Reducing Fear of Falling in Seniors Through Education and Activity Programs: A Randomized Trial

Brenda J. Brouwer, PhD, Cathy Walker, MSc, Sarah J. Rydahl, BSc, and Elsie G. Culham, PhD

OBJECTIVES: To determine the relative effect of education and activity programs on fear of falling, balance, strength, and health status.

DESIGN: A randomized intervention trial with two groups (education and activity); evaluators were blind to group allocation.

SETTING: Motor performance laboratory at Queen's University.

PARTICIPANTS: Thirty-eight community-dwelling seniors who reported a fear of falling and activity restriction but were free of neurological and mobility-limiting orthopedic conditions.

INTERVENTIONS: Programs designed to reduce fear of falling were delivered weekly to groups of three to five seniors for 8 weeks, each session lasting 1 hour. The activity program included low-resistance exercises and weight-shifting activities. Education focused on identifying and reducing risk factors for falls.

MEASUREMENTS: Balance confidence, activity level, limits of stability (LOS), isokinetic strength, and health status were measured twice preintervention (baseline), postintervention, and 6 weeks later.

RESULTS: Both programs reduced fear of falling ($P < .006$) as ascertained from the balance confidence scores. Differential effects were observed in LOS ($P < .05$); activity improved balance, whereas education led to modest declines. Gains in perception of health status were limited to physical health for the activity group and mental health for the education group. Benefits were generally sustained at follow-up.

CONCLUSION: Improved balance confidence is not intervention-specific, but associated changes in physical ability and health status are a function of the composition of the intervention program. **J Am Geriatr Soc 51:829–834, 2003.**

From the Motor Performance Laboratory, School of Rehabilitation Therapy, Queen's University, Kingston, Ontario, Canada.

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Address correspondence to Dr. Brenda Brouwer, Professor and Graduate Program Chair, School of Rehabilitation Therapy, Louise D. Acton Building, 31 George Street, Queen's University, Kingston, Ontario, Canada, K7L 3N6. E-mail: Brouwerb@post.queensu.ca

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Fear of falling in seniors has been identified as an independent risk factor for disability,[1] loss of quality of life,[2] and decreased mobility.[3] Knowing someone who has fallen, social isolation, depression, and anxiety are, in addition to fall history, contributors to fear of falling, which affects as many as 55% to 60% of community-dwelling elderly.[4,5] Fear of falling may be a reasonable response to certain events or situations leading to cautious behaviors contributing to fall prevention,[6] but it can also have serious negative consequences that may increase fall risk due to deconditioning.[7,8]

Cross-sectional studies have revealed that fear of falling is associated with impaired balance, gait abnormalities, poor self-assessed heath status, and reduced activity levels.[9–11] Prospective studies have concluded that fear of falling or poor fall-related self-efficacy leads to declines in physical performance, perceived physical function, and the ability to perform activities of daily living (ADLs).[7,12] Although temporal precedence is important for the identification of cause-effect, it is likely that these relationships are reciprocal, such that fear-related reductions in function can be expected to simultaneously affect the intensity of fear itself.[13] It follows that interventions directed at improving physical status or reducing fear of falling per se may yield physical and psychological benefits.

One study showed the efficacy of a cognitive-behavioral program delivered in eight 2-hour sessions, twice weekly, to reduce fear of falling.[14] The program improved falls efficacy for up to 1 year, but only modest short-term gains in mobility were detected. Whether changes in activity level or improved physical performance accompanied reductions in fear was not explored. Because fear of falling can confound physical performance,[3,4] measurement of both is important to better understand the interaction between these variables and their responsiveness to changes in balance confidence.

This study compared the short-term effectiveness of an education program and an activity-based program in increasing balance confidence in seniors with a fear of

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falling. In addition, program-associated changes in activity level, balance ability, strength, and perceived health status were examined postintervention and at 6-week follow-up.

