among NCB participants compared with controls. Reaction time averages were slightly prolonged in the control group, yet this difference remained within one standard error of the mean.



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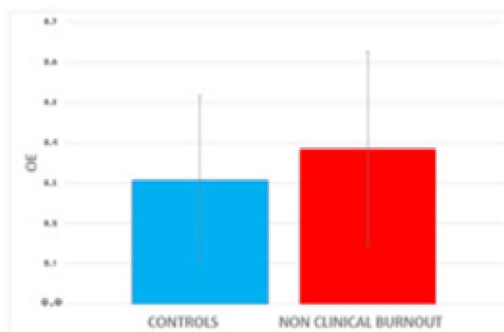

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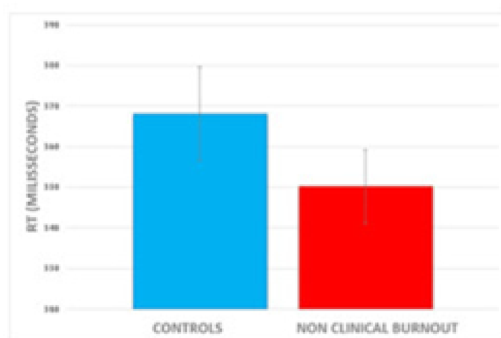

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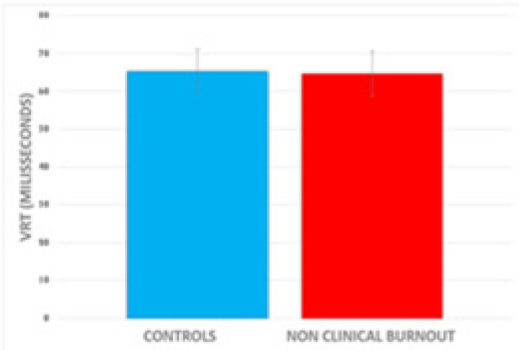

d)

Figure 3. Means of each CVAT variable according to the group (raw data). Data are expressed as the mean ± standard error of the mean. Abbreviations: CE = commission errors; OE = omission errors; RT = reaction time; VRT = intraindividual reaction time variability. Group differences reached significance for the CE variable.

Overall, the MANCOVA detected a substantial main effect of non-clinical burnout on attentional functioning, F (4, 21) = 3.55, P = 0.023, η2 = 0.40. These findings held steady even after statistical adjustment for age, sex, and RT as covariates. Subsequent univariate ANCOVAs confirmed that non-clinical burnout exerted a strong influence on commission errors, F(4, 21) = 12.90, P = 0.001, η2 = 0.35. No significant effects emerged for VRT [F (4, 21) = 0.003, P = 0.956], OE [F (4, 21) = 0.06, p = 0.811], or RT [F (4, 21) = 1.23, P = 0.279]. However, when VRT was re-analyzed while controlling for RT, a near-significant trend emerged (P = 0.07, two-tailed), suggesting greater variability in the NCB group than in controls.

Treating commission errors as the key outcome, Pearson correlation coefficients (R) demonstrated statistically significant links with every burnout dimension **(Table 2)**: exhaustion (R = 0.545, P = 0.004), cynicism (R = 0.563, P = 0.003), and reduced personal efficacy (R = −0.522, P = 0.006). Comprehensive checks were performed on all linear regression assumptions, including residual plots against predicted values, residual histograms, normality tests, as well as Cook's distances, DFBETAs, and Mahalanobis distance measures.

Table 2. Pearson correlation coefficients (n = 26).

