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Exploring the Potential of Virtual Reality in Eating Disorder Treatment

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ABSTRACT

Introduction: Eating disorders (EDs) are complex mental health conditions with significant treatment barriers, including stigma and limited access to care. Virtual reality (VR) offers a novel approach by providing immersive, controlled environments for addressing body image

concerns and maladaptive eating behaviours. This review explores VR's potential in ED treatment based on recent research.

Methods: A literature review was conducted using PubMed, Google Scholar, and Web of Science, focusing on studies from the past five years that examined VR as a treatment tool. Clinical outcomes, intervention types, and methodologies were analysed.

Summary of Findings: VR has shown promise in reducing body dissatisfaction, fear of weight gain, and binge eating behaviours. Studies using personalized avatars, attentional bias training, and exposure therapy demonstrated improvements in body image perception, anxiety reduction, and coping skills. VR-enhanced cognitive behavioural therapy (VR-CBT) was particularly effective for bulimia nervosa and binge eating disorder.

Conclusions: VR is an effective, accessible tool for ED treatment, offering safe and engaging therapeutic experiences. While promising, further research is needed to refine treatment protocols and enhance personalization. As technology advances, VR has the potential to bridge treatment gaps and improve ED recovery outcomes.

Keywords: eating disorders, Virtual Reality, body image, Virtual Exposure Therapy

Introduction

Eating disorders (EDs) are complex mental health conditions marked by disruptive eating behaviours and distressing thoughts, affecting people of all ages, genders, and body types. They can severely impact one's quality of life, especially psychological well-being, even in less severe or subclinical cases.[1] Among the most prevalent EDs, Other Specified Feeding or Eating Disorder (OSFED) affects around 7.4% of individuals, followed by Anorexia Nervosa (AN) (3.6%), Bulimia Nervosa (BN) (2.1%), and Binge Eating Disorder (BED) (2.0%), with women experiencing higher rates.[2]

Psycho-behavioural therapy is the cornerstone of treatment, typically provided on an outpatient basis, while more severe cases may require hospitalization. Evidence-based care delivered by clinicians trained in eating disorders has proven to be the most effective and cost-efficient method. However, recovery can be a long and challenging process, with many individuals postponing treatment for years. A variety of barriers - including low motivation, depression,

body image concerns, stigma, limited access to care, and poor health literacy - often lead to poor outcomes and contribute to the widening treatment gap. This highlights the critical need for more accessible and effective treatment options.[3]

In this context, virtual reality (VR) emerges as a promising tool for treating eating disorders. By offering an immersive, controlled environment, VR allows patients to confront food-related triggers and body image issues safely. It provides a sense of anonymity, which can reduce feelings of judgment and help patients feel more at ease. Furthermore, VR simulates real-life scenarios, enabling patients to practice healthy behaviours in a risk-free setting. Its interactive nature enhances patient engagement and motivation, while the ability to tailor experiences and deliver remote therapy increases accessibility and convenience.[4,5]

It is also worth noting that VR has already proven effective in addressing other psychological challenges, with previous research demonstrating its benefits in treating conditions like post-traumatic stress disorder (PTSD) or social anxiety disorder.[6,7,8] These successes underscore VR's potential to effectively tackle the complex emotional and behavioral issues associated with eating disorders.

The aim of this article is to explore VR as an innovative therapeutic tool for treating EDs and evaluate its effectiveness based on existing research.

Materials and Methods

This review assesses the effectiveness of virtual reality interventions in treating eating disorders, focusing specifically on studies where VR was used as a treatment approach, rather than as a diagnostic tool or for studying patient behaviours. The review emphasizes clinical outcomes, intervention types, and research methodologies. A comprehensive search was conducted across major databases, including PubMed, Google Scholar, and Web of Science, using keywords such as "virtual reality," "eating disorders," and "therapy." The review prioritizes studies from the past five years to highlight current trends, capturing the rapid advancements in VR technology and the development of new therapeutic approaches during this period.

Results

Virtual Reality in the Treatment of Eating Disorders: A Focus on Body Image and Attentional Bias

VR has emerged as a promising tool in the treatment of eating disorders, particularly in addressing distortions in body image and related anxieties. Recent studies have focused on the use of personalized avatars whose body mass index (BMI) is gradually increased over

successive sessions. This approach aims to help patients recalibrate their perceptions of body size and reduce maladaptive behaviours associated with AN.

