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An Exploratory Study on Attention Deficits in Healthcare Professionals Experiencing Non-Clinical Burnout

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ABSTRACT

Background: Burnout, a consequence of chronic workplace stress, is associated with physical, emotional, and cognitive impairments. Healthcare workers (HCWs), particularly during the Pandemics , faced significant stressors, making them a relevant group for studying non-clinical burnout (NCB). This study explored whether NCB impacts attention subdomains in HCWs, a cognitive domain critical for professional tasks and overall functioning.

Methods: The study recruited HCWs aged 25–45, excluding individuals with confounding medical or neurological conditions, substance use, or prior COVID-19 infection. Participants were classified into NCB and control groups using the Maslach Burnout Inventory (MBI). Attention performance was assessed using the Continuous Visual Attention Test (CVAT), measuring reaction time (RT), variability in RT (VRT), omission errors (OE), and commission errors (CE). Multivariate and univariate analyses were conducted to identify group differences and correlations between burnout dimensions and attention deficits.

Results: Among 154 participants, 26 met inclusion criteria (13 NCB and 13 controls). Significant group differences in CE were observed, with NCB participants demonstrating more inhibition errors ($F(4, 21) = 12.90$, $p = 0.001$, $\eta^2 = 0.35$). VRT analysis indicated a trend toward higher variability in the NCB group when controlling for RT. Correlations revealed significant associations between CE and burnout dimensions, including exhaustion ($R = 0.545$, $p = 0.004$) and cynicism ($R = 0.563$, $p = 0.003$), and an inverse relationship with personal efficacy ($R = -0.522$, $p = 0.006$).

Conclusion: HCWs experiencing NCB exhibit deficits in executive attention, particularly in sustained attention and impulsivity. Incorporating brief computerized attention assessments, such as the CVAT, alongside self-reported burnout measures, may help identify individuals at risk for cognitive impairments. These findings underscore the importance of addressing burnout to mitigate workplace errors and inform policy interventions in high-stress occupations.

Keywords: NCB, study, confounding, Covid-19

1. INTRODUCTION

Burnout, a consequence of chronic workplace stress, poses a significant health risk for employees across various professions (1). It is characterized by three primary dimensions: emotional exhaustion, depersonalization, and diminished personal efficacy. According to Schaufeli and Salanova (2), emotional exhaustion reflects a depletion of energy, depersonalization involves a detached attitude toward one's work, and diminished efficacy

corresponds to a decline in self-assessed competence. Furthermore, research has identified cognitive impairments among individuals experiencing clinical burnout (3,4,5,6,7). Deligkaris et al. (8) proposed integrating a cognitive aspect into the definition of burnout, emphasizing its substantial effect on cognitive function.

One study (9) suggested that individuals with burnout can be identified by high levels of emotional exhaustion coupled with a markedly negative score in at least one other burnout dimension. Employees who continue working despite high burnout scores are often referred to as experiencing non-clinical burnout (NCB) (10).

NCB represents an initial phase of burnout, characterized by exhaustion and detachment, where individuals remain in their roles despite these symptoms (11). Initially, NCB manifests as exhaustion and detachment, but continued exposure to stressors can intensify the condition, leading to more severe outcomes (10). Over time, this progression can result in clinical burnout, which includes profound emotional and physical exhaustion, depersonalization, and a reduced sense of accomplishment, often necessitating work leave (10,11).

Healthcare workers (HCWs) frequently face substantial job-related stress (12,13), with high exhaustion levels documented even before the Pandemics (14,15). The pandemic amplified these challenges, exposing HCWs to infection risks while they managed patient care. Recent findings indicate a significant increase in burnout symptoms among HCWs during the pandemic (16,17,18,19,20,21). Some reports highlighted depersonalization and emotional exhaustion as particularly impacted burnout dimensions during this period (22). Given the widespread burnout symptoms among HCWs, they represent a relevant group for exploring cognitive performance in individuals with NCB who remain active in their roles.