Variables	Average PE	Average CY	Average EXH
CE			
R Pearson	−0.522 *	0.563 *	0.545 *
p-value	0.006	0.003	0.004
OE			
R Pearson	−0.079	0.047	0.013
p-value	0.703	0.818	0.950
RT			
R Pearson	0.334	−0.318	−0.228
p-value	0.095	0.114	0.262
VRT			
R Pearson	0.074	−0.106	0.011
p-value	0.720	0.608	0.957

The table includes Pearson correlation coefficients (R) and p-values for variables CE, OE, RT, and VRT with the averages of EXH, CY, and PE. "R Pearson" refers to the Pearson correlation coefficient, which measures the strength and direction of the relationship between two variables. "P-value" refers to the probability value. Indicates that the result is significant at P < 0.01. Abbreviations: EXH = Exhaustion; CY = Cynicism; PE = Personal Efficacy; CE = commission errors; OE = omission errors; RT = reaction time; VRT = intraindividual reaction time variability.

The present findings revealed that healthcare workers who remain active in their roles but exhibit burnout symptoms (non-clinical burnout) display particular impairments in attentional functioning. Performance patterns on the attention test indicated a more impulsive response style among NCB participants compared with controls.

Executive deficits in NCB in healthcare workers during the COVID-19 pandemic

This investigation examined non-clinical burnout and its impact on attentional abilities among healthcare workers amid the COVID-19 pandemic — a high-pressure environment that has received limited attention in prior research. The exceptional demands of the pandemic created a valuable setting for exploring intensified NCB. In our sample, NCB participants showed marked elevations in exhaustion and depersonalization, along with diminished feelings of personal and professional accomplishment. During the pandemic, healthcare workers encountered severe difficulties in maintaining their emotional and physical resources because of intense stress, limited support, and heavier workloads. Such resource depletion can undermine self-regulatory capacity, which may manifest as greater impulsivity or hyperactivity during attention-demanding activities.

The CVAT paradigm involves rapid serial presentation of target and non-target stimuli, requiring participants to respond promptly to targets while suppressing responses to non-targets [37-41]. Inhibitory control is reflected in the frequency of commission errors (CEs). The observed increase in CEs among NCB individuals implies potential challenges in managing attention during routine work activities.

The clear group difference in the impulsivity-hyperactivity subdomain suggests that NCB workers may be more prone to errors in their duties. Sustained attention and response inhibition are well-established components of executive control [64]. Executive control encompasses the cognitive mechanisms that enable flexible regulation of perception and action in response to shifting task requirements [65]. When executive control is compromised, people typically struggle to suppress inappropriate responses [31]. Our results, therefore, align with the concept of executive dysfunction in individuals experiencing non-clinical burnout. Although sustained attention also falls under executive control — which would predict impairment in VRT for NCB participants — no such difference was observed in this variable.

The lack of a significant group effect on VRT can be understood in terms of its interrelationships with reaction time and commission errors. Raw data **(Figure 3)** showed comparable average VRT between groups, yet NCB participants tended to respond faster overall. A negative association existed between reaction time and inhibition errors. When ANCOVA models adjusted for RT, a significant group effect emerged, and follow-up analyses (controlling for RT) confirmed higher CE in the NCB group along with a trend toward elevated VRT ($P = 0.07$). Prior work [66] has shown that VRT can be reliably assessed even with brief tests (e.g., 1 min) as long as they include sufficient trials (typically over 25). Given that the CVAT includes 90 trials (72 correct targets) and exceeds 1 min in length, the emergence of higher VRT in NCB workers after RT adjustment strengthens the evidence for executive attention difficulties in this group. These results are consistent with previous clinical reports indicating that individuals with burnout experience attentional problems in everyday functioning [2, 7]. Linden *et al*. [7] used the Sustained Attention to Response Test (SART) and found that clinically burned-out participants performed worse on both CE and VRT. However, that same study reported no performance differences between non-clinical burnout cases and controls — seemingly at odds with our findings. Notably, the SART contains only 11% non-targets, compared with 20% in the CVAT. The higher proportion of non-targets in the CVAT likely improves the detection of impulsive errors. Consequently, the CVAT may offer greater sensitivity for assessing inhibitory control than the SART. Linden *et al*. [7] also observed a gradient of executive attention impairment, with the most severe deficits in the clinical burnout group, moderate deficits in the high (non-clinical) burnout group, and minimal deficits in controls.

