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Effectiveness and economic evaluation of a nurse delivered home exercise programme to prevent falls. 2: Controlled trial in multiple centres

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Abstract

Objectives To assess the effectiveness of trained nurses based in general practices individually prescribing a home exercise programme to reduce falls and injuries in elderly people and to estimate the cost effectiveness of the programme.
Design Controlled trial with one year's follow up.
Setting 32 general practices in seven southern New Zealand centres.
Participants 450 women and men aged 80 years and older.
Intervention 330 participants received the exercise programme (exercise centres) and 120 received usual care (control centres); 87% (371 of 426) completed the trial.
Main outcome measures Number of falls, number of injuries resulting from falls, costs of implementing the programme, and hospital costs as a result of falls.
Results Falls were reduced by 30% in the exercise centres (incidence rate ratio 0.70, 95% confidence interval 0.59 to 0.84). The programme was equally effective in men and women. The programme cost $NZ418 (£121) (at 1998 prices) per person to deliver for one year or $NZ1519 (£441) per fall prevented. Fewer participants had falls resulting in injuries, but there was no difference in the number who had serious injuries and no difference in hospital costs resulting from falls in exercise centres compared with control centres.
Conclusions An individually tailored exercise programme, delivered by trained nurses from within general practices, was effective in reducing falls in three different centres. This strategy should be combined with other successful interventions to form part of home programmes to prevent falls in elderly people.

Introduction

Three questions need to be addressed in the development and evaluation of a public health intervention: "can it work?", "does it work in practice?", and "is it worth it?"[1]

In this paper we report the results from the second of two pragmatic trials designed to test the effectiveness and efficiency of a home exercise programme to prevent falls in elderly people. In this trial the programme was delivered from general practices by trained practice nurses to men and women aged 80 years and older. We initiated the trial as a health promotion exercise to evaluate the processes involved and to determine whether the exercise programme would be as effective in reducing falls in routine clinical practice in the wider community as it had been for women in an initial trial in a research setting.[2 3]

Participants and methods

Participant recruitment

We identified potential participants aged 80 years and older from computerised registers at 32 general practices (56 doctors) in seven southern New Zealand centres. These patients received a letter from their doctor inviting them to take part in the study. The criteria for exclusion were inability to walk around own residence, receiving physiotherapy at the time of recruitment, or not able to understand the require-

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Table 1 Characteristics of participants at entry to trial. Values are numbers (percentages) unless stated otherwise

Characteristic	Control centres (n=120)	Exercise programme centres		
		1 (n=115)	2 (n=120)	3 (n=95)
Mean (SD) age (years)	84.2 (3.1)	82.7 (2.5)	83.6 (2.8)	84.1 (3.0)
Men	35 (29)	32 (28)	37 (31)	32 (34)
Living arrangements:				
Two or more participants in one home	20 (17)	26 (23)	24 (20)	12 (13)
Living alone	74 (62)	64 (56)	76 (63)	56 (59)
Living in nursing home	—	1 (1)	2 (2)	—
Fallen in previous year	55 (46)	47 (41)	54 (45)	53 (56)
Medical conditions:				
Parkinson's disease	3 (3)	2 (2)	1 (1)	1 (1)
Stroke	16 (13)	15 (13)	18 (15)	12 (13)
Hip fracture	3 (3)	2 (2)	8 (7)	3 (3)
Knee or hip pain, or both	34 (28)	34 (30)	39 (33)	25 (26)
Mean (SD) scores on SF-12*:				
Physical component	42.0 (10.2)	43.1 (10.0)	40.1 (11.0)	42.4 (11.6)
Mental component	56.4 (4.5)	55.6 (5.0)	55.1 (5.7)	54.1 (6.6)
Mean (SD) No of current prescribed drugs	3.0 (2.1)	2.7 (2.0)	3.8 (2.1)	2.6 (1.8)
Taking psychotropic drugs	16 (13)	4 (4)	13 (11)	17 (18)
Home assistance:				
Cleaning	47 (39)	47 (41)	49 (41)	34 (36)
Showering	9 (8)	3 (3)	4 (3)	10 (11)
Meals on wheels	16 (13)	7 (6)	16 (13)	10 (11)

*Score ranges 0–100, lower scores indicate poorer health.

ments of the trial. Recruiting took place over a six month period in 1998.