METHODS

Sixty-two seniors living independently in the Kingston community were recruited through newspaper and radio advertisements seeking individuals fearful of falling. All were asked whether they had a lasting concern about falling causing them to avoid or curtail activities they felt they were capable of doing.[15] Six seniors responded negatively and therefore were not eligible to participate. The remaining volunteers were further screened and 11 excluded because of coexisting conditions affecting balance (e.g., neuropathy, vestibular deficits, mobility limiting arthritis, preexisting neurological conditions), and seven could not commit to an 8-week intervention. Thirty-eight subjects (27 women and 11 men) ranging in age from 67 to 87 were admitted to the study over a 14-month period. The University Research Ethics Board approved procedures, and all subjects provided written, informed consent. After completing baseline testing, subjects were randomly allocated to the activity or education program.

Intervention Programs

The same physiotherapist, who was blinded to the subjects' baseline test results, delivered the two programs. Programs were held weekly for 8 weeks, with each session lasting about 1 hour. Each group involved three to five seniors who came to the university to participate in their respective program designed to reduce fear of falling. When programs were completed, a new group of seniors were baseline tested and allocated to an intervention program.

The activity program sessions consisted of a 10-minute warm-up (moderate to brisk walking and stretching), low-resistance exercises against gravity, using Theraband products (The Hygenic Corporation, Akron, OH) targeting major muscle groups of the legs and trunk, reaching, weight shifting through activity, marching in place, and stepping. The sessions ended with a 10-minute cool-down of relaxed, comfortable walking and stretching. Participants were encouraged to follow a 40-minute, twice-weekly home program of exercises and stretching, which were described and illustrated in booklet form. Participants were provided with a logbook to track their activities. They reported on program adherence to the instructor on a weekly basis.

The education program engaged participants in discussions about their concerns regarding falling and on topics pertaining to identifying and reducing risk factors of falls, including environmental hazards in and out of the home, the importance of good nutrition and activity, proper footwear, and how to stand up after a fall. A manual was provided to each participant consisting of documentation and resources pertaining to each topic of discussion, listings of community resources for seniors, and educational materials supplied by the local health unit.

Outcome Measures

To quantify the extent to which subjects exhibited the characteristics necessary for entry into the study, fear of falling and activity curtailment were measured using the Activities-specific Balance Confidence (ABC) scale and the Human Activity Profile (HAP), respectively. The ABC is a 16-item scale requiring subjects to rate on a continuum ranging from 0 (no confidence) to 100 (completely confident) their level of balance confidence when performing specific activities of daily living.[16]

The HAP is a survey of 94 activities rank ordered by increasing metabolic demands.[17] For each activity, respondents indicated whether they still do the activity, have stopped doing the activity, or have never done the activity. The maximum activity score (MAS) was the rank of the most demanding activity still being performed; an adjusted activity score was calculated by subtracting the number of activities an individual had stopped doing from the MAS. The HAP reflects engagement in daily activities including self care, home maintenance, social activity, and physical exercise.

Physical function was determined in several ways (random sequence). Limits of stability (LOS) represented the displacement of the center of pressure (COP) during maximal forward, backward, right, and left leaning relative to the COP position measured during 1 minute of quiet, eyes-open stance. Subjects stood barefoot on a force platform (Model OR-6-5-1, Advanced Mechanical Technology, Inc., Watertown, MA) with their medial malleoli aligned with the coronal axis and the lateral borders of the feet equidistant from the sagittal axis in accordance with their height.[18] Data were first acquired (60 Hz) during quiet stance after which subjects were given directionally appropriate instructions to lean as far as possible while keeping heels and toes in contact with the plate and knees and hips straight. A researcher was present to stabilize the subject if balance was lost. The maximum COP excursion from three 5-second trials in each direction was measured, and combined COP displacements in anterior-posterior (AP) and mediolateral (ML) directions were calculated.

Walking speed was calculated from the time taken to traverse the middle 10 meters of a 20-meter walkway as subjects walked (shoes on) at their comfortable pace. The average of 3 trials (1-minute rest interval between each) was recorded.

Isokinetic (60° per second), concentric flexor and extensor torques were measured about the ankle, knee, and hip joints (Biodex Medical Systems, Inc., Shirley, NY). Ankle and knee muscle strength was tested with subjects in a seated position; hip muscles were evaluated while standing. Straps were used to stabilize the subject and test limb to limit torque production to the muscle group of interest. Five reciprocal maximal contractions were performed at each joint through 95% of available range, and the peak torque (gravity corrected) was recorded and normalized to body weight.