To the best of our knowledge, this is the first empirical study to demonstrate that non-clinical burnout is linked to deficits in executive control. In a recent report, Koutsimani and Montgomery [27] documented visuospatial impairments in NCB participants. Given attention's central role in broader cognitive processes, we propose that such visuospatial difficulties may partly stem from underlying deficits in executive attention.

Limitations

Despite highlighting notable inhibitory control problems in non-clinical burnout, the present investigation had several important constraints.

First, the number of participants was relatively small. This restricts how broadly the findings can be applied and increases the chance that the observed statistical differences might reflect Type I error. Nevertheless, the detection of a clear difference in commission errors, even with limited group sizes, suggests that the true magnitude of cognitive impairments associated with burnout could be substantial.

Secondly, burnout symptoms were assessed exclusively through self-report instruments. Consequently, responses may have been influenced by various self-report biases. Future research would benefit from incorporating structured clinical interviews to complement questionnaire data.

Thirdly, attentional functioning was evaluated using a single instrument focused on only one cognitive domain. While establishing a person's capacity to focus on relevant stimuli and suppress inappropriate responses is a necessary foundation, subsequent studies involving larger samples and a wider range of neuropsychological tests (including memory, language, and other domains) would provide a more complete picture of how non-clinical burnout affects overall cognition.

Finally, the study did not measure or adjust for participants' current stress levels, available resources, self-regulatory capacity, or workload demands. Although the cross-sectional design precludes causal conclusions, assessing these variables in future work would help clarify whether resource depletion actually reduces self-regulation and leads to greater impulsivity or hyperactivity during attention-based activities.

Conclusion

The present study demonstrated that healthcare workers experiencing high levels of burnout, yet still actively employed, showed impaired performance on measures reflecting specific attention subdomains, particularly sustained attention and impulsivity control. These results support the value of combining a short computerized attention test with a self-reported burnout inventory as an objective method to evaluate attentional difficulties associated with burnout symptoms. Our findings indicate that the CVAT, when used with a burnout questionnaire, can effectively help identify individuals with both elevated burnout symptoms and deficits in executive attention. Incorporating this objective measure could help develop practical interventions to reduce work-related accidents caused by burnout, especially those driven by impulsive behavior. Additionally, such tools may help policymakers accurately quantify the real-world impact of burnout on the workforce, particularly in nations with high burnout rates, such as Brazil [67].

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Conflict of Interest: None

Financial Support: None

Ethics Statement: Participation in this study was voluntary and conducted in accordance with the recommendations of the Research and Ethics Committee of the Federal University of the State of Rio de Janeiro, Brazil (CAAE: 69406817.1.0000.5258), and adhered to the Declaration of Helsinki. All subjects gave written informed consent.

