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# Comparison of the effectiveness of two programmes on older adults at risk of falling: unsupervised home exercise and supervised group exercise

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**Objective**: To compare the effectiveness of unsupervised home and supervised group exercise on parameters related to risk of falling among older adults.
**Design**: Prospective, single-blind, randomized and controlled trial.
**Setting**: Nursing home.
**Subjects:** The subjects were selected from 535 independent individuals who resided in a nursing home. Forty-two older adults, aged $>65$ years, with risk of falling were recruited, and 32 of them completed the study.
**Intervention**: The 42 subjects were divided into two groups (unsupervised home exercise and supervised exercise group) randomly. Exercise sessions were performed three times a week for a period of eight weeks.
**Main measures**: Measurements were taken at baseline and after the completion of the exercise programme. The fear of falling was evaluated using a visual analogue scale, quadriceps muscle strength was measured with a dynamometer, flexibility was assessed with the sit and reach test, functional mobility was determined using the Timed Up and Go Test, balance was evaluated using one-leg and tandem standing, and Berg Balance Scale and proprioception was assessed with knee position sense.
**Results**: Thirty-two subjects (unsupervised home exercise $n=15$, supervised group exercise $n=17$) completed the exercise programme and all of the measurements. The unsupervised home exercise group showed significant improvement in balance, functional mobility and flexibility ($P<0.05$). In addition to balance, functional mobility and flexibility, the supervised exercise group also showed significant improvements in both strength and proprioception ($P<0.05$).
**Conclusions**: Supervised group exercise is more effective at reducing the risk factors related to falling among older adults living in a nursing home than is unsupervised home exercise.

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## Introduction

It has been found that changes in the body that occur as a result of ageing, such as muscle weakness, impaired balance and co-ordination, decreased flexibility and sensory loss, are all associated with an increased risk of falling.[1–4] Other risk factors for falling include the use of particular medications, dizziness, visual impairment, suffering from a chronic disease, having a history of falls, having a fear of falling, a low activity level, and use of an assistive device.[1,2,5,6]

Falling is a problem for one out of three people over the age of 65 years, and for people with a history of falls there is a two to three times even greater risk for falling.[3] Falling can have numerous direct and indirect effects on the individual, from the injuries sustained in the fall itself, such as sprains, lacerations, hip fractures, etc., to longer term physical impairment which can require dependence on others, a long rehabilitation period or even institutional care. Falling can even result in death. As the adult population ages, the medical, social and economic problems resulting from falls has led researchers to investigate various methods to help prevent falling.[5–13]

In their systematic review, Chang *et al.* stated that multifactorial fall risk assessments and management programmes combined with exercise intervention are beneficial in helping to reduce the number of falls.[14] In many studies, both exercise and increased activity levels have been shown to decrease the risk of falling by improving both balance and strength.[15–21]

Hauer *et al.* reported that supervised progressive resistance and functional training given to older adults in an outpatient geriatric rehabilitation unit was effective in reducing the number of falls.[16] Day *et al.* and Robinson *et al.* gave a combination of group exercise and home exercise programmes to older adults in their study for fall prevention.[17,21] DeVito *et al.*, after giving supervised group exercise sessions, and Campbell *et al.*, after delivering home visits, instructed the older adults in their study to continue performing the exercises at home.[20,22] Robertson *et al.* (meta-analysis) and Skelton and Beyer (review) recommended supervised home-based exercise programmes for older adults,[7,9] but the programmes found effective were continued at home for a period of one to two years.[7]

As seen in the literature, the exercise programmes carried out among community-dwelling older adults or those residing in nursing homes include supervised programmes, supervised programmes in combination with home programmes or unsupervised home programmes. In the literature, we have not encountered a study that compares the effectiveness in older adults of supervised group exercise programmes versus unsupervised home exercise programmes.

We designed our study so that we would be able to compare the effectiveness of unsupervised home exercise with supervised group exercise (both given by a physiotherapist) on reducing the risk factors of geriatric falling, including muscle strength, flexibility, functional mobility, and balance and proprioception, as well as how both programmes would reduce the fear of falling among the participants. For this study we used older adults who were nursing home residents with an increased risk of falling.

