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A Brief Mindfulness-Based Intervention Pilot Study: Lessons Learned in Feasibility and Acceptability Among Healthcare Professionals Experiencing Burnout

Myia S. Williams [1, 2, 3, *], Keyla Ordonez [1], D'Arcy King [1], Jeffrey Solomon [1], Suzanne Ardito [1], Jennifer Polo [1], Sindee Weiss [2], Negin Hajizadeh [1, 2, 3]

1. Institute of Health Innovations and Health Outcomes Research, Northwell Health, Manhasset, NY, USA; E-Mails: mwilliam26@northwell.edu; kla711k@gmail.com; dkingnyc@gmail.com; jeff@jeffsolomon.com; sardito@northwell.edu; jpolo1@northwell.edu; nha235@gmail.com
2. Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, Department of Medicine, Manhasset, NY, USA; E-Mail: sweiss3@northwell.edu
3. Feinstein Institutes of Medical Research, Manhasset, New York, USA

* **Correspondence:** Myia S. Williams; E-Mail: mwilliam26@northwell.edu

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Abstract

We explored the feasibility of a virtual-reality delivered mindfulness training intervention on burnout symptoms among corporate employees and clinicians in the Intensive Care Unit and Palliative Care Unit (PCU). To develop the VR mindfulness intervention we leveraged the Capability, Opportunity, Motivation, Behavior model (COM-B) as a guide for the design and implementation of the VR mindfulness training intervention. Using a pre-posttest within subjects design we assessed burnout syndrome, job stress and work-related outcomes such as workplace behavior using self-reported measures at baseline and one-month follow up. Due to COVID-19 we were unable to assess 3-month follow-up. Feasibility was measured based on the number of times participants returned for subsequent sessions. Pearson's correlation shows that more distress and mindfulness were positively related in clinical employees. For corporate employees we saw an increase in mindfulness pre and post-test and a reduction in counterproductive work behavior. However, the co-efficient alpha for the

counterproductive work behavior scale was -0.51, therefore results should be interpreted with caution. Lastly, we identified barriers to feasibility in recruitment and retention of participants. The results of the present study hold potential for future interventions to reduce job stress and burnout through virtual reality mindfulness-based interventions.

Keywords
Burnout; employee health; mindfulness; usability; virtual reality; job

1. Introduction

Individuals in healthcare professions are at higher risks of psychological distress, poor physical and mental well-being and burnout due to the stressful working environment and heavy workload [1, 2]. In their day-to-day practice healthcare professionals are faced with a number of physical (*e.g.* managing high patient workload during a single shift), emotional (*e.g.* dealing with patient suffering or death), social (*e.g.* disagreements over patient care/treatment), cognitive (complex decision-making under pressure) and systemic challenges (*e.g.* understaffing) that require sustained physical and mental effort [3]. According to the Medscape National Physician Burnout & Suicide Report, 42% of physicians reported feeling burnt out [4]. Similarly, the Agency for Healthcare Research and Quality, estimated that burnout affects between 10% and 70% of nurses, and 30% to 50% of physicians, nurse practitioners, and physician assistants [5]. The term burnout or burnout syndrome (BOS) is defined as a work-related syndrome characterized by chronic exhaustion (*e.g.* consistent feelings of tiredness), cynicism (*e.g.* distancing oneself from work and co-workers) and reduced professional efficacy (*e.g.* reduced feelings of competence and achievement [6].

Numerous studies examining burnout among healthcare professionals has shown an association between burnout and high job demands, lack of resources, decreased job satisfaction, and high levels of turnover [2, 3, 7, 8]. For example, in one longitudinal study exploring job demands and burnout, Mijakoski et al. [3] found that healthcare professionals experienced significantly higher levels of emotional exhaustion and depersonalization due to increased job demands over time, even as teamwork was implemented as a buffer to help reduce job demands. Another study conducted by Willard-Grace et al. [7] found similarly troubling results in primary care settings, where although 53% of clinicians and staff reported burnout, clinicians were more likely to report lower engagement which resulted in higher turnover rates. These findings highlight the need for comprehensive strategies that mitigate challenges in order to reduce burnout and retain healthcare workers [3, 7].

The negative impact of burnout on healthcare professionals leads to suboptimal patient care, threats to patient safety, and poorer patient satisfaction evaluations [2, 9, 10]. For example, a cross-sectional study of primary care physicians showed a direct negative effect of burnout on patient-provider communication, one of the key domains of patient experience [9]. In this study, as physician burnout increased, patient rated communication scores decreased significantly. In the same vein, physician burnout did not significantly affect patient's overall ratings on providers or access to care. Results from this study underscores the critical role of physician well-being in maintaining effective patient care and communication quality [9]. Similarly, results from a 2019 systematic review and meta-analysis further supports these findings [10]. More specifically, high

levels of burnout among physicians and nurses driven by external factors such as high workloads, long shifts, and strained interpersonal relationships compromised patient safety practices. Furthermore, effective patient safety practices were more likely to occur in healthcare settings that reduced job demands and challenges (*e.g.* organized workflows) and prioritized well-being and autonomy [10]. Overall, these studies highlight the critical need for healthcare administrators to identify evidence-based interventions that can be feasibly implemented in healthcare settings to reduce burnout and improve coping, employee and organizational outcomes, patient safety and satisfaction [9-11].