References

1. Leka S, Jain A, World Health Organization. Health impact of psychosocial hazards at work: an overview. Geneva: World Health Organization; 2010.
2. Schaufeli W, Salanova M. Burnout, boredom and engagement at the workplace. In: People at Work: An Introduction to Contemporary Work Psychology. Chichester: Wiley; 2014. p. 293–320.
3. Feuerhahn N, Stamov-Roßnagel C, Wolfram M, Bellingrath S, Kudielka BM. Emotional exhaustion and cognitive performance in apparently healthy teachers: a longitudinal multi-source study. Stress Health. 2013;29:297–306.
4. Jonsdottir IH, Nordlund A, Ellbin S, Ljung T, Glise K, Währborg P, et al. Working memory and attention are still impaired after three years in patients with stress-related exhaustion. Scand J Psychol. 2017;58:504–9.
5. Krabbe D, Ellbin S, Nilsson M, Jonsdottir IH, Samuelsson H. Executive function and attention in patients with stress-related exhaustion: perceived fatigue and effect of distraction. Stress. 2017;20:333–40.
6. Lemonaki R, Xanthopoulou D, Bardos AN, Karademas EC, Simos PG. Burnout and job performance: a two-wave study on the mediating role of employee cognitive functioning. Eur J Work Organ Psychol. 2021;30:692–704.
7. van der Linden D, Keijsers GPJ, Eling P, van Schaijk R. Work stress and attentional difficulties: an initial study on burnout and cognitive failures. Work Stress. 2005;19:23–36.
8. Deligkaris P, Panagopoulou E, Montgomery AJ, Masoura E. Job burnout and cognitive functioning: a systematic review. Work Stress. 2014;28:107–23.
9. Brenninkmeijer V, van Yperen NW. How to conduct research on burnout: advantages and disadvantages of a unidimensional approach in burnout research. Occup Environ Med. 2003;60:i16–i20.
10. van Dijk DM, van Rhenen W, Murre JMJ, Verwijk E. Cognitive functioning, sleep quality, and work performance in non-clinical burnout: the role of working memory. PLoS One. 2020;15:e0231906.
11. Bauernhofer K, Bassa D, Canazei M, Jiménez P, Paechter M, Papousek I, et al. Subtypes in clinical burnout patients enrolled in an employee rehabilitation program: differences in burnout profiles, depression, and recovery/resources-stress balance. BMC Psychiatry. 2018;18:10.
12. National Academies of Sciences, Engineering, and Medicine. Taking action against clinician burnout: a systems approach to professional well-being. Washington (DC): National Academies Press; 2019.
13. Wright T, Mughal F, Babatunde OO, Dikomitis L, Mallen CD, Helliwell T. Burnout among primary health-care professionals in low- and middle-income

countries: systematic review and meta-analysis. Bull World Health Organ. 2022;100:385A–401A.

