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Effectiveness of virtual reality games in improving physical function, balance and reducing falls in balance-impaired older adults: A systematic review and meta-analysis

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Abstract

Background: In recent years, sports games based on virtual reality (VR) have been widely used in the prevention and treatment of diseases related to the elderly. However, there seems to be no consensus on the improvement and comparison of physical function, balance and falls in elderly people with balance impairment.

Objective: This study aims to explore the effects of VR intervention on physical function, balance and falls in elderly people with balance impairment.

Methods: Systematic literature searches of the PubMed, Web of Science, Elsevier, Cochrane, CNKI, and Wanfang databases were performed for VR games-related randomized controlled trials or comparison studies among elderly participants with impaired balance, published in English or Chinese until March 20, 2022. The Cochrane collaboration risk of bias tool was used to evaluate the methodological quality of the studies. A meta-analysis was performed to calculate the standardized mean deviation or mean difference of the sample and its 95% confidence interval (CI) in VR games.

Results: The systematic review included 23 studies. The results showed that VR intervention had significant effects on hand grip strength (MD:1.30, P = 0.040), knee extension strength (MD:-6.27, P<0.001), five times sit-to-stand test scores (MD:1.13, P = 0.030), timed up-and-go test scores (MD:-1.01, P = 0.001), berg balance scale scores (MD:2.37, P<0.001), and falls efficacy scale scores (SMD:-0.28, P = 0.020). Subgroup analysis results showed that VR intervention was more effective on improving TUG and BBS scores than the conventional exercise group (MD=-0.54, P = 0.004; MD=3.24, P<0.001) and the non-intervention group (MD=-0.98, P = 0.001; MD=3.30, P < 0.001). The balance training-based VR had a significant effect on improving TUG (MD=-1.03, P = 0.004) and BBS (MD=2.93, P<0.001), and 20-45 min intervention, ≥3 times/wk, 5-8 wk cycles were significant in improving TUG (MD=-0.89, P<0.001; MD=-0.75, P = 0.0003; MD=-1.54, P<0.0001). VR intervention significantly improved TUG (MD=-2.27, P<0.0001) and BBS (MD=3.41, P<0.0001) in older adults in the hospital or nursing home compared with those residing in communities.

Conclusion: VR interventions can help the elderly with impaired balance to overcome traditional sports obstacles and improve physical function, balance and minimize falls. Balance training-based VR intervention is more effective in balance recovery and fall prevention compared with game program. An intervention plan comprising 20-45 min, 5-8 wk cycles, and ≥3 times/wk frequency has significantly higher effects for high-risk elderly populations living in hospitals or nursing homes.

Keywords: Balance; Fall; Old adults; Physical function; VR interventions.

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