



A Qualitative Study of Virtual Reality and Mindfulness for Substance Use Disorders

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Abstract

Substance use disorders (SUDs) are common and create a significant burden in the USA. The practice of mindfulness involves training one's attention on the present moment and learning to accept and tolerate difficult emotions. For people with substance use disorders (SUDs), there is compelling evidence on the psychological and physical health benefits of practicing mindfulness. Yet, many individuals with (and without) substance use disorders (SUDs) struggle to establish a regular mindfulness practice. Virtual Reality (VR) is a promising modality for engaging people with SUDs in mindfulness using immersive, interactive environments. This qualitative study explores VR-based mindfulness in a residential substance use treatment setting. A series of small patient and staff focus groups reveal how VR mindfulness can offer novel ways to engage with mindfulness practice, even for some who were previously hesitant or struggled with mindfulness. Our findings add to the literature suggesting VR can assist in focusing attention, improve perceived competency, and reduce distractions that might otherwise interfere with practicing mindfulness.

Keywords Virtual Reality · Mindfulness · Substance use treatment

Introduction

Virtual Reality (VR) is defined as a computer-generated simulation of a three-dimensional image or environment that users interact with using specialized electronic devices such as goggles with a screen inside (Oxford Dictionary). People typically engage with VR using commercially available headsets (e.g., Oculus Quest, Lenovo Mirage). These headsets cover the eyes and ears to block out stimuli in the “real world” and promote a sense of immersion (i.e., sense of being isolated from the “real world” and placed in another realistic setting) and presence (i.e., a psychological sense that one is “actually there” in an alternative environment).¹ The ability of VR to transport people to an infinite number of possible virtual environments safely and cost-effectively has led to a growing body of clinical research in recent years.

In the present study, we explore the use of VR as a facilitator for mindfulness training in people with substance use disorder (SUD).

SUDs are defined by the recurrent use of alcohol and/or drugs that cause clinically significant impairment in health and/or psychosocial functioning (Substance Abuse and Mental Health Services Administration (SAMHSA), 2016). In the USA, approximately 23 million people—one in 13—over the age of 12 need substance use treatment each year, according to the Substance Abuse and Mental Health Services Administration (SAMHSA, 2019). Less than 2% of those needing treatment receive any, and only about 11% of people receive care at a specialty facility. A recent study estimated the annual cost of care for people with substance use disorders (SUDs) in the USA at upwards of \$13 billion annually (Peterson et al., 2021). SUD treatment often requires ongoing engagement with mental health and medical professionals who provide a continuum of care ranging from outpatient to inpatient services (SAMHSA, 2019). A common reason individuals may not seek treatment is the perceived inability to afford care or an unwillingness to engage in intensive treatment; clearly, inexpensive and accessible treatment options for SUDs that can supplement or bridge the gap in traditional treatments are sorely needed

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to reduce the economic and societal burden of SUDs (Lee et al., 2016).

Chronic stress resulting from socioeconomic, health-related, and interpersonal struggles are strong predictors of developing a SUD. Studies suggest that a low-cost and effective way of managing stress is through practicing mindfulness (Grossman et al., 2004; Schumer et al., 2018; Hofmann et al., 2010; Khoury et al., 2015), which is defined as the practice of focusing on the present moment with a non-judgmental attitude (Kabat-Zinn 1994). Mindfulness-based interventions for SUD aim to minimize the psychological burden of stress and the physical urge that often precipitates substance use, as well as improve awareness of cognitive and physiological processes associated with craving, substance seeking, and using substances (Bowen et al., 2009; Zimmerman et al., 2018). A systematic review by Sancho et al. (2018) found that mindfulness-based interventions reduced substance dependence and craving and improved emotional regulation for people with SUD. A second systematic review and meta-analysis by Li et al. (2017a) revealed that mindfulness-based treatments reduced the frequency and severity of substance use, intensity of craving, and severity of psychological stress associated with SUD. A number of controlled evaluations of mindfulness training for SUD demonstrate greater improvements than treatment as usual regarding substance use post-treatment and abstinence post-treatment (with follow-ups ranging from 2 weeks to 12 months post-treatment) (Schuman et al., 2014; Garland et al., 2016). Some studies, however, failed to show a comparative advantage to treatment as usual, (Brewer et al., 2009) and meta-analyses have confirmed mixed results and highlight the need for more data from high-quality, adequately powered, and longitudinal studies (Grant et al., 2017; Li et al., 2017a, b).