## Methods

### Subjects and design

The subjects were selected from 535 older adults residing at the Republic of Turkey Emekli Sandigi Narlidere Nursing Home. Residents of this nursing home are ambulatory independent and are relatively independent in caring for themselves. In addition, a report from a state hospital psychiatrist which confirms that the individual does not have any psychological disease is required for registration at this nursing home. The selection criteria for subject recruitment were the following: being aged $>65$ years and being non-obese (i.e. body mass index (BMI) $<30$), not recently having had a stroke or recovery from an acute illness, no unstable or uncontrolled medical conditions (e.g. diabetes mellitus, hypertension), no resting angina, no recurrent heart failure or arrhythmias, no uncontrolled seizure disorder, no progressive neurological disease, no blindness or deafness, and no severe osteoporosis with two or more fractures.

Potential subjects were excluded from the study if they had a score of $>52$ on the Berg Balance Scale or if they had attended an exercise

programme regularly in the two months prior to the study. The first step in selecting subjects involved examining the health records of the nursing home residents, keeping in mind the inclusion and exclusion criteria. Figure 1 shows the flow of participants. Based on examination of health records, 404 of the nursing home residents were selected for face-to-face interviews. The 141 residents who were reached for the interview and volunteered were tested with the Berg Balance Scale for risk of falling. Forty-two older adults with a score of 52 or below on the Berg Balance Scale were randomly separated into two groups using cards in unmarked envelopes. The code

