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Patients with recurrent falls attending Accident & Emergency benefit from multifactorial intervention—a randomised controlled trial

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Abstract

Objectives: to determine the effectiveness of multifactorial intervention to prevent falls in cognitively intact older persons with recurrent falls.
Design: randomised controlled trial of multifactorial (medical, physiotherapy and occupational therapy) post-fall assessment and intervention compared with conventional care.
Setting: Accident & Emergency departments in a university teaching hospital and associated district general hospital.
Subjects: 313 cognitively intact men and women aged over 65 years presenting to Accident & Emergency with a fall or fall-related injury and at least one additional fall in the preceding year; 159 randomised to assessment and intervention and 154 to conventional care.
Outcome measures: primary outcome was the number of falls and fallers in 1 year after recruitment. Secondary outcomes included injury rates, fall-related hospital admissions, mortality and fear of falling.
Results: there were 36% fewer falls in the intervention group (relative risk 0.64, 95% confidence interval 0.46–0.90). The proportion of subjects continuing to fall (65% (94/144) compared with 68% (102/149) relative risk 0.95, 95% confidence interval 0.81–1.12), and the number of fall-related attendances and hospital admissions was not different between groups.

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Duration of hospital admission was reduced (mean difference admission duration 3.6 days, 95% confidence interval 0.1–7.6) and falls efficacy was better in the intervention group (mean difference in Activities Specific Balance Confidence Score of 7.5, 95% confidence interval 0.72–14.2).
Conclusion: multifactorial intervention is effective at reducing the fall burden in cognitively intact older persons with recurrent falls attending Accident & Emergency, but does not reduce the proportion of subjects still falling.

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Keywords: *recurrent falls, older persons, Accident & Emergency, fall-related injury, randomised controlled trial, elderly, treatment*

Introduction

Falls are the most common cause of accidents and associated morbidity and mortality in older people [1]. Thirty-five per cent of community-dwelling individuals aged over 65 will fall each year [**2**, 3].

Up to 45% of Accident & Emergency (A&E) department attendees over 65 years have fallen [**4**], and up to 10% of falls in community-dwelling older persons result in significant injury [5].

Recurrent falls lead to loss of confidence to perform functional activities [**6**], social isolation, increased hospitalisation [**7**], and an increased likelihood of early admission to nursing care [**8**]. Recurrent falls are also associated with increased mortality, unlike single falls [**8**].

Systemic reviews of over 60 randomised trials of interventions to prevent falls have concluded that multifactorial risk assessment and management programmes, or individualised, home-based exercise are most effective [9, **10**].

However, although recurrent fallers have the highest fall-related morbidity and mortality [**7, 8**], few studies have specifically assessed intervention in this group. Most successful interventions have been targeted at community-dwelling at-risk individuals, in whom a proportion have already fallen [**11–13**] or in mixed cohorts of single and recurrent fallers [**14**]. In recurrent fallers, two randomised controlled trials reported no benefit from intervention [**15**, 16]. In cognitively impaired older recurrent fallers attending A&E, multifactorial intervention was also unsuccessful at reducing falls [**17**].

The aim of this study was to determine whether multifactorial intervention in cognitively preserved recurrent fallers attending A&E reduces subsequent falls.

Methods

Design

The study was a randomised controlled trial of multifactorial assessment and intervention for identified falls risk factors compared with usual care as provided by A&E and primary care physicians.

Setting and subjects

The study population was recruited from subjects aged over 65 years presenting to A&E with a fall or fall-related injury.

Subjects were included if they had sustained at least one additional fall in the preceding year, and excluded if they were cognitively impaired (Mini-Mental State Examination (MMSE) < 24) [**18**], had >1 previous episode of syncope, were immobile, lived >15 miles from A&E, were registered blind, aphasic, had a clear medical explanation for their fall, i.e. acute myocardial infarction, stroke, or epilepsy, or were enrolled in another study.

Ethical approval was obtained from the local research ethics committees of Newcastle and North Tyneside, and Gateshead. All participants gave informed written consent.

Recruitment

A&E records were screened daily and eligible subjects contacted by postal questionnaire to determine fall history. Recurrent fallers were telephoned and invited to participate. Randomisation was by computer-generated block randomisation. An interviewer-led questionnaire was performed in the subject's home to assess baseline cognitive function (MMSE [**18**]), demographics, mental health status (Hospital Anxiety and Depression Scale [**19**]), and fear of falling (Activities-specific Balance Confidence Scale [**20**]). The interviewer was blind to randomisation status.

