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Innovative Approaches to Stress Reduction: A Review of Virtual Reality Therapy in University-Going Students

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ABSTRACT

Students face unique challenges in terms of stress and Virtual Reality Technology (VRT) is emerging as a novel method for managing it. It has immersive and engaging nature that makes it potentially more effective stress management tool. **Objective:** To analyzed the effectiveness of VRT in managing stress among university students. It also evaluates student willingness to adopt these interventions compared to traditional methods. **Methods:** Narrative approach was used to review existing literature, focusing on studies that assessed the impact of VRT on student stress levels. Data were analyzed considering variations in VR content, delivery format, and participant demographics. **Results:** The review revealed that students generally show a willingness to use VRT for stress management but the effectiveness of these interventions was inconsistent. VRT using natural environments especially with greenery was more effective in reducing stress as compared to virtual settings. However, some studies reported no significant difference between VRT and traditional methods. **Conclusions:** VRT has potential in enhancing student well-being but its effectiveness was influenced by the type of VR content, delivery method, and individual characteristics. The limitations suggest that VRT was not a definitive solution to stress. This shows that further research was needed to optimize VRT interventions and to implement them to broader academic settings.

INTRODUCTION

Academic stressors such as fear of failure, time management, coursework, exams, and the challenge of balancing social life significantly affect university students [1]. The prevalence of stress within university going students ranges from 15% to 30% [2]. After COVID-19 pandemic, due to disruptions, uncertainty, and loss of social life the presence of psychiatric disorder has significantly elevated [3]. This has led to increased stress levels and depression among students [4]. The incidence of suicidal thoughts and attempts is higher among students than in older individuals i.e., nearly 5%-7% in males and females respectively [5]. It has been reported in the literature that stressful environment and suicidal behavior is associated [6]. Another factor that causes higher prevalence of stress in students is the urbanization, migrating from rural less densely populated areas to urban areas [7]. Due to this, students get isolated from their natural environments [8, 9]. College and university students around the world are compelled to live independently for the first time in their life for studies which can lead to a lot of stress [10]. Additionally, other academic stressors like financial pressures, high academic workload, performance pressure, lack of social support, poor time management, health issues, and access to academic resources further increase the stress levels among students. Every situation that leads to negative emotions such as anxiety, anger, sadness and fear can lead to stress. On the contrary interest contentment, joy and love are positive emotions which reduces the levels of stress. In this review stress among university students and the efficacy of Virtual Reality Therapy (VRT) to mitigate the levels of stress is discussed. VRT is a novel tool that uses

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computer-generated simulations to create immersive, interactive 3D environments. This allows individuals to engage with these environments as if they were real. It has potential in therapeutic applications such as stress management. Traditionally, stress management for students has relied on counseling, meditation, and exercise regimes [10]. These approaches are effective but have limitations like accessibility, affordability, and long term adherence [11]. Modern students are tech-savvy and their perceptions about traditional approaches is that they are outdated and efficient for older adults [12]. Furthermore, the traditional approaches for stress management may be unappealing and stigmatizing to the students. Also, they require time and financial resources which the students usually lack. The alarming levels of stress among students requires innovative approaches for stress reduction [13]. It is known that physical exercises prevent negative emotions and is beneficial for the physical and mental wellbeing of individuals [14]. The literature suggests that the psychological effects of physical exercise can be attained by manipulating the brain with environmental changes through VRT [15]. This approach helps in improving the ability to calm down and stimulating positive emotions thus resulting in better stress management [16]. The main advantage of VRT in contrast to the traditional approaches of mental health management is that it can be tailored according to the individual's needs and preferences.

The aim of this study was to review the efficacy of VRT as a stress management tool among students, specifically among university going students. Considering the high prevalence of stress among university students and the drawbacks of traditional approaches for stress management the need for affordable, appealing and innovative approach for this purpose was higher than ever before. The use of VRT in phobia, anxiety and PTSD has been studied extensively. Nevertheless, the use of VRT in the management of stress primarily in students was limited. This paper seeks to synthesize the existing literature on this topic and critically analyze the efficacy of VRT based interventions and opening a portal for future research.