Trial design

This was a controlled trial, with one year's follow up. The sample size calculation was based on an expected reduction from 0.50 to 0.30 of the proportion of elderly people who fell once or more in a 12 month period. Our study was approved by the ethics committees of the Southern Regional Health Authority Otago and Southland.

We chose three centres as exercise centres and a similar mix of four towns to act as control centres. The 120 participants in the control centres were required to indicate that they would be willing to receive the exercise programme if it was offered. After written informed consent was obtained and baseline assessments (personal characteristics, health, and function) completed at home by an independent assessor, the 330 participants in the exercise centres received the muscle strengthening and balance retraining programme.

Fall events were defined and monitored for one year and the severity of injury categorised as described in the accompanying article.[4]

Methods used in economic evaluation

The methods used in the economic evaluation are detailed in the accompanying paper and on www.bmj.com.[4] We report costs in 1998 New Zealand dollars, exclusive of government goods and services tax.

Assuming that participants keep exercising, the benefits of the exercise programme would extend past the time individuals participated in the trial, but the extent of this benefit and longer term compliance rates are uncertain. We calculated cost effectiveness ratios for the duration of the trial only.

Statistical analysis

The mean (SD) time between the baseline assessment and the first home visit for the exercise programme was 17.0 (14.0) days. We analysed data on an intention to treat basis.

We compared the number of falls and the number of falls resulting in injuries (moderate or serious) in the exercise and control centres using negative binomial regression models, adjusting standard errors for clustering on centre.[5] We used Student's t test to compare means and Fisher's exact test or c^2 test to compare proportions between groups.

Results

Trial participants and follow up

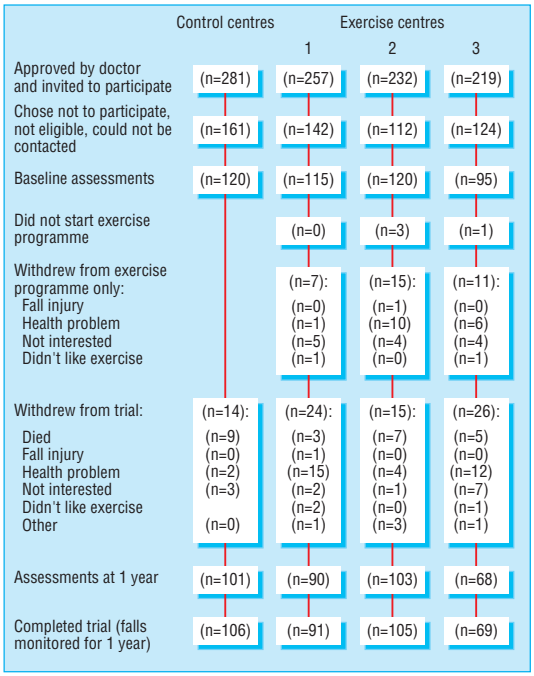
The participants in both groups were well matched on characteristics at entry to the trial (table 1). The figure shows the flow of participants through the trial. More participants from the control centres than the exercise centres completed the trial (88% v 80%, P = 0.066).

Overall, 43% (114 of 265) of participants who completed the trial carried out their prescribed exercise programme three or more times a week, 62% (n = 164) completed their exercise programme at least twice a week, and 63% (n = 167) walked at least twice a week during the one year.

Three adverse events were reported. One person stopped exercising and visited her doctor with pain due to the exercises, and two people fell while exercising, one pulling a muscle. One person walked backwards into a stool, and one collapsed while walking sideways.

Falls and fall related injuries

A significant reduction was found in the numbers of falls during the trial for the exercise centres compared with the control centres (incidence rate ratio from



Flow of participants through trial

negative binomial regression model 0.70, 95% confidence interval 0.59 to 0.84) (table 2).

Fewer falls in the exercise centres resulted in an injury (moderate or serious) than the control centres (incidence rate ratio 0.72, 95% confidence interval 0.62 to 0.82). No difference was found between the numbers of participants with serious injuries (15 of 330 in exercise centres versus 2 of 120 in control centres, P = 0.261).