One potential reason for these mixed findings regarding the usefulness of mindfulness in the treatment of SUD is that practicing mindfulness can be difficult, particularly for people with SUD. There are significant barriers to mindfulness practice for many people, including the perception of mindfulness as challenging or frustrating, the experience of becoming flooded with negative emotions, feelings of “doing it wrong,” or not being able to find the time or space to practice comfortably (Wyatt et al., 2014; Spears et al., 2017). Individual-level data indicate that in addition to some negative perceptions about mindfulness, novice mindfulness practitioners can experience fatigue and increased anxiety, and encounter unpleasant memories (Lindahl et al., 2017), which all function as barriers to developing a mindfulness practice.

Moreover, specific barriers are highlighted in the literature related to mindfulness training for SUDs. First and foremost, higher-than-average attrition appears to be relatively common in mindfulness interventions for SUD such that the majority of studies’ attrition rates exceeded the commonly accepted attrition rate of 20% (Grant et al., 2017). Second,

other findings suggest diminishing treatment effects as time elapses from post-treatment (Bowen et al., 2014). Taken together, the available evidence suggests that there is a gap in understanding of how to engage people with SUD in sustained mindfulness practice. The present study explores VR as one potentially useful tool for increasing retention in mindfulness training programs and encouraging ongoing mindfulness practice, to support people with SUD accessing the value of mindfulness as a coping skill.

Virtual Reality and Mindfulness

Virtual Reality (VR) is a promising new teaching modality for mindfulness. VR’s ability to help users feel they have been transported to a different environment offers novel methods of practicing mindfulness, particularly for those who have reported difficulties with traditional approaches to mindfulness training (Wilkinson et al., 2021; Seabrook et al., 2020). VR headsets are becoming increasingly affordable for the average consumer, and free or low-cost mindfulness applications are available on VR app stores (e.g., Oculus.com or Viveport.com). Many mindfulness apps (e.g., “Guided Meditation VR” for the Oculus Quest (<https://www.oculus.com/experiences/quest/3385318684883998/>), Calm (<https://calm.com>), or the TRIPP VR app used in this study (<https://www.tripp.com/>) place users in relaxing simulated environments and offer guided exercises that reinforce learning.

Researchers in the broader mental health field have long capitalized on the immersive quality of VR. Systematic and meta-analytic reviews support VR-based treatment for anxiety disorders, phobias, and PTSD (Valmaggia et al., 2016; Botella et al., 2017), reducing peoples’ subjective experience of acute and chronic pain (Mallari et al., 2019), and reducing depressive symptoms in hospitalized patients (Li et al., 2011; Manzoni et al., 2009). Particularly relevant to this study, some researchers have investigated the mechanisms by which VR might lead to higher rates of treatment retention and engagement. For example, one study compared patient preferences and adherence to in vivo exposure therapy for anxiety disorders to VR-based exposure therapy and found that over three quarters of participants preferred VR-based exposure therapy, and only 3% refused VR-based exposure therapy compared to the 27% who refused in vivo exposure therapy (Garcia et al., 2007).