Although cognitive impairments are well-documented in clinical burnout, their presence in NCB populations remains a topic of debate. While some studies suggest cognitive deficits in NCB (10), others do not corroborate these findings (23,24). Moreover, even less is understood about cognitive impairments in HCWs experiencing NCB.

The investigation of cognitive function in HCWs with burnout symptoms holds both practical and theoretical relevance. Practically, cognitive impairments can lead to workplace errors, exacerbating distress, anxiety, and depression (4,25,26). Theoretically, some researchers have posited that NCB is associated with cognitive deficits, potentially due to reduced brain-derived neurotrophic factor levels, which could impair cognitive function even in burnout's early stages (28). In contrast, other theories suggest that compensatory mechanisms, such as cognitive reserve and self-regulation, might mask cognitive deficits in NCB (27,29,30). Cognitive reserve theory posits that individuals with NCB utilize alternative neural networks to compensate for cognitive challenges (29). Meanwhile, self-regulation theory argues that NCB employees can manage cognitive resources effectively to maintain performance, leveraging their capacity to control impulsive responses and focus on objectives (30).

Disparities in cognitive assessment tools may partly explain the inconsistent findings regarding cognitive performance in NCB. Attention, a critical cognitive domain, plays a pivotal role in daily functioning. It enables individuals to selectively focus on relevant stimuli, which is essential for activities like driving, learning, and professional tasks (31,32,33). Impairments in attention can increase the likelihood of errors and accidents in the workplace (33). Additionally, attention is foundational for functioning in other cognitive domains (31,34). Despite its importance, attention performance in NCB has not been thoroughly examined.

Evidence suggests that attention encompasses four subdomains: alertness, behavioral inhibition, focused attention, and sustained attention (35,36). Intrinsic alertness pertains to internally regulated arousal, behavioral inhibition involves suppressing inappropriate responses, focused attention relates to responding accurately to specific targets, and sustained attention refers to maintaining concentration over time to detect relevant events (31). These subdomains can be effectively measured using Continuous Performance Tests, such as the Continuous Visual Attention Test (CVAT) (37,38,39,40,41).

While prior research has highlighted the cognitive effects of clinical burnout, this study specifically explores the attention subdomains in HCWs with NCB. Utilizing the CVAT, we aimed to investigate whether NCB affects performance in these subdomains among HCWs working during the Pandemics . Our hypothesis posits that NCB may contribute to attentional deficits in this population.

2. MATERIALS AND METHODS

2.1. Participants

Healthcare workers (HCWs), including physicians, nurses, and nursing aides, were recruited from a tertiary care facility during the Pandemics . Initially, brief clinical interviews were conducted with HCWs aged 25 to 45 years. The lower age limit (25 years) was based on meta-analytical findings indicating heightened emotional exhaustion and depersonalization among younger nurses, as younger age may exacerbate burnout symptoms, while older age may offer protective effects against burnout (42). The upper age limit (45 years) was selected due to evidence suggesting declines in cognitive processing speed beyond this age (43, 44, 45). These age constraints minimized variability in Continuous Visual Attention Test (CVAT) scores (46), reducing the risk of confounding and ensuring group differences could be detected without excessively increasing the sample size.

Exclusion criteria included the use of antipsychotic or antiepileptic drugs (which could influence CVAT performance), a history of head trauma with loss of consciousness, active substance or alcohol use, pre-existing neurological or psychiatric disorders, shift work, and prior diagnosis. Excluding participants with a history of COVID-19 was necessary due to the potential cognitive impairments associated with the illness (39, 40, 41). To avoid fatigue as a confounder, participants were tested at the start of their work shifts.

Based on the Maslach Burnout Inventory (MBI) responses, participants were categorized into two groups: those with non-clinical burnout (NCB) and controls. Classification criteria relied on the validated Portuguese version of the MBI (Sections 2.2 and 2.4.2). HCWs with high burnout symptoms willing to join the study were scarce, similar to prior studies (7). Ultimately, 13 participants with significant burnout symptoms (NCB group) completed the attentional testing. From the remaining 24 participants without burnout symptoms, 13 were selected as controls, matched by age, sex, educational level, and professional role. A prior power analysis (Section 2.3) had determined the required sample size.