A number of evidence-based interventions used to reduce burnout are based on the mind-body connection which indicates that positive changes in the mind will result in positive changes in one's body and physical health [12, 13] [NO_PRINTED_FORM]. One such practice is *mindfulness* which is described by Bishop et al. [14] as "including self-regulation of attention in the present moment and being open and accepting towards the experience." There is extensive and well-established evidence that shows mindfulness helps individuals develop greater emotional regulation, thus enabling them to be more inept to respond and adapt to stressors, especially in those in high pressure environments like healthcare [15]. Hence, practicing mindfulness has the ability to mitigate the key symptoms of burnout: emotional exhaustion, depersonalization, and reduced professional efficacy [15, 16]. Within their working environment, healthcare professionals are consistently exposed to high job demands, emotional strain and limited resources which causes chronic stress that leads to burnout [3, 5]. By incorporating mindfulness practices into their daily routine, healthcare professionals can develop the mental tools and resources which are necessary to cope with the demands and challenges of their working environment [16]. This is because mindfulness directly confronts these challenges by fostering a sense of self-awareness, encouraging a more balanced emotional response, and helping individuals create a healthy psychological distance from work-related stress [15, 16]. Given the increasing prevalence of burnout among healthcare professionals, it is therefore not surprising that mindfulness has been used across the board by healthcare professionals as a strategy to reduce burnout, enhance patient care, boost job satisfaction, promote resilience and well-being [15].

Previous research has shown that mindfulness-based interventions (MBI) are instrumental in reducing burnout and increasing job satisfaction and patient care [11, 17, 18]. MBI is an intervention using meditation to cultivate a judgment-free moment-to-moment awareness of an individual's experience to lower anxiety, improve working memory, decrease negative thinking, and manage physical pain [19]. Referencing these mindfulness techniques enables the person to develop focused, present moment awareness in order to activate a relaxation response, thereby increasing their capacity to cope with job-related stressors, emotional distress and maladaptive behaviors [17, 18].

Mindfulness-based interventions have demonstrated effectiveness across diverse populations, particularly those facing significant stress in high pressure environments [20, 21]. For example, a study by Nooripour et al. [20] on Iranian university students during the COVID-19 pandemic found that mindfulness played a crucial role in reducing stress and enhancing psychological hardiness. More specifically, results showed that compared to those who did not practice mindfulness, students who practiced mindfulness reported lower levels of stress and greater resilience in coping with the challenges posed by the pandemic. Hence, for healthcare professionals who face similar emotional and psychological demands in their work environments, these findings highlight the potential of mindfulness to mitigate stress in similar high-pressure environments [12, 13].

Previous studies have also shown mindfulness has proven effective in managing risky behaviors and promoting resilience [21, 22]. A study conducted at a juvenile correction and rehabilitation center demonstrated that mindfulness significantly reduced risky behaviors and improved distress tolerance and resilience among adolescents [21]. Healthcare professionals who experience chronic levels of high stress can benefit from mindfulness to help foster emotional resilience and coping mechanisms in managing daily responsibilities [22]. Similarly, mindfulness training was shown to significantly improve both psychological well-being and emotional regulation [23]. In one study examining the effects of mindfulness-based training on psychological wellbeing and emotion regulation of menopausal women, results showed that the participants, who underwent an eight-session mindfulness program, exhibited enhanced emotional regulation and overall well-being [23]. Such outcomes from mindfulness-based training programs and mindfulness practices can be beneficial to healthcare professionals who experience emotional fluctuations and stress daily [24-26].

In spite of its benefits, mindfulness practice has not been successful because it requires noticing the passage of distractions and all associated emotions and returning to the chosen anchor (*e.g.*, breathing) and cultivating a sense of presence especially for novice individuals who may encounter frustration and boredom [27]. In recent years, there has been a call for and development of virtual technology (*e.g.* web and mobile-based) interventions to support mindfulness practice [28, 29]. Mindfulness practice via virtual reality (VR) training is an alternative method to support mindfulness [30] and increase adherence to mindfulness practice [31, 32]. VR mindfulness training is different from other traditional forms of mindfulness training because it provides the individual with an immersive, predictable and engaging auditory and visual sandbox free of external distractions [29, 33]. In this way, VR mindfulness pragmatically minimizes the challenges often encountered during traditional meditation practices by shifting the individual's attention away from that of the real-world allowing them to truly focus their attention and be accepting of the current experience [32, 34].

For healthcare professionals, VR mindfulness training represents a groundbreaking advancement in the field of stress management and burnout prevention with many benefits [16, 35-37]. First, unlike traditional mindfulness practices, VR mindfulness offers a fully immersive experience which is free external interruptions thus further enhancing engagement with the training. Second, VR mindfulness training is easily accessible for healthcare professionals with busy schedules. Third, by incorporating visually enriching, calming and serene environments coupled with guided meditations, VR mindfulness training can facilitate emotional regulation and stress relief more effectively than traditional methods [20, 21, 23]. As noted previously, several studies have shown that this type of immersive experience can lead to quicker stress reduction, improved emotional resilience, and increased overall well-being, making it a powerful tool in preventing burnout and improving job satisfaction among other organizational outcomes [20, 21, 23]. Fourth, VR mindfulness training is easy to integrate into workplace wellness programs. VR mindfulness training can be tailored to individual needs providing a personalized, engaging solution to manage their mental health in high-pressure environments [38]. This cutting-edge approach offers a new way to tackle the growing issue of burnout in healthcare, providing both immediate stress relief and long-term benefits for emotional well-being [15, 16].