METHODS

An extensively structured search was conducted in Pub Med database using the following keywords: "virtual reality therapy", "stress reduction", "students" and "university". The search strategy utilized in this review was influenced by a prior systematic investigation exploring the use of VRT in promoting the well-being of young adults [17]. The search had no time restrictions to include all the relevant studies. The inclusion criteria were as follows: (a) studies with college and university students as participants, (b) studies that evaluated the efficacy of virtual reality therapy for stress reduction, (c) studies published in English language and (d) publications of peer reviewed journals. The exclusion criteria were: (a) studies including participants other than students, (b) studies focusing on approaches for stress management other than VRT, (c) studies in which the assessment of efficacy of VRT was related to other psychological complications such as PTSD. We excluded studies focusing on PTSD because the primary aim was to evaluate the efficacy of VRT specifically for stress reduction. PTSD was related to stress but it represents a distinct clinical condition with specific therapeutic approaches and outcomes. Adding PTSD would have introduced variables not comparable to general stress management. This could potentially affect the results of specific impact of VRT on everyday stress experienced by students. The initial search resulted in the identification of 512 published articles. The titles and abstracts of all the articles were screened carefully by the principal author and resulted in the isolation of 12 studies. After a thorough full text study of these articles 4 studies were finalized that met the inclusion criteria. In the process of studying these articles 3 new studies were identified based on the citations. Majority of the studies were excluded because they focused on participants other than the students or the efficacy of VRT on stress reduction was not the objective of the studies. The complete process of screening was scrutinized by the corresponding author. For this purpose, Mendeley reference management was used. The data from the included studies was extracted regarding the names of the authors, year of study, study design, sample size, intervention, objectives and conclusions of the studies. An excel sheet was devised to record the data systematically (See supplementary material). For the data synthesis a narrative approach was used to qualitatively interpret the findings of the studies. Such approach was used in order to explain qualitatively the different methods, results and circumstances of the studies included in the analysis. This approach makes it possible to make a broader and more thorough assessment of VRT in different forms and in a variety of populations [18]. It was advantageous because studies on the topic are limited and also varied. Meta-analysis on the other hand, necessitates that studies are similar on a number of fronts while in this case the narrative synthesis can allow the differences in study and study outcomes. The studies published in high impact journals were focused more for the synthesis. The data synthesis was focused primarily on the use of VRT as a stress management tool among university students, its effectiveness, compliance and potential in the future research.

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RESULTS

Seven studies were shown to be satisfactory for the purpose of the review. Basic characteristics of these studies are set forth in table 1. These studies explore the use of Virtual Reality technology for stress management among various student populations. figure 1 Gao *et al.*, conducted a cross-sectional study with 120 college students and used the Profile of Mood States (POMS-SF) to assess changes in restorative states before and after VR visual stimulation [19]. Jo *et al.*, did a Randomized Controlled Trial (RCT) with 60 college students and examined the effect of VR-based forest videos on EEG outcomes [20]. Modrego-Alarcón *et al.*, targeted a total of 280 undergraduates and assessed response to a virtual reality-based mindfulness-based intervention [21]. FFMQ and SCS scales measuring perceived stress levels were also used and a significant reduction was seen. Plante *et al.*, conducted an experimental study with 112 psychology students [22]. They investigated the impact of physical activity and its adherence to the exercise combined with VR together with VR. AD-ACL, PACES and MC-SDS were some of the tools that had been utilized. Valtchanov *et al.*, did an RCT with 69 undergraduate students to compare physiological and affective responses to different VR environments [23]. They focused on nature versus urban settings and used the Zuckerman Inventory of Personal Reactions. Villani *et al.*, also evaluated to what extent VR technology was superior to more traditional approaches such as relaxation DVDs and audiotapes [24]. All 64 general students were involved in an experiment where the following scales were used: STAI-Trait, COPE, VAS, PANAS and STAI-State. Finally, Xu *et al.*, studied the feasibility of a 6-week VR exergame-based intervention for reducing anxiety, depression, and perceived stress among 15 university students [17]. Outcomes were rated using Perceived Stress Scale (PSS). These studies as a whole show that VRT is flexible tool in relieving stress in students. The outcomes of different VR treatments differ in various studies depending upon type of content used and type of format or participant's characteristics.

Table 1: Basic Attributes of the Studies Incorporated in this Review

S.No.	Authors	Method	Sample Size	Population	Tool	Objective
1	Gao *et al* [19]	Cross-Sectional	120	College Students	Profile of Mood States (POMS-SF)	To figure out the Difference in the Restorative State Before and After Visual Stimulation by Using VR Devices.
2	Jo *et al* [20]	RCT	60	College Students	Questionnaires	The effect of Watching Forest Videos using VR on the EEG.
3	Modrego-Alarcón *et al* [21]	RCT	280	University Students	FFMQ and SCS	To Investigate the Effectiveness of a MBP Delivered through Virtual Reality for Reducing Perceived Stress in University Students.
4	Plante *et al* [22]	Experimental	112	College Psychology Students	AD-ACL, PACES and MC-SDS	To Evaluate the Psychological Effects of Exercise when Paired with Virtual Reality.
5	Valtchanov *et al* [23]	RCT	69	Under-graduate Students	Zuckerman Inventory of Personal Reactions	To Investigate the Physiological and Affective Responses of Individuals when Immersed in different VR Environments, Specifically Comparing the Effects of Nature and Urban Settings.
6	Villani *et al* [24]	Experimental	64	Students in General	STAI-Trait, COPE, VAS, PANAS, STAI-State	To Evaluate the Effectiveness of Virtual Reality as a Tool for Relaxation Compared to DVD and Audiotape
7	Xu *et al* [25]	Experimental	15	University Students	Perceived Stress Scale (PSS)	To Explore the feasibility of a 6-week VR Exergame-Based Intervention in Reducing Anxiety, Depression, and Perceived Stress Among University Students and to Examine the Usability And Acceptability of Such Games.