To determine the presence or absence of significant burnout symptoms, we applied a stringent classification criterion proposed by Brenninkmeijer and colleagues (9), requiring high scores in exhaustion and cynicism and low scores in personal efficacy. The Brazilian population's validated MBI manual's cutoff values were utilized: average exhaustion (EX) ≥ 3.2, average cynicism (CY) ≥ 2.2, and average personal efficacy (PE) ≤ 4.0 (52, 53, 54, 55).

Additionally, burnout was analyzed as a continuous variable by separately summing the scores of each burnout dimension. For each dimension, the total score was divided by the number of questions related to that dimension to obtain an average score for each participant.

Analysis

analysis was conducted using two statistical approaches: (1) comparing mean differences in attention performance between groups categorized by the presence of burnout symptoms, and (2) exploring the relationships between burnout dimensions and attention performance. For both analyses, the significance level (α) was set at 0.05, and the statistical power ($1-\beta$) was 0.80, with a Type II error rate (β) of 0.20.

For the first approach, where participants were grouped based on the presence or absence of burnout symptoms, multivariate analysis of covariance (MANCOVA) was employed to account for potential correlations among the dependent variables (attention subdomains). Regardless of the MANCOVA outcomes, follow-up t-tests were performed to identify specific group differences. Since these post hoc comparisons utilized t-tests, power calculations were based on independent t-tests. Minimum differences (Δ) were estimated based on clinical relevance and standard deviations derived from prior studies on attention performance in healthy individuals and those with attention deficits. Using Cohen's d as a measure of effect size, a difference of 1.5 standard deviations was deemed clinically significant. A power analysis using the smallest effect size among the four CVAT variables indicated a minimum sample size of 18 participants (9 per group). The study achieved adequate power with a sample size of 26 participants (13 per group), meeting the required conditions ($\alpha = 0.05$, $\beta = 0.20$, power $= 0.80$, $d = 1.5$).

For the second approach, burnout was treated as a continuous variable, and the relationships between burnout dimensions and attention performance were analyzed using Pearson correlation coefficients (R). Here, R^2, representing the effect size, was used to estimate practical significance. In the absence of empirical data for presumed population correlations (ρ), previous guidelines suggested using R^2 values around 0.25 or higher as significant benchmarks (57, 58). Assuming large effect sizes ($\rho = 0.50–0.55$), the required sample size ranged from 23 to 29 participants. The study's sample size of 26 fell within this range.

The study followed established guidelines for comprehensive reporting (59). Participants were screened using inclusion and exclusion criteria through an interview. Eligible individuals completed the Maslach Burnout Inventory (MBI) and were then categorized into two groups: controls and those exhibiting significant burnout symptoms (referred to as the non-clinical burnout group). Subsequently, all participants undertook the Continuous Visual Attention Test (CVAT). The researchers administering the CVAT were blinded to participants' burnout classifications. Analyses were conducted on matched groups.

The CVAT assessed four attention subdomains, while the MBI evaluated three burnout dimensions.

Computerized Visual Attention Test (CVAT)

The CVAT required participants to respond to a continuous stream of visual stimuli on a computer screen by pressing the spacebar for specific target stimuli while ignoring non-targets. Each stimulus appeared for 250 ms with a 750-ms interstimulus interval. Across 90 trials, 72 (80%) were targets, and 18 (20%) were non-targets. Performance metrics included reaction time (RT), intraindividual variability in reaction time (VRT), omission errors (OE), and commission errors (CE). RT was measured as the average reaction time for correct responses, while VRT represented the standard deviation of correct RTs for each participant. Omission errors occurred when participants failed to respond to a target, and commission errors reflected incorrect responses to non-target stimuli (60).