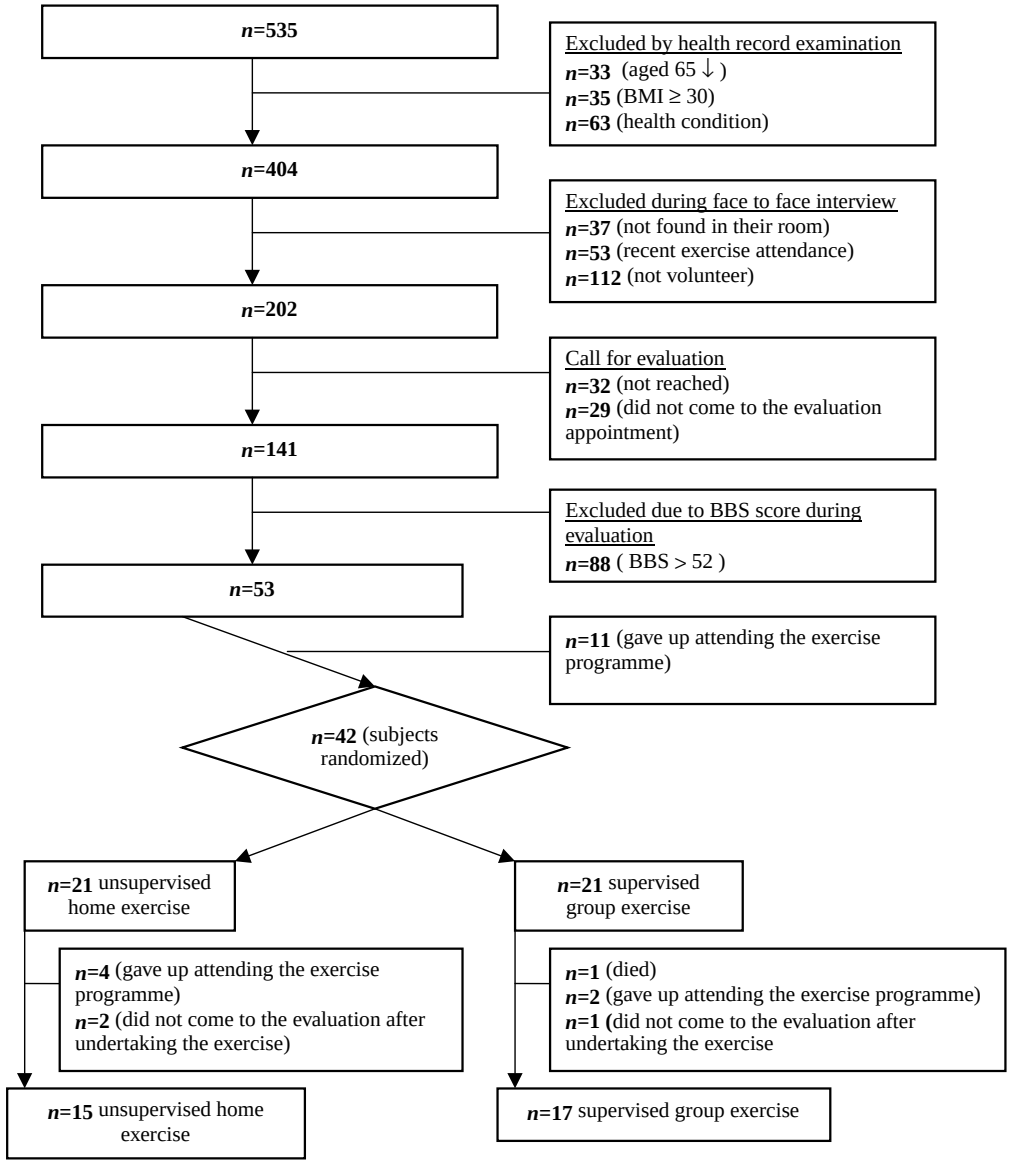


**Figure 1** The flow diagram for subject recruitment.

number of each subject was written on a card and placed in an envelope, and the envelopes were then put in two groups by a person with no knowledge of the codes. The same person also chose the cards in envelopes with the group names to determine to which group the subjects were to be assigned, either unsupervised home exercise ($n = 21$) or supervised group exercise ($n = 21$). During the recruitment process and during the exercises, the volunteers had no knowledge of which group they would be placed in. The physiotherapist, who carried out all measurements, both at baseline and after the exercises, was also unaware of the group the subjects were in.

Prior to the data collection, all of the volunteers had the study fully described to them and then gave their consent to participate. The protocol for this study was approved by the Ethics Committee of Dokuz Eylül University.

After the assessments and exercise programmes had been described to the subjects, information about the personal characteristics of the subjects, such as age, medical history, alcohol consumption, self-reported history of falls, use of assistive device for ambulation, and medication usage, was then collected. The same physiotherapist carried out all of the assessments.

## Measurements

Baseline measurements were taken at the beginning of the study for muscle strength, flexibility, fear of falling, functional mobility, balance, and position sense of the knee. These same measurements were again taken at the completion of the exercise programmes at the end of the eight-week period.

To determine the fear of falling in daily living, the visual analogue scale (VAS) described in the study by Wolf *et al.* was used.[15] Subjects were asked to express their overall feelings of fear of falling by drawing a mark on a vertical line exactly 10 cm in length (0: no fear of falling; 10: very afraid of falling). The score was the number of centimeters between '0' and the subject's mark.

A leg dynamometer (Takei Back and Leg Dynamometer, Japan) was used to evaluate leg strength in kilograms. The subject stood on a platform with knee flexion at nearly 45° while grasping each end of a bar with their hands. The subject's back was kept straight in order to eliminate activation of the back muscles. The subject then took a deep breath and exhaled slowly while attempting to extend the knees as forcefully as possible. Three attempts were made and the mean score of the three was recorded.[16,17]

The sit and reach test, reported to be reliable and valid in older adults by Jones *et al.*, was used in order to assess the flexibility of the trunk and lower extremities.[23] The subject was instructed to sit with knees straight and to reach forward as far as possible from this seated position. The score was determined by the distance the subject was able to reach with the fingertips on a scale in centimeters. Three attempts were made and the mean score of the three was recorded.