Given the existing literature that suggests that MBIs represent a possible avenue for alleviating BOS in healthcare professionals, and that VR based training may make MBI more appealing and

easier to engage with, we developed a brief VR mindfulness training and conducted a feasibility and usability study to preliminarily test the effect of the training in decreasing burnout symptoms. The goal of this study was to test the feasibility and effectiveness of a VR mindfulness- based intervention on burnout in healthcare professionals in a clinical and corporate setting. The purpose of the VR mindfulness training is to increase mindfulness practice and aid in reducing job-related stresses in healthcare professionals in clinical and corporate settings.

In the development of this the intervention, we leveraged the Capability, Opportunity, Motivation, Behavior (COM-B) model of behavior which stipulates that there are three determinants of behavior: opportunity (physical and social environment), capability (physical and psychological capability) and motivation (automatic and reflective mechanisms) [39]. The framework outlines a process to identify the most important behavioral influences that must be present in order to realize behavior change [39]. It is important that these conditions be met in a specific order for them to be effective. Capability and opportunity must first exist before the individual is motivated to engage with the behavior. As with most behaviors, the more we believe we can be successful in participating in the behavior (in this case that the VR intervention will be helpful in cultivating mindfulness and preventing burnout) and the easier it is to engage in the behavior (it is easy to access and use), the more enticing it is to follow through with the behavior (increasing adherence to regular use of the VR intervention over time). That being said, feedback is critical for ongoing participation. Should the experience of using the VR mindfulness intervention prove to be easy and fulfill expectations, reengagement is more likely. However, if it proves to be difficult or time consuming, motivation to engage with the intervention again will diminish [39, 40].

In the context of this study, capability was addressed by the immersive nature of the VR environment, which minimized external distractions, making it easier for participants to focus on the mindfulness exercises. This ensured that participants had the necessary psychological capacity to engage with the mindfulness practice, therefore, increasing their capability to engage in the intervention [39, 40]. With VR mindfulness sessions available in a dedicated “recharge room” free from workplace demands during work hours, this created plenty of opportunity [39, 40]. Additionally, the opportunity was further achieved by providing participants the flexibility of choosing the duration of their mindfulness sessions (5, 10, or 15 minutes). By doing this the intervention catered to the participants’ time constraints and preferences, further enhancing the opportunity for engagement due to easy access and use [39, 40]. Finally, the design of the VR experience helped facilitate motivation by addressing the barriers that typically hinder individuals from participating in mindfulness practices [39, 40]. Oftentimes, traditional mindfulness practices are associated with initial resistance or boredom, however, the immersive and engaging nature of the VR intervention helped participants overcome those barriers [29, 33, 34]. Consequently, the appealing visuals, calming sounds and the sense of being “transported” into an alternative serene environment provided encouragement for repeated use of the intervention by participants [29, 33, 34, 39].

Herein, we describe the results of a pilot study testing the VR mindfulness intervention among healthcare professionals in clinical and corporate settings. We hypothesized that VR mindfulness meditation would be acceptable to users, feasible to implement, and signal improvement in burnout symptoms.

2. Materials and Methods

2.1 Intervention Development

For the purposes of intervention development, we used an Oculus Rift VR device which connects to a personal computer (PC) via a cable and is controlled by a series of software programs on a PC. The Oculus Rift VR device was chosen as a relatively affordable and accessible option in case another device was needed. In addition to ease of use, for both the study team and participants who may not have any experience with VR devices. The virtual reality systems on the market for consumer use are sophisticated but not as mature as highly adopted technologies such as personal computers and smartphones. As a result, the usability of the virtual reality systems used in our intervention is critical to the success of the tool being able to reliably deliver a mindfulness-based stress reduction (MBSR) experience for the user. During the development phase, a research assistant was on-hand to support each user and provide training. We developed a user manual, with illustrated step by step instructions, to guide users through each step of the process required to successfully engage with the MBSR experience on the device. We refined the manual based on input from members of the study team and then conducted an initial remote usability testing session with a study team member who had not previously used the device.

The study protocol was reviewed and approved by the Feinstein Institutes of Medical Research (#20-0435). The initial approval date was on March 13, 2017, and the second approval on Dec 9th 2019.

2.2 Intervention

The intervention included guided audio mindfulness meditation and scenic environments produced using virtual reality technology along with calming music. The intervention was designed to last either 5, 10, or minutes. Participants had the option to choose the length. The three virtual reality experiences during the intervention were: forest, lake, and beach. Each virtual reality experience simulated how the respective natural environment would look like in real life. In each virtual reality experience, participants were able to explore around the boundaries of the environment and interact with the environment. Interactions were limited to adding additional trees, moving bushes, adding basic shapes and even floating up to the sky. From there participants could choose to either listen to a 5, 10, or 15 minute guided meditation; or no music at all. The guided meditation utilized MBSR techniques including breathing techniques, noticing and directing your attention (self regulation), being present in the moment, observing your current environment, and being aware of your thoughts without judgment (Script S1) [6, 41].