Table 2 Incidence of fall events and follow up times in control and exercise programme centres

	Control centres (n=120)	Exercise programme centres		
		1 (n=115)	2 (n=120)	3 (n=95)
No of falls*	105	57	87	54
Falls per 100 person years	93.9	57.4	78.4	66.4
No of injurious falls†:	46	27	37	22
Serious	2	3	9	4
Moderate	44	24	28	18
Injurious falls per 100 person years	41.1	27.2	33.3	27.1
No (%) of falls for which medical care sought	24 (23)	14 (25)	24 (28)	9 (17)
Mean (SD) follow up time (months)	11.2 (2.6)	10.4 (3.4)	11.1 (2.8)	10.3 (3.3)
Total follow up time (person years)	111.83	99.38	111.03	81.29

*Incidence rate ratio 0.70 (95% confidence interval 0.59 to 0.84), P=0.001.
†Incidence rate ratio 0.72 (0.62 to 0.82), P=0.001.

Economic evaluation

The exercise programme cost $NZ137 878 or $NZ418 per person to deliver to the 330 participants in the exercise centres for one year. Overall, 71 of 303 (23%) falls resulted in the use of healthcare services (table 2). No significant difference was found in the numbers of hospital admissions as a result of a fall injury (12 in total) between the exercise and control centres. The difference between the actual cost of these hospital admissions for participants from the exercise ($NZ50 470) and control centre ($NZ10 993) as a result of a fall was not significant (P = 0.584).

Cost effectiveness measures

The incremental cost per fall prevented was $NZ1519. Estimates for the cost per fall with an injury prevented ranged from $NZ2553 to $NZ4255 for the different cost scenarios (for more detail see www.bmj.com).

Discussion

Falls can be reduced in men and women aged 80 years and older receiving an exercise programme from trained nurses based in general practices, and this is achievable in usual clinical practice. It was more difficult to gauge whether the exercise programme gave value for money. The programme cost a similar amount per person to deliver as the first pragmatic trial involving a district nurse prescribing the programme, and there were similar estimates for cost effectiveness ratios when the costs of implementing the programme only were considered. Hospital costs were not reduced, however, and therefore the programme was not as cost effective as the first trial.[4] This may be due to the sample sizes used, which were based on falls and not on injury rates, and the fact that the data for hospital costs have a skewed distribution. The participants from the exercise centres had fewer moderate injuries as a result of a fall, but no differences were found in the numbers of serious injuries between the two groups.

What is already known on this topic

One half of those aged 80 years and older will fall in any one year, often with serious health and social consequences

An exercise programme delivered by a physiotherapist or trained district nurse was successful in reducing falls and moderate injuries in elderly people

What this study adds

An exercise programme to prevent falls in elderly people can be delivered safely and effectively by trained nurses in general practices

The nurses obtained results that were consistent with the physiotherapist in the research setting and the district nurse in the accompanying paper

Methodological issues

As this was a trial of implementing a programme in the community, we used control and exercise centres rather than a randomised controlled design. The pragmatic design ensured that the delivery of the intervention matched as closely as possible what might occur in normal practice using practice nurses. This also avoided contamination as increased public awareness may lead to sharing of information. It is possible that the variable success of the programme in the different centres was influenced by the expertise of the instructor.

Different conditions in different centres may result in different rates of falls. Bias in the findings may have occurred as blinding was not possible except for classifying fall events. It is possible participants in the exercise centres did not want to report falls and disappoint their instructor. However the nurses all developed considerable rapport with the participants, and we believe the effect of this on outcome was minimal.

We investigated only the immediate health related costs and benefits in the economic evaluation, and this resulted in a conservative estimate of cost effectiveness. The benefits of exercising may continue longer than the one year of follow up. In a previous trial we found that reduction of falls continued for two years and involved very little extra use of resources.[3] In this trial 53% (139 of 261) of participants completing the exercise programme said they intended to keep exercising, and 41% chose to keep the ankle cuff weights (from 1 to 8 kg). Healthcare costs after a fall may well continue to accrue for the remainder of an individual's life.