Health status was determined using the 36-item short form (SF-36) health-related quality-of-life questionnaire.[19] This instrument contains 36 items for which subjects indicated whether presented statements about health applied to them and rated the intensity of symptoms or symptom effect on the previous 4 weeks of their lives. Questionnaires were scored on eight health-related domains, including physical and social function, limitations due to emotional and physical problems (role emotional and role physical, respectively), mental health, vitality, bodily pain,

and general health. Summary scores for physical (physical function, role physical, bodily pain, and general health) and mental components (social function, role emotional, vitality, and mental health) were derived[20] and used in subsequent analyses.

All outcomes were measured at baseline, and a second baseline testing session of the physical function measures only was scheduled within 5 to 7 days to establish consistency. Intraclass correlation coefficients ranged from 0.80 to 0.92, indicating excellent reliability.[21,22] To determine program efficacy, all outcomes were measured within 1 week after program completion and 6 weeks later. Individuals who acquired the data were blind to the subjects' group allocation.

Data Analysis

Baseline equivalency between groups was established using independent *t* tests. To determine the effects of the interventions, analysis of variance with one between-subject factor (intervention group) and a repeated measure of time (baseline, postintervention, and follow-up) was performed for each dependent variable. Change scores were calculated relative to baseline measures.

RESULTS

Thirty-eight subjects completed baseline testing, but four subjects were lost before program completion; one was dissatisfied with the group allocation and withdrew, one was unable to commit to regular attendance, and two withdrew because of illness. Thirty-four subjects completed the programs (17/group) with excellent attendance (>92% for both programs). Twenty-one seniors attended all eight sessions, 10 missed one session, and three missed two sessions. Adherence to the home program for those in the activity program was also high. The log books indicated that exercises were performed two to four times a week for 20 to 45 minutes. Postintervention data were collected from all those who completed the programs, and follow-up data were obtained from 30 of 34 participants. Of the four lost to follow-up, two were ill and two were unavailable for retesting.

The two groups were equivalent in terms of age, sex, and physical characteristics ($P > .56$; see Table 1). Subjects in the activity program had similar preintervention levels of balance confidence (mean ± standard deviation) as those in the education program (65.6 ± 18.7 vs 68.4 ± 12.6; $P = .609$) and there were no differences in the extent to which activities were curtailed ($P = .962$). All physical performance measures were comparable between the groups at baseline ($P \geq .060$), as were the physical and mental component summary scores of the SF-36 ($P \geq .097$). These data are described in Table 2.

All subjects showed improved balance confidence unrelated to the intervention to which they were exposed ($P = .005$). There was a systematic tendency for most subjects (29/34) to adopt a higher level of physical activity (MAS), and those who participated in the activity program were more inclined to resume activities that they had previously stopped doing than those in the education program (12/17 and 8/17, respectively), although these findings were not significant ($P = .125$ and $P = .055$, respectively). The gains were generally preserved at follow-up, but those who completed the education program later reduced their activity levels somewhat (Table 2, Figure 1A).

The specific program that groups were exposed to was particularly important in terms of effecting change in balance ability. Participants in the activity program demonstrated significant improvement in their weight shifting ability in both AP and ML directions, whereas those in the education group shifted their COP to a lesser degree after the intervention ($P < .05$; Figure 1A). Correlation analysis indicated that the changes in AP and ML LOS were associated with gains in balance confidence ($r = 0.347$ and $r = 0.486$) in those who completed the activity program but not those who participated in the education program ($r = 0.083$ and $r = 0.001$). Significant alterations in gait speed did not accompany these balance performance changes (Table 2 and Figure 1A).

In general, muscle strength measurements did not distinguish between groups or change over time, with two exceptions. Throughout the study period, plantarflexor torque increased on average by 28% in those in the activity program, whereas those in the education program showed a slight decline (4%). Participants in both groups generated higher knee flexor torques immediately and 6 weeks after completing the interventions ($P = .001$). The changes observed in plantarflexor and knee flexor torques were not associated with altered balance function or activity level ($r \leq 0.036$, $P \geq .843$).