The Timed Up and Go (TUG) test, reported by Shumway-Cook *et al.* to be a sensitive and specific measure for identifying older adults at risk of falling, was used to measure the basic functional mobility of the subjects. The time taken to complete rising from a chair, walking 3 m, turning around, walking back to the chair and sitting down again was recorded in seconds. After completing three test trials the mean score was recorded.[24,25]

As is commonly used in the literature to assess balance, we measured the time that each subject was able to do one-leg standing (for both the right and left legs) and tandem standing (up to 30 s, eyes both open and closed). Each test was performed three times and the mean value was recorded in seconds.[26,19]

The Berg Balance Scale, which has been found to be reliable and valid for use with older adults, was used to evaluate both balance and the risk of falling.[27] The Berg Balance Scale is a 14-item balance assessment tool that measures the level at which each subject is able to perform various tasks, and each task is scored on a five-point ordinal scale (0–4). A score of 0 indicates that the subject is unable to perform the task while a score of 4 demonstrates that the subject can safely and independently perform the task.

The subject's position sense of the knee joint was evaluated using lower limb matching tasks, as described by Lord *et al.*[4] Subjects were seated and a vertically held clear acrylic sheet ($60 \times 60 \times 1$ cm) that had been inscribed using a protractor was placed between their legs. Each side of the sheet was divided into degrees and marked accordingly.

The subjects were then asked to align their lower limbs simultaneously on both sides of the acrylic sheet. To prevent any limited motion at the knee joint from confounding the results of this test, we tested the limbs near the midrange of the knee joint motion. Any difference in the alignment of the lower limbs was measured in degrees. After two practice trials (with eyes open), the mean score of five experimental trials (eyes closed) was recorded. A lesser difference, in degrees, between the lower limbs was indicative of better position sense.

**Intervention**

Both groups performed the same exercise programme three times a week for a period of eight weeks. Each exercise session lasted 45–50 min. The exercise programme was based on balance training, strengthening and stretching of the lower limbs, increasing flexibility, posture exercises and functional activities (Table 1). Body weight was used for strengthening of the lower limbs. Balance exercises progressed from being done with open eyes to being done with closed eyes and from being done with a support to being done without a support. The subjects did their exercises next to a chair so that if they lost their balance they could hold it for support. For each exercise, the duration and number of repetitions increased as the subjects' tolerance increased and as time progressed.

Each group was asked to walk daily for 10 min during the course of the eight weeks, and the walking sessions were followed by marking weekly charts which were given to the subjects in both groups.

The physiotherapist demonstrated the exercises to all of the subjects in the unsupervised home exercise group, and then observed them practising the exercises once to make sure that the they understood how to do them properly. These subjects were required to do the exercises on their own and in their own rooms. In addition, they were all given a written exercise programme with a weekly chart to help them keep a record of what they had accomplished. On this chart the subjects marked the exercises they completed on the various days. Furthermore, they were asked to come to meet the physiotherapist at the end of the second and fourth weeks in order to make sure that

**Table 1** The components of the exercise programme with progressions

| | | Time (min) |
|---|---|---|
| Warm-up | Walking at moderate speed for 1–2 min, trunk flexibility while standing (3–5 times trunk rotation, lateral flexion and forward flexion) | 5 |
| Posture exercises | In sitting position 3 times bilateral shoulder flexion with the combination of breathing and, cervical rotation, lateral flexion and flexion/extension for 8 times and 3–5 times bilateral scapular adduction | 35–40 |
| Balance and lower limb co-ordination exercises | 5–8–10 times reciprocal hip–knee flexion, knee extension and dorsi/plantar flexion while sitting, in standing position 2–4 times anteriorly-posteriorly and laterally weight shifting, marching in place for 30 s, pacing anterior-posterior and laterally with weight shifting twice to each direction with right and left foot, 10–30 s tandem standing (2–3 times and for each foot at the front), 10–30 s one-leg standing (2–3 times on each foot, 5–10 s standing on heels and fingertips (5–10 times) | |
| Functional activities | 3–5 times sit to stand (one foot in front of the other one to side by side under chair), while standing reaching out 3–5 times for each direction (upward, forward and laterally with single and both hands) | |
| Walking training | Tandem walking, heel and fingertip walking, walking backwards (2 min overall) | |
| Stretching | Gastrosoleus stretching towards the wall, hamstring stretching in sitting position (with a duration of 5–10 s and 3–5 times for each foot) | |
| Strengthening | Abduction and extension of hip while standing 5–10 times, mini-squat against the wall for 5–10 times with 5–10 s duration, stepping 5–10 times | |
| Cool-down | Walking slowly for 1–2 min, trunk flexibility while standing (3–5 times trunk rotation, lateral flexion and forward flexion) | 5 |
| Total | | 45–50 |