[1]**Abbreviations:** RCT, randomized controlled trials; FFMQ, five facet mindfulness questionnaire; SCS, self-compassion scale; AD-ACL, activation deactivation adjective check list; PACES, protective and compensatory experiences; MC-SDS, Marlowe Crowne social desirability scale; STAI, state-trait anxiety inventory; COPE, coping orientation to problems experienced; VAS, visual analogue scale; PANAS, positive and negative affect schedule.

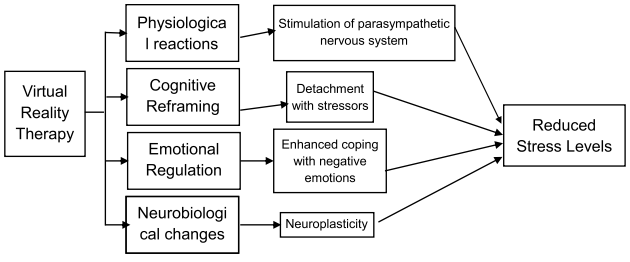

Figure 1: Potential Mechanisms Involved in Reduction of Stress Through Virtual Reality

The research findings on the effectiveness of VRT in stress management are presented in table 2. In all the studies included in this review the intervention of VRT somehow was effective in managing stress. Almost all the studies incorporated a control group to compare the intervention with. Notably the interventions were not significantly effective in all the reported studies in this review. Nonetheless, decreased negative emotions, increase in positive emotions and more relaxed state were reported in different studies. One of these studies reported no significant difference between mindfulness-based

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programs and VRT [19]. Another study suggested that the effect of VRT was increased if the individuals feel more engaged in the environment [22]. Most of the studies were conducted among university students but some were also conducted on undergraduate students, college students of nursing and medical backgrounds. The VRT interventions used in these studies varied. Panoramic VR based photographs, VR nature imagery, VR combined with MBP, VRT combined with exercise, VR visuals of urban, natural and geometrical visuals, VR with forest images, VR based boxing games were used as an intervention in the included studies. The data synthesis suggests that VRT with natural images and visuals particularly with greenery seems to be more effective for stress management as compared to other VRT interventions [19, 23]. The available evidence suggests that the VRT interventions tailored for individual's preference are more effective in managing stress [22]. The potential for VRT as a stress management tool lies in its general efficacy and the adaptability to the needs of student populations [26]. The review highlights the need to tailor VRT procedures to the individuals on whom it was applied. Such personalization can however be extended to cover other sociographic factors such as age, sex, socio-cultural factors and technological capabilities of the students. For instance, children or those who are not technology-oriented could be provided with primitive screens and orientation sessions. On the other hand, students who are more familiar with technology could be taken through the more sophisticated VRT sessions. Moreover, even though the choice of the virtual environment might be determined in terms of users social and cultural lines some cultural factors might also come in. For instance, the social setting that was preferred may be the one that matches the home atmosphere of the student. Different delivery formats can be used like one-on-one sessions, group interactions, or self-guided experiences. Based on student preferences alone an introvert student may do better with the self-guided or individual VRT sessions while an extrovert average better in VRT experiences which are group-based. VRT was capable of presenting any form of experience thus it was flexible. This flexibility provides a chance to come up with more universal measures of stress management based on the peculiarities present in the student samples [27]. Additionally, individual sessions with proper guidelines are seen to be more effective. It should be noted that the individual sessions and sessions with proper guidance give better results as compared to group sessions. However, they are costly and more time consuming which limits the use of VRT for stress reduction. We acknowledge that the data to compare the delivery formats was inadequate and more studies are needed to compare the delivery formats. The review regarding the use of VRT for stress management in students found studies involving students from different backgrounds as mentioned previously. Notably the studies of this review showed homogeneous results regardless of the academic background of students. It can be assumed that participants from higher education and female participants are more likely to benefit from VRT interventions for stress reduction [17]. Additionally, the students with high baseline levels of stress are more likely to experience positive effects of this intervention. Also, the students more inclined towards the use of technology are more likely to choose to experience this intervention. The authors acknowledge that the current literature was not adequate and further studies are required to evaluate the effectiveness of VRT among different groups of students based on demographics. The available literature further suggests that the university students are more willing to engage with the VRT interventions [25]. For the participants with currently enrolled in academic programs the use of VRT was not a complex or unpleasant to use process. The students were happy to complete the intervention-based programs. It should be noted that the effectiveness of VRT for the stress management was may not significantly higher than the traditional methods, but the adherence and acceptability was quite higher than the traditional approaches among college and university students [20]. The synthesis of the qualitative data indicated that this intervention was "easy to use, polished to a professional standard, fun and innovative" for students [28].

