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 Review

VIRTUAL REALITY (VR) DEVICE WITH INTEGRATED BIOFEEDBACK SENSORS (ReViSide) TO COPE WITH EMOTIONAL BURNOUT STATE AMONG EMPLOYEES EXPERIENCING STRESS AT WORKPLACE: PROBLEM OVERVIEW AND ACTION PLAN

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SUMMARY

Introduction: *In this study we examine the issue of employee burnout, caused by long-term exposure to workplace stressors, considering its complex phenomenology in the context of contemporary psychological and psychiatric views. Towards the development of innovative technologies to correct burnout in the context of psychosocial rehabilitation, we present our study protocol involving the ReViSide virtual reality (VR) and biofeedback intervention, including monitoring of respiratory rates and EEG rhythms.*

Methods: *The randomized controlled trial protocol includes adult participants aged 18 to 65 years (n=140) who exhibit emotional burnout in the workplace. The intervention group will undergo a course of VR correction (ReViSide), while the control group receives a standard psychocorrection. The primary endpoint will be level of emotional burnout to the Maslach Burnout Inventory (MBI). We shall also assess anxiety, depression, asthenia and subjective improvement in condition using validated scales (HADS, HARS, HDRS, VAS-A, PGI-C).*

Results: *We shall test our hypothesis that the VR-correction group will show significant improvements in MBI scores, particularly in emotional exhaustion, depersonalization, and personal accomplishment, compared to the control group. Secondary outcome measures are likewise expected to demonstrate more prominent improvements in the VR group, correlating with the magnitude of burnout reduction to MBI. Analysis of EEG data may reveal changes in alpha rhythm patterns during VR sessions, potentially correlating with reduced distress levels.*

Conclusions: *We designed this study to test the integration of an interdisciplinary approach for treating burnout, highlighting the ReViSide technology. Confirming the efficacy of this approach for psychosocial rehabilitation targeting burnout states among employees should improve their stress resilience, daily motivation, and work productivity in the context of the modern high working pressure environment and demanding corporate culture.*

Key words: *biofeedback – burnout – ReViSide - stress at workplace - virtual reality*

Abbreviations: *BF – Biofeedback; EB – Emotional Burnout; HADS – Hospital Anxiety and Depression Scale; HARS – Hamilton Anxiety Rating Scale; HDRS – Hamilton Depression Rating Scale; MBI – Maslach Burnout Inventory; PGI-C – Patient Global Impression of Change; VAS-A – Visual Analog Scale for Fatigue; VR – Virtual Reality*

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INRODUCTION

Emotional burnout (EB) is term used by psychologists to describe a syndrome of malaise predominantly arising due to long-term exposure to stressors at work or in other life domains (Maslach et al. 2001). This EB condition leads to emotional exhaustion, a growing sense of detachment from professional duties and events occurring at the workplace, dehumanization characterized by a negative attitude towards clients and colleagues, decreased productivity, and reduced sense of personal accomplishment. This emotional response has been notably observed among healthcare workers during the COVID-19 pandemic (De Berardis et al. 2023). Characterized as a critical response to ongoing stressors, including interpersonal factors at the workplace, EB is accompanied by a complex combination of cognitive, emotional, and physical/somatic symptoms. For companies and organizations, the consequences of EB among employees can be significant, impacting productivity, increasing absenteeism, and escalating turnover rates. This state not only leads to direct financial losses, but also adversely affects morale and corporate culture, potentially degrading the quality of customer service and harming the company's reputation (Demerouti et al. 2001).