The intervention group received hospital-based medical assessment, and home-based physiotherapy and occupational therapy assessment followed by a prioritised individualised intervention for fall risk factors. The control group did not undergo medical or therapy assessment. Those admitted to hospital with their index fall were recruited after discharge.

Assessment and intervention

The medical assessment and interventions replicated those described for cognitively impaired fallers [**17**]. Medical and fall history and full clinical examination were performed including assessment of medications [**21**] and vision [**22**]. A comprehensive cardiovascular assessment was performed in all intervention subjects to assess for orthostatic hypotension, carotid sinus hypersensitivity and vasovagal hypersensitivity [**23**]. Laboratory blood tests and electrocardiogram were performed. Interventions for identified abnormalities followed recognised treatment recommendations [**24, 25**, 26].

Gait and balance were assessed by modified Performance Orientated Mobility Score [**27**], along with feet, footwear and assistive devices [**28**], with standardised intervention for abnormal scores [**27, 28**].

Occupational therapy assessment utilised a checklist for home environmental hazards (User Safety and Environmental Risk)[**29**].

For full details of assessment and intervention methods, please see Appendix 1 available as supplementary data on the journal website (http://www.ageing.oupjournals.org).

Fall causation

Following full multidisciplinary assessment, a prioritised list of fall risk factors was determined by consensus with specific interventions for each risk factor.

Outcome measures

The primary outcome was the number of falls and the number of subjects who fell again during 1 year of follow-up. Secondary outcome measures were injury rates and fall-related hospitalisation, mortality, and changes in fall efficacy (Activities-specific Balance Confidence Scale) [**20**]. A fall was defined as 'inadvertently coming to rest on the ground or other lower level with or without loss of consciousness or injury' [**30**].

Fall data were collected prospectively by fall diaries, with four weekly cards per diary, returned every 4 weeks over 12 months. There was telephone prompting to maximise compliance. Subjects were asked to detail the frequency and circumstances of each fall. These data were processed by a researcher blinded to randomisation and otherwise unconnected with the study. Secondary outcome measures were recorded with interviewer-led questionnaires at 3, 6 and 12 months after index presentation. The interviewer was blind to randomisation.

Hospital and A&E attendances were recorded prospectively, prompted by diary reports, and hospital records were checked retrospectively at 1 year for all participants. For each episode, an independent reviewer determined whether attendances were fall-related.

Statistical analysis

A reduction of 33% in the number of subjects sustaining a further fall during the follow-up year was considered clinically significant. At the 5% level, a sample size of 352 subjects would give 90% power of detecting a significant difference between groups.

Normally distributed values were compared using Independent Samples t-test. Mann–Whitney U test was used for non-parametric variables, and Fisher's exact test for categorical variables.

Analysis of falls data was done on an intention-to-treat basis. The effect of the intervention was estimated using methods appropriate for comparing independent samples. The proportions of subjects who fell in each group were compared using Fisher's exact test. The total number of falls per person was analysed using negative binomial regression [**31**]. This analysis corrects for over-representation of falls by any individual subject who has multiple events and has been used in the analysis of other falls intervention studies [**12, 13**, 32]. Quality of life and baseline characteristics were analysed using t-tests and Mann–Whitney test. Ninety-five per cent confidence intervals were calculated for the difference in mean scores or for the relative risk as appropriate. Calculations were performed using SPSS version 10.0.7 and Stata version 8 statistical software.

Results

Recruitment and baseline demographics

A total of 5,090 A&E attendees aged over 65 years presented between September 1998 and December 1999 with a fall or fall-related injury; 1,989 sustained two or more falls in the preceding year, 415 were excluded and 1,261 declined study involvement, mostly after initial postal questionnaire. Thus, 313 patients were randomised—159 subjects to the intervention group and 154 to the control group (Figure 1).

There were no significant differences in baseline demographics, age, sex, cognitive test scores and previous fall history between intervention and control groups (Table 1).

Fall risk factors identified

A full risk factor assessment was performed on 146 of the 159 intervention subjects (13 withdrew from the study before completion of multidisciplinary assessment).