Table 2: Insights of the Studies Incorporated in this Review

S.No.	Authors	Intervention	Outcome
1	Gao *et al* [19]	VR Panoramic Photographs	While The Study Shows a Reduction in Negative Mood and Attentional Fatigue, Which are often Associated with Stress, it Doesn't Explicitly Conclude that these Environments Reduce Stress Overall.
2	Jo *et al* [19]	2D Videos and VRT	As a Result of the above, it was Investigated that Forest Videos using vr had a Positive Effect on the Physiological Stress on College Students. Therefore, it is Expected that a Positive effect will Occur if vr is used as an Alternative to Stress Management for College Students.
3	Modrego-Alarcón *et al* [21]	MBP and VRT	The Inclusion of VR Exposure Resulted in an Improved Adherence to the Mindfulness Program, although it did not Affect the Efficacy of the Intervention.
4	Plante *et al* [22]	Exercise, Exercise + VRT, VRT	Both Female and Male Participants walking in the Laboratory with the Virtual Reality were more Relaxed and Experienced the least Tension of the three Conditions.
5	Valtchanov *et al* [23]	VR Visuals of Nature, Urban and Geometric Shapes	Exposure to a Virtual Nature Environment led to Significantly Improved Affect and Reduced Stress Levels Compared to Exposure to an urban or Neutral Virtual Environment. This Suggests that Virtual Nature Experiences could have Restorative effects similar to real Nature, Potentially offering a Valuable Tool for Stress Reduction.
6	Villani *et al* [24]	VR, DVD Condition Audio Condition	More Immersed someone Feels in the Virtual Environment, the more effective the Relaxation Intervention will be.

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7	Xu *et al* [25]	Boxing-style VR Exergame called FitXR (FitXR Limited) Twice Per Week	The mean Perceived Stress Score for the Pretest was 16.87 (SD 4.88), and the mean Perceived stress score for the Posttest was 16.13 (SD 5.81). A 2-tailed Paired ttest showed that there was no significant difference between the Pretest and Posttest Scores (t14=0.564; P=.58)

[2]**Abbreviations:** VR, virtual reality; 2D, two dimensional; MBP, mindfulness-based program. SD, standard deviation.

DISCUSSION

The results of this review underscore the growing interest in Virtual Reality Technology (VRT) as a tool for stress management among students, with seven studies meeting the inclusion criteria. The diversity in study design, intervention types, and measurement tools reflects the exploratory nature of research in this area. Despite the variability in methodologies, several key themes and findings emerged that warrant discussion. First of all, the methodology through which VRT produces its effects is: The VRT can cause Physiological Relaxation, distract the individual from stressful environments, and can divert them from their stressful lives and provide more relaxed visuals. As outlined earlier in this review natural visuals are more effective in relaxing the participants thus coping with stress. Evidence exists that the sympathetic nervous system is responsible for stress in the body [25]. The diversion produced by VRT stimulates the parasympathetic nervous system, which is responsible for the relaxed state of the individuals. In more accessible terms the sympathetic nervous system and parasympathetic nervous system is responsible for 'fight or flight' and 'rest and digest' responses in the body, respectively [26]. The shift of body towards parasympathetic nervous system predominance results in the diminution of blood pressure, heart rate and muscle tension thereby eliciting relaxation [27]. It was also known that the phenomenon of stress is triggered by the external or internal events or situations known as stressors [29]. The individual's cognitive appraisal of stressors determines the levels of stress. For the management of stress, the cognition needs to be reconstructed. The VRT provides psychological detachment of the individual with the stressors and the visuals provided by the VRT can help them in reframing the cognition through providing relaxation stimuli [30-32]. The VRT visuals and even gaming equips the individuals to enable them to effectively confront the negative emotions and stress in real life [33]. Furthermore, the VRT experience may provide emotional regulation i.e., facilitating the ability to accept and regulate the emotions. It reduces the reactivity by providing an environment where instead of being overloaded by intense emotions in real life the person can relax and make better decisions about handling the situation [28]. Additionally, gaming in VRT has been shown to increase the mindfulness by detaching with stressful thoughts and engaging in the present. The visuals of VRT can empower the person experiencing it to cope with emotions. Virtual Reality Technology (VRT) facilitates stress management through a complex interaction between cognitive reframing, emotional regulation, and physiological changes. Cognitive reframing in VRT involves altering negative thought patterns by immersing individuals in controlled environments that challenge their perceptions and encourage positive reinterpretation of stressors [34]. This process was supported by the vivid, immersive nature of VRT, which allows users to experience and practice new ways of thinking in a safe, virtual space. Emotional regulation is another key component in this regard. VRT makes users able to manage their emotional responses by providing a buffer against overwhelming stressors [35]. Virtual environments are designed to reproduce the conditions that soothe individuals and assist them in practicing emotional self-regulation. The expectancy of stress response improves and the reactivity is improved. For instance, the capacity of the users to deal with stress in a build virtual environment can be transferred to affect the emotional stability in the actual world. Discussing the physiological aspects, the influence of VRT is such that it incorporates the working of the autonomic nervous system through the induction of relaxation by parasympathetic activity [36]. The physiological indicators of stress such as Heart Rate and Blood Pressure are seen to decrease as VRT transforms the status of the person from the state of 'fight or flight' to the state of 'rest and digest'. This change in physiology diminishes the stress factor and helps maintain the cognitive and emotional improvements achieved in VRT sessions. VRT stress relief is achieved through a combined action of cognitive dissonance, affective modulation, and bodily relaxation. Hence, it is a holistic approach to stress management and a powerful tool for improving mental well-being. Some neurobiological changes are also induced by VRT. Neuroplasticity is a process in which the brain adapts and modifies its structure and functions in response to experiences encountered by the body [37]. The VRT may stimulate this process to manage stress. The process involves decreased activity in the amygdala which is responsible for emotional responses to threats such as fear and anxiety [38]. Simultaneously, the prefrontal cortex of the brain which plays a role in the emotional regulation, decision making and cognitive functioning [39, 40]. The VRT induced neuroplasticity improves the ability of this region. Additionally, this process results in growth of new brain