14. Poghosyan L, Clarke SP, Finlayson M, Aiken LH. Nurse burnout and quality of care: cross-national investigation in six countries. Res Nurs Health. 2010;33:288–98.
15. Shanafelt TD, West CP, Sinsky C, Trockel M, Tutty M, Satele DV, et al. Changes in burnout and satisfaction with work-life integration in physicians and the general US working population between 2011 and 2017. Mayo Clin Proc. 2019;94:1681–94.
16. Buselli R, Corsi M, Baldanzi S, Chiumiento M, Del Lupo E, Dell'Oste V, et al. Professional quality of life and mental health outcomes among health care workers exposed to SARS-CoV-2 (COVID-19). Int J Environ Res Public Health. 2020;17:6180.
17. Duarte I, Teixeira A, Castro L, Marina S, Ribeiro C, Jácome C, et al. Burnout among Portuguese healthcare workers during the COVID-19 pandemic. BMC Public Health. 2020;20:1885.
18. Haidari E, Main EK, Cui X, Cape V, Tawfik DS, Adair KC, et al. Maternal and neonatal health care worker well-being and patient safety climate amid the COVID-19 pandemic. J Perinatol. 2021;41:961–9.
19. Ruiz-Fernández MD, Pérez-García E, Ortega-Galán ÁM. Quality of life in nursing professionals: burnout, fatigue, and compassion satisfaction. Int J Environ Res Public Health. 2020;17:1253.
20. Sexton JB, Adair KC, Proulx J, Profit J, Cui X, Bae J, et al. Emotional exhaustion among US health care workers before and during the COVID-19 pandemic, 2019–2021. JAMA Netw Open. 2022;5:e2232748.
21. Ulfa M, Azuma M, Steiner A. Burnout status of healthcare workers in the world during the peak period of the COVID-19 pandemic. Front Psychol. 2022;13:952783.
22. de Medeiros AIC, de Mesquita RB, de Macêdo FS, de Matos AGC, Pereira ED. Prevalence of burnout among healthcare workers in six public referral hospitals in Northeastern Brazil during the COVID-19 pandemic: a cross-sectional study. São Paulo Med J. 2022;140:553–8.
23. Castaneda AE, Suvisaari J, Marttunen M, Perälä J, Saarni SI, Aalto-Setälä T, et al. Cognitive functioning in relation to burnout symptoms and social and occupational functioning in a population-based sample of young adults. Nord J Psychiatry. 2011;65:32–9.
24. McInerney S, Rowan M, Lawlor B. Burnout and its effect on neurocognitive performance. Ir J Psychol Med. 2012;29:176–9.
25. Williams PG, Suchy Y, Rau HK. Individual differences in executive functioning: implications for stress regulation. Ann Behav Med. 2009;37:126–40.
26. Eskildsen A, Andersen LP, Pedersen AD, Andersen JH. Cognitive impairments in former patients with work-related stress complaints—one year later. Stress. 2016;19:559–66.
27. Koutsimani P, Montgomery A. Cognitive functioning in non-clinical burnout: using cognitive tasks to disentangle the relationship in a three-wave longitudinal study. Front Psychiatry. 2022;13:978566.
28. He SC, Zhang YY, Zhan JY, Wang C, Du XD, Yin GZ, et al. Burnout and cognitive impairment associated with serum BDNF in a Chinese Han population. Psychoneuroendocrinology. 2017;77:236–43.
29. Stern Y. What is cognitive reserve? J Int Neuropsychol Soc. 2002;8:448–60.
30. Baumeister RF, Vohs KD. Self-regulation and the executive function of the self. In: Handbook of self and identity. 2nd ed. New York: Guilford Press; 2012. p. 180–197.
31. Mackie MA, Van Dam NT, Fan J. Cognitive control and attentional functions. Brain Cogn. 2013;82:301–12.
32. Altarabichi MG, Ahmed MU, Ciceri MR, Balzarotti S, Biassoni F, Lombardi DB, et al. Reaction time variability association with safe driving indexes. In: Proceedings of the Transport Research Arena TRA2020; 2020.
33. Anderson BA, Kim N, Gregoire L, Yan N, Ahn CR. Attention failures cause workplace accidents: why workers ignore hazards and what to do about it. Available from: https://www.citedrive.com/en/discovery/attention-failures-cause-workplace-accidents-why-workers-ignore-hazards-and-what-to-do-about-it/ (accessed 1 Jan 2024).
34. Lezak MD, Howieson DB, Bigler ED, Tranel D. Neuropsychological assessment. 5th ed. New York: Oxford University Press; 2012.
35. Egeland J, Kovalik-Gran I. Measuring several aspects of attention in one test: the factor structure of

