Effect of Modified Otago Exercises on Postural Balance, Fear of Falling, and Fall Risk in Older Fallers With Knee Osteoarthritis and Impaired Gait and Balance: A Secondary Analysis

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Abstract

Background: Osteoarthritis (OA) is considered an established risk factor for falls. Published studies evaluating secondary falls prevention strategies among individuals with OA are limited.

Objective: To evaluate the effect of a personalized home-based exercise program to improve postural balance, fear of falling, and falls risk in older fallers with knee OA and gait and balance problems.

Design: Randomized controlled trial.

Setting: University of Malaya Medical Centre.

Participants: Fallers who had both radiological OA and a Timed Up and Go (TUG) score of over 13.5 seconds.

Main Outcome Measure: Postural sway (composite sway) was quantified with the Modified Clinical Test of Sensory Interaction on Balance (mCTSIB) under 4 different sensory conditions: eyes open on firm surface, eyes closed on firm surface, eyes open on unstable foam surface, and eyes closed on unstable foam surface. Participants were asked to stand upright and to attempt to hold their position for 10 seconds for each test condition. The average reading for all conditions were calculated.

Methods: Participants randomized to the intervention arm received a home-based modified Otago Exercise Program (OEP) as part of a multifactorial intervention, whereas control participants received general health advice and conventional treatment. This was a secondary subgroup analysis from an original randomized controlled trial, the Malaysian Falls Assessment and Intervention Trial (MyFAIT) (trial registration number: ISRCTN11674947). Posturography using a long force plate balance platform (Balancemaster, NeuroCom, USA), the Knee injury and Osteoarthritis Outcome Score (KOOS) and the short-form Falls Efficacy Scale–International (short FES-I) were assessed at baseline and 6 months.

Results: Results of 41 fallers with radiological evidence of OA and impaired TUG (intervention, 17; control, 24) were available for the final analysis. Between-group analysis revealed significant improvements in the Modified Clinical Test of Sensory Interaction on Balance (mCTSIB), Limits of Stability (LOS), and short FES-I scores by the intervention group compared to the control group at 6 months. No significant difference in time to first fall or in fall-free survival between the intervention and control groups was found.

Conclusion: Home-based balance and strength exercises benefited older fallers with OA and gait and balance disorders by improving postural control, with no observable trend in reduction of fall recurrence. Our findings will now inform a future, adequately powered, randomized controlled study using fall events as definitive outcomes.

Level of Evidence: I

Introduction

Falls among older adults are often multifactorial, and the consequences of falls may range from minor injuries to death [1,2]. Falls prevention program in general older populations have been studied for decades, with exercise being the most widely evaluated intervention [3]. Falls and osteoarthritis (OA) commonly coexist among older people [4,5]. Osteoarthritis is often associated with impaired mobility due to pain and muscle weakness, and hence is considered an established risk factor for falls [2,6,7].
As individuals with OA represent a unique group of patients with specific symptoms and therapy needs, falls prevention programs using physical therapy should take into account patient symptoms and barriers to exercise [8]. With the correct form and intensity, exercise has benefited older adults with OA by reducing pain and improving mobility [9,10]. Therefore, it is vital that acceptable levels of appropriate exercises are offered, as in any fall prevention program, to ensure its success [11]. Furthermore, an intervention that could reduce multiple existing risk factors for falls simultaneously, such as fear of falling (FoF), together with gait and balance problems, should also be encouraged. A recent systematic review, however, has found no previous intervention studies in OA that have evaluated actual falls outcomes [12].

The Otago Exercise Program (OEP) is effective in primary falls prevention [3]. A Cochrane Review on community-based interventions for falls prevention confirmed the effectiveness of OEP among older adults aged 75 years and above [3,13-15]. The OEP, however, has not previously been tested among older fallers with OA. Our objective was therefore to evaluate the effects of a modified OEP delivered as part of a multifactorial intervention program on postural control and FoF in fallers who had knee OA and established gait and balance problems. In addition, fall recurrence and fall frequency were considered to inform future larger studies.

Methods

Setting and Participants

This study was a prespecified substudy of a randomized controlled study on multifactorial interventions among older fallers, the Malaysian Falls Assessment and Intervention Trial (MyFAIT) (trial registration number: ISRCTN11674947) [16]. The study complied with the Declaration of Helsinki of 1975, revised in 1983. It was approved by the University of Malaya Medical Centre Medical Ethics Committee (approval number 925.4), and written informed consent was obtained from all study participants. The recruitment period of the sub-study was between September 2012 and September 2013.