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cells; neurogenesis which enables enhanced cognitive functioning and improving the mood. In conjunction with this, the activity of neurotransmitters is increased such as dopamine, serotonin and Gamma Amino Butyric acid (GABA) which are associated with motivation, feeling of happiness and a calming effect, respectively [41].The findings of most of the studies used in this review suggest that VRT is effective in stress management, although with varying levels of effectiveness. For example, Gao *et al.*, and Jo *et al.*, were able to investigate the effect of VRT on negative emotions and noted that it had a significant effect of improving emotions on the participants, particularly for interactive virtual environments despite the decoration of these environments. However, the authors also caution that not all studies showed any statistical significance results. For example, Xu *et al.*, work involving a study earning a VR exergame did appreciate or observe any changes in the level of stress of the participants following the change and so emphasizing the challenges that characterize the quest to possible find the suitable VRT techniques. The content type of the VR seems to be very important in determining the success of the intervention program [42]. In this case, natural environments, particularly green ones, were always more effective in helping the users to relieve stress than other virtual environments. Such findings are consistent with the evidence regarding the positive impact of nature on one's well-being and support the use of VRT as an alternative approach for achieving the same effects [43]. The findings from Valtchanov *et al.*, study, which highlighted the superior stress-reducing effects of virtual nature environments over urban or geometric visuals, further support this conclusion. Another aspect that stands out was the character and manner of delivery of VRT interventions. The review shows that VRT sessions that are oriented to individual needs and offered on a one to one basis are more effective. Such sessions although personalized are also costlier which may restrict their reach. It was therefore warranted that more research be carried out on the best model of delivery since the weight of the existing literature does not allow for any conclusion to be drawn. The characteristics of the participants also affected the results. It was noted in the review that it is more probable that higher education students, especially females, and those suffering from higher metrics of stress at baseline, would benefit more from VRT interventions. This correlates with the concept that stress affects the way one responds to the interventions given. In addition, the studies reviewed show that students who are more technology savvy are more likely to take interest and participate in VRT programs and this may affect the mode of the results. While VRT shows promise as a stress management tool, it is essential to recognize that its effectiveness may not significantly surpass that of traditional methods. However, the higher acceptability and engagement levels associated with VRT, particularly among university students, suggest that it could be a valuable complement to existing stress management strategies. It should be noted that the effectiveness of VRT for the stress management was may not significantly higher than the traditional methods, but the adherence and acceptability is quite higher than the traditional approaches among college and university students [22]. The synthesis of the qualitative data indicated that this intervention was "easy to use, polished to a professional standard, fun and innovative" for students [25]. VRT is dissimilar to the conventional types of stress relieving procedures such as counseling, meditation, and physical exercise in several ways. The first is the high level of immersion and engagement of the users. VRT Interest in adopting new technologies was highest for interactive 3D environment simulated placements [44]. Such interactivity adds to the VRT's capacity to reach out to users in a way that was not achieved by older methods. It also increases the level of engagement from users, especially the younger generation who tend to be more enthusiastic about such activities. VRT has also a high range of customization. It also considers the preferences of the person and therefore makes use of VRT more effective. For example, students may select certain environments instead of simply browsing, allowing for relaxation with a certain type of environment [45]. This level of adaptability is not possible with other, less recent techniques. Nevertheless, even though VRT does have its limitations. The technology is still nascent and while more research is being conducted, it does not have the body of evidence that is available for other forms of interventions such as cognitive-behavioral therapy or mindfulness practices. It is also important to highlight that the process of designing, developing, and putting VRT to use is costly, and the necessary technology is often lacking in many locations, most especially in low income communities. Another limitation was that one or more of the users are likely to have some form of cyber sickness, that is motion sickness in other words, and this might affect the utilization of VRT [46]. Within the confines of this review, the findings enhance the understanding of VRT as a strategy in relation to university student stress, but the same cannot be said for its use in other settings. Most of the studies that satisfied the inclusion criteria for this review were too tailored to a specific kind of student. The other aspect was that since different types of VRTs and various study designs were used, it also means that the types of virtual environment in use, the level of stress in

