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Older people can stay on their feet: final results of a community-based falls prevention programme

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SUMMARY

Objective: To evaluate a multi-strategic community-based intervention to prevent older people falling.
Design: A prospective cohort study comparing randomly selected samples from intervention and control area target populations (residents over 60 years). Repeat, cross-sectional (annual) reviews of fall-related hospitalizations were also conducted providing an independent measure of falls incidence in the target populations.
Setting: North Coast of New South Wales, Australia (a large, rural region).
Subjects: Cohort study (1991–1995): randomly selected subjects aged 60 years and over, enrolled via telephone interview into intervention and control area cohorts. Cross-sectional study (1991/1992–1994/1995): all residents aged 60 years and over, from intervention and control areas hospitalized with fall-related injuries.
Intervention: A 4-year (1992–1995) multi-strategic intervention targeting fall-related knowledge, attitudes, behaviours and risk factors.
Main outcome measures: Self-reported falls and fall-related hospitalization incidence rates. Fall-related knowledge, attitudes, behaviours and risk factor prevalence rates.
Results: At follow-up there was a 22% non-significant lower incidence of self-reported falls in the intervention compared to the control cohort ($p = 0.17$). This was supported by a 20% lower fall-related hospitalization rate in target group residents from intervention compared to control areas ($p < 0.01$). Increased falls knowledge, physical activity and safe footwear were also observed in the intervention cohort together with improved balance and reduced intake of fall-related medications.
Conclusions: Promotion of appropriate behaviours, environments and policies can improve fall-related outcomes given a commitment to involvement of older people and sufficient lead time.

Key words: community-based prevention; falls; injury; older people

INTRODUCTION

The proportion of older people in the population is rising with a resulting increase in the demand for health services (Australian Institute of Health, 1988; Fildes, 1994). Because much of this demand stems from preventable illness, preventive interventions offer great potential (Cumming and Scanlon, 1994). Falls are a prime target for prevention, being the most common cause of injury for people aged over 65 years (Baker and Harvey, 1985; Campbell *et al.*, 1990).

A quarter of falls restrict activity because of injury or fear of further falls. About 4% result in major injury (Nevitt *et al.*, 1989). Risk factors for falls include unsafe footwear, poor vision, balance or gait, inappropriate medication, underlying medical conditions, insufficient exercise and environmental hazards (Vaughan and Kempton, 1990). Being female, living alone or experiencing a prior fall also increase the risk (Wild *et al.*, 1981). The likelihood of falling increases with

the number of risk factors, most of which are modifiable. A multi-strategic preventive intervention is thus indicated (Tinetti *et al.*, 1988; Tinetti *et al.*, 1994; Gillespie *et al.*, 1997), with a community-based approach, addressing both behavioural and environmental factors, currently considered to be the most likely to succeed (Wagner *et al.*, 1994; Province *et al.*, 1995; Gillespie *et al.*, 1997). To date, very few interventions targeting individual risk factors have been shown to be effective (Campbell *et al.*, 1997). Intensive regimes for individual patients are also difficult to replicate at the community level.

The North Coast 'Stay On Your Feet' (SOYF) programme (1992–1995) targeted 80 000 residents aged 60 years and over on the North Coast of New South Wales (NSW) where the proportion and growth rate of the older population exceed national averages (Kempton *et al.*, 1993; Sladden, 1993). SOYF addressed footwear, vision, physical activity, balance and gait, medication use, chronic conditions, plus home and public environmental hazards (Kempton *et al.*, 1993; Hahn *et al.*, 1996; Garner *et al.*, 1996). Multiple strategies consistent with the Ottawa Charter for health promotion (World Health Organization, 1986) were implemented including awareness raising, community education, policy development (with both state and local governments), home hazard reduction, media campaigns, and working with clinicians and other health professionals. The total cost of the intervention including evaluation was $600 000.

SOYF targeted non-institutionalized, older people aged 60 years and over. It was based on published, epidemiological evidence with a comprehensive evaluation design (van Beurden *et al.*, 1998). This paper reports on the programme reach and observed health outcome changes.