Initially conceptualized by psychologist Herbert Freudenberger in the 1970s to describe chronic distress among service professionals, the term EB has since been applied to describe states in various challenging work conditions and personal life situations (Freudenberger 1974). It has since become a widely recognized phenomenon in occupational health, psychology, and related fields. Nowadays, the term "emotional burnout" is used in various sectors, especially those involving high stress and emotionally demanding work. People working in professions requiring intense interpersonal interactions, critical decision-making, emotionally charged work, and high responsibility levels, such as healthcare workers and educators, are particularly vulnerable to developing EB (Fesun et al. 2020, Rotenstein et al. 2018). Research confirms the widespread prevalence of EB among professionals in different fields. For instance, up to 80.5% of doctors and approximately 30% of emergency nurses report having experienced symptoms of EB as assessed by the Maslach Burnout Inventory (MBI), including those working in COVID-19 red zones (Gomez-Urquiza et al. 2017, Rotenstein et al. 2018, Smirnova et al. 2022).

The signs and symptoms of EB are diverse, manifesting as chronic fatigue, irritability, a sense of ineffectiveness, distorted value perceptions, cynicism/indifference towards one's work, and a feeling of detachment and disengagement from work processes. Associated physical/somatic and behavioral manifestations may include weakness, appetite changes, decreased productivity, and refusal to work (Maslach et al. 2001). Additionally, somatic symptoms such as headaches, sleep disturbances, and gastrointestinal issues may occur. Overall, EB sufferers experience a psychological sense of frustration with their work or life circumstances.

The EB syndrome evidently shares many phenomenological overlaps with mental health conditions such as anxiety disorders or depression, although the criteria for diagnosis EB apply to earlier stages of psychological distress, typically associated with work-related settings or specific situations at the workplace (Lu et al. 2019, Misiolek-Marin et al. 2020). When considering EB as a process, it assume a resemblance to critical psychological phenomena like learned helplessness and exhaustion depressions (asthenic, asthenohypodynamic depressions), where chronic subthreshold distress leads to the depletion of mental resources (Karasek & Theorell 1990, Maslach & Leiter 2016), and feelings of helplessness and hopelessness (Seligman 1975). The impact of chronic stressors on biological systems, particularly in relation to their putative mediation by neurotransmission in dopamine and serotonin networks, plays a crucial role in the manifestation of reduced motivation, mood, and cognitive functions (Suls & Mullen 2004). Both in EB and learned helplessness, afflicted individuals develop negative cognitive patterns and/or psychological defense mechanisms such as pessimism, catastrophizing, and self-blame, which together hinder adequate situation assessment and constructive problem-solving in challenging situations (Seligman 1975). Consequently, individuals come to exhibit passive behavioral responses: avoidance, procrastination, and withdrawal from activities or taking an action.

Given this backgroumd, the terms "burnout" and "distress" (i.e., neurotic, stress-related, and somatoform disorders according to the ICD-10 criteria) in contemporary psychological and corporate discourse, are likely used to describe related but distinct aspects of psychological tension and stress. The term "burnout" is predominantly used in professional and corporate contexts, despite EB potentially arising in various life activities, and not being limited to subclinical forms of response. The preference for the term reflects its lesser stigmatization and strong integration into professional psychological concepts, making it more acceptable for discussion in corporate settings. Unlike EB, the term distress describes a broader spectrum of stress reactions and negative emotional states that can occur under any life circumstances. Although both terms indicate the presence of emotional discomfort and psychological tension, EB in the professional discourse is applied as a more specialized concept, emphasizing the link specifically to professional activities and the work environment.

Prevention and reduction measures for EB manifestations should consider a multi-level approach, including (i) individual, (ii) organizational, and (iii) social strategies. Social strategies encompass supporting public awareness initiatives about EB, as well as developing policies to support work-life balance and improve working conditions at the national level. Governmental and non-governmental organizations can play a key role in this process by providing resources and support for research, developing recommendations, and implementing best practices in EB prevention and stress management in the workplace ("World Health Organization. Guidelines for the Management of Conditions Specifically Related to Stress" 2013). At the organizational level, management initiatives should aim to create a healthier work environment that reduces stressors and supports employee well-being. These adjustments may include improving working conditions, ensuring access to health and well-being resources, implementing flexible work schedules, training managers in effective management and communication skills, and fostering a culture of openness and support within the work team (Adriaenssens et al. 2015). At the individual level, strategies for developing self-management and stress management include meditation, regular physical exercise, maintaining adequate sleep levels, mindfulness

practices, relaxation techniques, and cognitive-behavioral therapy aimed at reducing negative perceptions of work pressure (West et al. 2016).