The SF-36 summary scores revealed a tendency for subjects to improve perception of their physical health status in the short term, although only those who completed the activity program sustained the gains at follow-up. In contrast, participants in the education program fared better in the mental health domains, as reflected by a 5% increase in the mental component summary score, which continued to improve at follow-up. Those who completed the activity program showed a slight decline postintervention that became more pronounced at follow-up (Figure 1B). Although these findings were not statistically significant, because large treatment effects would be required due to the high variability in scores, differential or change scores of 5 points or more are considered clinically relevant.[19,23]

A comprehensive summary of the data and statistical findings is presented in Table 2.

Table 1. Subject Demographics by Group Allocation

Variable	Activity Program (n = 17)	Education Program (n = 17)	*P*-value
Age, mean ± SD	77.1 ± 5.1	78.0 ± 5.5	.618
Height, cm, mean ± SD	164.1 ± 7.3	162.7 ± 7.8	.568
Weight, kg, mean ± SD	71.7 ± 13.4	71.8 ± 13.4	.996
Sex, male/female	5/12	4/13	

SD = standard deviation.

DISCUSSION

The major finding of this study was that fear of falling can be reduced significantly by participating in education or

Table 2. Scores and Performance Indicators by Group at Baseline and Following Intervention

	Baseline			Postintervention		Follow-Up				
	Activity (n = 17)	Education (n = 17)		Activity (n = 17)	Education (n = 17)	Activity (n = 14)	Education (n = 16)	*P*-value†		
Variable	Mean ± SD		*P*-value*	Mean ± SD				Time	Group	Interaction
Balance confidence (ABC)	65.6 ± 18.7	68.4 ± 12.6	.609	73.4 ± 21.5	72.4 ± 16.5	71.9 ± 21.1	74.6 ± 11.5	.005	.524	.782
Maximum activity score	71.5 ± 6.9	71.57 ± .5	.551	73.6 ± 8.3	72.2 ± 10.6	74.8 ± 8.1	71.8 ± 9.5	.125	.108	.798
Adjusted activity score	59.2 ± 12.1	62.0 ± 8.0	.962	63.3 ± 11.7	62.0 ± 12.7	62.1 ± 11.7	59.2 ± 10.6	.317	.074	.055
Gait speed, m/sec	1.14 ± 0.19	1.09 ± 0.22	.565	1.21 ± 0.19	1.11 ± 0.26	1.18 ± 0.19	1.11 ± 0.25	.157	.475	.426
Anterior-posterior LOS, cm	9.63 ± 1.68	8.34 ± 3.47	.268	10.51 ± 2.10	8.04 ± 3.26	9.95 ± 2.09	8.18 ± 3.17	.821	.111	.046
Mediolateral LOS, cm	17.35 ± 2.62	15.77 ± 4.97	.393	18.46 ± 3.53	14.84 ± 4.72	18.72 ± 4.06	16.01 ± 3.75	.324	.146	.013
Plantarflexor torque, Nm/kg	0.31 ± 0.14	0.30 ± 0.16	.940	0.38 ± 0.17	0.27 ± 0.13	0.40 ± 0.18	0.27 ± 0.15	.300	.138	.008
Dorsiflexor torque, Nm/kg	0.23 ± 0.05	0.20 ± 0.04	.060	0.24 ± 0.06	0.22 ± 0.08	0.23 ± 0.07	0.20 ± 0.05	.075	.188	.438
Knee extensor torque, Nm/kg	1.02 ± 0.22	0.93 ± 0.30	.309	1.08 ± 0.23	0.94 ± 0.34	1.12 ± 0.26	0.90 ± 0.31	.388	.117	.093
Knee flexor torque, Nm/kg	0.45 ± 0.10	0.42 ± 0.19	.517	0.52 ± 0.13	0.46 ± 0.16	0.54 ± 0.14	0.45 ± 0.18	.001	.184	.329
Hip extensor torque, Nm/kg	0.53 ± 0.25	0.56 ± 0.24	.668	0.65 ± 0.25	0.66 ± 0.27	0.69 ± 0.24	0.55 ± 0.24	.079	.206	.592
Hip flexor torque, Nm/kg	1.08 ± 0.21	1.01 ± 0.19	.167	1.11 ± 0.22	0.97 ± 0.22	1.13 ± 0.27	0.96 ± 0.22	.873	.030	.957
PCS	41.1 ± 7.4	39.9 ± 7.2	.648	45.0 ± 8.6	41.7 ± 7.6	43.8 ± 9.3	38.7 ± 10.1	.694	.197	.165
MCS	54.6 ± 9.1	48.8 ± 9.7	.097	53.4 ± 10.3	51.1 ± 9.9	52.0 ± 9.5	51.8 ± 8.7	.772	.136	.081