Participants had the option to choose their environment, the length of the session, and whether or not they'd like to listen to the mindfulness script and/or music. The participants could have undergone more exposures if they desire, but no more than once per day. Participant preferences and usage were logged on a paper copy associated with each subject's unidentifiable subject ID and stored in REDCap.

2.3 Recruitment and Consenting

Inclusion criteria was adult (≥18 y), employed full time at that particular corporate office building or Intensive Care Unit (ICU) or Palliative Care Unit (PCU), fluent in English and willing to undergo study protocols. The study protocol was reviewed and approved by the Feinstein Institute of Medical Research (#20-0435). Participants in the corporate building were recruited via flyers posted at different locations in the corporate office and a building-wide email sent out on December 27th, 2019. Both contained information about the study and contact information of the research assistant (RA) and principal investigator (PI), and RedCap link for self-enrollment with the consent form and pre-test baseline measures. By accessing the RedCap link, participants were provided with an eligibility questionnaire. Only those who met the inclusion/eligibility criteria and provided consent participated in the study. Once e-consent was given by the participant, the PI received a notification that participant was consented, and the investigator then signed consent form, which was then e-mailed to the participant for their records. Recruitment for clinical participants in the ICU and PCU took place in person during information sessions and Grand Rounds. All staff members who worked in the units were asked to participate. Participants were given the informed consent forms and baseline measures in person. After providing consent and completing baseline measures, all participants then scheduled their first VR session with the RA. The same measures were given at baselines, one-month and three-month follow-up to assess for changes.

Efforts were made by the RA to address every interested participant, whether it be in person or via email. IRB-approved flyers were posted at various different approved locations throughout the whole building. In addition, building-wide emails were sent out at least 2-3 times. When possible the RA could demonstrate the device to interested participants and explain the study while showing a glimpse of the technology. Since the study was limited to our one corporate building, efforts were made to reach as many employees as possible regardless of department.

2.4 Data Collection

2.4.1 VR Sessions

RA contacted the fully enrolled participant through email to schedule the first VR-mindfulness session in the "*Recharge Room*". The recharge room was available from 8 am-4 pm Monday-Friday. In the recharge room were the VR headset (Oculus Rift) set up, the session log, blood pressure machine, pulse oximeter, and sanitation supplies. Once a participant came in for the session the RA would briefly go over the study timeline and answer any questions, then explain how to use the VR controllers if the participant wanted to interact with the environment. Once that was explained, the pre heart rate and blood pressure were recorded in the session log. After, the participant chose from one of three VR environments (beach, lake, or forest) and session length (5, 10, or 15 minutes); of note the first session was always 5 minutes for baseline. The RA logged the choices and then the participant put on the wiped down/cleaned (with disinfectant and eye safe cleanser) headset. The accompanying audio script plays, and the session would officially start. A pulse oximeter was optional to be worn throughout the whole session. After the allotted time was complete the post heart rate, blood pressure and any comments from the participant were recorded. Participants had the option to return for a session at any time in between their one-month and three-month follow-

ups (max 1× per day). For the purposes of this manuscript, we only report the data from self-reported measures.

2.5 Usability Testing

To ensure that the device performs as intended, it was usability tested and edited before being studied in the target population. There was an alpha and beta version of the solution developed by ellicom. These versions were each usability tested by the study team and feedback was incorporated into developing the final Gold version of the solution. No participants were involved in the usability testing of the alpha and beta versions. Once the Gold version was finalized, the study began, and the solution tested in our desired population.

2.6 Measures

For the clinical employees we measured mindfulness, moral distress, and wellness. For corporate employees we measured employee engagement, organizational citizenship behaviors, counterproductive work behaviors, physical symptoms, anxiety, depression and job stress using the scales listed below. We also summarized field notes including barriers and facilitators of use taken during the qualitative naturalistic observation conducted during the usability phase of the pilot from implementation. Naturalistic observation was chosen as the preferred qualitative method for this study as to be as unobtrusive as possible when participants were engaging with the VR mindfulness intervention.

2.7 Measure Clinical Employees

Mindfulness was measured using the Kentucky Inventory of Mindfulness Skills (KIMS) [42]. The KIMS survey is a measure of mindfulness skills a person possesses. Participants are asked to rate each item on a scale of 1 (Never or very rarely true) to 5 (Very often or always true). Sample items include "*When I'm doing something, I'm only focused on what I'm doing, nothing else*." This scale was also used with corporate employees.

Wellness was measured using 10-item Mini Z [41] which asked questions on stress, satisfaction, clinical environment, and teamwork among others. A single item (*using your own definition of "burnout", please circle one of the answers below)* was used to measure burnout. A sample answer included "*I enjoy my work, I have no symptoms of burnout".* There was also one open-ended question "*Tell us more about your stresses and what we can do to minimize them"*.

Moral distress was measured using the 23-item Moral Distress Scale – Revised (MDS-R) [43]. The MDS-R is used to measure moral distress in a clinical practice by providing situation statements under which professionals believe that they cannot carry out ethically appropriate actions due to various constraints. Sample items include *"avoid taking action when I learn that a physician or nurse colleague has made a medical error and does not report it."* Participants were asked to rate answers on a frequency scale ranging from 0 (never) to (4) very frequently and level of disturbance ranging from 0 (none) to great extent (4).