One innovative study by Ascione et al. (2023) investigated the efficacy of Attentional Bias Modification Training (ABMT) in 23 female adolescents with AN. Utilizing an HTC Vive Pro Eye headset equipped with Tobii eye-tracking and immersive Unity 3D environments, the researchers engaged participants with personalized avatars. The intervention began with a baseline assessment using the BIAS-BD questionnaire to measure body dissatisfaction (BD) and an initial five-minute VR protocol designed to foster body ownership. During this period, eye-tracking captured fixation time and frequency on weight- and non-weight-related body areas. The training session, lasting 10–15 minutes, involved directing attention to geometric figures appearing across various body areas, with the aim of modifying attentional bias away from weight-related stimuli. Post-training assessments revealed significant reductions in both fixation time on weight-related areas (from 3269.88 ms to -94.88 ms) and overall body dissatisfaction (from 42.83 to 33.26 on the BIAS-BD scale). These findings demonstrate that ABMT, delivered via VR, is effective in reducing maladaptive attentional patterns and body dissatisfaction in adolescents with AN. While the frequency of fixations did not change significantly, the reduction in fixation time suggests a shift in attentional focus that could lead to long-term improvements in body image.[9]

In parallel, Behrens et al. (2023) explored VR exposure therapy in a sample of 24 patients with anorexia nervosa. Their protocol incorporated an initial diagnostic and educational session, followed by four structured 50-minute exposure sessions. Central to this study was the gradual exposure to body shapes reflecting a BMI of at least 19 kg/m², with incremental increases tailored to each participant's specific concerns regarding body shape and weight gain. Physiological markers were meticulously monitored during these sessions, including continuous heart rate measurements and periodic self-assessments of arousal. The results revealed a significant reduction in the fear of weight gain, with scores decreasing from 71 (SD = 24) in session 1 to 54 (SD = 34) in session 4. However, no significant changes were observed in body dissatisfaction or ideal body measures. While the data did not show significant statistical changes in these areas, trends indicated medium to large effects within sessions, suggesting that prolonged exposure could have a cumulative positive effect on body image. Interestingly, participants who displayed higher levels of arousal, particularly those in Cluster 3 (who focused on perceived "ugly" body parts and used avoidance strategies), showed less improvement in fear of weight gain than those in other clusters. This highlights the importance

of considering emotional responses and individual differences when designing VR-based interventions.[10]

Similarly, Malighetti et al. (2021) focused on the role of embodiment in body perception among young women with AN. In their study, seven participants engaged in a VR body size estimation task across four sessions. The intervention involved gradually adjusting the avatar's BMI from an underweight to a healthy level, thereby providing a dynamic platform for patients to confront and re-evaluate their distorted body image perceptions. Participants were asked to recall emotionally salient life events—negative memories when interacting with the underweight avatar and positive memories with the healthy BMI avatar—to reinforce the therapeutic process. Clinical assessments conducted before and after the intervention showed that participants significantly improved in estimating their desired BMI from session 1 to session 4. This shift toward more accurate body size perceptions was further supported by a reduction in body dissatisfaction as indicated by clinical assessments. Although decreases in concerns about body image and body shame were not statistically significant, the trends still suggested meaningful clinical improvements. Notably, the embodiment questionnaire revealed that participants felt a higher level of ownership, location, and agency over the virtual body when embodied with avatars reflecting their real BMI as opposed to their desired BMI. This finding underscores the importance of fostering a realistic sense of embodiment, which may contribute to improved self-perception and long-term changes in body image.[11]

Adding further evidence to the effectiveness of VR-based interventions, Porras-Garcia *et al.* (2021) conducted a study with 35 patients diagnosed with AN, dividing them into an experimental group (16 patients) receiving VR-based body exposure alongside cognitive-behavioural therapy (CBT) and a control group (19 patients) receiving standard treatment. The VR exposure sessions gradually adjusted the virtual body's BMI to match the real-size silhouette of each participant. Outcome measures included visual analog scales (VAS) for body image and anxiety, eye-tracking technology (ET) for attention bias, and the Eating Disorder Inventory 3 (EDI-3) for symptomatology. Results showed that the experimental group demonstrated significantly lower fear of gaining weight ($MD = 23.21$, $SE = \pm 9.94$, $p = 0.028$) compared to the control group at post-assessment. Additionally, significant improvements were observed in body distortion ($p = 0.030$), body dissatisfaction (EDI-BD, $p = 0.048$), and fear of weight gain ($p = 0.026$), with these effects persisting at follow-up. While attentional bias towards weight-related stimuli showed a decreasing trend, the changes were not statistically significant. Notably, younger participants within the experimental group exhibited the most