Research into VR-based mindfulness programs is early and evolving. A recent narrative review by Arpaia et al. (2021) suggested that more rigorous research is needed; out of 53 papers considered in the review, 90% were rated as weak using a standardized, 6-point study assessment metric, and none met the criteria for “strong quality.” Nevertheless, there are promising indicators that VR can play a key role in making mindfulness more accessible and engaging. Findings from Chandrasiri et al. (2020) suggest that a single session

of VR-based mindfulness can produce similar results in promoting mindfulness compared to audio-guided conventional strategies—a finding supported by the earlier work of Navarro-Haro et al. (2016). Early findings also suggest that VR may help people overcome common barriers to mindfulness practice. Navarro-Haro et al. (2019) reported a 30% attrition rate in a conventional mindfulness intervention condition for people with generalized anxiety disorder, compared with a 0% attrition rate for the same mindfulness intervention that also included a VR component.

A recent mixed methods study by Seabrook et al. (2020) explored one mechanism by which VR may facilitate mindfulness practice. Among a sample recruited from the general population ($n = 37$), participants who completed VR mindfulness demonstrated increases in self-reported state mindfulness and attributed an enhanced focus on the present moment to various immersive features of the VR experience, including the omni-directional video of a lush forest and stream, the ability to move the head and “explore” the relaxing environment in an intuitive way, and a soothing guided voiceover queuing skills such as focusing on the breath. The authors concluded that the sense of “presence” (e.g., a feeling of really “being there”) and agency to explore the calming environment contributed to fully engaging in the present moment. The “reality” of Virtual Reality seems to evoke real feelings and states of mind in the user.

Additional research is needed to better understand VR’s role in making mindfulness training more accessible and engaging, particularly among clinical populations actively seeking SUD treatment. During early phases of intervention adaptation, qualitative methods are particularly relevant when complex phenomena, like reactions to VR-based mindfulness, do not have clear underlying numerical values or cannot be measured with clinical instruments or tests (e.g., thermometer for temperature or glucose test for blood sugar) (Nastasi & Schensul, 2005). Using qualitative methods with clinical populations to explore patient reactions to VR mindfulness would help the field better understand how to design VR environments for mindfulness training and how to integrate this intervention within existing clinical workflows.

Virtual Reality, Mindfulness, and Substance Use Treatment

Published treatment studies evaluating VR-based mindfulness treatment for SUDs are limited but show promising results. Hargett et al. (2022) explored the use of VR-based mindfulness in an inpatient setting with a small group of people with opioid use disorders ($n = 11$); they found that guided meditation in VR resulted in statistically significant reductions in patient-reported pain scores and represented a potential alternative to opioid use in treating chronic

pain. While there are no studies exploring the use of VR to facilitate mindfulness training for reduction of symptoms of SUDs such as craving, use, and relapsing (Worley, 2019; Segawa et al., 2020; Amista et al., 2017), basic research has explored the use of VR and its immersive qualities to facilitate exposure therapy (i.e., eliciting cravings) in SUD populations. For instance, VR environments with substance use depictions can reliably trigger cravings among people with SUDs related to alcohol, opioids, stimulants, and cannabis; (Bordnick & Washburn, 2019) however, there is no clear evidence that VR-based exposure therapies lead to a reduction in cravings (Trahan et al., 2019). Moreover, other than a published study protocol for a randomized controlled trial to evaluate for a VR-based cue exposure treatment for methamphetamine use disorder, there are no further treatment studies evaluating VR mindfulness interventions for reducing the symptoms and negative outcomes of SUDs.

Despite limited treatment literature on VR-based mindfulness and SUD, results from the anxiety literature suggest that VR may help retain and engage patients in mindfulness training throughout their course of treatment. The present study attempts to address questions related to VR’s role in supporting mindfulness training in a SUD population using qualitative methods among an inpatient SUD treatment setting.

Methods

The study explored patient and staff reactions to VR-based mindfulness at the Inpatient Residential Treatment (IRT) Program at the Center for Dependency Addiction and Rehabilitation (CeDAR), the addiction treatment center of University of Colorado. CeDAR serves patients with primary substance use disorders (SUDs) and co-occurring mental health diagnoses.