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individuals, and the degree to which technologies are adopted will affect the efficacy of VRT. In the end, although VRT is, in some respect, an attempt to reduce the stress even when applied to people for academic research purposes, there are limits on the scope of any study due to principles of the functional design that define behavior in new environments with new audience. It would be of interest for subsequent research to assess the limitations of the VRT across a broader spectrum of people and in more diverse situations in order to define the potential use of the VRT. The application of VRT in stress management has various ethical challenges. There is also fear that rather than engaging in real life contextual plain interactions with fellow students, students may opt to interact within the confines of the virtual environments leading to increased isolation or dislocation. From an ethical perspective it was critical that stress management techniques and social interactions are not replaced by the Virtual Reality Therapy.

CONCLUSIONS

Throughout this review, the emerging field of VRT has been examined as a potential tool for stress reduction among university students. It seems likely that its mechanisms of action can be ascribed to several processes, such as relaxation, cognitive reframing, improved emotional management, and possibly the ensuing neurobiological effects of such practice. It also seems likely that students find it engaging and largely acceptable; meaning that it holds significant benefits likes personalization and immersion. However, the costs, availability, and the need for further research are some of the primary concerns associated with it. Future studies should focus on long-term effects, optimal programmatic choices, and possible disadvantages like cyber sickness. As the technology grows in sophistication and the body of research on it expands, this tool of stress reduction may prove revolutionary in how we conceptualize and approach how well students fare in their academic environment in the digital age.

Authors Contribution

Conceptualization: Z, SB, SK

Methodology: Z, SB, SK

Formal analysis: Z, SB, SK

Writing, review and editing: Z, SB, SK

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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REFERENCES

[1] Abdul Majeed HB, Sanuddin NDB, Mazlan SAB. Emotional Intelligence and Stress among University Students in the Situation of Covid-19. International Journal of Academic Research in Business and Social Sciences. 2023 Feb; 13(2). doi: 10.6007/IJARBSS/v13-i2/15581.

[2] Asif S, Mudassar A, Shahzad TZ, Raouf M, Pervaiz T. Frequency of depression, anxiety and stress among university students. Pakistan Journal of Medical Sciences. 2020 Jul; 36(5): 971. doi: 10.12669/pjms.36.5.1873.

[3] Barbayannis G, Bandari M, Zheng X, Baquerizo H, Pecor KW, Ming X. Academic stress and mental well-being in college students: correlations, affected groups, and COVID-19. Frontiers in Psychology. 2022 May; 13: 886344. doi: 10.3389/fpsyg.2022.886344.

[4] A V and Saleem N. Impact of Covid-19 Pandemic on Anxiety and Obsession Level of the University Students and Its Relation to Their Academic Performance. International Journal of Advanced Research (Indore). 2021 Feb; 9(02): 564-70. doi: 10.21474/IJAR01/12483.

[5] Kabir R, Syed HZ, Vinnakota D, Okello S, Isigi SS, Kareem SK *et al*. Suicidal behaviour among the university students in the UK: a systematic review. Heliyon. 2024 Jan; 10(2): e24069. doi: 10.1016/j.heliyon.2024.e24069.

[6] Carrasco-Barrios MT, Huertas P, Martín P, Martín C, Castillejos MC, Petkari E *et al*. Determinants of suicidality in the European general population: a systematic review and meta-analysis. International Journal of Environmental Research and Public Health. 2020 Jun; 17(11): 4115. doi: 10.3390/ijerph17114115.

[7] Trivedi JK, Sareen H, Dhyani M. Rapid urbanization-Its impact on mental health: A South Asian perspective. Indian Journal of Psychiatry. 2008 Jul; 50(3): 161-5. doi: 10.4103/0019-5545.43623.

[8] Van den Berg AE, Jorgensen A, Wilson ER. Evaluating restoration in urban green spaces: Does setting type make a difference?. Landscape and Urban Planning. 2014 Jul; 127: 173-81. doi: 10.1016/j.landurbplan.2014.04.012.

[9] Colléony A, White R, Shwartz A. The influence of spending time outside on experience of nature and environmental attitudes. Landscape and Urban Planning. 2019 Jul; 187: 96-104. doi: 10.1016/j.landurbplan.2019.03.010.

[10] Asif S, Mudassar A, Shahzad TZ, Raouf M, Pervaiz T. Frequency of depression, anxiety and stress among

DOI:https://doi.org/10.54393/pjhs.v5i08.1950

university students. Pakistan Journal of Medical Sciences. 2020 Jul; 36(5): 971. doi: 10.12669/pjms.36.5.1873.

[11] Ganapathi P, Aithal PS, Kanchana D. Stress Management: Concept, Approaches, and Analysis. International Journal of Management, Technology and Social Sciences. 2023 Nov; 8(4): 213-22. doi: 10.47992/IJMTS.2581.6012.0319.