significant improvements, whereas age was a predictor of worse outcomes. In contrast, the control group did not exhibit any significant changes. These findings suggest that VR-based interventions, particularly when combined with CBT, can lead to meaningful reductions in body dissatisfaction and fear of weight gain, with greater effectiveness in younger patients.[12]

In conclusion, VR interventions that employ avatars with gradually increased BMI offer a novel and multifaceted approach to the treatment of eating disorders. The collective findings from recent studies provide a strong basis for further exploration of VR's potential in addressing body image disturbances and related psychopathologies in patients with anorexia nervosa. The promising outcomes observed, such as reductions in body dissatisfaction, fear of weight gain, and improvements in body size estimation, suggest that VR-based interventions hold significant potential in supporting individuals with anorexia nervosa in reshaping their body image and fostering healthier psychological and physiological responses.

The Role of Virtual Reality Exposure Therapy in Treating Eating Disorders

VR exposure therapy leverages realistic simulations to help patients confront and manage the emotional and behavioural challenges associated with conditions such as bulimia nervosa, anorexia nervosa, and binge eating disorder. By integrating principles of cognitive behavioural therapy (CBT) with virtual environments, these interventions not only allow for tailored exposure to problematic stimuli—ranging from food cues to distorted body images—but also enable patients to practice coping strategies in a safe setting.

A study by Sansoni et al. (2024) investigated the use of VR-enhanced CBT (VR-CBT) in 24 participants diagnosed with Bulimia Nervosa (BN). This intervention combined traditional CBT with immersive VR sessions using NeuroVR software. Over the course of 5 weekly CBT sessions and 10 biweekly VR sessions, patients were exposed to 14 different virtual environments—such as supermarkets, restaurants, pubs, and even swimming pools—to simulate real-life scenarios that typically trigger abnormal eating behaviours. In the initial session, therapists identified individual triggers including food exposure and body shape concerns. During subsequent sessions, techniques like Socratic questioning helped patients process their experiences and develop adaptive strategies for emotional regulation, problem-solving, and decision-making.

The results were compelling. Patients in the VR-CBT group demonstrated significant improvements on the Eating Disorder Inventory-2 subscales, particularly in measures of bulimia (EDI-BU) and drive for thinness (EDI-DT), with improvements sustained at both post-treatment and 1-month follow-up. Additionally, while both the VR-CBT and control groups

(Integrated Inpatient Program) experienced reductions in BMI immediately after treatment, the VR-CBT group maintained these improvements over a 12-month period, suggesting a more stable, long-term benefit of VR interventions.[13]

VR has also been effectively applied to the treatment of anorexia nervosa. In a study by Natali et al. (2024), 145 participants underwent VR exposure therapy aimed at reducing food-related anxiety. Using Oculus Quest 2 headsets, participants were immersed in a virtual kitchen environment. They were randomly assigned to one of three conditions: a baseline condition with the kitchen environment alone, a positive mood condition enhanced by the presence of a virtual pet, or a social support condition featuring a supportive avatar delivering motivational scripts. The study's findings revealed that only the positive mood condition resulted in a significant reduction in food-related anxiety, highlighting the importance of an uplifting, emotionally supportive virtual environment in mitigating anxiety triggers. Conversely, participants in the baseline condition experienced an increase in food-related anxiety, underscoring that the context in which exposure is delivered can substantially affect outcomes.[14]

VR technology has also been harnessed to target binge eating and loss-of-control (LOC) eating behaviours. Nameth et al. (2021) implemented Virtual Reality-based Cognitive Exposure Therapy (VR-CET) in a group of 11 patients with binge eating disorder. In these sessions, participants were exposed to personalized, food-related VR triggers, with the goal of reducing anxiety and cravings. The treatment protocol, which involved up to eight one-hour sessions using the Oculus Rift platform, led to a dramatic reduction in objective binge episodes—from an average of 3.27 per week pre-treatment to 0.94 post-treatment—and similar decreases in subjective binge episodes. These improvements persisted at follow-up, with a majority of participants demonstrating clinically significant reductions in binge eating and purging behaviours.[15]