Maslach Burnout Inventory (MBI)

The MBI (61) is a self-reported instrument consisting of 16 items designed to assess three key dimensions of burnout: exhaustion (e.g., "I feel used up at the end of the workday"), cynicism (e.g., "I have become less enthusiastic about my work"), and reduced personal efficacy (e.g., "I believe I am effective in my job"). Participants rated the frequency of these experiences on a 7-point scale ranging from "never" to "every day." Scores for each dimension were calculated by summing and averaging the respective items.

Statistical Analysis

To evaluate differences in attentional performance between participants with and without burnout symptoms, a MANCOVA was conducted. Dependent variables included RT, VRT, OE, and CE, while the independent variable was group classification (non-clinical burnout vs. controls). Homogeneity of covariance matrices was assessed using Box's M-test. Significant MANCOVA results warranted post hoc ANCOVAs to explore differences in individual attention variables. Independent t-tests were also performed for validation.

Despite using a matched design, potential confounders (age and sex) were included as covariates in some analyses, as accounting for confounders may enhance the robustness of statistical results (63). Analyses were performed with and without these covariates, with RT included as a cofactor in some cases, as it has been shown to influence error rates and variability in attentional performance (7). Fatigue was excluded as a confounding variable due to the absence of shift workers and the short duration of the CVAT (1.5 minutes).

RESULTS

A total of 154 healthcare workers (HCWs) participated in interviews, of which 53 were excluded due to prior infection, and 22 were omitted for other medical conditions. This left 79 participants eligible, among whom 13 were classified as belonging to the non-clinical burnout (NCB) group, while 24 displayed no symptoms related to burnout across all three dimensions. Following these criteria, 13 individuals without burnout symptoms were chosen as controls, resulting in 26 participants for the final analysis.

The ages of the final sample ranged from 25 to 44 years, with a mean age of 35.31 (standard deviation = 5.47). The sample included 17 males and 9 females, comprising 11 physicians and 15 nursing professionals. Table 1 outlines demographic characteristics and Maslach Burnout Inventory (MBI) scores. Despite some minor mismatches between the groups, no significant demographic differences were identified. However, significant disparities were observed in burnout dimensions due to the classification of the NCB group.

A multivariate analysis of covariance (MANCOVA) indicated a significant overall impact of non-clinical burnout on attention performance, $F(4, 21) = 3.55$, $p = 0.023$, $\eta 2 = 0.40$. These findings remained consistent after adjusting for covariates, including age, sex, and reaction time (RT). Univariate ANCOVAs revealed that non-clinical burnout significantly affected cognitive efficiency (CE), $F(4, 21) = 12.90$, $p = 0.001$, $\eta 2 = 0.35$, while other measures, such as visual reaction time (VRT) [$F(4, 21) = 0.003$, $p = 0.956$], overall efficiency (OE) [$F(4, 21) = 0.06$, $p = 0.811$], and RT [$F(4, 21) = 1.23$, $p = 0.279$], were not significantly impacted. After adjusting for reaction times, VRT analysis suggested a marginal group difference, with the NCB group showing slightly higher VRT compared to controls ($p = 0.07$, two-tailed).

Correlations between CE and the three burnout dimensions were statistically significant (Table 2). Pearson coefficients revealed positive correlations for exhaustion ($R = 0.545$, $p = 0.004$) and cynicism ($R = 0.563$, $p = 0.003$), while a negative correlation was found for reduced personal effectiveness ($R = -0.522$, $p = 0.006$). Assumptions for linear regression were thoroughly examined, including residual diagnostics, normality checks, and influence statistics, such as Cook's distances, DFBETAs, and Mahalanobis distances.

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

Demographics and Burnout Dimensions	**Non-Clinical Burnout ($n = 13$)**	**Group DIFF (P)**
Female	5 (38.46%)	ns
Age	34.23 ± 7.0	ns
Physicians	5 (38.46%)	ns
Nurses And Nurse Aides	8 (61.15%)	ns
Average Exh	5.11 ± 0.59	<0.01
Average Cy	4.49 ± 1.12	<0.01
Average Pe	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.