A median of five fall risk factors were identified (range 1–10). The commonest abnormalities were: balance, 136 (93%); gait, 117 (80%); culprit medication, 77 (53%); home environmental hazards, 70 (48%); visual impairment, 39 (27%); neurological abnormalities including peripheral neuropathy, 25 (17%); and depression, 12 (8%).

Fifty-four (37%) had orthostatic hypotension and 9 (6%) vasovagal syndrome. Twenty-nine out of 121 (23%) intervention subjects who consented to carotid sinus massage (CSM) had cardioinhibitory responses. Seven had a normal response to CSM on re-testing after ceasing culprit medications. Fourteen underwent dual-chamber pacemaker implantation. Three subjects declined pacemaker despite a history of unexplained falls and a syncopal response to CSM. The other five subjects had no history of syncope or unexplained falls, and no symptoms during CSM.

Intervention patients attended hospital a median of two occasions (range 0–10) for stabilisation of risk factors, received a median of two physiotherapy intervention visits (range 0–16) and one occupational therapy visit (range 0–4) with a median follow-up time of 32 days (range 0–143).

Thirty-three (21%) of the control subjects received some form of specialist falls intervention during follow-up. Indeed, 18 (12%) were assessed in a 'falls clinic' and eight received day hospital physiotherapy for falls.

Attrition

A total of 141 (89%) of the 159 intervention subjects and 141 (92%) of the control group remained in the study after 1 year. There were five deaths in the control group (mean 234 days after enrolment (SD ± 88)) compared with three in the intervention group (mean of 166 days (SD ± 16) (P=0.16)). This includes one control and one intervention subject who died having previously withdrawn from the study for other reasons. None of the deaths was due to falls or fall-related injuries. Of the 25 subjects who withdrew, 13 (52%) did so within 1 month of enrolment. The main reasons for withdrawal were: 'too much effort' (eight subjects), too ill to continue (five), and 'did not want tests' (three). (Table 2).

Fall diary returns

Of 15,045 weekly fall diaries, 13,484 (89.6%) were returned, and return rates for both groups were similar (intervention 88 ± 23% versus control 88 ± 22% (mean difference 0.06%, 95% CI −0.05 to 0.05)). Fall data are presented on the 295

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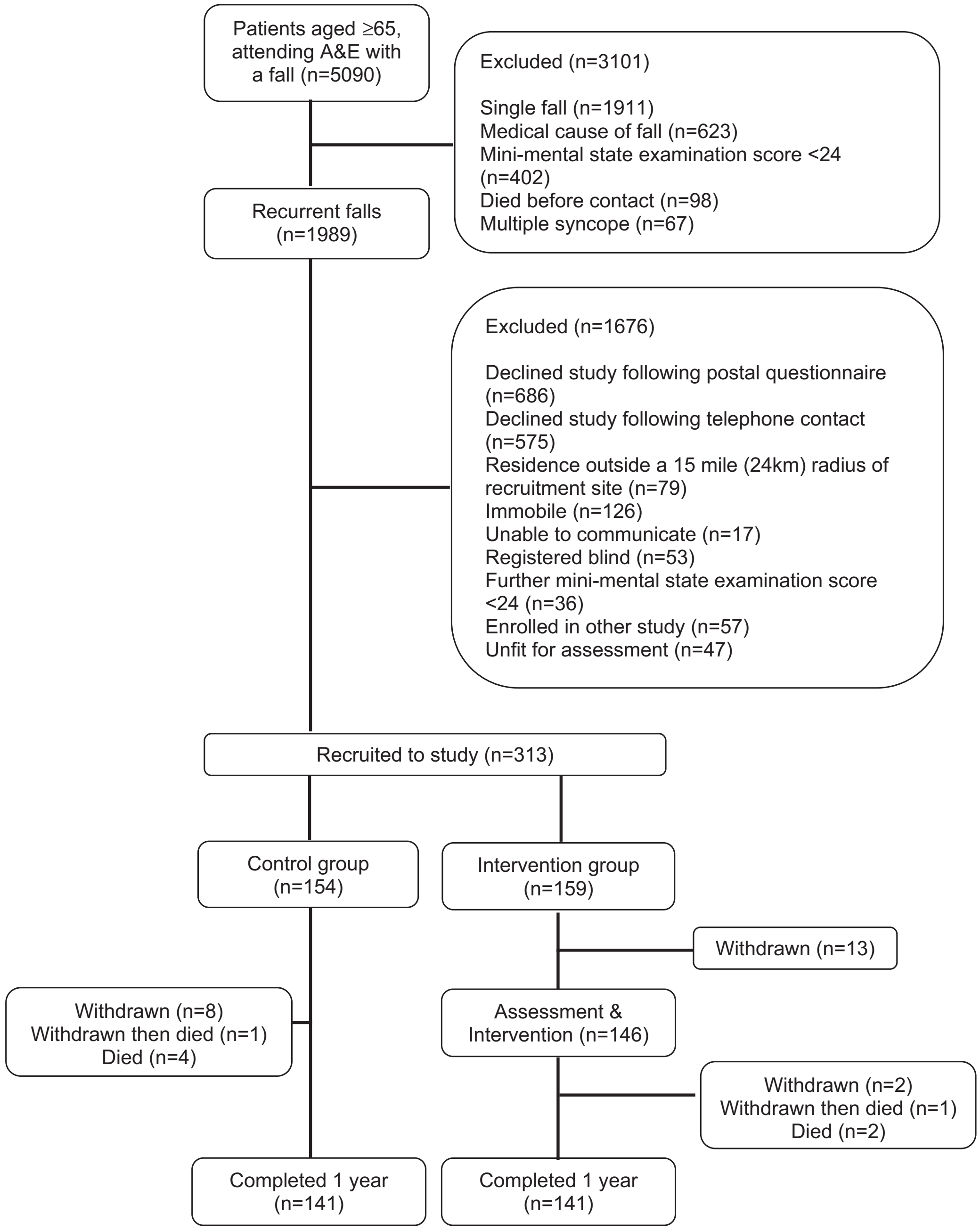