In this study, we conducted focus groups to allow for a free-flowing, interactive discussion among participants and facilitators. Focus groups are useful for generating new ideas through active discussion, illuminating what participants think and feel, and why (Morgan, 2018). Through sharing and comparing experiences, participants uncover where they find consensus and diversity in their views (Morgan, 2018). Furthermore, focus groups are consistent with the group treatment setting at this inpatient program. One prior study Seabrook et al. (2020) used qualitative methods to examine whether different elements of VR usage were viewed as helpful or distracting in mindfulness practice among a general population, adding color to our understanding of why VR can be useful for mindfulness. This study aims to include the voices of a SUD population in the evidence base as well.

For the duration of the study, patients' first activity of the day, 6 days a week, was 30 min of meditation. All patients had access to nine VR headsets for optional use during this time. Staff also had access to the headsets during their group supervision time and throughout their respective shifts. The Institutional Review Board approved all study procedures.

Participants

Patients admitted between November 2019 and February 2020 to the Inpatient Residential Treatment (IRT) program at CeDAR were eligible to participate. Participants were over the age of 18, presented with a primary substance use disorder, and were medically stabilized following successful detoxification. All patients meeting these criteria and admitted during this time were offered the opportunity to participate. Exclusion criteria included patients who had not completed detoxification, had an untreated history of seizures, epilepsy, motion sickness, or vertigo, experiencing active nausea or vomiting, or receiving court-ordered residential treatment. Thirty-eight patients consented to participate in the study, and approximately 25 unique patients attended focus groups: 17 male and 8 female. Their time in treatment ranged from 7 to 81 days. Participants ranged in age from 22 to 65.

Virtual Environment

The mindfulness experience, termed "Focus," was developed by TRIPP, Inc. (Los Angeles, CA). TRIPP provided use of the "Focus" experience and the hardware for the study. As of this writing, the "Focus" experience is available as part of a free demo of the software, which costs \$4.99 per month on the Oculus app store. We utilized a Lenovo Mirage Solo VR headset for this study. The headset allowed for 6 degrees of freedom (movement laterally, forward or backward, and up or down) for a fully immersive experience. Each headset included a single remote control for navigating menus and accessing the meditation app, though all interaction during the mindfulness experience was done solely using head movements. The "Focus" mindfulness experience is a combination of computer-generated visuals (shown in Fig. 1) combined with relaxing music and a gentle audio voiceover to provide a unique guided mindfulness experience. "Focus" is approximately 7 min in length and begins with a brief orientation to the environment followed by a guided breathing exercise, an interactive gaze-enabled exercise to practice focusing the attention, a journey through a colorful abstract fractal tunnel, and a reflection on positive images such as kittens, babies, and blades of grass.

The milieu staff received training on how to operate and charge headsets and place participants in the VR experience

if assistance was required. Staff were present during morning meditation sessions to assist patients who needed orientation to the headset or help adjusting the headset to a comfortable position. All headsets and remote controls were cleaned with disinfecting wipes after every use. Detailed handouts with equipment trouble-shooting tips (e.g., steps for connecting to the internet, charging of equipment, support contact) were provided to staff members and stored adjacent to the headsets for reference.

Data Collection

We invited study participants to attend in-person, semi-structured focus groups during the 4-month duration of the study. Participants who met inclusion criteria could attend regardless of how many weeks of treatment they had completed or how much exposure they had to VR mindfulness during their treatment. Following recommendations from Morgan (1997) on reaching saturation in qualitative analyses, we held small focus groups ($n = 16$) weekly, with one to five participants attending each group. Groups for men and women were held separately in a private space per the CeDAR protocols for group meetings. Conversations were digitally recorded, each 15 to 45 min in length.