In MyFAIT, participants aged ≥65 years with either a history of 2 falls or 1 injurious fall over the past 12 months were recruited from the Departments of Emergency Medicine, Primary Care and Geriatric Medicine. The presence of OA was determined by fulfilling American College of Rheumatology classification criteria [17], namely, knee pain plus at least 1 of the following: age >50 years, stiffness <30 minutes, crepitus sound, or presence of osteophytes. Plain radiographs were graded by 2 experienced consultant radiologists (F.F. and F.I.R.) using the Kellgren-Lawrence (KL) grading scales. Fallers from MyFAIT were randomized to either the intervention group or the control group. The method of randomization has been described in a published protocol [16]. The participants in the intervention group received a personalized and modified OEP as part of a multifactorial intervention. Participants in the control group received general health advice and standard care from their existing health care professionals.

Participants with at least mild OA, KL grade 2-4 [18], and gait and balance disorders as determined by a Timed Up and Go score of over 13.5 seconds [19] were included in this prespecified substudy, in which additional posturography, symptom severity, and falls efficacy measurements were conducted at 6 months. Exclusion criteria were clinically diagnosed dementia (International Classification of Diseases, 10th edition [ICD 10] definition), severe physical disabilities (ie, unable to walk even with a walking aid), and major psychiatric illness. Demographic details were obtained from all participants.

Intervention

All participants in the interventional group received a multifactorial intervention, in up to 6 specific treatment modalities through prescribed individualized treatment programs, by a medical specialist: falls education, home hazards intervention, cardiovascular intervention, visual intervention, medication review, as well as exercise intervention (OEP) [16]. The former 5 potential interventions were not anticipated to influence composite postural sway, the primary outcome of this study. The OEP is a home-based balance and strength retraining program [20] comprising the following strengthening exercises with graded levels of difficulty: knee extension (4 levels), knee flexion (4 levels), hip abduction (4 levels), ankle plantar flexion (2 levels), and ankle dorsiflexion (2 levels). The balance retraining exercises consists of the following: knee bends (4 levels), backwards walking (2 levels), walking and turning around (2 levels), sideways walking (2 levels), tandem stance (2 levels), tandem walk (2 levels), 1-leg stand (3 levels), heel walking (2 levels), toe walking (2 levels), heel-toe walking backward (1 level), and sit to stand (4 levels) [20]. Participants were encouraged to perform the exercise program 3 times per week (approximately 30 minutes each time) for 6 months. Each participant was given an exercise manual with pictorial representations and written descriptions of each exercise. Ankle weights ranging from 1-3 kg were also provided according to each participant’s ability, to be used with the relevant strengthening exercises. Participants were required to go the hospital for monthly follow-up visits for 3 months. Depending on the outcomes of the individual assessments by the physiotherapist at each visit, the selection of exercises and the appropriate level of difficulty for each exercise and ankle weights were prescribed. The walking component in the original OEP was
not included in this modified program [21]. Another modification made to the original program was that our exercises were prescribed and progress recorded from center-based visits instead of home-based visits [20].

**Outcome Measures**

Outcome variables for postural control, FoF, OA symptoms, and functional ability were measured at baseline and 6 months later. An assessor who was blinded to the group assignment conducted the outcome measurements. Falls occurrence in the preceding 6 months at the 6-month follow-up visit was also recorded.

**Postural Control**

Each participant was tested with 2 established groups of balance tests using a long force plate balance platform (Balancemaster, NeuroCom USA). The Modified Clinical Test of Sensory Interaction on Balance (mCTSIB) and the Limits of Stability (LOS) test were selected for this purpose [22,23]. Individual task performance was recorded and analyzed with the standard software supplied with the equipment.

Postural sway was quantified with the mCTSIB under 4 different sensory conditions: eyes open on firm surface, eyes closed on firm surface, eyes open on unstable foam surface, and eyes closed on unstable foam surface. Participants were asked to stand upright and to attempt to hold their position for 10 seconds for each test condition. Each condition was tested 3 times. Composite mCTSIB, which was the primary outcome, was quantified as the mean sway velocity averaged over 12 measurements and expressed in degrees per second (°/s).