Thorough investigations of breath regulation methods such as breathing exercises and meditation have shown significant benefits regarding their potential to reduce individual and group stress levels in the adult population (Jeitler et al. 2020). Breathing exercises such as Buteyko breathing and coherent breathing have shown immediate effects in reducing perceived stress levels (Bulbuli et al. 2019). The first level of autogenic training, which uses breath regulation to achieve calm and relaxation, is actively used in psychotherapeutic practice for patients with neurotic and stress-related, somatoform disorders, adjustment disorders, clients with interpersonal interaction problems, and other conditions (Karvasarskiy 2000). Moreover, EEG biofeedback methods aimed at increasing EEG alpha rhythm power can result in reduced distress parameters (Bazanova et al. 2013).

Wearable devices that measure physiological indicators such as heart rate, heart rate variability, body temperature, and activity levels can monitor sleep quality and duration, which can be indicators of stress. Based on stress data, such devices can provide users with recommendations for improving their stress management, such as relaxation techniques, exercise, and time management tips. Recent studies have shown that feedback from wearable devices can effectively reduce stress levels and manifestations of EB (Allen & Smith 2020, Doherty & Doherty 2021). A systematic review and meta-analysis of the use of mobile applications for correcting emotional disorders demonstrated their predominant effectiveness in the preclinical stages of distress (Astafeva et al. 2022). Additionally, innovative technologies such as ReViSide, which are currently under development, can serve effectively not only for regulating emotional states in general, but also for targeted correction of EB (Patent No. 2800590, 2023; Certificate No. 2023669030, 2023) (Table 1).

Table 1. Comparison of the phenomena of emotional burnout, learned helplessness, generalized anxiety disorder, and clinical depression according to the criteria of the corresponding stages of distress, manifestations/symptoms, and approaches to correction/therapy

Phenomenon / Diagnosis	Stage of Distress	Manifestations / Symptoms	Correction / Therapy
Emotional Burnout	1. Tension	Fatigue Decreased concentration Irritability	Psychotherapy Reducing workload Improving sleep and nutrition
	2. Resistance	Cynicism Decreased motivation Drop in productivity	
	3. Exhaustion	Apathy Depression Psychosomatic symptoms	
Learned Helplessness	2. Resistance	Sense of helplessness Lack of motivation Passivity	Cognitive-behavioral therapy Developing self-confidence
	3. Exhaustion	Pessimism Avoidance of new tasks	
Generalized Anxiety Disorder	1. Tension	Excessive worry Uncontrollable fear Physical symptoms (sweating, rapid heartbeat)	Psychotherapy Pharmacotherapy
	2. Resistance	Decreased concentration Irritability Difficulty falling asleep	
	3. Exhaustion	Depression Panic attacks Social isolation	
Depression	3. Exhaustion	Depressed mood Loss of interest in life Guilt Suicidal thoughts Decreased appetite Sleep disturbances Decreased concentration	Psychotherapy Pharmacotherapy

The aims of this study is to evaluate the effectiveness of VR-correction with elements of biofeedback (ReViSide) for the reduction of emotional burnout among professional workers.

METHODS

Study Design

We will conduct an open randomized controlled trial (RCT) over a two-week period. The study will involve two groups: an intervention group receiving VR-correction with biofeedback (ReViSide) and a control group receiving standard care or no intervention. Given the nature of the VR intervention, a blind trial method is not feasible, necessitating an open-type study design.

To account for potential dropouts, we shall recruit 140 participants, aiming for a final sample size of approximately 128 participants (64 per group). We have calculated this sample size to suffice for detecting a medium effect size with an alpha of 0.05 and power of 80%, based on Cohen's power analysis conventions.