Conclusions

We recommend a home based exercise programme delivered by trained nurses. Other components such as awareness of falls, home safety advice, and referral to doctors for reassessment of psychotropic drugs could be included to maximise effectiveness. A programme to prevent falls within general practice is practical, can reduce trauma and help maintain independence, and has the potential to reduce costs due to injury.

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support coordinator, HealthCare Otago; Shona Ellis, clinical costing, Southern Health; Irene Henderson, manager, Gore Hospital; Peter Herbison, statistician; Professor Murray Tilyard and the General Practice Research Unit; and Sheila Williams, statistician.

All authors contributed to the study or protocol design, or both, interpreted the data, and wrote the paper. AJC directed the project. MCR managed the project and the data gathering, analysed and interpreted the data, and wrote the paper. MMG trained and supervised the exercise instructor. ND and Dr Paul Scuffham advised on the economic evaluation. RM advised on health promotion aspects. AJC and MCR will act as guarantors for the paper.

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Benzodiazepines and hip fractures in elderly people: case-control study

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Abstract

Objective To determine whether benzodiazepines are associated with an increased risk of hip fracture.
Design Case-control study.
Participants All incident cases of hip fracture not related to traffic accidents or cancer in patients over 65 years of age. 245 cases were matched to 817 controls.
Setting Emergency department of a university hospital.
Main outcome measures Exposure to benzodiazepines and other potential risk or protective factors or lifestyle items.
Results The use of benzodiazepines as determined from questionnaires, medical records, or plasma samples at admission to hospital was not associated with an increased risk of hip fracture (odds ratio 0.9, 95% confidence interval 0.5 to 1.5). Hip fracture was, however, associated with the use of two or more benzodiazepines, as determined from questionnaires or medical records but not from plasma samples. Of the individual drugs, only lorazepam was significantly associated with an increased risk of hip fracture (1.8, 1.1 to 3.1).
Conclusion Except for lorazepam, the presence of benzodiazepines in plasma was not associated with an increased risk of hip fracture. The method used to ascertain exposure could influence the results of case-control studies.

Introduction

Hip fracture is common in elderly people, resulting in important morbidity and mortality. Hip fracture is usually due to the combination of an acute event, usually a fall, with a chronic condition, such as osteoporosis. Risks can therefore pertain to falling[1] or to a propensity to fracture after a fall.[2] Many risk factors for hip fracture have been proposed or recognised, such as increasing age, low body weight, low intake of calcium and dairy products, age at menopause, number of children, osteoporosis, and a personal and family history of fractures.[3 4] Associated diseases, handicaps, and drugs could also play a part. The use of certain psychotropic drugs such as tricyclic antidepressants and selective serotonin reuptake inhibitors has been suggested as a risk factor for falling and hip fractures.[1 5] The role of benzodiazepines is more disputed: some studies have found an association between benzodiazepines, especially the longer acting ones, and hip fracture[3 6 7] and others have not.[8 9] Studies have also related hip fracture with dosage of benzodiazepine rather than the half life of the various formulations.[10] Some of these discrepancies could be related to difficulties in ascertaining exposure especially in elderly people, in part because of cognitive factors, which may also by themselves be a risk factor for falling and could influence the use of benzodiazepines.[11 12] One study found that falls in elderly people were associated with the presence of benzodiazepines in blood, but it did not consider fractures.[13] We therefore aimed to determine the association between benzodiazepines and other factors with the risk of hip fracture in elderly people, taking into account cognitive aspects and the status of exposure as ascertained from the presence of benzodiazepines in blood.

Participants and methods

From January 1996 to July 1997 we assessed all patients aged over 65 presenting to the emergency departments of the Pellegrin and Saint André university hospitals in Bordeaux, France, for inclusion in our study. A blood sample was obtained at admission after informed written consent had been obtained. The samples were frozen for later analysis.

Cases were all elderly people admitted to the hospitals with acute hip fracture resulting from a fall that was not associated with cancer, a traffic accident, or aggression. Hip fracture was ascertained from *x* ray films and orthopaedic consultation.