The measured parameters for LOS were directional control (DCL) (comparing the amount of movement in the intended direction toward the target and the amount of extraneous movement away from straight line), end-point excursion (ie, the distance traveled by the center of gravity at first attempt), and maximum excursion (MXE; ie, the farthest distance traveled by the center of gravity).

**Fear of Falling**

The short-form Falls Efficacy Scale—International (short FES-I) was used to determine the severity of FoF. The short FES-I consists of 7 items, each scored on a 4-point Likert scale, with 1 indicating no concern and 4 indicating severe concern about performing stated activities without overbalancing. The minimum and maximum scores for the short FES-I are therefore 7 and 28, respectively. The short FES-I is reliable and useful in clinical practice. It is also validated for older adults with cognitive impairment [24].

**Osteoarthritis Symptoms and Functional Ability**

The Knee injury and Osteoarthritis Outcome Score (KOOS) was used to quantify the severity of OA symptoms. It is a self-administered test that includes 5 domains: stiffness, pain, other symptoms, functional impairment, sports and recreation function, and knee-related quality of life. The KOOS is a reliable and sensitive assessment tool for short-term and long-term outcomes after knee surgery and physical therapy [25,26].

**Falls Occurrence**

Participant-reported falls were recorded prospectively using a diary with daily entry, specifically adapted to the multilingual environment and educational level of older Malaysians. Participants who did not return their diaries within the last 5 working days of each month and those who recorded a fall were followed up through a phone interview by a research assistant who was blinded to group assignment.

**Adherence to the Modified OEP**

Intervention adherence was defined by the number of days that the individual had completed the modified OEP divided by the number of days for which the modified OEP was prescribed. This was monitored using a diary given to the participants at the start of the modified OEP. Participants were advised to document the frequency and duration of exercises performed at home. Diaries were returned to the hospital monthly. If the diary was not returned, the participants would be followed up through a phone interview.

**Statistical Analysis**

The primary outcome of this study was composite postural sway. The power calculation was conducted with the G*Power 3.1 power calculation software [27] for composite postural sway as the main outcome. A sample size of 18 participants per group was found to be required to detect a 10% decrease in computed mCTSIB from baseline to 6-month follow-up (power = 80%, \( \alpha = 0.05 \)). This predicted difference equates to a moderate effect size. A recruitment target was set at 50 to allow for loss to follow-up. This study, however, was not powered to detect significant differences in falls outcomes.

The data were analyzed using SPSS software, version 21. Normality of data distribution was tested using Kolmogorov-Smirnov normality test. Baseline differences were tested using independent t test and Mann-Whitney U test for normal distributed and non—normally distributed data, respectively. The change scores in mCTSIB, LOS, KOOS, and the overall short FES-I were calculated by subtracting the baseline scores for each parameter from the scores obtained at the 6-month follow-up visit. The
outcome measures and normally distributed mean differences between intervention and control groups were analyzed with the independent \( t \) test. Within-group changes before and after exercise intervention were analyzed by paired \( t \) tests for normally distributed data and Wilcoxon signed rank test for the non–normally distributed outcomes.

Results

Of the fallers from MyFAIT, 50 met inclusion criteria and were considered eligible for this substudy. In all, 22 individuals had been randomized to the intervention arm, and 28 to the control arm. A total of 41 participants completed 6-month follow-up and were included in the analysis, and 9 participants were lost to follow-up. Figure 1 shows the flow of participants through the study.

Demographic Characteristics of Participants

The demographic characteristics of 41 participants, 24 in the control group, and 17 in the intervention group are displayed in Table 1. The mean age ± standard deviation (SD) of participants was 73.3 ± 5.8 years (range 69.5-78.0 years), and 80.5% were women. Participants in the intervention arm were significantly older than in the control arm (\( P = .02 \)). There was also a significant difference in fear of falling between arms, with participants in the intervention arm having a greater fear of falling (\( P = .01 \)).

Changes Over 6 Months of Follow-up

Between-Group Comparisons

Differences in change in mCTSIB, LOS, and short FES-I scores at 6 months from baseline between the intervention and control groups are reported in Table 2. The intervention group showed a significant difference in change in the primary outcome measure, which was the composite mCTSIB (Table 2) and under the eyes closed, foam surface condition of the mCTSIB test at 6 months of modified OEP. Significant differences between groups were also observed in the changes for the LOS test, with significantly greater improvements in \( \Delta \text{MXE} \) and \( \Delta \text{DCT} \) in the intervention group. A significant reduction in short FES-I scores was also observed between the 2 groups in favor of the modified OEP. There was no difference in change in KOOS results between groups.