METHODS

Evaluation strategies have been described previously (Hahn *et al.*, 1996; van Beurden *et al.*, 1998). Briefly, the control area (Sunshine Coast, Queensland) was carefully selected to match the intervention area in terms of geography (coastal, rural region with urban centres), demography (high proportion of retirees) and climatic factors, yet to be remote enough not to be influenced by the SOYF intervention, and not to have any systematic falls prevention interventions in place. The control area health service agreed to stay intervention-free for the 5-year SOYF programme period.

Programme reach was tracked via annual follow-up (1994–1996), cross-sectional, random sample telephone surveys (in the intervention area only) to identify what older people had noticed regarding falls prevention (Table 1). Randomly generated lists of telephone numbers

Table 1: Cross-sectional surveys of SOYF programme reach, indicating target population exposure to different SOYF components

SOYF component	1994 $n = 494$ No. (%)	1995 $n = 709$ No. (%)	1996 $n = 744$ No. (%)
Seen, read or heard about falls prevention	212 (43.0)	399 (56.4)	504 (67.7)[b]
Heard of SOYF	117 (23.7)	310 (43.7)	378 (50.8)[b]
Seen a falls TV ad	119 (24.1)	238 (33.5)	248 (33.3)[b]
Seen a falls newspaper item	100 (20.2)	168 (23.7)	294 (39.5)[b]
Received a SOYF book	60 (12.1)	155 (21.8)	233 (31.3)[b]
Received a SOYF calendar	37 (7.5)	NA	64 (9.0)[a]
Heard a SOYF radio ad	NA	NA	98 (13.2)
Used a 'pill bag'	NA	36 (5.1)	69 (9.3)[a]
Attended a SOYF talk about falls	28 (5.7)	39 (5.5)	46 (6.2)[a]
Attended a gentle exercise class	26 (5.3)	37 (5.2)	59 (7.9)[a]
Had a SOYF home safety check	11 (2.2)	30 (4.2)	81 (10.9)[a]
Attended a Medication Workshop	7 (1.4)	4 (0.6)	18 (2.4)[b]
Attended a SOYF Falls Expo	1 (0.2)	2 (0.2)	NA
Involved with any SOYF component	255 (51.6)	480 (67.7)	572 (76.9)[b]

[a]$p < 0.05$, [b]$p < 0.01$ (χ^2 test comparing first and last instance: d.f. = 1).
NA, not applicable (interventions not conducted in these years).

from the study area were obtained via electronic white pages. After excluding commercial and facsimile numbers, residential numbers were dialled up to three times, households screened for a respondent within the target age group, an invitation offered to participate, and interviews then conducted with one subject per household.

Independent to the cross-sectional reach surveys, changes in falls incidence and knowledge, attitude and risk factor prevalence were monitored via prospective follow-up of a cohort of 2000 older residents (60+ years). The sample size was based on average, previously published fall rates in community-dwelling older people (33.3%) (Campbell *et al.*, 1981; Prudham and Evans, 1981; Perry, 1982; Speechley and Tinetti, 1991). Calculations took into account expected attrition and were set to provide 80% power to detect a targeted 10% reduction with confidence of 95% in the main outcome indicator, self-reported falls incidence (i.e. from 33.0 to 29.7%). Subjects were accessed in a similar but separate manner to the reach samples via randomly generated telephone number lists for the intervention area. These were compared to 1600 randomly selected control subjects from the Queensland Sunshine Coast. Baseline data were collected during the year prior to the intervention (1991). Loss to follow-up was minimized by contacting the cohort after 12 months and then at the final 4-year follow-up (1995) by tracing subjects who had moved, identification of deceased subjects, and up to eight call attempts per subject at last known contact number.

Where possible, indicator questions in the 20-min survey instrument were taken from previously validated instruments and further validated within the new instrument by pre-testing, expert review and pilot testing in a non-target community. Self-reported falls incidence was elicited by the questions: 'Have you fallen in the last 12 months?' and 'If yes, how many times?'.

Variable frequencies, proportions and pre/post differences were calculated using SAS (SAS Institute, 1987). Cochran's test for unadjusted changes, multivariate Mantel Haenszel tests, and multiple logistic and linear regression analyses were used to adjust for control area changes and age and gender differences. Stepwise reduction logistic modelling strategy was performed, with each dependent (outcome) variable (e.g. fall post-intervention) modelled against the baseline outcome measure, exposure to the intervention (yes/no), and all known and potential confounding factors identified from initial univariate analyses. Confounders not contributing significantly to the model were removed stepwise to achieve the final model.