Conners's continuous performance test. J Atten Disord. 2010;13:339–46.
36. Petersen SE, Posner MI. The attention system of the human brain: 20 years after. Annu Rev Neurosci. 2012;35:73–89.
37. Schmidt SL, Simões EN, Carvalho ALN. Association between auditory and visual continuous performance tests in students with ADHD. J Atten Disord. 2019;23:635–40.
38. Simões EN, Carvalho ALN, Schmidt SL. The role of visual and auditory stimuli in continuous performance tests: differential effects on children with ADHD. J Atten Disord. 2021;25:53–62.
39. do Carmo Filho A, van Duinkerken E, Tolentino JC, Schmidt SL. Attention profile of physically recovered COVID-19 inpatients on the day of discharge. J Psychiatr Res. 2022;150:189–96.
40. Schmidt SL, Araguez IM, Neves VV, van Duinkerken E, Schmidt GJ, Tolentino JC, et al. Attention deficits in Brazilian health care workers with chronic pain. Front Psychol. 2022;13:1024584.
41. Tolentino JC, Gjorup ALT, Schmidt GJ, Schmidt SL. Early attention impairment in a patient with COVID-19. Psychiatry Clin Neurosci. 2021;75:66–7.
42. Gómez-Urquiza JL, Vargas C, De la Fuente EI, Albendín-García L, Velando-Soriano A, Ortega-Campos EM, et al. Age as a risk factor for burnout syndrome in nursing professionals: a meta-analytic study. Res Nurs Health. 2017;40:99–110.
43. Salthouse TA. Selective review of cognitive aging. J Int Neuropsychol Soc. 2010;16:754–60.
44. Harada CN, Natelson Love MC, Triebel K. Normal cognitive aging. Clin Geriatr Med. 2013;29:737–52.
45. Singh-Manoux A, Kivimäki M, Glymour MM, Elbaz A, Berr C, Ebmeier KP, et al. Timing of onset of cognitive decline: results from Whitehall II cohort study. BMJ. 2012;344:d7622.
46. Schmidt SL, Manhães AC. Manual do teste computadorizado de atenção visual. Rio de Janeiro: Cognitive Neuropsychology; 2019.
47. Maslach C, Jackson SE. The measurement of experienced burnout. J Organ Behav. 1981;2:99–113.
48. Maslach C, Jackson SE. Maslach Burnout Inventory: manual. Palo Alto (CA): Consulting Psychologists Press; 1986.
49. Halbesleben JRB, Demerouti E. The construct validity of an alternative measure of burnout. Work Stress. 2005;19:208–20.
50. Ricardo YR, Paneque FRR. Hacia un estudio bidimensional del síndrome de burnout en estudiantes universitarios. Cien Saude Colet. 2014;19:4767–75.
51. Kristensen TS, Borritz M, Villadsen E, Christensen KB. The Copenhagen Burnout Inventory. Work Stress. 2005;19:192–207.
52. Maslach C, Jackson S, Leiter M. Maslach Burnout Inventory manual. 3rd ed. Lanham (MD): Scarecrow Education; 1996.
53. McLaurine WD. Correlational study of job burnout and organizational commitment among correctional officers. PhD thesis. Capella University; 2008.
54. Schuster MS, Dias VV, Battistella LF. MBI-GS aplicação em universidade pública. Rev Fac Adm Econ. 2015;6:182–95.
55. Schuster MS, Dias VV, Battistella LF, Grohmann MZ. Validação da escala MBI-GS. REGE Rev Gest. 2015;22:403–16.
56. Jak AJ, Bondi MW, Delano-Wood L, Wierenga CE, Corey-Bloom J, Salmon DP, et al. Quantification of five neuropsychological approaches to defining mild cognitive impairment. Am J Geriatr Psychiatry. 2009;17:368–75.
57. Schafer WD. Interpreting statistical significance and nonsignificance. J Exp Educ. 1993;61:383–7.
58. Cohen J. A power primer. Psychol Bull. 1992;112:155–9.
59. STROBE statement—checklist of items that should be included in reports of observational studies. Int J Public Health. 2008;53:3–4.
60. Simões EN, Padilla CS, Bezerra MS, Schmidt SL. Analysis of attention subdomains in obstructive sleep apnea patients. Front Psychol. 2018;9:435.
61. Maslach C, Jackson SE, Leiter MP. Maslach Burnout Inventory manual. 4th ed. Menlo Park (CA): Mind Garden; 2018.
62. Olejnik SF, Algina J. Parametric ANCOVA and rank transform ANCOVA. J Educ Stat. 1984;9:129–49.
63. Pearce N. Analysis of matched case-control studies. BMJ. 2016;352:i969.
64. Manly T, Robertson IH, Galloway M, Hawkins K. The absent mind. Neuropsychologia. 1999;37:661–70.
65. Norman DA, Shallice T. Attention to action. In: Davidson RJ, Schwartz GE, Shapiro D, editors.

Consciousness and self-regulation. Boston: Springer; 1986.
66. Manuel AL, Foxe D, Bradshaw N, Cullen B, Lawlor B, Robertson IH. Sustained attention failures as a marker of dementia. J Neurol. 2019;266:1323–31.
67. Chirico F, Magnavita N. Burnout syndrome and meta-analyses. Int J Environ Res Public Health. 2020;17:741.