Within-Group Comparisons

Improvements were observed in the intervention group at 6-month follow-up for component scores within mCTSIB and LOS (Table 2). For mCTSIB measurements, postural sway in the eyes open, foam surface condition was significantly reduced at 6 months in the intervention group (\( P = .03 \)). For LOS measurements, the MXE and DCT scores were significantly better at 6 months in the intervention group (\( P = .03 \) and \( P = .01 \), respectively). Total short FES-I scores were also significantly reduced at 6 months within the intervention group (\( P = .03 \)). No significant change in mCTSIB, LOS, or short FES-I was observed within the control group for any of the parameters assessed. No differences between KOOS

Recruitment

Randomization

Met inclusion criteria and baseline assessment

Completed 6-month follow up

Figure 1. Flow of participants recruited for the modified Otago Exercise Program study.
scores at 6 months were observed in either group. Within group comparisons of the composite mCTSIB scores from baseline to 6-month follow-up were not statistically significant in either the intervention or control group (Figure 2).

Table 1

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Control (n = 24)</th>
<th>Intervention (n = 17)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>71.96 (5.06)</td>
<td>76.29 (5.86)</td>
<td>.02</td>
</tr>
<tr>
<td>Gender, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5 (20.8)</td>
<td>3 (17.6)</td>
<td>&gt;.99</td>
</tr>
<tr>
<td>Female</td>
<td>19 (82.4)</td>
<td>14 (82.4)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity, n (%)</td>
<td></td>
<td></td>
<td>.15</td>
</tr>
<tr>
<td>Malay</td>
<td>4 (16.7)</td>
<td>3 (17.6)</td>
<td></td>
</tr>
<tr>
<td>Chinese</td>
<td>17 (70.8)</td>
<td>8 (47.1)</td>
<td></td>
</tr>
<tr>
<td>Indian</td>
<td>2 (8.3)</td>
<td>6 (35.3)</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>1 (4.2)</td>
<td>0 (0.0)</td>
<td></td>
</tr>
<tr>
<td>BMI</td>
<td>24.10 (3.60)</td>
<td>25.84 (5.37)</td>
<td>.22</td>
</tr>
</tbody>
</table>

Postural control

mCTSIB (sway velocity, °/s)

<table>
<thead>
<tr>
<th></th>
<th>Control</th>
<th>Intervention</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eyes open, firm surface</td>
<td>0.51 (0.18)</td>
<td>0.60 (0.26)</td>
<td>.22</td>
</tr>
<tr>
<td>Eyes closed, firm surface</td>
<td>0.62 (0.30)</td>
<td>0.79 (0.43)</td>
<td>.13</td>
</tr>
<tr>
<td>Eyes open, foam surface</td>
<td>1.70 (2.03)</td>
<td>2.03 (1.52)</td>
<td>.58</td>
</tr>
<tr>
<td>Eyes closed, foam surface</td>
<td>2.46 (1.01)</td>
<td>3.06 (1.66)</td>
<td>.17</td>
</tr>
<tr>
<td>Composite mCTSIB°</td>
<td>1.20 (0.90-1.40)</td>
<td>1.30 (1.10-2.10)</td>
<td>.21</td>
</tr>
</tbody>
</table>

Fear of falling

Δ Short FES-I score | 12.42 (5.03) | 17.00 (5.55) | .01     |

Values are expressed as n (%) or mean (standard deviation). Boldface data indicate statistical significance at P < .05.

BMI = body mass index; mCTSIB = Modified Clinical Test of Sensory Interaction on Balance; Short FES-I = short-form Falls Efficacy Scale—International.

* Expressed as median (interquartile range).

Falls Risk

A total of 18 falls were reported by 8 participants in the intervention group and 10 in the control group. In all, 47.1% (n = 8) in the intervention group and 41.7% scores at 6 months were observed in either group. Within group comparisons of the composite mCTSIB scores from baseline to 6-month follow-up were not statistically significant in either the intervention or control group (Figure 2).