Note: Activity scores were derived from the Human Activity Profile (range: 0–94).

*Independent *t* test.

†Complete case analysis—repeated measures (time) analysis of variance with one between-subject factor (group).

SD = standard deviation; ABC = Activities-specific Balance Confidence score (range: 0–100); LOS = limits of stability reflecting center of pressure excursion; PCS = physical component summary score of the 36-item short form (SF-36); MCS = mental component summary score of the SF-36.

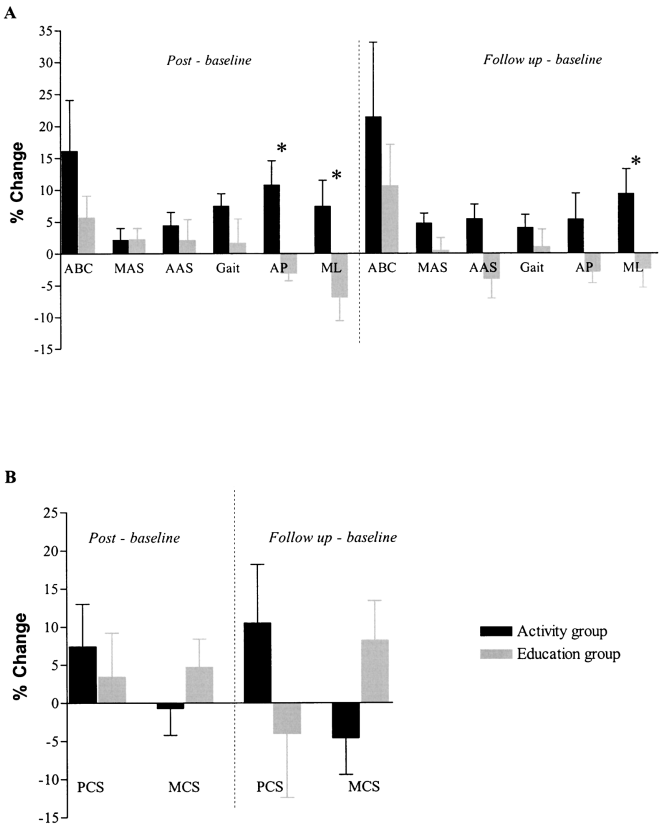

Figure 1. Mean ± standard error of the mean percentage change over baseline scores for measures of balance confidence and physical ability (A) and perceived health status (B) relative to the intervention program. *Significant difference between groups; $P < .02$. ABC = Activities-specific Balance Confidence (range: 0–100); MAS = maximum activity score (from the Human Activity Profile (HAP); range: 0–94); AAS = adjusted activity score (from the HAP); AP = anterior-posterior limits of stability reflecting center of pressure excursion; ML = mediolateral limits of stability; PCS = physical component summary score of the 36-item short form (SF-36); MCS = mental component summary score of the SF-36.

activity programs, but the effects accompanying improved balance confidence were program specific. Fear of falling can have negative consequences on measures of physical performance due to apprehension and anxiety that interfere with an individual's capacity to maximally challenge their abilities.[4,24] It follows that restoration of confidence would be associated with improvements in performance. Indeed this was the case for those involved in the activity program, as demonstrated by significant gains in limits of stability associated with reductions in fear of falling. However, those in the education program failed to improve balance performance. The disparity in balance behaviors between groups likely reflects the unique nature of each program. Participants in the activity program performed exercises and activities to improve weight-shifting ability, and the associated task specificity would be expected to result in improved balance performance.[25] In contrast, it was impressed upon those in the education group that they should consider the risk of falling when determining their ability to perform activities. Maximal weight shifts may have been viewed as high risk, resulting in individuals taking a more-cautious approach to performing the task relative to their baseline performance. Although risk perception was not evaluated, in the absence of evidence revealing discrepancies between groups in measures of physical function (strength, gait speed, and activity level) that could account for differential balance ability, this explanation cannot be discounted.