the exercise programme was being performed properly and to discuss any problems encountered. At these meetings the subjects were also instructed on how to make the appropriate progressions to higher level exercises.

The other subjects who were in the group supervised by the physiotherapist attended exercise class three times a week. The participation of these subjects was tracked by the physiotherapist using a common chart. As with the unsupervised home exercise group, the progressions of those in the supervised group were also carried out at the end of the second and fourth weeks. The evaluation of both groups was repeated at the end of the eighth week.

### Statistical analysis

The minimum sample size of the groups was calculated as 313 and 313 at 95% confidence interval, 80% power, exposed/unexposed equal, expected frequency of fall risk (measured with Berg Balance Scale) at the end of the procedure for the supervised exercise group as 20%, OR (odds ratio) = 1.5 for the unsupervised home exercise group, at Epiinfo Statcalc.

Using the Statistical Package for Social Sciences version 11.0 (SPSS Inc., Chicago, IL, USA) for the data analyses, the level of significance was accepted as 0.05 for each test. All the data were presented as medians with ranges, including change scores for all parameters in the groups. The Mann–Whitney *U*-test (two tailed) was used to analyse the difference between the groups at baseline and the Wilcoxon signed rank test was used to make comparisons within each of the groups. Pearsons' chi-square test was used to analyse any difference in sex between the groups and the results of Pearson's chi-square test were given with standard deviation (SD).

## Results

After starting the exercise programme, four subjects in the unsupervised home exercise group failed to complete the exercise programme and two failed to come to the evaluation after completing the exercise programme. In the supervised exercise group, one subject died, two gave up attending the exercise group, and one failed to come to the evaluation after completing the exercise programme (Figure 1). As a result, these 10 subjects were excluded from the study, and so the data of 32 subjects was used in the analyses (unsupervised home exercise $n = 15$, supervised group exercise $n = 17$).

No statistically significant differences were found between the older adults who completed the study ($n = 32$) and the dropouts ($n = 10$) in terms of age ($U = 149.5$, $P = 0.76$), sex ($\chi^2 = 0.49$, SD = 1, $P = 0.48$) and Berg Balance Scale scores (median (range) = 51 (9) for 32 subjects and 52 (11) for 10 dropouts; $U = 137.0$, $P = 0.48$) (Table 2).

No significant differences were found between the groups in terms of both age (median (range) = 79 (21) years for the unsupervised home exercise group and 81 (19) years for the supervised exercise group; $U = 97.0$, $P = 0.26$) or in terms of sex ($\chi^2 = 0.20$, SD = 1, $P = 0.64$). The demographics and medical history of the subjects are summarized in Table 2.

No significant differences were found between the groups at baseline for the following scores: fear of falling, tandem and one-leg standing times, scores of the Berg Balance Scale, leg strength, flexibility, functional mobility, and position sense ($P > 0.05$) (Table 3).

The number of exercise and walking sessions completed by each subject was calculated from the weekly charts. There was a statistically significant difference between the groups (median (range) for the number of walking sessions completed = 42 (28) for the unsupervised home exercise group and 55 (21) for the supervised exercise group; $U = 71.5$, $P = 0.031$). There were no significant differences between the groups for the number of exercise sessions completed (median (range) = 21 (8) for the unsupervised home exercise group and 17 (11) for the supervised exercise group; $U = 89$, $P = 0.14$).