Over the same study period, we invited all staff involved in patient treatment to attend at least one of four total semi-structured focus groups. In total, 11 staff members participated, including clinicians, overnight milieu staff, and staff alumni. Conversations were digitally recorded, each 35 to 45 min in length (see the Appendix for the focus group guides).

Analysis

We analyzed transcripts using a priori codes focused on VR for mindfulness and emotion regulation to identify emergent themes (NVivo12, QSR International), following the guidance of Miles et al. (2014). A priori codes were generated and refined through multiple discussions based on literature reviews and input from co-authors with clinical expertise in SUD and mindfulness treatment (i.e., RH, DB, and SH). In addition, we visualized data through a data display matrix, which condensed responses from all 16 focus groups by key themes, including past experience with mindfulness; perception of how VR fits with patient recovery; connection between TRIPP and mindfulness, mood, and cravings; and future interest in VR. The matrix allowed us to track the number of groups mentioning the topic and the intensity of their views, each critical for analysis according to Morgan (1997). This group-to-group validation, making constant contrasts and comparisons across groups, revealed consistent themes and patterns Morgan (1997). To help rule out threats to validity, we continually reviewed text within each

Fig. 1 Focus VR example background



code to identify discrepant data Maxwell (1996) so that views atypical of the rest of the group were included in the key findings.

Results

Thematic analysis from patients and staff revealed an overall positive response to practicing mindfulness in VR, enhancing mood, and overcoming persistent barriers to mindfulness practice.

VR Enhances Mood

Most focus group participants spoke of the benefits of using VR for decreasing negative emotions and cultivating a sense of well-being. The experience helped some

patients reduce anxiety or irritability, arrive at a “calm content space,” and feel “more at ease”:

[In using VR for mindfulness] every time is a positive experience for me. Two days ago, I was having a very hard morning. I came in here, and I did the [VR] meditation because I knew I was going to be thinking about what was bothering me. Just the fact that I could use that headset to pull me out of that mood, instead of sitting in a funk all day.... That particular day was definitely a good day to have these headsets because... if those headsets weren't here, I would have had a whole bad day. That whole day. (patient)

Several mentioned that VR mindfulness helped induce a state of physiological relaxation that created beneficial emotional effects or a positive outlook that lasted throughout the day:

I feel it all over my body. My shoulders relaxing, I'm almost in the scene, floating. I can feel... when the breath comes in... just breathing in and breathing out... it relaxes you, it centers you, it centers your mind and your body. (patient)

I'm here for anxiety and depression. Years of it. For me personally, when I put it on, and I get through the first one... My whole body is relaxed. I feel good. I go to the second one, I get even more relaxed. My anxiety goes from a 10 to like a four or five. Maybe even a two. I'm very relaxed. I feel good. And then as the day goes on, we have to talk, my anxiety goes back up. That's when I wish I could go walk back in here and breathe. (patient)

VR Facilitates Mindfulness Practice

Both patients and staff conveyed that having VR available was a low-effort way to introduce novelty and interest into a regularly scheduled morning meditation time. Patients described enjoying the option to start their day with a “new,” “intriguing,” and “different” method for practice:

[Using VR in the morning] sets you up, because after that it's pretty intensive – group things, lecture. You come out [of VR] more focused and relaxed. It's kind of what you need if you didn't have the best sleep. It's helpful to start off the day like that. (patient)

Several patients were so enthusiastic about the potential of VR mindfulness in supporting their well-being and recovery that they reported intent to use a headset at home post-treatment.

We're actually contemplating getting [a VR headset] for my family... It's one of those things that really gets your mind off of what you might be caught up in. (patient)

Almost all patients reported that VR was a helpful addition to their “mindfulness toolkit,” stating that the program offered unique benefits over other strategies (such as quiet sitting meditation, audio-guided meditation, and self-guided breathing exercises). We elaborate on ways in which participants described how VR helped address typical barriers to practicing mindfulness below.