[12] Narasuman S, Yunus MR, Kamal AA. Net generation student teachers: how tech-savvy are they?. Asia Pacific Journal of Educators and Education. 2011 Jan; 26(1): 71-89.

[13] Bell IH, Nicholas J, Alvarez-Jimenez M, Thompson A, Valmaggia L. Virtual reality as a clinical tool in mental health research and practice. Dialogues in Clinical Neuroscience. 2020 Jun; 22(2): 169-77. doi: 10.31887/DCNS.2020.22.2/lvalmaggia.

[14] Mahindru A, Patil P, Agrawal V. Role of physical activity on mental health and well-being: A review. Cureus. 2023 Jan; 15(1). doi: 10.7759/cureus.33475.

[15] Caponnetto P, Casu M, Amato M, Cocuzza D, Galofaro V, La Morella A *et al.* The effects of physical exercise on mental health: From cognitive improvements to risk of addiction. International Journal of Environmental Research and Public Health. 2021 Dec; 18(24): 13384. doi: 10.3390/ijerph182413384.

[16] Pan X, Zhang YC, Ren D, Lu L, Wang YH, Li GX *et al.* Virtual reality in treatment for psychological problems in first-line health care professionals fighting COVID-19 pandemic: a case series. The Journal of Nervous and Mental Disease. 2022 Oct; 210(10): 754-9. doi: 10.1097/NMD.0000000000001531.

[17] Xu J, Khanotia A, Juni S, Ku J, Sami H, Lin V *et al.* Effectiveness of virtual reality-based well-being interventions for stress reduction in young adults: Systematic review. Journal of Medical Internet Research Mental Health. 2024 Mar; 11(1): e52186. doi: 10.2196/52186.

[18] Barnett-Page E and Thomas J. Methods for the synthesis of qualitative research: a critical review. BioMed Central Medical Research Methodology. 2009 Dec; 9: 1-1. doi: 10.1186/1471-2288-9-59.

[19] Gao T, Zhang T, Zhu L, Gao Y, Qiu L. Exploring psychophysiological restoration and individual preference in the different environments based on virtual reality. International Journal of Environmental Research and Public Health. 2019 Sep; 16(17): 3102. doi: 10.3390/ijerph16173102.

[20] Jo SH, Park JS, Yeon PS. The effect of forest video using virtual reality on the stress reduction of university students focused on c university in Korea. International Journal of Environmental Research and Public Health. 2021 Dec; 18(23): 12805. doi: 10.3390/ijerph182312805.

[21] Modrego-Alarcón M, López-del-Hoyo Y, García-Campayo J, Pérez-Aranda A, Navarro-Gil M, Beltrán-Ruiz M *et al.* Efficacy of a mindfulness-based programme with and without virtual reality support to reduce stress in university students: A randomized controlled trial. Behaviour Research and Therapy. 2021 Jul; 142: 103866. doi: 10.1016/j.brat.2021.103866.

[22] Plante TG, Cage C, Clements S, Stover A. Psychological benefits of exercise paired with virtual reality: Outdoor exercise energizes whereas indoor virtual exercise relaxes. International Journal of Stress Management. 2006 Feb; 13(1): 108. doi: 10.1037/1072-5245.13.1.108.

[23] Valtchanov D. Physiological and affective responses to immersion in virtual reality: Effects of nature and urban settings (Master's thesis, University of Waterloo).

[24] Villani D, Riva F, Riva G. New technologies for relaxation: The role of presence. International Journal of Stress Management. 2007 Aug; 14(3): 260. doi: 10.1037/1072-5245.14.3.260.

[25] Xu W, Liang HN, Baghaei N, Ma X, Yu K, Meng X *et al.* Effects of an immersive virtual reality exergame on university students' anxiety, depression, and perceived stress: pilot feasibility and usability study. Journal of Medical Internet Research Serious Games. 2021 Nov; 9(4): e29330. doi: 10.2196/29330.

[26] Mohd Muhaiyuddin ND, Abdul Mutalib A, Abdul Salam SN, Alis N. Image-Based Virtual Reality Stress Therapy Application (Vrt-Stressnomore): An Alternative Tool For Self Therapy. Journal of Information System and Technology Management. 2022; 7(29): 222-41. doi: 10.35631/JISTM.729020.

[27] Zhang M, Ding H, Naumceska M, Zhang Y. Virtual reality technology as an educational and intervention tool for children with autism spectrum disorder: current perspectives and future directions. Behavioral Sciences. 2022 May; 12(5): 138. doi: 10.3390/bs12050138.

[28] Naugle KM, Naugle KE, Teegardin M, Kaleth AS. Physical activity to prevent the age-related decline of endogenous pain modulation. Exercise and Sport Sciences Reviews. 2023 Oct; 51(4): 169-75. doi: 10.1249/JES.0000000000000325.

