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Study of the influence of virtual reality technology on the psychoemotional state of healthy volunteers

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ABSTRACT

Background. Mental disorders occupy a leading position in modern medicine and bear the burden of significant economic costs associated with the treatment and rehabilitation of patients. Non-drug strategies of assistance have a number of significant advantages, including optimization of medical personnel resources, elimination of the need for the period of selection and titration of drug dosages, as well as avoidance of waiting for the effects of pharmacotherapy. Data are accumulating on the possibilities of using virtual reality technologies for the correction of mental disorders, which makes promising studies aimed at transferring relaxation practices to high-tech platforms. **Objective**: to study the possibilities of using virtual reality technologies in psychiatry by assessing the effect of the method on the psycho-emotional state of healthy volunteers. **Hypothesis**. Completing a course of sessions of a relaxation VR scenario helps to reduce the severity of anxiety and affective symptoms, improve night sleep in healthy volunteers. **Material and Methods**. The study sample included 19 healthy volunteers aged 23 (22; 24) years. The indices of anxiety, depression, and sleep disorders were assessed using the following questionnaires: Beck Depression Inventory (BDI), Hospital Anxiety and Depression Scale (HADS), Sleep Disorder Severity Questionnaires – Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI) before the study and after 5 sessions of immersion in a dynamic virtual environment using the PICO 4 PRO hardware and software system and VR relaxation computer programs. The session duration was 15 minutes. Statistical analysis of the data was performed using the SPSS (V.23.0) standard software package. **Results**. A statistically significant decrease in indices on all scales was revealed when using the proposed relaxation technique. **Conclusion**. The use of virtual reality technologies has demonstrated effectiveness in the correction of affective and neurotic symptoms in healthy individuals, which can subsequently be used to develop technologies for non-drug correction of affective and neurotic disorders in personalized patient therapy programs.

Keywords: healthy volunteers, psychometric assessment scales, depression, anxiety, insomnia, hopelessness, virtual reality.

INTRODUCTION

Mental disorders along the other most important nonepidemic disorders continue to occupy the leading position in the modern medicine. The WHO estimates that about 300,000,000 people worldwide have depression and about 260,000,000 suffer from anxiety disorders [1]. A special attention should be paid for direct and indirect economic loss due to costs of the substantial part of the national budget for diagnosis, treatment and rehabilitation of patients with mental disorders, particularly taking into account the increase in total sickness rate with mental disorders in many Russian regions [2, 3]. A number of researchers have ascertained that mental disorders constitute 10.4% of costs from healthcare world budget [4].

Mental disorders exert a serious economic impact due to costs of treatment and losses in productivity. The society needs to recognize this loss for the purpose of support of the healthcare system [5]. To reduce the growth of costs and heighten the accessibility of evidence-based methods of treatment, technologies of digital healthcare: e-medicine, virtual reality (VR) currently are actively developing and are demanded. Technological innovations will help in coping the mental health crisis throughout the world, because digital platforms allow people implementing the self-control of mental health in reality [6]. Data is accumulated on opportunities of VR-technologies use for the correction of mental disorders. The technique of the investigation of phobic anxiety disorders in VR-environment allows adapting the VR-scenes with account for the individual traits and parameters of behavior in a specific user by means of the selection of latent patterns documented with ECG and EEG signals [7]. The inclusion of the virtual reality therapy (VRET) in the complex of rehabilitation interventions (pharmacotherapy, multimode desensibilization, memory reconsolidation, transcranial magnetic stimulation) in PTSD positively influences the results due to reinforcement of the presence effect and major experience personalization. VRET is an efficacious, controllable and cost-effective alternative for PTSD treatment in combatants with low results of the convenient therapy [8]. A large number of VRET sessions reduces steadily symptoms of depression and PTSD according to the materials of three- and six-month observations [9]. Inhibitory training methods and integration in speech therapy (public speaking technique exercises) may be the way of VRET adaptation with account for cognitive-behavioral processes underlying the experiences of social anxiety in stuttering people [10]. Efficacy of immersive VR (with the use of head-mounted displays) has been shown in the clinical evaluation and treatment of addictive disorders based on aversive modes training [11]. VR as a method of training relaxation in schizophrenic patients in remission against the background of antipsychotic therapy showed improvement of the mood, wellness and functioning of parasympathetic HNS regions, reduction of experiences of diffuse psychophysiological impairments [12]. At the same time, transferring methods of cognitive-behavioral therapy of depression into VR mode is poorly attempted including psychoeducation, behavioral activation, cognitive restructuration, social skills training although alternative implementation and interaction with virtual pets can become therapeutic ones. Creating the evidence base for VR interventions of low intensity in depression should be considered a research priority in public mental health care [13].

Nondrug care strategies possess a number of significant advantages including optimization of medical staff resources, removal of the necessity of selection and titration of medication dosing, and also avoiding the expectation of the effects of pharmacotherapy. In addition, these strategies not only free from the necessity of the account for drug-drug interactions and potential side effects but also contribute into increase of compliance of the patient with psychopharmacological therapy.

OBJECTIVE OF THE STUDY

To study prospects of VR-technologies use in psychiatry through the evaluation of the influence of the method on psychoemotional state of healthy volunteers.