VR Helps Limit Distractions

Approximately 75% of focus group participants mentioned that VR mindfulness helped focus attention on the present moment—an essential component of mindfulness practice. The combination of immersive visuals and sound appeared to effectively capture and sustain participants' attention, limiting distractions within the meditation room. For many,

certain game-like features of the “Focus” experience helped with concentration by sustaining focus in ways that limited external distractions and internal mind-wandering.

If I was exceptionally distracted, nervous, or anxious I would use the headset because it helps completely envelop me and makes me focus on what's right in front of me. (patient)

Immersion in virtual environments appealed to some who previously struggled to minimize racing thoughts during mindfulness practice. Participants praised the ease of putting on the headset and having a visual element to help them enter a “different mind space” where they were less distracted.

VR Mindfulness Feels More Accessible

Some patients mentioned prior difficulties with traditional, instructor-led mindfulness practices and that VR mindfulness made it easier to initiate or maintain a practice. Patients often expressed how they were hesitant to practice mindfulness and meditation due to perceptions of mindfulness as esoteric or overwhelming. Both patients and staff relayed how VR could offer an initial entrée into a mindfulness practice, serving as a stepping stone to the possibility of a deeper practice:

It's something that has helped me start in my meditation practice because it focused on my whole being, I was just in this realm. It was the only thing I needed to focus on. It was kind of nice to get that sense of, ‘Ok, this is what meditating can feel like and then I can use that to cross over into [other] mindfulness exercises. (patient)

It takes you into a different reality ... There's calming voices and music in the background. That could be helpful if [patients] don't know how to meditate [when they enter residential treatment]. (staff)

Some patients mentioned how VR mindfulness helped reinforce skills even when they were not in VR. Patients described how the experience of visualizing the breath in VR helped them, at other times of day, to “ground” and “go into” their practice:

I would also say too that it introduced me to meditation, so if I'm having a particularly stressful day I'll use it, at the same time because it introduced me to it I now can develop my own self meditation skills, where I can lie on the floor and meditate versus having to use the headset to be able to focus. (patient)

Staff also highlighted this feature emerging in their conversations with patients. Focusing on the breath, inhaling, and exhaling to a slow stream of light in and out, prevented

patients' minds from wandering, especially among patients new to meditation:

I think overall to point out something specific from it, from the headset, they really do like the breath visualization. That's something in our discussions I've been able to go and talk about how that's such a huge part of mindfulness. That connection [between VR and "real world"] is something some patients are able to make. (staff)

Understanding Apprehension Around VR

Some patients who attended the focus groups expressed mild discomfort associated with wearing the VR headsets: nausea, headache, or mild vertigo were the most commonly reported issues, though none felt they were prohibitive concerns. Importantly, staff explained that many patients opted out of using VR because the experience could be "overstimulating" or trigger feelings of being unsafe for some patients, especially for those with complex trauma histories. As an immersive technology, patients could no longer rely on their normal hearing and sight to assess their safety:

The folks who have not enjoyed [VR] tend to have more extensive trauma history... It's not knowing [what is going on around you], not being able to see... it can just be a lot. Especially with the headphones too. (staff)

Null Findings on VR and Cravings

Contrary to our predictions, no patients who attended the focus groups reported reductions in cravings related to using VR.

Discussion

The current findings suggest that VR mindfulness may be useful to people in residential substance use treatment who previously hesitated to try mindfulness, or struggled with common barriers, to engage in mindfulness practice. The qualitative nature of this study revealed several common themes about potential affective, cognitive, and motivational mechanisms whereby participants engaged more meaningfully with mindfulness. For example, participants reported enthusiasm about the potential of VR to support mindfulness practice, and a desire to return to the experience multiple times per week over a period of several months. These findings align with observations from Arpaia et al. (2021)'s recent systematic review that characterizes VR-based mindfulness as a form of "gamification" that uses similar mechanisms to video games that contribute to user motivation and persistence. The present study contributes to the notion that the

game-like feel of VR can increase the appeal of practicing mindfulness among people who might have experienced barriers to cultivating a practice in the past.