Figure 1. Recruitment profile.

subjects, including those who withdrew or died, who returned at least one diary.

Falls

There were 435 falls reported in the intervention group over 1 year follow-up compared with 1,251 falls in the control group. One control subject reported 634 falls and one intervention subject had 48 falls. Both patients had a diagnosis of progressive supra-nuclear palsy and were excluded from further analysis as isolated outliers. The remaining data are thus presented on 293 subjects.

Analysing by negative binomial regression, falls were reduced by 36% in the intervention group (relative risk 0.64, 95% CI 0.46–0.90) (Table 2).

Fallers

The proportion of subjects who fell again during follow-up did not differ significantly between the two groups; 94/144 subjects (65%) fell in the intervention group versus 102/149 (68%) in the control group (relative risk 0.95, 95% CI 0.81–1.12).

Secondary outcomes

The mean MMSE declined by 0.8 (SD 3.0) in the intervention group and 0.3 (SD 3.1) in the control group (mean difference 0.5, 95% CI −0.3–1.2).

Falls efficacy was significantly better in the intervention group. The mean Activities-specific Balance Confidence

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Table 1. Baseline characteristics of study population

	Control (n = 154)	Intervention (n = 159)	P value
Age (mean (SD))	77 (7)	77 (7)	0.291
Female (%)	112 (73)	114 (72)	0.900[a]
Age left school (mean (SD))	15 (1)	15 (1)	0.992
Number (%) in residential/nursing care	0 (0)	1 (1)	0.324
Median MMSE at baseline (IQR)	28 (26–30)	29 (26–30)	0.431[b]
ABC score (mean (SD))	58 (27)	59 (27)	0.62
Median number of falls in preceding year (IQR)	3 (1–5)	3 (1–5)	0.986[b]
Hospital admission due to index fall, n (%)	29 (19)	32 (20)	0.887[a]
Fracture with index fall, n (%)	45 (29)	39 (25)	0.371[a]
Soft tissue injury with index fall requiring treatment, n (%)	29 (19)	25 (16)	0.395[a]

[a]Fishers exact test.
[b]Mann–Whitney U test.