After completing the exercise programme, there was no significant change within either group in fear of falling ($P > 0.05$). Significant increases were observed within both groups for tandem and one-leg standing times, Berg Balance Scale scores, flexibility and functional mobility ($P <$ 0.05), whereas leg strength and position sense

**Table 2** Characteristics of the subjects included in the unsupervised home and supervised group exercise groups and the ones who left the study

| | Unsupervised home exercise ($n = 15$) | | Supervised group exercise ($n = 17$) | | Drop-outs ($n = 10$) | |
|---|---|---|---|---|---|---|
| | (*n*) | Median (range) | (*n*) | Median (range) | (*n*) | Median (range) |
| Sex | | | | | | |
| Female | 10 | | 10 | | 5 | |
| Male | 5 | | 7 | | 5 | |
| Age (years) | | 79 (21) | | 81 (19) | | 79 (20) |
| BMI (kg/m$^2$) | | 27.2 (6.5) | | 27.8 (8.9) | | 28.3 (9) |
| Number of chronic diseases | | | | | | |
| 0–3 | 6 | 4 (6) | 11 | 3 (5) | 10 | 2 (3) |
| 4–6 | 9 | | 6 | | 0 | |
| Number of medication used | | | | | | |
| 1–3 | 5 | 4 (6) | 5 | 4 (7) | 5 | 3.5 (6) |
| 4–6 | 8 | | 8 | | 5 | |
| 7–8 | 2 | | 4 | | 0 | |
| Assistive device | | | | | | |
| Inside | 0 | | 1[a] | | 0 | |
| Outside | 3[a] | | 4[b] | | 0 | |
| No | 12 | | 12 | | 10 | |
| Alcohol consumption | | | | | | |
| Yes | 1 | | 1 | | 4 | |
| No | 14 | | 16 | | 6 | |
| History of falling in previous year | | | | | | |
| 0 | 9 | 0 (2) | 8 | 1 (2) | 9 | |
| 1 | 4 | | 5 | | 1 | |
| $>2$ | 2 | | 4 | | 0 | |

[a]Cane; [b]two unilateral crutches, two canes.
BMI, body mass index.

significantly improved only in the supervised exercise group ($P < 0.05$) (Table 3).

## Discussion

We sought to compare the effectiveness of two exercise programmes – a supervised group exercise programme versus an unsupervised home exercise programme, by evaluating how each programme affects factors that contribute to the risk of falling. The content of both exercise programmes was exactly the same for both groups. The exercise programme that we designed was easy, safe and economical, and was focused on factors related to the risk of falling. There were no statistically significant differences between the two groups of subjects at baseline. After the exercise programme, the fear of falling was not observed to change significantly in either of the groups, which is similar to the findings of Wolf *et al.*[15] All of the other parameters (balance, functional mobility and flexibility) improved significantly in both groups, whereas muscle strength and position sense only significantly improved in the supervised exercise group. It was also observed that two of the subjects in the supervised exercise group who had used canes prior to the exercise programme stops using these assistive devices after completing the exercise programme.