Fear of falling is associated with physical deconditioning as individuals adopt more-sedentary lifestyles.[8,10] In the current study, all participants indicated that they curtailed their activity levels because of fear, although arguably, deconditioning could also be the precipitating factor, because weakness limits balance and physical abilities.[8,26,27] Without directly assessing the extent to which activities were curtailed, it is difficult to judge whether deconditioning was a critical factor. One study[28] reported that seniors with similar balance confidence scores (65.0 ± 26.3) tended to be weaker than their nonfearful counterparts.

The relationships between fear of falling, strength, and activity level are complex, and their interdependency is further underscored by the findings of this study. The activity program was modestly superior in increasing lower limb strength, with plantarflexor torques increasing by about 28%. That such a change was not accompanied by improvements in balance or gait speed implies that baseline strength was ample to perform these tasks optimally.[26] Examination of the data trends revealed that all mean torques (except dorsiflexor) increased after the activity program, whereas increases after the education program were smaller and limited to the knee flexors and hip extensors. Gains in strength similar in magnitude to those observed after the activity program have yielded significant effect on mobility function and falls efficacy in frail community-dwelling elders.[26] The generalized strength gains may account for the strong tendency for those benefiting from the activity program to resume a more active lifestyle. What is less clear is why subjects in both groups tended to feel they were able to perform more-demanding physical activities. A possible explanation is that, because fear of falling precipitates a reduction in perceived ability to perform daily activities,[7,12] improved balance confidence would be expected to be associated with a more optimistic outlook on one's physical capabilities. The positive change in subjects' perceptions of their physical health status supports such a view.

Fear of falling, regardless of fall status, leads to deterioration in perceived health status and is associated with poor social function that threatens autonomy and quality of life.[6,7,29] All subjects experienced improved balance confidence, but better perception of physical health status was limited to those involved in the activity program only. However, those in the education program showed improved mental health status relative to a slight decline in subjects in the other program. These findings suggest that changing balance confidence alone may not affect the perception of well-being. Howland et al.[6] reported that seniors who indicate that they are fearful of falling but who maintain their activity levels score higher on the physical domains of the SF-36. This study's data are compatible with this, with the physical component summary change

scores mirroring those associated with adjusted activity levels. In terms of mental health status, programs designed to reduce fear of falling by increasing self-efficacy and sense of control over fall risk have significantly improved social function for up to 12 months postintervention.[14] Social support and communicating about falling are important covariates of fear of falling and can provide effective strategies to improve mental well-being.[6] The education program in the current study provided opportunity for social interaction and discussion of concerns related to falling; these issues were not addressed in the activity program. The psychosocial aspect of educational interventions warrants further investigation, particularly in view of the potential benefit to mental health as suggested by gains in mental component summary scores.

Improvements in balance confidence were realized in response to activity and educational interventions, unlike evoking changes in physical function and health status, which was a function of the nature of the intervention itself. In combination, these findings argue against the possibility that the results were due to effects of social interaction and attention. The inclusion of a control group would have enabled us to address the issue directly, but others have clearly established that contact control and interaction alone fail to induce changes in fear of falling, physical ability, or social function.[14,30,31]

In the present study, the effect and longevity of the gains in balance confidence and health status beyond 6 weeks are not known. Nevertheless, the fact that, in a short period of time, significant gains were achieved in high functioning, relatively healthy seniors suggests that effects may be more robust in a more vulnerable population. Furthermore, to reap both physical and mental health benefits, a logical approach would be to incorporate aspects of both activity and education programs.

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