Table 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Control</th>
<th>Intervention</th>
<th>Mean difference (Δ intervention-Δ control)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary outcome:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postural sway</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Composite mCTSIB (°/s)*</td>
<td>1.20 (0.90-1.40)</td>
<td>1.20 (1.00-1.75)</td>
<td>-0.20</td>
<td>.03</td>
</tr>
<tr>
<td>Secondary outcome:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mCTSIB (sway velocity, °/s)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eyes open, firm surface</td>
<td>0.51 (0.18)</td>
<td>0.60 (0.26)</td>
<td>-0.01</td>
<td>.84</td>
</tr>
<tr>
<td>Eyes closed, firm surface</td>
<td>0.62 (0.30)</td>
<td>0.79 (0.43)</td>
<td>-0.04</td>
<td>.60</td>
</tr>
<tr>
<td>Eyes open, foam surface</td>
<td>1.70 (2.03)</td>
<td>2.03 (1.52)</td>
<td>-0.55</td>
<td>.35</td>
</tr>
<tr>
<td>Eyes closed, foam surface</td>
<td>2.46 (1.01)</td>
<td>2.93 (1.52)</td>
<td>-1.26</td>
<td>.03</td>
</tr>
<tr>
<td>Limits of stability (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>End-point excursion</td>
<td>56.50 (11.73)</td>
<td>56.43 (13.10)</td>
<td>4.02</td>
<td>.29</td>
</tr>
<tr>
<td>Maximal excursion</td>
<td>73.04 (14.76)</td>
<td>69.04 (13.26)</td>
<td>11.22</td>
<td>.01</td>
</tr>
<tr>
<td>Directional control</td>
<td>63.54 (11.68)</td>
<td>61.45 (14.14)</td>
<td>13.49</td>
<td>.001</td>
</tr>
<tr>
<td>OA symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KOOS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symptoms</td>
<td>75.85 (18.84)</td>
<td>80.56 (13.83)</td>
<td>5.12</td>
<td>.43</td>
</tr>
<tr>
<td>Pain</td>
<td>80.25 (17.64)</td>
<td>79.95 (15.38)</td>
<td>8.18</td>
<td>.21</td>
</tr>
<tr>
<td>Function</td>
<td>79.67 (17.41)</td>
<td>80.44 (15.77)</td>
<td>9.17</td>
<td>.23</td>
</tr>
<tr>
<td>Sport</td>
<td>57.08 (30.85)</td>
<td>62.34 (30.21)</td>
<td>5.04</td>
<td>.62</td>
</tr>
<tr>
<td>Quality of life</td>
<td>53.38 (26.63)</td>
<td>61.96 (26.10)</td>
<td>6.61</td>
<td>.46</td>
</tr>
<tr>
<td>Fear of falling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Δ Short FES-I score</td>
<td>12.42 (5.04)</td>
<td>13.63 (6.25)</td>
<td>-5.23</td>
<td>.02</td>
</tr>
</tbody>
</table>

Values are expressed as n (%) or mean (standard deviation). Boldface data indicate statistical significance at P < .05.

mCTSIB = Modified Clinical Test of Sensory Interaction on Balance; OA = osteoarthritis; KOOS = Knee injury and Osteoarthritis Outcome Score; Short FES-I = short-form Falls Efficacy Scale—International; Δ = change.

* Expressed as median (interquartile range).
(n = 10) in the control group reported recurrence of falls. The median number of falls, with interquartile ranges (IQR), experienced in the 6 months were 1 (IQR 0-1) for the intervention group and 1 (IQR 0-1) for the control group.

**Adverse Events**

None of the participants reported any symptoms or adverse event associated with the exercises.

**Adherence to Exercise Program**

The median number of exercise sessions per week performed by the intervention group was 3 times per week, ranging from 1-5 days per week. Sixteen participants returned their diaries, and all reported exercising at least a median of 1 exercise session per week; 68.8% exercised at least a median of 2 times per week, 56.3% exercised at least a median of 3 times per week, and 31.3% exercised at least a median of 5 times per week. One participant did not return any diary and could not be contacted for adherence data.

**Discussion**

Our study demonstrated that older adults with recurrent or injurious falls with radiologically diagnosed knee OA and abnormal Timed Up and Go test results showed improvements in postural control and reduction in FoF after modified OEP. Our older adults were able to carry out the modified OEP with no worsening of their knee symptoms. Early evidence, however, suggests no effect on falls outcomes.

