Virtual reality and the prevention of falls in the real world

Falls are a leading cause of morbidity and mortality in older adults.1,2 Studies conducted in Europe, the USA, and Australia show that roughly a third of community-living people aged 65 years or older fall at least once per year,3 with half of this number having multiple falls in this period.2 Falls impose major social and economic burdens for individuals, their families, health services, and the economy. With the number of older people increasing across the world, the costs associated with falls will increase substantially in the coming decades,3 making the prevention of falls an urgent public health challenge.

The Article by Anat Mirelman and colleagues4 reported in The Lancet presents positive findings of an innovative fall prevention strategy. Their study was a multicentre, randomised controlled trial that compared a combined treadmill training and virtual reality (VR) intervention with treadmill training alone in 302 participants aged 60–90 years at high risk of falls. The VR component consisted of motion capture of the participants’ feet, which was then projected onto a screen, with challenges in the form of obstacles, pathways, and distractors that required continual adjustment of steps.

The groups were well matched at baseline, and the incident rate of falls was similar in both groups before training, with 10.7 (SD 35.6) falls per 6 months in the treadmill training group and 11.9 (39.5) falls per 6 months for the treadmill training plus VR group. The main finding, assessed in a modified intention-to-treat sample of 282 (93%) participants, was that falls were reduced by 42% in the treadmill training plus VR group compared with the treadmill training group in the 6 month period following the end of training (incident rate ratio 0.45, 95% CI 0.24–0.86; p=0.015). Furthermore, important secondary outcome measures, including gait variability during obstacle negotiation, functional balance and gait, and quality of life were significantly improved in the treadmill training plus VR group after training compared with the treadmill training group, with some gains retained at the 6 month follow-up.

The finding of a 42% reduction in falls is in line with the most effective fall preventions that have assessed in systematic reviews.5 It is also notable that the reduction in falls reported in the current trial is made in comparison to a treadmill walking intervention of similar intensity, as opposed to no intervention or usual care.

Unlike traditional exercise where the principle of “use it or lose it” is assumed, the intervention was of short duration (ie, 6 weeks). The 6 month retention of improved functional balance and gait and improved obstacle negotiation suggests that task-specific learning relevant for negotiating hazards and avoiding trips in the real world might have contributed to the reduction of falls seen in the treadmill training plus VR group. This mechanism is consistent with complementary research that has shown short-term trip and slip training can have lasting benefits for fall prevention in older people.6,7

A major difference in the two interventions compared in this trial was the cognitive component included in the treadmill training plus VR group, yet no differential improvement in executive function was detected in participants assigned to this group (p=0.40 for executive function index, p=0.61 for attention index score). It could be that pen-and-paper cognitive tests are not sensitive enough to detect differences, but might also suggest that the intervention effects were quite specific and restricted to improved gait adaptability in situations requiring focused attention and planning.

Participants with Parkinson’s disease (who represented more than 40% of the study population) benefited the most from the combined intervention (incident rate ratio 0.45, 95% CI 0.24–0.86; p=0.015). This finding is encouraging because, despite evidence for remediation of physical fall risk factors, there is little evidence of translation of these improvements into the prevention of falls in this group.8 Notably, secondary analyses of a recent trial examining the effects of the cholinesterase inhibitor rivastigmine on falls in people with Parkinson’s disease suggest the beneficial effect may also have been related more to reducing gait variability than to improving cognition.3

Mirelman and colleagues’ findings have important implications for clinical practice. No serious adverse events occurred and adherence was good. A health economic analysis was not presented, and although it is the case that VR training is not substantially more resource-intensive than treadmill training, one-on-one supervision was used in this study. It is conceivable,
however, that treadmill training with a VR component could be administered in community gyms and rehabilitation clinics, and since the intervention is relatively short term in nature, throughput of many people would be possible.

As with all studies, the findings need confirmation in additional populations. It also needs to be established whether beneficial effects are retained beyond 6 months and whether older people with a history of multiple falls and those with mild cognitive impairment benefit from this intervention approach (subgroup analysis suggested that this was not the case in this trial). Finally, related research has shown the importance of gait adaptability in ageing and fall risk and the incorporation of such adaptive stepping responses along with other exergame attributes such as brain training, engaging recreation, and performance feedback require further research and application more generally to exercise programmes for older people.

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