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

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

The table includes correlation coefficients (R Pearson) and *p*-values for variables CE, OE, RT, and VRT against 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 proof 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.

DISCUSSION

Our findings reveal distinct attention deficits in individuals experiencing symptoms of non-clinical burnout (NCB) while continuing to work. Results from the attention test suggest that NCB participants displayed a tendency toward more impulsive behaviors compared to controls.

This study explored the impact of NCB on attention performance in healthcare workers under the unique circumstances of the Pandemics , a subject not extensively covered in prior research. The pandemic's severe stressors created an opportunity to study NCB under heightened pressures. Healthcare workers in our sample exhibited significant exhaustion, depersonalization, and diminished professional efficacy. The intense demands of their roles likely depleted emotional and physical resources, potentially impairing self-regulation and manifesting as heightened impulsivity during attention tasks.

The CVAT paradigm involves sequentially presenting target and non-target stimuli, requiring participants to respond accurately to targets and inhibit incorrect responses (37–41). Inhibition, which is evaluated through commission errors (CEs), reflects the ability to suppress inappropriate actions. The elevated CE rates in NCB participants indicate potential difficulties in maintaining attention during daily activities.

The observed differences in impulsivity-related errors between NCB individuals and controls suggest a higher likelihood of errors during work among the former. Sustained attention and inhibition, both components of executive functioning, are crucial for effective task performance (64). Executive functioning encompasses cognitive processes responsible for regulating perception and actions in response to changing demands (65). Deficits in this area are linked to difficulties in controlling inappropriate motor responses (31). These findings support the hypothesis of impaired executive functioning in NCB participants. Contrary to expectations, however, NCB participants did not demonstrate deficits in visual reaction time (VRT), another element of executive functioning.

The lack of significant differences in VRT could be attributed to interactions between VRT, reaction time (RT), and CE. Although raw data indicated no major VRT differences, NCB participants tended to respond faster than controls. A negative correlation between RT and inhibition errors was observed. When controlling for RT, group differences in CE remained significant, and a trend toward increased VRT in the NCB group emerged. Prior research (66) has shown that VRT can be effectively measured using brief tests with numerous trials. Given the CVAT's extensive trials and longer duration, the observed trend supports the hypothesis of attention-related executive deficits in NCB individuals.

These results align with earlier clinical studies that reported attention difficulties among individuals experiencing burnout (2, 7). For example, Linden et al. (7) found that participants with clinical burnout performed poorly on CE and VRT measures. Although their study reported no significant differences between NCB and control groups, their use of the SART, which includes fewer non-targets, might account for this discrepancy. The higher proportion of non-targets in the CVAT may enhance its sensitivity to impulsivity-related errors, suggesting it could be more effective for evaluating inhibition deficits. Linden et al. (7) also highlighted a gradient in executive attention deficits, with the most severe impairments in clinical burnout, moderate deficits in NCB individuals, and minimal impairments in controls.

This study represents one of the first empirical investigations linking NCB to deficits in executive attention. Recent research by Koutsimani and Montgomery (27) identified visuospatial deficits in NCB individuals, which

may reflect underlying executive attention impairments.

CONCLUSIONS

Healthcare workers experiencing high levels of burnout symptoms exhibited impairments in specific attention subdomains, particularly sustained attention and impulsivity. Our study highlights the potential utility of combining a brief computerized attention test (e.g., CVAT) with a self-reported burnout questionnaire to objectively identify individuals at risk for executive attention deficits. This approach may facilitate the development of interventions to mitigate workplace accidents linked to burnout and inform policymakers on the broader implications of burnout in high-risk occupational groups. By addressing these issues, targeted strategies can be implemented to reduce the prevalence and impact of burnout-related attention deficits in the workforce (67).

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