**Table 3** The median (range) values at baseline, at eight weeks and the change scores for both groups

| | Baseline | | *P*-value[a] (Mann–Whitney *U*) | At eight weeks | | | | Change scores[b] | |
|---|---|---|---|---|---|---|---|---|---|
| | UHE | SGE | | UHE | | SGE | | UHE | SGE |
| | Median (range) | Median (range) | | Median (range) | *P*-value[c] | Median (range) | *P*-value[d] | Median (range) | Median (range) |
| Fear of falling (cm) | 3 (10) | 5 (10) | 0.34 (102.5) | 3 (10) | 0.305 | 4 (10) | 0.13 | 0 (9.5) | −0.5 (17.5) |
| Leg strength (kg) | 49.5 (96) | 37.5 (74.5) | 0.32 (101.5) | 45 (79) | 0.532 | 43 (76.5) | 0.006 | 5.5 (43) | 6 (41) |
| Flexibility (cm) | 9 (43) | 10 (43) | 0.70 (117.5) | 12 (37) | 0.004 | 15 (34.5) | 0.000 | 1.5 (31.5) | 3 (17.5) |
| Timed Up and Go (s) | 13.8 (14.3) | 15.4 (10) | 0.58 (113) | 11.7 (6.9) | 0.004 | 12.1 (5.7) | 0.002 | −2.3 (13.1) | −1.9 (10.3) |
| Berg Balance Scale (score) | 51 (9) | 51 (9) | 0.54 (108.5) | 54 (9) | 0.001 | 55 (5) | 0.000 | 3 (12) | 5 (5) |
| One-leg standing (s) | | | | | | | | | |
| Eyes open | | | | | | | | | |
| Right | 2.5 (16.4) | 2.5 (14.9) | 0.82 (121.5) | 5.1 (18.3) | 0.01 | 6.4 (29.3) | 0.01 | 1.1 (18.7) | 3.6 (18.8) |
| Left | 2.3 (8) | 3.3 (19.9) | 0.49 (109.5) | 4.2 (16.2) | 0.002 | 9.9 (28) | $<0.001$ | 1.2 (10.8) | 5.8 (27.1) |
| Eyes closed | | | | | | | | | |
| Right | 1 (4.2) | 1.2 (3.4) | 0.93 (125.5) | 1.7 (6.2) | 0.045 | 1.9 (12.4) | 0.008 | 0.2 (4) | 5 (10.2) |
| Left | 0.9 (3.7) | 1.3 (3.2) | 0.44 (108) | 2.2 (9.9) | 0.011 | 2.6 (9.6) | 0.002 | 0.2 (8.3) | 0.8 (9.8) |
| Tandem standing (s) | | | | | | | | | |
| Eyes open | 9.3 (24.2) | 18.1 (30) | 0.36 (103.5) | 27.6 (30) | 0.001 | 26.6 (26.5) | 0.001 | 7.6 (23.3) | 7.3 (30.4) |
| Eyes closed | 2.5 (6.7) | 3.1 (24.7) | 0.39 (105) | 7.1 (19.10) | 0.001 | 8.4 (30) | 0.015 | 4.1 (13.8) | 3 (32.7) |
| Position sense (degree) | | | | | | | | | |
| Right | 4 (12) | 5.4 (7.6) | 0.55 (112) | 2.8 (7.4) | 0.177 | 3.6 (6.4) | 0.028 | −1.2 (14.4) | −1.2 (8.2) |
| Left | 5.4 (12.2) | 4.2 (5.8) | 0.55 (112) | 4 (6.2) | 0.172 | 2.4 (11) | 0.047 | −1.2 (13.4) | −1.2 (11.2) |

UHE**,** unsupervised home exercise ($n=15$); SGE, supervised group exercise ($n=17$).
[a]*P*-values for difference between groups at baseline.
[b]Posttest minus pretest values for both groups.
[c]*P*-values for significance of changes at eight weeks in unsupervised home exercise.
[d]*P*-values for significance of changes at eight weeks in supervised group exercise.

A limitation with this study is that the number of subjects in both groups was low. The residents of the nursing home were not easily persuaded to participate in the study, and some that had joined failed to complete the study.

During the recruitment period and during the exercises the subjects were not told which group they were in, but because all of the participants lived in the same nursing home it was very difficult to plan a double-blind study.

Studies published by both Hauer *et al.* and Lord *et al.* utilized group exercise programmes of 3 and 12 months, respectively, and found the programmes to be effective in increasing the strength of older adults with a history of injurious falls.[16,28] Hauer *et al.* also reported significant functional improvements.[16] Ambrose *et al.* stated that supervised class exercise programmes (strength and agility training: coordination and balance) are effective in decreasing the risk of falling.[29] In a study by Bastone *et al.*, it was reported that regular group exercise for a period of six months for subjects living in a nursing home resulted in significant improvements in both knee extensor strength and balance but not in lower extremity proprioception.[30] We noticed that there were not many studies in the literature that used exercise programmes involving proprioception evaluation and training to decrease geriatric falls. The conflicting findings of some of these studies can be explained as the result of different body parts being targeted for treatment in the various and different methods of assessment used in the studies.