The data presented here also parallel the findings of Seabrook et al. (2020), whose mixed methods study assessed VR's acceptability and efficacy in cultivating mindful awareness, positive emotional effects, sustained attention, and increased engagement during a 15-minute mindfulness practice in a laboratory with a general population. Similarly, our findings indicate that the immersion and presence of VR calm the mind, focus attention, and reduce distractions that might otherwise limit their interest in practicing mindfulness. Our study expands the qualitative findings of Seabrook et al. (2020) to a real-world clinical setting. Our study also suggests that there may be sustained benefits over multiple sessions of mindfulness practice spread over an extended period (up to three months)—indicating promise for VR-based mindfulness in SUD treatment.

These findings are important given the paucity of literature on using VR to promote mindfulness-based interventions for SUD treatment, and the potential for mindfulness practice to aid in the regulation of difficult emotions that lead to substance use. In particular, the findings suggest that VR-based interventions designed to promote user enjoyment and immersion may engage people with SUD in sustained mindfulness practice. Further research is needed to explore the efficacy of VR-based mindfulness in areas such as craving reduction, substance-seeking behaviors, and substance use. Future researchers may also continue to explore what kinds of VR experiences best promote sustained engagement in mindfulness with other populations who may have different needs. Systematic, large-scale surveys (Barnes et al., 2008; Olano et al., 2015) converge on the findings that men, racial and ethnic minorities, and those with lower education are generally less likely to use mindfulness than women, White people, and those with higher education; thus, further exploration of the benefit of VR to better engage these specific groups is warranted. Washburn et al. (2021) also call for researchers and developers of VR-based SUD treatments to identify ways to utilize the unique immersive capabilities of VR for specific populations, particularly older adults with SUDs.

Interestingly, in the present study, of participants who did consent to use VR and attend focus groups, there were significantly more men than women. Staff at the residential treatment facility also observed that women were more likely to opt out of using VR during their allotted morning meditation time. It may be that VR-based mindfulness interventions are best suited for particular sub-populations and future studies could explore this question more thoroughly.

The present study indicates that VR may not appeal to everyone, given women and people with extensive trauma

histories were more likely to opt out. On the other hand, a large number of participants who engaged in VR mindfulness as part of this study identified VR as a viable approach for increasing interest and engagement in mindfulness practice. Traditional mindfulness techniques are often not optimal for all people, and this can be especially true for people who use substances to help avoid negative emotions and have difficulty remaining present in the here-and-now (Hone-Blanchet et al., 2014). Any alternative that offers unique pathways to cultivating a mindfulness practice warrants further attention. As VR becomes more affordable and accessible for everyday consumers, it has the potential to introduce mindfulness concepts to new and broader audiences and generate renewed interest in people who may have already dismissed mindfulness as “not for them.”

Limitations

The current study indicated acceptability of VR mindfulness for people with SUD. However, there are several limitations to note. The single-arm design did not include a control condition, and some patients opted out of study participation. Therefore, the feedback presented from this study represents participants who may have been more interested in VR-based mindfulness from the outset. Future research employing randomized controlled treatment designs could help address these limitations.

It is also important to recognize that participants had limited access to any technology in the residential treatment facility, so their engagement in the VR program may have been higher compared to a less restrictive or non-residential setting. Assessment time points varied between participants such that some reported on their experiences after their first use and others reported after two or more uses. Future studies should explore VR use across additional settings and with more consistent assessment schedules. Given the nature of qualitative research, there is also the possibility of subjective bias by the coders who were also closely involved in the focus group administration. However, our study team analyzed codes independently and jointly, generating common themes and highlighting outliers. Since this is the first evaluation of the TRIPP “Focus” VR experience in a residential facility, the findings should be interpreted with caution until qualitative analyses of new cohorts in additional treatment facilities are available.