Participants

The study will include adults aged 18 to 65 who are actively engaged in professional activities and experiencing symptoms of EB. Inclusion criteria will require participants to have a Maslach Burnout Inventory (MBI) score greater than 17, indicating mild to moderate severity of EB. All participants must provide written informed consent.

Exclusion criteria will include any history of severe mental illnesses that could conceivably affect the reliability of results or the safety of the psychocorrection process. Additionally, candidates with VR-induced motion sickness or medical contraindications to VR technology use will be excluded. We note that the presence of anxiety disorders or depression overlapping with EB symptoms will not be a criterion for exclusion, thereby allowing for a more comprehensive assessment of the effectiveness of the VR intervention.

VR-Correction Group (Intervention)

Participants in this group will undergo a course of VR sessions aimed at reducing stress levels and improving emotional regulation. The sessions will utilize the ReViSide technology, a software-hardware complex that allows for breathing control based on biofeedback principles. Each session will consist of seven 2-minute training stages with 20-second rest periods between stages. The VR environment will present dynamic animations of weather changes via goggles, serving as visual biofeedback. Participants will be tasked with regulating their breathing rate to improve the weather conditions in the virtual scene, progressing from stormy to clear and sunny.

Control Group

The control group will receive standard psychocorrection methods. To maintain their engagement, they will be provided with general information and psychoeducation within a VR framework, but without the specific breathing exercises and biofeedback elements of the intervention group.

Outcomes

The MBI will serve as our primary outcome measure. This 22-item scale assesses three key aspects of burnout: emotional exhaustion, depersonalization, and personal accomplishment. The MBI will be administered at baseline and after the two-week intervention period. We shall use other scales as secondary outcomes to collect broader data on how the VR intervention affects the participants' psychological well-being. These scales are: Hamilton Anxiety Rating Scale, which measures the severity of anxiety symptoms (Hamilton 1959), Hospital Anxiety and Depression Scale, which assesses both anxiety and depression in a medical setting (Zigmond & Snaith 1983), Hamilton Depression Rating Scale, which evaluates the intensity of depressive symptoms (Hamilton 1960), Visual Analog Scale for Asthenia, which gauges the level of fatigue or weakness, and Patient Global Impression of Change, which asks the participants to rate how much they have improved or worsened since the start of the intervention.

During the VR sessions, we shall record six-channel EEG data, focusing on the frontal (FP1, FP2), temporal (T3, T4), and occipital (O1, O2) lobes. The EEG data will be used in a pilot phase to verify the reduction of distress levels and potentially as an additional biofeedback method. Additionally, we shall monitor breathing rate using an integrated sensor in the ReViSide device.

Data Analysis Plan

Our analysis will begin with descriptive statistics to present the initial characteristics of participants. We shall use independent samples t-tests and chi-square tests to compare the groups at baseline. For our primary and secondary outcomes, we shall conduct analyses of covariance (ANCOVA), considering individual baseline values as covariates. To control for the overall Type I error rate in multiple comparisons, we shall apply the Bonferroni correction, and to assess

the robustness of our results, we shall perform sensitivity analyses. All of the analyses will adhere to the intention-to-treat principle, ensuring that every participant who is randomized is included in the final analysis.

RESULTS

We expect to observe significant difference of changes in MBI scores between the intervention and control groups, with the VR-correction group showing greater improvement in emotional exhaustion, depersonalization, and personal accomplishment. In addition, we hypothesize that secondary outcome measures (anxiety, depression, and fatigue levels, PGI-C scores) will also show more prominent improvement in the VR-group, and will be associated with magnitude of reductions of burnout. We anticipate that the pilot analysis of EEG data may show changes in alpha rhythm patterns during VR sessions, potentially correlating with reduced distress levels. Finally, we shall closely monitor adherence rates to VR sessions and document any reasons for dropouts, which will inform future refinements of the intervention.