Direct age-standardized fall-related hospitalization rates compared to an Australian standard population (1991) were calculated (±95% confidence intervals) for intervention and control area male and female residents aged 60 years and over, for financial years (July–June) 1990/1991–1994/1995 (latest outflow data available) (NSW Health Department, 1998; Queensland Health Department, 1998). Fall-related hospitalizations were identified for all patients with an International Classification of Disease (v9) with Clinical Modification external cause code within the range 'E880'–'E888.9'. Hospitalization rates were for study area residents (not hospitals), including outflow referral of residents to hospitals out of the area. There were no changes in referral patterns over the intervention period. The chosen outcome measure was fall not fracture incidence, as every fall has the potential to cause a fracture, and the SOYF community-based prevention programme targeted this external cause of injury rather than injury per se.

RESULTS

Study sample

The NSW North Coast estimated resident population (ERP) over 60 years of age in 1992 was 79 425, comprising 42 158 females (53.1%) and 37 267 males (46.9%). For the Queensland Sunshine Coast the ERP over 60 years was 61 758, comprising 32 636 females (52.8%) and 29 122 males (47.2%). There was no significant difference in gender ratio ($\chi^2 = 0.30$, $p > 0.05$), and only small differences in the age distribution of control and intervention groups (i.e. the control group had 5% more aged 60–64 years and 5% less aged 80–84 years with $\chi^2 = 10.74$, $p < 0.001$ and $\chi^2 = 6.44$, $p < 0.02$).

Strategy reach

The SOYF programme reach (i.e. contact of the target population with SOYF) is depicted in Table 1. The gender ratio was 2 : 1 females : males. Age distribution was: 71% aged 60–74, 24% aged 75–84 and 5% aged 85+ years.

One in 12 (8%) respondents reported talking with someone about falls. The most common advice was to take care or avoid risk factors. One third of these (32%) were with GPs, a quarter (23%) with family, 10% with community health nurses and 10% with other health workers. This represented wider awareness of falls than at mid-term evaluation (1994) when most discussions were with GPs. The most commonly reported attendance at meetings or classes was gentle exercise classes (8%) and talks by SOYF advisers (6%). Many respondents were more aware of falls (38%), required more information (27%) and approved of SOYF (26%). Almost three-quarters (73%) took up the offer of a free SOYF kit and book (Garner, 1994).

Cohort follow-up

Independent to the reach surveys, cohort participation rates for intervention and control area subjects at baseline were 82 and 72%, respectively. Of the 1992 intervention and 1665 control group subjects enrolled into the cohort, 1314 (66.0%) and 1131 (67.9%) were followed up, respectively. Non-response bias due to attrition was minimal and only significant in three out of 15 variables tested (Table 2). Similar reasons for loss to follow-up in the two groups included refusal, morbidity and mortality.

Univariate analysis

As expected with an ageing cohort the mean falls incidence (baseline versus follow-up) rose in both intervention (0.297–0.365 falls/person/year) and control (0.280–0.413 falls/person/year) groups. This represented a net 24.6%, non-significant lower falls incidence in the intervention cohort [$t = 1.37$, d.f. = 2216, $p(t) = 0.17$]. Other indicator changes are shown in Table 3. Intervention subjects had significantly increased awareness that falls are preventable, of their risk of falling, and of footwear safety.

Multivariate analysis

Multivariate results are given in Table 4. After controlling for age and gender differences via linear regression, the impact of the intervention was a non-significant reduction (from 0.297) of 0.066 falls/person/year (–22%), β (intervention) = –0.071, SE = 0.047, $F = 2.22$, $p = 0.14$.

Attitudinal changes included significant increases in odds of intervention subjects considering falls to be preventable (34%), that they were at risk of falling (31%), and non-significant increases in belief that falls were a problem (10%), and knowledge of falls risk factors (17%).

Risk factor indicators included a significant increase in intervention subjects wearing jogger-style or other safer footwear (35%), and non-significant improvements in self-reported balance (9%), fall-safe changes to homes (5%) and vision checks (2%). There was also a reduction in dizziness on rising (4%), and a 6% increase in reported physical activity (+ 0.64 h/person/week), β = 0.738, SE = 0.672, $F = 1.21$, $p = 0.27$.