Future research could also explore additional modalities to implement immersive content (e.g., interactive VR rooms) to understand whether it is more amenable and appropriate for patients with extensive trauma histories or who otherwise did not engage in the TRIPP “Focus” VR. This study supports the need for further research with more rigorous study designs to evaluate the potential value of VR for improving outcomes for people with SUD. VR content possibilities are

far-ranging, so understanding the mechanisms facilitating mindful awareness and regular practice will be critical to creating effective VR-based mindfulness interventions.

Conclusion

This study suggests that VR may be useful in helping individuals with SUDs overcome persistent barriers to practicing mindfulness by generating an enthusiastic outlook on and sustained interest in mindfulness from people who reported previous ambivalence or hesitation to practice. As VR technology rapidly evolves and becomes available at a lower cost and higher quality, it may help more people reap the benefits of mindfulness and reduce personal, healthcare, and societal burdens associated with SUDs.

Appendix Focus group interview guides

Patient Interview Guide

1. Can I first ask how many times you have tried VR for mindfulness here at CeDAR?
2. When you think about using VR for mindfulness, what is the first thing that comes to your mind? (Prompt: If a friend or family member asked you to do VR mindfulness, what would you tell them about it?)
3. Why did you decide to try or not to try VR mindfulness?
4. What was it like to use the equipment? Prompts: Easy or hard to use?
5. How is VR different than other mindfulness you do at CeDAR or that you have done in other places? (point: comparison to other approaches to mindfulness).
6. How does the VR fit into your overall treatment here at CeDAR?
7. What positive reactions have you experienced, if any?
8. What negative reactions have you experienced, if any?
9. (If not already addressed) How did using the VR mindfulness affect your cravings?
10. (If not already addressed) How did it affect your mood?
11. How do you think VR mindfulness can be improved? (broad: equipment, content, how it is incorporated at CeDAR).
12. If you could design your own VR mindfulness experience, what would you include?
13. At what other times (or for what other use cases) could VR mindfulness be made available during your treatment?
14. What other content would you be interested in using besides the TRIPP app and why?

15. Are you interested in continuing with VR mindfulness while in treatment? Continuing to use VR mindfulness after your time in treatment? Why or why not?
16. Anything else you would like to share that we have not touched on?

Staff Interview Guide

1. First name, role at CeDAR, and when you think about using VR for mindfulness, what is the first thing that comes to your mind? (Prompt: If a friend or family member asked you about VR mindfulness, what would you tell them about it?).
2. What were some of the initial reactions your patients had when VR was introduced?
3. Why did some patients decide to try VR mindfulness and others decided not to? (Prompts: physical symptoms, belief system).
4. What was it like for patients to use the equipment? (Prompts: Easy or hard for patients to use?).
5. How does VR mindfulness fit within your workflow?
6. What are your perceptions of administering mindfulness in VR?
7. How have you heard your patients talk about VR mindfulness vs other mindfulness you offer? (point: comparison to other approaches to mindfulness).
8. What clinical benefit have your patients experienced, if any? (prompts: how do you know/how have you seen that?).
9. What negative clinical implications/effects have your patients experienced, if any? (prompts: how do you know/how have you seen that?).
10. (If not already addressed) How did using the VR mindfulness affect subjective patient cravings? (Prompts: How have you seen this change?).
11. (If not already addressed) How did it affect patient mood? (Prompts: How have you seen this change?).
12. How do you think VR mindfulness can be improved? (broad: equipment, content, how it is incorporated at CeDAR).
13. If you could design a VR mindfulness experience for your patients, what would you include?
14. Are you interested in continuing to offer VR mindfulness while in treatment (after the study ends)? Why or why not?

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Declarations

Disclaimer The virtual reality hardware and software used in this study were provided by TRIPP VR, Inc. After the study was conducted, NMHC and TRIPP VR established a formal partnership to provide consultation.

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