2.8 Measures Corporate Employees

Mindfulness was measured using the Kentucky Inventory of Mindfulness Skills (KIMS) [42]. The KIMS survey is a measure of mindfulness skills a person possesses. Subjects are asked to rate each item on a scale of 1 (Never or very rarely true) to 5 (Very often or always true). Sample items include "*When I'm doing something, I'm only focused on what I'm doing, nothing else*."

Job Burnout was measured using the Maslach Burnout Inventory (MBI) – General Survey [6]. The MBI survey is used to measure the level of burnout in certain occupations. There are specific versions for specific professions, and we opted to use the general survey as we were aware of the varying range of professions in our office building. The survey also specifically measures Exhaustion Cynicism, and Professional Efficacy as it related to the subject's job. Sample items include "*I feel emotionally drained from work.*" Subjects are asked to indicate how they feel about each item on a scale from *Never to Every Day.*

Employee engagement was measured using the 9-item short form of the Utrecht Work Engagement Scale (UWES) [44]. UWES-9 is a measure commonly used throughout the field and consists of items across the three dimensions of engagement (vigor, dedication, and absorption). Sample items include, "*When I get up in the morning, I feel like going to work"* (vigor); *"my job inspires me"* (dedication); and *"I get carried away when I am working"* (absorption). Participants rated those statements on a 7-point Likert scale ranging from 1 (*never*) to 7 (*always/every day*).

Organizational Citizenship Behaviors was measured using the 10-item short version of the Organizational Citizenship Behaviors Scale (OCB) [45]. Sample items include, "*took time to advise, coach, or mentor a co-worker."* Participants rated items on a 5-point Likert scale ranging from 1 (*never*) to 5 (*every day*).

Counterproductive Work Behaviors (CWB) was measured using the 10-item short version of the Counterproductive Work Behavior Checklist (CWB-C) [46]. Sample items include, "*purposely wasted your employer's materials/supplies.*" Participants rated items on a 5-point Likert scale ranging from 1 (*never)* to 5 (*everyday).*

Physical Symptoms was measured with the 18 item Physical Symptoms Inventory [47]. An example item is "An upset stomach or nausea." Participants were instructed to indicate how often they have experienced each item over the past 30 days using a three-point scale, ranging from 1 – *"No"* to 3 – *"Yes, and I saw a doctor".*

Anxiety was assessed using the 4-item anxiety subscale of the Emotional Strain Scale [48]. A sample item is "I felt jittery." Participants were asked to rate how often they experienced each item over the past month on a four-point Likert scale ranging from 1 (*Never or a little*) to 4 (*Most of the time).*

Depression was assessed with the 5-item depression subscale of the Emotional Strain Scale [48]. Sample items included "I could not get going". Participants were asked to rate how they felt during the past week on a four-point Likert scale ranging from 1 (*Rarely or None of the Time)* to 4 (*Most or all of the Time).*

Job stress. Job stress was measured with a four-item scale developed by Motowidlo et al. [49]. The four items were "My job is extremely stressful," "Very few stressful things happen to me at work" (reverse scored), "I feel a great deal of stress because of my job," and "I almost never feel stressed because of my work" (reverse-scored). Responses were made on a 5-point scale ranging from 1 (strongly disagree) to 5 (strongly agree).

2.9 Statistical Analyses

We used SPSS version 27 (IBM Corp. Armonk, NY, USA) for all statistical analyses. Descriptive statistics were used to analyze demographic data. An independent sample *t*-tests was used to test any pre-post differences. However, due to the small sample size and feasibility and usability characteristics of this study, results from inference statistics should be interpreted with caution.

3. Results

3.1 Clinical Employees

As shown in Table 1 a total of 22 employees took the survey of which all employees worked either in the ICU or PCU. The mean age was 38.3 years and mean years of experience was 4.14 years. A majority of our participants were female (68.2%), had a Bachelor's degree (36.4%), were nurses (40.9%) and white (68.2%). Results from Pearson's correlation in Table 2 show that moral distress and wellness are positively correlated (r = 0.45, p = 0.04).

Table 1 Demographics for Clinical Employees.

	Count	Count	%		Count	%
Experience				Race		
	Less than 1 year	2	9.1%	American Indian or Alaskan Native	0	%
	1-3 years	4	18.2%	Asian	2	9.1%
	4-6 years	7	31.8%	Black or African American	1	4.5%
	7-9 years	1	4.5%			
	10-12 years	2	9.1%	Native American, Hawaiian or Other Pacific Islander	0	0%
	13-15	3	13.6%	White	15	68.2%
				Some other race	2	9.1%
	19-21 years	1	4.5%			
	25 or more years	2	9.1%			
Ethnicity				Education		
	Hispanic/Latino	2	9.1%	High School	1	5%
	Not Hispanic/Latino	18	81.8%	Some college credit	0	0%
				Associate's degree	1	4.5%
Gender				Bachelor's degree	8	36.4%
	Male	5	22.7%	Master's degree	6	27.3%
	Female	15	68.2%	Doctoral Degree	4	18.2%

Note = 22, 2 missing.

Table 2 Correlations among variables and variable descriptives for clinical employees.