Influence of knowledge and attitudinal factors on fall-related behaviours was also assessed. After controlling for covariates, subjects in the intervention group who reported improved awareness of falls risk had a significant 62% lower odds of taking fall-related medications than control group subjects (OR = 0.38, 95% CI 0.29–0.50), and 43% greater odds of having good or excellent self-reported balance (OR = 1.43, 95% CI 1.07–1.91).

Table 2: Response bias at follow-up: comparison of baseline versus follow-up profiles of intervention and control area cohorts (1991–1995)

Variable	Intervention		Control	
	Bias at follow-up	χ^2, d.f., sig	Bias at follow-up	χ^2, d.f., sig
Age	Fewer aged 75+: (20% cf. 26%) mean 69.2 cf. 70.1 years	18.1 3 <0.01	Fewer aged 75+: (18% cf. 22%) mean 68.8 cf. 69.6 years	11.3 3 <0.05
Gender	Fewer males: (31% cf. 35%)	3.9, 1, <0.05	Fewer males: (34% cf. 36%)	1.0, 1, NS
Active 7+ h/week	More active: (53% cf. 48%)	8.5, 1, <0.01	More active: (59% cf. 55%)	4.8, 1, <0.05

Table 3: Univariate baseline versus follow-up outcome indicator differences in intervention and control cohorts (1991–1995)

Outcome indicator (Positive value)	Intervention			Control			Net% difference: intervention versus controls (95% CIs)[a]
	Pre (%)	Post (%)	Percent change	Pre (%)	Post (%)	Percent change	
Fell (yes)	21.5	26.9	+5.4	18.6	27.0	+8.4	–0.5 (–4.0, 2.9)
Falling a problem (yes)	88.0	93.4	+5.4	86.0	92.4	+6.4	0.6 (–1.3, 2.7)
Falling preventable (yes)	45.5	66.6	+21.1	47.0	60.8	+13.8	6.1 (2.4, 9.9)
Risk factor knowledge (3+)	70.6	64.7	–5.9	72.4	61.2	–11.2	3.7 (–0.2, 7.5)
Risk of falling (high/medium)	29.7	36.2	+6.5	26.0	29.5	+3.5	5.8 (1.5, 10.1)
Eyes checked (annually)	57.5	64.1	+6.6	60.4	63.4	+3.0	1.2 (–2.6, 5.0)
Dizziness (never/rarely)	22.2	20.1	–2.2	21.4	21.3	–0.1	–0.6 (–3.7, 2.6)
Balance (excellent/good)	82.1	78.5	–3.6	85.2	78.3	–6.9	1.4 (–1.8, 4.6)
Walking aid (yes)	7.3	14.5	+7.2	8.3	14.9	+6.6	1.2 (–1.4, 3.6)
Footwear (wear/buy safe)	73.4	74.8	+1.4	63.6	66.9	+3.3	4.7 (1.3, 8.1)
Medication (fall-inducing)	48.6	56.9	+8.3	40.0	52.1	+12.1	–0.1 (–3.2, 3.0)
Made changes (yes)	14.6	12.0	–2.6	13.7	11.1	–3.6	0.8 (–1.7, 3.3)

[a]Cochran's method is used to adjust for initial proportions of both negative and positive responses, i.e. the resulting changes are not simply net differences between the two areas.

Table 4: Logistic regression for the effect of the intervention on each dependent variable

Dependent variable	Category	Intervention odds ratio	95% Confidence interval
Fell	yes	0.95	0.79–1.15
Falls a problem	yes	1.10	0.80–1.52
Falls preventable	yes	1.34	1.13–1.59[a]
Knowledge score 0–3	identify three risk factors	1.17	0.99–1.38[b]
Risk of a fall	high/medium	1.31	1.08–1.59[a]
Eyes checked	annually	1.02	0.86–1.21
Dizziness	never/rarely	0.96	0.79–1.18
Balance	excellent/good	1.09	0.89–1.35
Walking aid	yes	1.00	0.75–1.32
Footwear	wear/buy safe	1.35	1.11–1.64[a]
Medication	use fall-inducing	1.00	0.82–1.23
Improved home-safety	yes	1.05	0.81–1.36

Logistic regression: indicator (post) = indicator (pre) + intervention (yes/no) + age + sex. Wald's χ^2: [a]$p < 0.05$; [b]$p = 0.07$.

