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TITLE: VIRTUAL REALITY REHABILITATION IMPROVES DUAL-TASK WALKING ABILITY IN OLDER WOMEN WITH MIXED URINARY INCONTINENCE.

Hypothesis / aims of study

Recent research suggests that women with mixed urinary incontinence (UI) demonstrate poorer executive functioning (EF) than women with stress UI or continent women (1). Poor EF has been associated with dual-task walking deficits and an increased risk of falls (2). Accordingly, this could suggests that women with mixed UI, hence poor EF, have a greater risk of falling (e.g., when walking while talking). The aim of this pilot study was to evaluate the effect of pelvic floor muscle (PFM) training, using virtual reality rehabilitation (VRR) component, on the ability of older women with mixed UI to perform a cognitive task while walking. Given the association between EF and mixed UI, we hypothesized that VRR, which requires executive control decisions, combined with a PFM training programme would improve dual-task walking ability among older women with mixed UI.

Study design, materials and methods

This study employed a quasi-experimental pre-test, post-test design. Twenty-four community-dwelling women were recruited from a bank of potential participants operated by a research centre. To be included in the study, they had to be 65 or older, live at home, be ambulatory (i.e., able to walk indoor/outdoor without assisted devices), understand French or English (verbal and written instructions), suffer from mixed UI and, at a minimum, experience urinary leakage secondary to urgency, physical exertion, coughing or sneezing more than twice a week in the 3 months prior to the evaluation. The presence of mixed UI was established through an affirmative answer to questions 3 and 4 on the Urogenital Distress Inventory (UDI). Eligibility was assessed during a telephone interview through a standardised questionnaire.

The ability of participants to perform a cognitive task while walking was measured during the 1h pad test with standardised bladder volume on three separate occasions: two pre-training evaluations (Pre1, Pre2) and one post-training evaluation (Post-test). To assess the test-retest improvements in the cognitive tasks, the first two pre-training evaluations were conducted two weeks apart (Pre1, Pre2) followed by a post-test at the end of the 12-week training programme. The PFM/VRR training occurred between Pre2 and the Post-test. All three evaluations were conducted by the same experienced physiotherapist. During the evaluations, each participant was assessed on her ability to perform a cognitive task while walking. For the cognitive task, participants performed a 2-back task (3), in which participants were presented with a series of random single-digit numbers (e.g., 8, 2, 5, 1) and asked to report out loud, in an uninterrupted and unprompted flow, the number they heard 2 numbers back (e.g., when they hear 5 they should say 8; when they hear 1 they should say 2). The 2-back task was undertaken in both a seated position (single task) and while walking (dual task). The total number of response errors were tabulated for both the single- and dual-task conditions and a dual-task cost (DTC) score was computed for each participant (DTC = single-dual). A negative DTC indicates that more errors were made in the dual task than the single task.

The PFM/VRR training programme consisted of a weekly 60-minute exercise class, in groups of eight, for 12 consecutive weeks, supervised by an experienced physiotherapist not implicated in the evaluations. Each class session comprised a 10-minute education period on UI, a 30-minute session of static PFM training in different positions and a 20-minute period of VRR training using the free open-source software dance game StepMania. Participants were also given a 20-minute PFM exercise programme to do at home five days a week.

Exercises in both the PFM and VRR components were progressed (increased in difficulty) every four weeks. The dance game stimuli included five songs with no lyrics, synchronized to dance steps. Songs were paired with visual cues instructing the participants on how to dance each of the music tracks. The dance game involved decision making: a scrolling display of arrows moved upwards over the screen to cue each move in the four cardinal positions (when the arrows reached the top of the screen), subsequent to which the participant had to make the corresponding step, on the dance mat. The dance game also involved higher-level dual tasking: (1) the right and left feet were doing independent dance steps and (2) PFM contractions (represented by a red dot) were incorporated into the arrow sequences. The post-test was done within two weeks of completing the training.

Data from the three evaluations were normally distributed, thus the dual-task cost (DTC) outcome measures (number of response errors in the 2-back task: 2-back error DTC) for each participant were assessed with repeated measures analysis of variance (ANOVA).

Results

Twenty-four participants completed the study; however, one participant was unable to complete the walking assessment of the post-intervention evaluation because of an acute ankle injury (n=23). The 23 participants had the following means (SD): age 70.7 (3.5) years, body mass index of 26.0 (3.6) kg/m^2, hysterectomy 0.7 (0.5) and pregnancy 1.6 (1.4), including 1.2 (1.2) vaginal deliveries and 0.1 (0.3) Caesarean sections. For pad testing, not all participants reached the expected bladder volume. However, there were no differences in the 2-back error DTC between those who reached the expected volume and those who did not therefore we completed our analysis on the whole group (p = 0.231).

The means and standard deviations (SD) of the 2-back error DTCs, prior to and after the PFM/VRR programme, are presented in Table 1.

Table 1: Mean and SD of the 2-back error DTC at Pre1, Pre2 and Post-test (n=23)

	Pre1 Mean ± SD	Pre2 Mean ± SD	Post Mean ± SD
2-back error DTC	-0.22 ± 1.64	-1.07 ± 1.22	0.30 ± 1.88

[*] *Note* : A negative DTC indicates that more errors were made in the dual task than the single task.

The 2-back error DTC, diminished significantly over time for the entire sample [F (2, 21) = 3.667; p = 0.034; η^2 = 0.14]. Comparisons of the three evaluations (Pre1, Pre2, Post-test) revealed no significant improvements in 2-back error DTCs between Pre1 and Pre2 (p = 0.14). Significant improvement in 2-back error DTCs occurred only after the training was completed, between Pre2 to Post-test (p = 0.022).

Interpretation of results

Subsequent to the PFM/VRR training programme, participants demonstrated improvement in their cognitive dual-task cost scores independently of bladder volume, suggesting that the combined training had an effect on executive function. Ultimately, the inclusion of a training component specifically targeting executive control seemed to improve the participants' ability to perform a cognitive task while walking, immediately following training.

Concluding message

A combined, more dynamic, PFM/VRR training programme that addresses cognitive functions and physical rehabilitation could facilitate the ability to manage dual-task situations encountered in everyday life (i.e., walking and talking) among older women with mixed UI. Larger studies as well as additional longitudinal research is needed to determine, whether this type of training, in the long-run, reduces the number of falls in the target population.

References

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Disclosures

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