Balance deficits are associated with increased risk of falls among older persons with OA [28]. Our study has shown that a modified OEP benefited the intervention group by improving their postural control. The modified OEP was designed to reduce the risk of falls by improving balance and lower limb girdle strength [20,29,30]. To measure the effect of the OEP intervention, traditional tests on physical performance such as the Timed Up and Go test, Sit to Stand, and Berg Balance Scale (BBS) have usually been used [31-35]. Postural stability quantified by a balance platform has been used to determine falls risk among older adults with OA in a number of previous studies [28,36,37]. In the present study, we found that the modified OEP had significantly decreased the postural sway among the intervention group compared to the control. The results were similar to those of a recent randomized controlled study that examined the effects of OEP on Physiological Profile Assessment (PPA) in 74 older adults with a history of falls [20].

In another study in older women, OEP led to a positive effect on the BBS, a validated questionnaire-based instrument designed to objectively measure static and dynamic balance [38]. Our study, however, was unique in its inclusion of fallers with established OA and gait and balance disorders exclusively. Although previous studies had not consciously excluded participants with OA [13,20], it was important to conduct such a study among fallers with OA and gait and balance disorders to demonstrate that the modified OEP was indeed suitable for and beneficial to this group of patients.

In the present study, FoF was significantly reduced in the intervention group compared to the control group. Fear of falling is associated with increased risk of falls due to restriction of activities that eventually results in balance impairment, muscle weakness, social isolation, and negative psychological sequelae [2]. Among older adults with knee OA, high levels of FoF have been attributed to the presence of OA symptoms such as pain [39]. A previous study has found that a home-based exercise program helped to reduce FoF in women with severe knee joint arthritis [40]. Our study therefore confirms that a home-based modified OEP was also beneficial in reducing FoF among older fallers with OA and gait and balance disorders.

To our knowledge, this was the first study to examine falls outcomes in participants with OA and gait and balance disorders following an exercise intervention. Although our study was not powered to detect significant differences in falls outcomes, no trend was observed in fall recurrence or number of falls between the intervention and control groups. Previous studies have obtained surrogate falls risk measurements using a variety of balance tests [12]. Our findings, however, highlight the importance of conducting studies that measure actual falls outcomes, as improvements in balance measurements may not necessarily translate into fall reduction. As ours was only a substudy of a larger randomized
controlled trial, a larger randomized controlled study evaluating modified OEP by using diary-reported falls as a primary outcome measure with a longer period of follow-up is now indicated.

Our study is limited by its small sample size and relative short follow-up period of 6 months. A longer follow-up period is likely to be required to detect any significant differences in falls outcomes. The study participants included in this study would also have been exposed to falls education, and may have been provided with home hazards interventions, eye assessments, medication review, and cardiovascular interventions according to individual needs. Some of the observed benefits in falls efficacy could have been attributed to these interventions. The improvements observed on posturography, however, were likely to be wholly attributed to our physical interventions alone, as the other interventions were unlikely to directly affect physical performance. The dropout rate in our study of 20% is considered acceptable when compared to that in other similar studies evaluating OEP in fallers [41]. However, because of our small sample size, and because this was a secondary analysis of a larger randomized controlled study, we had conducted a complete case analysis rather than an intention-to-treat analysis, which may have introduced bias, as dropouts in our study may not have occurred at random. Baseline differences existed between the intervention and control groups, which had not been adjusted for because of our small sample size [42].

Conclusion

In this study, a home-based balance- and lower limb—strengthening exercise program in the form of the modified OEP benefited older fallers with OA and gait and balance disorders by improving postural control and reducing FoF. This study also found that the modified OEP did not adversely affect OA symptoms. However, no statistical difference or trend in fall reduction was observed. An adequately powered randomized controlled study with a longer follow-up period should now be conducted to establish whether the improvements in postural control observed with the modified OEP in individuals with OA will lead to a significant reduction in fall recurrence.

Acknowledgments

This study was funded by a University of Malaya Grand Challenge grant (GC002A-14HTM) and University of Malaya research grants RP008-13HTM UMRG. S.M. was also the recipient a University of Malaya Postgraduate Research Fund (PG013-2014B).

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Disclosure

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Disclosure: nothing to disclose

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Disclosure: nothing to disclose

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Disclosure: nothing to disclose

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CME Question
In this study, the group that received modified Otago Exercise Program (OEP) had:

a. Increase in the severity of osteoarthritis symptoms.
b. Decrease in postural sway.
c. No change in fear of falling.
d. Decrease trend of fall occurrence.

Answer online at me.aapmr.org