HYPOTHESIS OF THE STUDY

Passing the course of relaxation VR-scenario sessions contributes into reduction of the severity of anxiety and affective symptoms

and also the improvement of the nocturnal sleep in healthy volunteers.

MATERIALS AND METHODS

The study participants were healthy volunteers (clinical residents of the Mental Health Research Institute of Tomsk NRMC, Department of Psychiatry, Addictology, Psychotherapy of the Siberian State Medical University of the Ministry of Health of The Russian Federation, students of National Research Tomsk Polytechnic University.) The study sample was represented by 19 volunteers, most of them (n=14, 73.7%) were females, median age in group was 23 (22; 24) years. Inclusion criteria: written voluntary consent to participate in the research project, absence of signs of any mental, neurologic disorder or specific condition (strain, alcohol or drug intoxication, simulative behavior, intake of psychotropic or neurotropic agents, pregnancy etc.) at the moment of the examination. The study participants were examined in time course (at baseline and after 5 sessions of the VR-exposure) with the use of standardized psychometric tools for evaluation of the time course of the state: Beck Depression Inventory (BDI), Hospital Anxiety and Depression Scale (HADS), Questionnaires for evaluation of the severity of sleep disorders: Pittsburg Sleep Quality Index (PSQI), Insomnia Severity Index (ISI).

The session of immersion in a dynamic virtual environment was carried out using a VR system - a PICO 4 PRO hardware and software complex (Snapdragon XR2 processor, Pico OS 5.0 Android, 8/512 GB) and relaxation computer VR programs: Meditation VR, Kayak VR: Mirage (publisher, developer: Better Than Life), Beyond Blue (publisher, developer: E-Line Media), hosted on an online computer games service (Steam). The study participants were exposed to 5 sessions, daily, with duration of 15 min. Data processing was performed with the use of standard program toolkit SPSS (V.23.0).

RESULTS AND THEIR DISCUSSION

All study participants corresponded to inclusion criteria. The subjective evaluation of the actual state did not reveal any signs of strain, deficit of sleep. Although four participants (21,1%) declared a presence of actual stress of low or middle degree of intensity. The assessment of the state with the use of structured diagnostic Mini-International Neuropsychiatric Interview (MINI) did not reveal mental health disorders in the examined group. Insignificant severity of symptoms was noted in two blocks: Depressive episode (n=16, median score 2 [1; 3]) and Generalized anxiety disorder (n=15, 2 [1; 6]). The findings of complex psychometric examination were within reference values. In addition, after the study we have noted a statistically significant decrease in indices across all used scales (table 1).

During investigation we did not noted any unwanted reactions on the side of probands.

VR represents a technology providing the creation of an interactive environment where a patient or healthy volunteer has a possibility to actively move and interact with digital objects, subjectively perceiving themselves

Table 1. **Comparative dynamics of indices according to scales for anxiety, depression, insomnia and hopelessness during investigation of psychoemotional state of healthy volunteers**

Title of the scale	Index at the baseline	Index after 5 sessions of VR-exposure	Non-parametric p-criterion of Wilcoxon
Hospital scale HADS-A (anxiety)	3 (2; 7)	1 (0; 5)	**0.001**
Hospital scale HADS-D (depression)	2 (1; 4)	1 (0; 3)	0.054
Pittsburg Sleep Quality Index (PSQI)	12 (5; 20)	8 (3; 5)	**0.001**
Insomnia Severity Index (ISI)	6 (4; 11)	4 (1; 7)	**0.002**
Beck Hopelessness Scale (BDI)	7 (1; 14)	3.5 (0; 6.5)	**0.001**

inside the virtual situation. The main characteristics of the VR-programs intended for therapeutic sessions are the level of immersion (immersivity), the sensation of presence, as well as the possibility to interact with the objects. VR as a modern tool for the development of IT in psychiatry finds increasingly application in education, distant counseling, therapeutic planning, based on thorough evaluation and account for individual aims of the treatment as well it is used in the rehabilitation of patients with mental disorders contributing into improvement of their social skills and augmentation of psychotherapeutic methods [14]. Currently these innovative technologies are promising for use in the area of clinical psychology and psychiatry [15].

CONCLUSION

Summarizing mentioned above (decrease in the severity of anxiety and depressive symptomatology, improvement of the quality and duration of the night sleep, improvement of the emotional perception of the future as well as absence of severe unwanted side effects and complications), the use of VR-technologies is represented as a prospective method for the correction of the psychoemotional state and opens the opportunities of effective application in the groups of patients with affective and neurotic disorders.

CONFLICTS OF INTEREST

Authors declare absence of explicit and potential conflicts of interest in association with publication of this article.

SOURCE OF FUNDING

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ACCORDANCE TO ETHICAL PRINCIPLES

The study was performed in accordance with “Ethical principles of conducting the scientific medical research with participation of humans” and “Clinical Practice Guidelines in the Russian Federation.” It was approved by Local Ethics Committee at the Mental Health Research Institute of the Tomsk NRMC (protocol of the LEC session no. 167 of November 17, 2023, file no. 167/2.2023).

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