Petrella *et al.* also reported that age-related decreases in proprioception could be alleviated with regular exercise.[31] In our study, we found that proprioception (knee position sense) significantly improved among the subjects in the supervised exercise group. Therefore, we believe that supervised exercise is more effective at maintaining and restoring proprioception than is unsupervised exercise.

DeVito *et al.* instructed older adults at risk of falling to continue performing low-intensity exercises at home for more than six months after the completion of the first 24 supervised group exercise sessions, resulting in significant improvement in both balance and strength. Gait and balance scores increased significantly during the second six months while strength was found to only slightly decline.[20] In a study performed by Campbell *et al.*, the older adults were visited a total of four times by a physiotherapist in the first two months of the exercise programme. It was found that for those older adults who kept exercising the benefits and improvements extended over a two-year follow-up period.[22]

Yates and Dunnagan reported a significant improvement in functional mobility and lower extremity power after the completion of a home-based exercise programme (performed three times a week for 10 weeks) which was intended to decrease the risk of falling among older adults.[32] Our results indicated that leg strength did not change significantly after eight weeks of an unsupervised home exercise programme.

Wolf *et al.* stated that individual, supervised exercise programmes delivered at home or at a physical therapy centre can improve the functional balance of older adults.[15] Judge reported in his review that home programmes (using low-intensity strengthening and balance training) improve balance and reduce falling rate by 40%, while class-based exercise programmes performed at senior centres increase the balance and physical performance of the participants and some of them decrease the rate of falls. He also pointed out that better results and performance are observed among those subjects who are motivated and attend the class regularly.[33] The importance of motivated participation in such exercise programmes is also pointed out by Shumway-Cook *et al.*[34]

## Clinical messages

- Unsupervised home exercise and supervised group exercise without the use of any special equipment both led to improved balance, functional mobility, and flexibility.
- In the supervised exercise group significant benefits were also observed in strength and position sense.

In addition, King *et al.* have suggested that subjects may adapt better to home exercise sessions than to supervised sessions.[35] A similar pattern of adaptation was seen in our study. The reason for this may be that the unsupervised home exercise group had the chance to do the exercises on three days of the week of their choosing, while if the subjects in the supervised exercise group were unable to attend the group exercise session on a given day or at a given time then they would not be able to complete three sessions in that week. Although not a statistically significant difference, the number of sessions attended by the subjects in the supervised group was lower than that for the unsupervised group. Conversely, the number of walking sessions performed by the subjects in the supervised group was higher. We think that this difference can be explained by the fact that the subjects in the supervised group were required to do the walking exercise in order to participate in the exercise class. This fact might have given them added encouragement to walk for at least 10 min.

In both the supervised exercise group and the unsupervised home exercise group balance, functional mobility, and flexibility all were seen to improve among the subjects with risk of falling. Strength and proprioception however, improved only within the supervised exercise group. Due to the ease of participation and the economical advantages, we suggest that unsupervised home exercises may be preferable to supervised exercise groups. Furthermore, the unsupervised home exercises can be enhanced by improving the strengthening and proprioceptive exercises.

The findings of the present study indicate that supervised group exercise is effective at improving balance, functional mobility, flexibility, strength and proprioception, whereas unsupervised home exercise was found to be effective in improving only balance, functional mobility and flexibility. There is still, however, a need for further studies to investigate the optimal number of sessions for the participants, the control frequency, and the duration of the exercise programme. Future studies should compare similar exercise programmes among community-dwelling older adults and incorporate a multidimensional approach, investigating environmental factors and the role of medical modifications in addition to other potential sources of variation. Finally, future studies should involve a long follow-up period.

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**Authors' contributions**

Hülya Donat: analysis and interpretation of data, draft of article and critical revision for important intellectual content. Ayşe Özcan: conception and design, final approval of the version to be published.

**Competing interests**

None declared.

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