Upon the completion of this study, several critical points will be addressed. First, the results will be interpreted within the context of the existing literature on EB interventions, evaluating the effectiveness of VR-correction in mitigating emotional burnout and comparing our findings with those of previous studies. The study will also explore the relationship between the reduction of EB and changes in anxiety, depression, and fatigue. This examination aims to illuminate the interconnected nature of these psychological constructs and their collective impact on emotional burnout. Additionally, the observed correlations between EEG changes, breathing regulation, and EB reduction will be discussed, potentially enhancing our understanding of the physiological mechanisms underlying the effects of the VR intervention.

We shall address the limitations and potential biases inherent in the study, particularly those related to the open trial design. The extent to which our findings can be generalized to broader populations and various professional contexts will also be considered.

Based on results, we shall explore the potential for integrating VR-correction into workplace wellness programs, focusing on its cost-effectiveness relative to traditional EB interventions and practical considerations for implementation in different organizational settings. Results will inform a discussion of potential avenues for future research, including longer-term follow-up studies, investigations targeting specific professions or burnout profiles, and potential refinements to the VR intervention to enhance its efficacy.

Finally, we shall summarize the key findings of the study, emphasizing their practical implications for managing EB in professional settings. This study introduces a novel approach to addressing the pressing issue of emotional burnout among professionals. By leveraging VR technology and biofeedback principles, we aim to contribute valuable insights to the field, and to potentially offer a new, effective tool for burnout prevention and treatment.

DISCUSSION

EB, manifesting in chronic fatigue, decreased efficiency, and cynicism towards work, is becoming increasingly prevalent among professionals engaged in intensive intellectual labor and emotionally demanding work (Maslach et al. 2001). Early detection and correction of conditions associated with EB in the context of multifactorial stress are of particular importance. The multi-level approach described in this study emphasizes the importance of comprehensive intervention, including prevention, early detection, and correction of EB using innovative technologies such as VR and biofeedback (Crevenna 2022). VR technologies provide new opportunities for EB correction through immersive experiences, which should allow users to immerse themselves in virtual environments that promote relaxation and emotional regulation (Borisova et al. 2020).

Based on our working hypothesis, the intervention with ReViSide technology should evoke a significant reduction in EB levels among participants in the experimental group, as assessed by the MBI, as compared to the control group. This anticipated outcome aims to establish a robust evidence base for the positive impact of VR correction in enhancing psycho-emotional well-being and alleviating burnout symptoms. Such findings would confirm the effectiveness of employing innovative technologies like ReViSide in the correction of emotional burnout.

The potential implications of these results are substantial. If the study successfully demonstrates a significant reduction in EB levels, it would provide strong support for the integration of VR-based interventions in professional wellness programs. This could lead to the widespread adoption of such technologies in various organizational settings, offering a novel and effective tool for managing and preventing burnout. Furthermore, the confirmation of VR correction's efficacy in improving the psycho-emotional state could spur additional research into other applications of VR technology in mental health, potentially revolutionizing how psychological interventions are delivered.

CONCLUSIONS

In the broader context of workplace health, these findings could influence policy and decision-making, encouraging employers to invest in innovative solutions for employee well-being. The cost-effectiveness of VR interventions compared to traditional methods could also make them an attractive option for organizations looking to enhance productivity and employee satisfaction while reducing healthcare costs associated with burnout and related conditions.

Ultimately, the successful demonstration of the impacr of ReViSide technology on reducing EB symptoms could pave the way for future research into more specialized applications, such as targeting specific professional groups or refining the technology to enhance further its effectiveness. This would contribute to a deeper understanding of the mechanisms underlying burnout and the development of more personalized and effective interventions.

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Conflict of interest:

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Contribution of individual authors:

Daria Smirnova, Anna Spikina, Daria Mezentseva, Andrei Vlasov & Darya Astafeva: search and analysis of literature, collection of clinical data, data interpretation, drafting of the first draft.

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All authors approved the final version of the article before its submission.

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