Complementing these findings, another study by Manasse et al. (2021) employed VR-based inhibitory control training (ICT) with 10 participants who reported frequent LOC eating episodes. In this intervention, patients interacted with food items in a virtual dining setting via a Go/NoGo task, where increasing levels of difficulty aimed to strengthen inhibitory control over impulsive eating behaviours. The results were promising, LOC eating episodes significantly decreased from an average of 9.86 at baseline to 1.93 at follow-up. Although measures of impulsivity yielded mixed results, reductions in food consumption during a sham

taste test were moderately correlated with decreases in LOC episodes, suggesting that improvements in inhibitory control may contribute to healthier eating patterns.[16]

Virtual reality exposure therapy represents a cutting-edge approach to treating eating disorders by enabling immersive, controlled exposure to real-world triggers. The studies reviewed herein illustrate the diverse applications of VR—from VR-CBT for bulimia nervosa to VR-based exposure and inhibitory control training for anorexia nervosa and binge eating disorder. Despite variations in study design and patient populations, a common thread emerges: VR interventions facilitate the development of adaptive coping strategies by replicating challenging environments in a safe, therapeutic setting.

Discussion

Virtual reality (VR) has undergone significant transformation in recent years, turning what was once a technology limited to laboratories into a widely accessible tool. Advances in graphics cards, smartphones, and modern head-mounted displays (HMDs) have made VR devices lighter, with higher resolutions and wider fields of view. Thanks to advanced gyroscopic technology, smartphones can now function as VR platforms, extending the technology's applications beyond entertainment and into healthcare.[17]

As VR has become more accessible, numerous studies have explored its potential in therapy. Analysing patients' emotional and cognitive responses in virtual environments has provided insights into the challenges of body acceptance, particularly in individuals with anorexia.[18] For instance, some studies have shown that lower levels of body illusion may indicate difficulties with body perception, suggesting that more realistic, multi-sensory VR experiences could assist in therapy.[19] Simultaneously, research has identified the role of food aversion in negative eating behaviours, and personalizing VR environments could help reduce this aversion.[20] Furthermore, the process of interacting with food in VR involves both rapid, subconscious reactions and slower, more controlled stages of information processing, opening up new possibilities for designing more effective therapeutic interventions.

Alongside scientific research, feedback from both therapists and patients has affirmed the potential of VR as a therapeutic tool. Therapists appreciated the system's ease of use and the opportunities it provided, while patients, despite initial anxiety, quickly grew more comfortable and trusting of the method. Interactions with avatars and the ability to conduct therapy in an anonymous online space fostered emotional expression and deep reflection on body image. The inclusion of interactive features further enriched the sessions, making them feel less formal and more approachable.[21]

Despite these promising results, there are several limitations to VR-based studies. Small sample sizes, short observation periods, and a lack of full control over variables - such as disorder subtypes or disease duration - can affect the accuracy and generalizability of the findings. Moreover, VR technology has not always been fully tailored to the individual needs of participants, which may reduce the quality of the experience and the effectiveness of the therapy. Given the challenges, such as issues with interoception in patients with eating disorders, further research and modifications are necessary to optimize VR's potential in therapy.

Conclusions

In conclusion, VR represents a promising and innovative approach to the treatment of EDs, offering a safe, immersive, and controlled environment for patients to confront body image issues, food-related anxieties, and maladaptive eating behaviours. The studies reviewed highlight the effectiveness of VR interventions, particularly in addressing body dissatisfaction, fear of weight gain, and distorted body image perceptions, especially in individuals with anorexia nervosa, bulimia nervosa, and binge eating disorder. When combined with CBT or other therapeutic approaches, VR has shown potential to foster long-term improvements in eating behaviours, emotional regulation, and self-perception.

Although the current evidence is promising, there are still limitations, including small sample sizes and short-term observation periods, that necessitate further research to fully understand the long-term benefits and optimize the technology for personalized treatment. As VR technology evolves, it has the potential to bridge gaps in care, offering flexible and effective treatment for individuals with eating disorders. By overcoming barriers to traditional therapy, VR can improve accessibility, enhance treatment effectiveness, and support better recovery outcomes.

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