	Age	Experience	Sex	Mindfulness	Wellness	Moral Distress
Age	-					
Experience	0.75**	-				
Sex	-0.23	0.15	-			
Mindfulness	0.06	-0.06	0.30	-		
Wellness	-0.40	-0.12	0.21	-0.08	-	
Moral distress	-0.36	-0.23	-0.26	-0.26	0.45*	-
n	20	22	20	21	21	21
M	38.30	4.14	1.75	114.81	34.67	109.14
SD	11.10	2.60	0.44	11.82	3.37	62.68

**$p < 0.01$ (two-tailed), *$p < 0.05$(two-tailed).

3.2 Corporate Employees

A total of 61 participants completed pre-test surveys. As shown in Table 2, 56% of participants had 1-5 years of experience in their current position, 51% white, 81.3% non-Hispanic/Latino and 70% female and 41% had either a Bachelors or Master's degree. Of the 61 participants, 28 completed post-test measures. The coefficient alphas, means, standard deviation and correlations among the main study variables are shown in Table 3. Results on co-efficient alphas for the various measures ranged from 0.51-0.91. The counterproductive work behavior (CWB) had a coefficient alpha of 0.51, thus results based on this scale should be interpreted with caution.

Table 3 Demographics for Participants Pre Test.

	Count	Count	%		Count	%
Experience				Race		
	Less than 1 year	12	19.7%	American Indian or Alaskan Native	1	2%
	1-5 years	36	59%	Asian	12	20%
	6-10 years	6	9.8%	Black or African American	8	13%
	10-15 years	3	4.9%	Mixed	2	3%
	15-20 years	1	1.6%	Native American, Hawaiian or Other Pacific Islander	0	0%
	20+ years	3	4.9%	White	31	51%
				Some other race	7	11%
Ethnicity				Education		
	Hispanic/Latino	8	13.3%	High School	1	1.6%
	Not Hispanic/Latino	52	86.7%	Some college credit	4	6.6%
				Associate's degree	3	4.9%
Gender				Bachelor's degree	25	41%

Male	18	30%	Master's degree	25	41%
Female	42	70%	Doctoral Degree	3	4.9%

Note: *N* = 61.

3.3 Effect of VR Mindfulness Intervention on Employee Outcomes

Table 4 shows the correlations between variables. Mindfulness was negatively correlated to burnout states of emotional exhaustion (*r = -0.30, p < 0.05)* and cynicism (*r = -0.53, p < 0.01)*, as well as CWB (*r = -0.37, p < 0.01),* anxiety (*r = -0.37, p < 0.01)* and depression (*r = -0.40, p < 0.01).* Mindfulness is positively correlated to the burnout state of personal accomplishment (*r = 0.51, p < 0.01),* workplace engagement (*r = 0.60, p < 0.01),* and OCB *(r = 0.27, p < 0.05).*

Table 4 Correlations among variables and variable descriptives.

	Gender	Mindful	EEx	Cyn	PA	Eng	OCB	CWB	PhySym	Anx	Dep	JobStr
Gender	-											
Mindful	-0.18	-										
EEx	0.19	-0.30*	-									
Cyn	0.13	-0.53**	0.60**	-								
PA	-0.03	0.51**	-0.08	-0.34*	-							
Eng	-0.15	0.60**	-0.48**	-0.66**	0.57**	-						
OCB	0.17	0.27*	-0.09	-0.11	0.41**	40**	-					
CWB	-0.06	-0.37**	0.29*	0.55**	-0.17	-0.37**	-0.11	-				
PhySym	0.09	-0.18	0.40**	0.36**	-0.14	-0.38**	-0.12	0.26*	-			
Anx	0.29*	-0.37**	0.46**	0.54**	-0.31*	-0.54**	-0.17	0.22	0.52**	-		
Dep	0.23	-0.40**	0.50**	0.50**	-0.34**	-0.62**	0.04	0.25	0.62**	0.72**	-	
JobStr	0.23	-0.07	0.58**	0.50**	0.15	-0.25		0.15	0.32*	0.38**	0.19	-
N	60	63	62	62	62	62	62	62	62	62	62	61
M	1.7	128.31	2.91	1.95	4.85	4.82	3.2	11.73	5.95	2.01	1.72	3.09
SD	0.46	18.20	1.58	1.52	0.93	1.16	0.69	1.94	3.46	0.63	0.68	0.89
A	-	0.89	0.79	0.79	0.79	0.91	0.84	0.51	0.74	0.73	0.83	0.79

**$p < 0.01$ (two-tailed), *$p < 0.05$ (two-tailed), EEx = emotional exhaustion, Cyn = cynicism, PA = personal accomplishment, Eng = workplace engagement, OCB = organizational workplace behavior, CWB = counterproductive workplace behavior, PhySym = physical symptoms, Anx = anxiety, Dep = depression, JobStr = Job Stress; correlations only for variables at baseline

We hypothesized that the VR mindfulness intervention would have beneficial effects on employee outcomes, burnout, engagement, OCB, CWB, physical symptoms, anxiety and depression and increase mindfulness. As shown in Table 5, we saw an increase in mindfulness pre and post the intervention (*t(27) = 43.24, p < 0.001*) and a reduction in CWB (*t(25)* = 31.37, *p* < 0.001). It should be noted that due to the low alpha of the CWB scale, results should be interpreted with caution. There were no significant differences pre-post test for burnout (emotional exhaustion, *t(27) = -0.58, p = 0.56*; cynicism *t(27) = -0.80, p = 0.43;* personal accomplishment *t(27) = -0.07),* workplace engagement *(t(26) = 0.37, p = 0.72),* OCB *(t(26) = 0.20, p = 0.86),* physical symptoms *(t(25) = 0.81, p = 0.43),* anxiety *(t(25) = 1.73, p = 0.10),* depression *(t(25) = 1.49, p = 0.15), and* job stress *(t(25) = 0.04, p = 0.97).*

Table 5 Pre and Post VR mindfulness intervention for self-reported employee outcomes.

