

Using Virtual Reality Technology to Therapy Adolescents and Youth Depression Disorder: A Systematic Review and Meta Analysis

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Pu, YL; Luo, HX.

Corresponding author:

Yilong Pu

puyilong@mails.ccnu.edu.cn

Author Affiliation:

Central China Normal University.

ADMINISTRATIVE INFORMATION**Support** - no financial support.**Review Stage at time of this submission** - Completed but not published.**Conflicts of interest** - None declared.**INPLASY registration number:** INPLASY2024110079**Amendments** - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 19 November 2024 and was last updated on 19 November 2024.**INTRODUCTION**

Review question / Objective This study provided a comprehensively and systematically review and meta-analysis of the virtual reality intervention on depression disorder in adolescents and youth over the past fourteen years (January 2011 to October 2024).

Rationale Articles and related information were obtained according to the PRISMA protocol, which included assessing whether the articles met the requirements for analysis according to specific standards. This study abided by the Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement for the selection and use of research methods.

Condition being studied Depression disorder is one of the most common mental disorders in modern society(Erskine et al., 2016). Depression disorder can lead to mood disturbances, loss of interest in daily activities, disturbed sleep and

appetite, loss of energy, psychomotor retardation or agitation (Fernandez-Alvarez et al., 2021) and in the worst case, suicide (H. Wang et al., 2024). The incidence of depression has been trending younger in recent years(Wang, Kong, Bai, Zhang, & Yin, 2024). And 34% of adolescents worldwide are at a risk of developing clinical depression(Shorey, Ng, & Wong, 2022). Virtual reality (VR), has been successfully used to treat a variety of mental illness, including depression orderBut there is a lack of review article and meta-analysis focusing on studies on treating adolescents and youth depression disorder with VR.

METHODS

Search strategy We selected articles from the Web of Science core database, APA PsycINFO database (via EBSCO), Wiley Online Library, ScienceDirect database, IEEE Xplore, PubMed, Scopus and Springer Link. Articles were limited to those written in English and published between January 2011 and October 2024. The following

search terms were used: (a) “virtual reality” or “VR” or “immersive technology”; (b) “adolescents or young adulthood or youth”; (c) “depression”. Using these search criteria, a total of 600 articles were retrieved.

Participant or population Based on the average age and age range of the participants reported in studies, 18% of participants were between 8 and 18 years old (n=106) and 82% were between 18 and 26 years old (n=483). The vast of young participants were university students. Out of all the studies, 69.6% participant populations that were mostly female (female participants made up approximately two-thirds of the total, n=16), 13% had approximate gender balance (n=3), 8.7% studies that were mostly male (male participants accounted for approximately two-thirds of the total, n=2) and 8.7% studies were all male (n=2). Overall, there were a total of 215 male and 374 female participants (M: F=1:1.74). This is similar to the findings of Santomauro et al. (2021) that the incidence of depression is roughly twice as high in female as in male. The participants not only suffered from depression disorder, but they often had a number of other mental disorder, such as anxiety, stress, loneliness, posttraumatic flashbacks, self-harm and suicidal ideation.

Intervention Using Virtual Reality technology to treat depression in adolescents and youth.

Comparator Participants in the control group either received conventional psychotherapy or no intervention at all.

Study designs to be included Empirical studies.

Eligibility criteria 1. Published from January 2011 to October 2024; 2. Written in English; 3. Participants are adolescents or youth; 4. Using VR for psychotherapy; 5. Research focuses on depression symptoms.

Information sources Web of Science core database, APA PsycINFO database (via EBSCO), Wiley Online Library, ScienceDirect database, IEEE Xplore, PubMed, Scopus and Springer Link.

Main outcome(s) The results of meta-analysis showed that virtual reality technology had an overall medium effect size (Hedge’s $g=0.486$) in the treatment of adolescents and youth depression. There was significant moderating effect in number of interventions, technology type, VR function, therapeutic approach and objective.

Additional outcome(s) Firstly, short-term VR interventions have significant positive effects on the treatment of depression in adolescents and youth. Secondly, the most common types of technology are simulations and virtual worlds, and the most therapeutic are virtual worlds and VR games. Thirdly, the most used devices are low-cost head-mounted displays produced by Meta Platform Inc, capable of providing a fully immersive experience, as well as mostly capable of providing more than moderate levels of interaction and fidelity. Fourthly, VR-based music therapy and the most commonly used cognitive-behavioral and restorative environment therapies have significant positive effects on the treatment of depression. Finally, VR can significantly reduce depressive symptoms in adolescents and youth by positively regulating their affection and action.

Data management Literature management using ENDNOTE and meta-analysis using CMA 3.0.

Quality assessment / Risk of bias analysis Most of the study effect values were distributed at the top of the funnel plot, and symmetrical distribution on both sides of the center line proved that the possibility of publication bias was small. What’s more, we used Egger’s test for further testing. The result of Egger’s regression test shows that $t=5.845$, $p<0.05$, which indicates that there is no obvious publication bias (Egger et al., 1997). In addition, the classic fail-safe N test was 3885, which is higher than the $5k(k=55) + 10$ proposed by Rosenthal (1979). In summary, there appeared to be no bias in the meta-analysis, and the results of this study would be reliable.

Strategy of data synthesis We recorded five categories of specific information for the articles that were ultimately included: article metadata, participant characteristics, research design, technological features, and treatment program design. Then we coded these articles according to the coding scheme. Sample size(N), mean value (Mean), standard deviation (SD), p-value, or t-value were extracted from the experimental group and the control group or before and after for a single group in the study. In addition, if a follow-up test was conducted in the study, we used the follow-up test data instead of the posttest data.

Subgroup analysis To determine the factors affecting the effectiveness of VR for the treatment of adolescents and youth depression, we analyzed the moderating variables, and the results are shown in Table 6. There were five moderating variables that can affect the therapeutic effects of VR, including number of interventions,

technological type, therapeutic approach, objectives, and VR function.

Sensitivity analysis To evaluate the robustness of the meta-analysis results, we sequentially excluded each outcome and recalculated the effect size (Mathur & VanderWeele, 2020). The results showed that regardless of which outcome was excluded, the overall effect size ranged from 0.457 to 0.496. This range falls within the 95% confidence interval (0.383~0.588) of the original overall effect size. Therefore, the findings of this study demonstrate high robustness.

Language restriction This article is written in English.

Country(ies) involved China.

Keywords virtual reality; depression; adolescent; youth.

Dissemination plans Preparing for publication in a journal.

Contributions of each author

Author 1 - Yilong Pu. - The first author drafted the first draft of the article.

Email: puyilong@mails.ccn.edu.cn

Author 2 - Heng Luo - The second author provided ideas, method guidance, participated in t coding analysis and revised and edited the paper.

Email: luoheng@mail.ccn.edu.cn