[29] Ondicova K and Mravec B. Multilevel interactions between the sympathetic and parasympathetic nervous systems: a minireview. Endocrine Regulations. 2010 Apr; 44(2): 69-75. doi: 10.4149/endo_2010_02_69.

[30] Jarczok MN, Jarczok M, Thayer JF. Work stress and autonomic nervous system activity. Handbook of socioeconomic determinants of occupational

DOI:https://doi.org/10.54393/pjhs.v5i08.1950

health: From macro-level to micro-level evidence. 2020: 1-33. doi: 10.1007/978-3-030-05031-3_27-1.

[31] Won E and Kim YK. Stress, the autonomic nervous system, and the immune-kynurenine pathway in the etiology of depression. Current Neuropharmacology. 2016 Oct; 14(7): 665-73. doi: 10.2174/1570159X14666151208113006.

[32] Yalçin F, Abraham MR, Garcia MJ. Stress and Heart in Remodeling Process: Multiple Stressors at the Same Time Kill. Journal of Clinical Medicine. 2024 Apr; 13(9): 2597. doi: 10.3390/jcm13092597.

[33] Zulkarnain AH, Cao X, Kókai Z, Gere A. Self-Assessed Experience of Emotional Involvement in Sensory Analysis Performed in Virtual Reality. Foods. 2024 Jan; 13(3): 375. doi: 10.3390/foods13030375.

[34] Heng YK, Liew JS, Abdullah MF, Tang Y, Prestopnik N. ReWIND: A CBT-Based Serious Game to Improve Cognitive Emotion Regulation and Anxiety Disorder. International Journal of Serious Games. 2023 Sep; 10(3): 43-65. doi: 10.17083/ijsg.v10i3.603.

[35] Kadović M, Mikšić Š, Lovrić R. Ability of emotional regulation and control as a stress predictor in healthcare professionals. International Journal of Environmental Research and Public Health. 2022 Dec; 20(1): 541. doi: 10.3390/ijerph20010541.

[36] Kumpulainen S, Esmaeilzadeh S, Pesola AJ. Assessing the well-being benefits of VR nature experiences on group: Heart rate variability insights from a cross-over study. Journal of Environmental Psychology. 2024 Aug; 97: 102366. doi: 10.1016/j.jenvp.2024.102366.

[37] Noda Y. Exploring Optimal Neuroplasticity: Neuromodulation for Enhanced Human Well-Being. Journal of Integrative Neuroscience. 2024 Aug; 23(8): 155. doi: 10.31083/j.jin2306112.

[38] Kenwood MM, Kalin NH, Barbas H. The prefrontal cortex, pathological anxiety, and anxiety disorders. Neuropsychopharmacology. 2022 Jan; 47(1): 260-75. doi: 10.1038/s41386-021-01109-z.

[39] Šimić G, Tkalčić M, Vukić V, Mulc D, Španić E, Šagud M *et al* . Understanding emotions: origins and roles of the amygdala. Biomolecules. 2021 May; 11(6): 823. doi: 10.3390/biom11060823.

[40] Moses TE, Gray E, Mischel N, Greenwald MK. Effects of neuromodulation on cognitive and emotional responses to psychosocial stressors in healthy humans. Neurobiology of Stress. 2023 Jan; 22: 100515. doi: 10.1016/j.ynstr.2023.100515.

[41] Georgiev DD, Georgieva I, Gong Z, Nanjappan V, Georgiev GV. Virtual reality for neurorehabilitation and cognitive enhancement. Brain Sciences. 2021 Feb; 11(2): 221. doi: 10.3390/brainsci11020221.

[42] Sies H. Oxidative stress: Eustress and distress in redox homeostasis. In Stress: physiology, biochemistry, and pathology: Academic Press; 2019. 153-163.

[43] Baniasadi T, Ayyoubzadeh SM, Mohammadzadeh N. Challenges and practical considerations in applying virtual reality in medical education and treatment. Oman Medical Journal. 2020 May; 35(3): e125. doi: 10.5001/omj.2020.43.

[44] Woo OK, Lee AM, Ng R, Eckhoff D, Lo R, Cassinelli A. Flourishing-Life-Of-Wish Virtual Reality Relaxation Therapy (FLOW-VRT-Relaxation) outperforms traditional relaxation therapy in palliative care: results from a randomized controlled trial. Frontiers in Virtual Reality. 2024 Jan; 4: 1304155. doi: 10.3389/frvir.2023.1304155.

[45] Goi CL. The Impact of VR-Based Learning on Student Engagement and Learning Outcomes in Higher Education. Teaching and Learning for a Sustainable Future: Innovative Strategies and Best Practices. 2024: 207-23. doi: 10.4018/978-1-6684-9859-0.ch012.

[46] Zainab H, Bawany NZ, Rehman W, Imran J. Design and development of virtual reality exposure therapy systems: requirements, challenges and solutions. Multimedia Tools and Applications. 2024 Jan; 83(2): 6137-60. doi: 10.1007/s11042-023-15756-5.