Measure (N = 28)	Pre		Post		95% Confidence Interval of the Difference		*t*
	M	*SD*	*M*	*SD*	*Lower*	*Upper*	
Mindful	*130.85*	*15.12*	*27.68*	*5.91*	*98.28*	*108.07*	*43.24***
Burnout							
EEx	*2.84*	*1.45*	*2.98*	*1.74*	*-0.62*	*0.35*	*-0.57*
Cyn	*1.90*	*1.55*	*2.08*	*1.62*	*-0.63*	*0.28*	*-0.80*
PA	*4.75*	*1.87*	*4.76*	*0.20*	*-0.27*	*0.25*	*-0.06*
Eng	*4.69*	*0.22*	*4.63*	*0.25*	*-0.26*	*0.37*	*0.36*
OCB	*3.06*	*0.13*	*3.05*	*0.14*	*-0.13*	*0.15*	*0.20*
CWB	*12.03*	*0.37*	*1.20*	*0.04*	*10.13*	*11.53*	*31.37***
PhySym	*6.38*	*2.77*	*6.04*	*3.24*	*0.53*	*1.23*	*0.81*
Anx	*2.06*	*0.14*	*1.92*	*0.13*	*-0.03*	*0.30*	*1.73*
Dep	*1.73*	*0.68*	*1.6*	*0.62*	*-0.05*	*0.30*	*1.49*
JobStr	*3.08*	*0.94*	*3.07*	*0.98*	*-0.28*	*0.29*	*0.30*

***p* < 0.01 (two-tailed), **p* < 0.05 (two-tailed), EEx = emotional exhaustion, Cyn = cynicism, PA = personal accomplishment, Eng = workplace engagement, OCB = organizational workplace behavior, CWB = counterproductive workplace behavior, PhySym = physical symptoms, Anx = anxiety, Dep = depression, JobStr = Job Stress; correlations only for variables at baseline.

3.4 Feedback on VR Mindfulness from Clinical Participants

Due to the barriers presented below we were unable to get a significant number of respondents to provide feedback on the VR mindfulness intervention. For the participants who did respond, their feedback was positive, with participants reporting that their needs were met (*e.g. it was a great way to relax...)* and that VR mindfulness is helpful for the ICU and very therapeutic.

3.5 Barriers

By leveraging the COM-B model of behavior change, we were able to identify some of the barriers in regard to capability, opportunity and motivation to trial and that the VR intervention provided

the appropriate influences to overcome these potential roadblocks [49]. We outline these barriers below.

3.6 Recruitment and Retention

We identified multiple barriers in recruiting participants and retaining them in the study. First, our recruitment flyers and email went out in December of 2019, during the holiday season. At that time many employees were out of office and would not have access to e-mails or be onsite to see our flyers. We sent a follow e-mail in January (2 weeks after the first e-mail was sent out), but we were still unable to garner interest in the study. Second, participants reported that while they were willing to come in to test out the VR mindfulness intervention, they found it difficult to take time from their day and work tasks to come to the recharge room, even though some were scheduling appointments in advance. Mitigation attempts included having availability after-work hours and during lunch hours. Second, the specific corporate building at which the study was conducted was massive, which made distance another issue that we had to contend with for participants to visit the recharge room.

Third, at the time that we were recruiting participants for our study, the COVID-19 was in its beginning stages and the corporate offices were transitioning employees to work from home. For the participants that we had enrolled in the study, we attempted to get Google goggles, however we found it difficult to monitor and keep engagement/interest of subjects while remote, we did not have a structured schedule where we would either have checkpoints or have some sort of time where we would check up on a participant's progress with their sessions. As it was left open ended and up to each individual, possibly due to a lack of routine, or being incorporated as a daily task, it became difficult to recruit participants both on site and on-line. This is because on-site there was no one in the corporate office and on-line we could not recruit as we were physically unable to test the VR goggles. We made multiple attempts to test virtually, however, all RA and study team members were heavily involved with COVID-19 studies and mitigation at our hospitals.

Fourth, we simultaneously tested our intervention in three different environments; this is rare in usability studies and may not be best practice [19, 39]. While a strength of this design is that we were able to build and tweak an intervention in real time, what we found was that despite participants providing positive reviews, no one came back twice. Since this was only a usability study, participants we reached out to did not want to continue to participate in the study because they did not see a benefit for themselves. Furthermore, we did not compensate our participants, therefore with a lack of reward there was no incentive for participants to keep coming to the VR sessions leading to attrition. Future research studies should be mindful of their recruiting schedule as well as providing suitable compensation for participants.