Hospitalizations

At follow-up there was a 20% lower age-standardized rate of fall-related hospital admissions in the intervention relative to the control area (Figure 1, rate ratio = 0.80, 95% CI 0.76–0.84). This is a conservative estimate of effect as 1995/1996 data were incomplete (outflow to other area's data not currently available). The change was similar for males (23%) and females (19%).

DISCUSSION

The community-based approach and public nature of the SOYF intervention precluded use of a randomized controlled evaluation design for the programme. Separate communities in disparate locations would have had to be randomly allocated to intervention or control arms, and even then cross-contamination of control communities, partially exposed to intervention material, would still exist. It would also be difficult to ensure comparability of different communities and to standardize implementation of the intervention in each locality. Instead, bias and confounding due to secular trends, study control area baseline differences and cohort attrition were minimized via use of a prospective, longitudinal evaluation design. Cohort subjects were randomly selected from the intervention and control area target populations that were comparable for key demographic attributes. Multivariate methods, as described previously (van Beurden *et al.*, 1998),

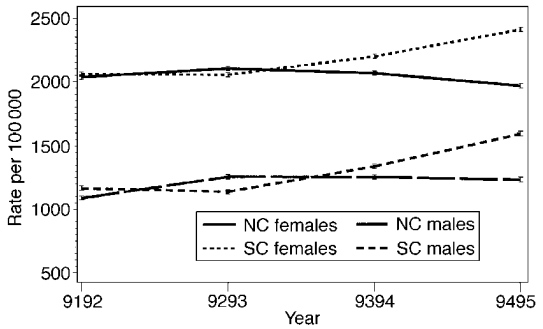

Fig. 1: Direct age-standardized fall-related hospitalizations per 100 000 male and female residents (60+ years) of intervention (NC) and control (SC) areas, with 95% CIs (1991/1992–1994/1995). *Sources*: New South Wales Inpatient Statistics Collection and Queensland Morbidity Data Collection (1991–1995).

were used to adjust for known and potential confounders. The possibility of self-report bias from heightened awareness in the intervention area remained. Sample size calculations were based on expected falls rates (33.3%), which proved to be higher than observed (21.5%), leaving the cohort with inadequate statistical power to detect the targeted reduction.

The loss to follow-up rate of 30% is of obvious concern, especially as reasons for loss may be associated with the study outcomes (e.g. falls incidence). However, the nature of the study population (persons over 60 years) meant that any prospective study (including randomized trials) will suffer from the problem of attrition due to morbidity, mortality and relocation. Efforts were made to locate persons who had moved prior to follow-up (including into nursing homes). The evaluation design also included partial remedies, e.g. demographic matching of study groups, adjustment for baseline differences through covariate analyses, and final comparison of falls rates in intervention and control areas. Whilst the computed odds ratios (OR) overestimate the relative risk for more common variables, the associations observed were not strong (no OR was greater than 1.35 and most were within the range 0.90–1.10) which acts to reduce any overestimate. The hospital rate estimates may be subject to annual fluctuations, and further follow-up periods are warranted to confirm observed trends in fall-related admissions, and to examine any sustained effects of the programme.

Not withstanding the above limitations, two independent measures of effect were remarkably consistent. The 22% lower incidence of self-reported falls and 20% lower fall-related hospitalization rate in the intervention area compared to the control area suggests effects in terms of maintaining quality of life, and reducing morbidity and health care costs.

The reach surveys indicated that awareness-raising strategies reached a third to half of older North Coast residents, which is consistent with the 34% relative increase in intervention subjects adopting a preventive attitude and the 31% increase in considering themselves to be at risk of falling. The SOYF booklet reached almost one-third of the target group, with a 17% increase in knowledge of falls risk factors. Possible associations between other reach and outcome indicators are less clear. Falls awareness, gentle exercise and medication classes were well attended but audiences were self-selected. There were greater improvements in falls rate, wise medication use, physical activity and balance among subjects whose attitudes or knowledge had improved. Approaches to GPs and home safety checks were resource intensive, based on individual assessments without the same reach as population level approaches.

These findings illustrate measurable gains in intermediate and health outcomes from a community intervention targeting falls prevention, reflecting the need for such interventions to be evidence based and thoroughly evaluated, and to involve the target group.

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