4. Discussion

Our results show promise in that we saw an increase in mindfulness and reduction in CWB in our corporate employees. We were able to determine a correlation between wellness and moral distress, however our sample size was small and did not have a randomized comparator arm.

4.1 Practical Implications

The findings of this study have important practical implications for healthcare organizations and their workplace wellness/well-being initiatives. First, it is crucial for healthcare organizations to adopt evidence-based interventions that address this growing issue of burnout among healthcare professionals [15, 16]. This is particularly important since despite numerous initiatives to combat burnout among healthcare professionals, it continues to affect a significant portion of this population particularly after the COVID-19 pandemic [15, 16]. Numerous studies, including our own indicate that VR-based mindfulness interventions present a promising solution for reducing burnout and enhancing employee well-being [15, 16]. Second, VR systems allow for consistent delivery of the intervention, and the variability in facilitator experience that can impact traditional mindfulness sessions is minimized. This ensures that every participant receives a high-quality, immersive mindfulness experience.

Third, the immersive nature and flexibility of VR allows for tailored experiences (*e.g.* selecting a calming environment) which helps individuals focus deeply on mindfulness exercises. For healthcare professionals this means that they are committed to creating healthy mental health habits that become embedded in their daily routine [15]. This fosters emotional regulation, reduces chronic stress, thus ultimately leading to improved adherence and accessibility for healthcare professionals. This in turn, can contribute to reduced emotional exhaustion, improved mental resilience, and a greater sense of professional efficacy [38].

4.2 Recommendations for Integration

To successfully integrate VR-based mindfulness into existing workplace wellness/well-being programs, healthcare organizations should take several key steps [38]. Based on the findings of this study, we offer the following recommendations for implementing such programs:

First, it is essential to provide access to VR equipment in easily accessible locations, such as break rooms, wellness centers or recharge rooms, where healthcare staff can use the intervention during their breaks. Second, organizations should offer training sessions to familiarize employees with the technology and ensure they feel comfortable using it. Third, promoting the intervention through leadership buy-in and incorporating it as part of a broader wellness strategy will encourage participation and highlight its importance. Fourth ongoing evaluation of the effectiveness of the intervention is crucial. Organizations should track key metrics such as employee well-being, burnout rates, and job satisfaction to assess the impact of VR mindfulness over time. Regular feedback from employees will also be valuable in refining the program and ensuring it meets their needs [38].

4.3 Limitations

One major limitation of our study is that we were unable to measure the participants again after we made a few changes to accommodate participants during the COVID-19 pandemic. Ideally, we would have loved to have made even more changes and implemented the intervention for healthcare workers during a crucial time of the COVID-19 pandemic. However, with all hands-on deck during this time, we were unable to do this. When we do return to the office, we intend to do a future study based on the lessons learned (*e.g.* compensation for participants) in this study. Another limitation is that due to our small sample size and participants not returning, we were

unable to assess end user comprehension of the VR mindfulness intervention and have to interpret with caution our survey responses. Lastly, there are a number of wellness programs in our health system aimed at stress reduction for healthcare professionals. It is likely that our participants were using other methods to help reduce their job stress. For future studies, our participants or end users may not have access to wellness programs, however, since our target population is healthcare professionals the opinions of the participants in this study gave us insight that this intervention is very much needed and valuable. This may also be subject to a potential bias stemming from sampling based on self-selection, which was not random, and which could have introduced a bias relating to people who already have a disposition, need, or prejudice towards mindfulness. The authors acknowledge the need to interpret the findings considering these limitations.

5. Conclusion

Previous research consistently shows that burnout is a significant result of stress in healthcare providers [5, 7, 8, 26]. Over the years, mindfulness-based interventions have been seen as a possible solution to reducing the prevalence of burnout [11, 16, 50]. However, there have been various challenges set forth which have limited their efficacy, leading researchers, and other health care professionals to adopt VR -based mindfulness interventions which can potentially immerse users more easily into the meditative experience [15, 16]. In our study, we aimed to test the feasibility and usability of VR mindfulness in clinical and corporate employees. One of our greatest challenges in this study was our ability to recruit participants, and for participants to reuse the platform. We recognized that there were two possible reasons for this; first, employees grappled with allowing for self-care while in the workplace environment. Second, while initial use was reported as a positive experience, much like other behaviors, it takes multiple times of repeat use for the behavior to become routinely adopted. Based on the COM-B model [39], although we were able to provide access to the intervention it may not have been as easy to access as if it was available at the person's own workplace (such as their desk, or in the break room for the ICU staff). Further, there may not have been the immediate benefit noticed that would motivate repeat use. Although it is still possible that the VR platform provided a more immersive experience into the meditative experience, continued use would still be necessary to experience long-term health effects. Future studies should collaborate with workplace wellness initiatives to encourage and support self-care while at work. The intervention should also require a commitment to a minimum number of sessions and to set expectations for time-to-effect.

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Author Contributions

M.W., K.O., J.P., J.S., S.A., D.K., and N.H. contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. S.W. contributed to the analysis of the results and to the writing of the manuscript.

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Competing Interests

The authors have declared that no competing interests exist.

Data Availability Statement

Due to the nature of this study, data sharing is not available.

Additional Materials

The following additional materials are uploaded at the page of this paper.

1. Script S1: Guided Mindfulness Meditation Script - 5 min narration.

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