Table 2. Results at 1-year follow-up

	Intervention group (n = 159)	Control group (n = 154)	Relative risk ratio (95% CI)
Study status at 1 year			
In study	141 (89%)	141 (92%)	0.97 (0.90–1.04)
Withdrawn	16 (10%)	9 (6%)	1.72 (0.78–3.78)
Died[a]	3 (2%)	5 (3%)	0.58 (0.14–2.39)
	(n = 145)	(n = 150)	
Falls	435	1251	
	(n = 144)	(n = 149)	
Falls (two outliers excluded)	387	617	
Fallers (%)	94 (65)	102 (68)	0.95 (0.81–1.12)
Mean (SD) number of weeks fall diary returned	46 (11)	45 (12)	−0.77 (−3.4–1.87)[b]
Median (IQR) number of falls per subject	1 (0–5)	2 (0–7)	0.133[c]
Mean (SD) rate of falls per year	3.3 (5.0)	5.1 (7.9)	0.64 (0.46–0.90)[d]
Secondary outcomes	(n = 159)	(n = 154)	
Fractured neck of femur	1 (1)	2 (1)	0.48 (0.04–5.29)
Other fracture	6 (4)	11 (7)	0.53 (0.20–1.39)
Fall-related A&E attendance	25 (16)	27 (18)	0.90 (0.55–1.47)
Fall-related hospital admission	14 (9)	17 (11)	0.80 (0.41–1.56)
Total no. of days in hospital	131	688	
Length of stay (mean (SD) no. of days)	0.8 (3.4)	4.5 (22)	3.6 (0.1–7.6)[b]
Fall-related outpatient attendances (mean (SD) no.)	0.8 (2.3)	0.7 (1.2)	0.1 (−0.3–0.5)[b]
Mean ABC score at 12 months	61 (28)	53 (29)	7.5 (0.7–14.2)[b]

[a]Includes one subject in control group and one subject in intervention group who withdrew from study prior to death.
[b]Mean difference (95% confidence interval).
[c]Mann–Whitney U test.
[d]Negative binomial distribution.

score at 1 year was 61% (SD 28) in the intervention group versus 53% (SD 29) in controls; mean difference 7.5 (95% CI 0.72–14.2).

Fracture rate was low. Only six (4%) intervention subjects and 11 (7%) controls sustained a fracture in the year of follow-up (RR 0.53, 95% CI 0.20–1.39). There were only three femoral neck fractures, one in the intervention group and two in the control group (RR 0.48, 95% CI 0.04–5.29).

There was no difference between the number of attendances at A&E as a consequence of further falls or of the number of hospital admissions due to another fall (Table 2). However, the duration of hospital admission was significantly less in the intervention group (mean length of stay 0.8 (SD 3.4) days versus 4.5 (SD 22) in the control group; mean difference 3.6, 95% CI 0.1–7.6).

Discussion

We have demonstrated that multifactorial falls assessment and intervention reduces subsequent falls by 36% in cognitively preserved older persons presenting to A&E with recurrent falls. However, the number of subjects continuing to fall was not reduced.

The reduction in cumulative number of falls is comparable with other secondary prevention studies in A&E which have included subjects with either single or multiple falls [**14**], though the size of the effect was less. Our cohort demonstrated a well established pattern of falls with a median of three falls in the year prior to study entry, which was reduced to a median of one in the year after intervention.

Recurrent fallers are at higher risk of early admission to nursing care and premature death [**7, 8**] and the failure to

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change a 'recurrent faller' to a non-faller may reflect the multiple synergistic fall risk factors present in a 'high-risk' group.

Falls and syncope are the sixth commonest cause for emergency hospital admission in persons over 65 years [**33**]. The number of fall-related hospital admissions was similar in both groups in this study. However, the length of hospital stay for intervention patients was significantly shorter. This is an important observation and may have relevant cost implications when justifying resourcing for falls services. It is likely that length of stay was influenced by either continued assessment by study personnel or by more effective therapies for fall prevention. The reasons for reduced length of stay were not a planned study outcome.

Intervention patients experienced a reduction in 'fear of falling' as assessed by the Activities-specific Balance Confidence score. Other A&E based studies have demonstrated improvements in functional activity scales [**14, 34**], even when falls were not significantly reduced [**34**]. Interventions may appear less effective at reducing falls, as maintaining activity may increase the opportunity for falling [**34, 35**].

Ours was an intensive and comprehensive medically driven assessment and intervention programme, which required a median of two hospital attendances and two therapy visits to achieve targets. The cost benefits of such a programme for falls prevention now need to be explored in the context of fracture prevention.

There were too few fractures identified to determine any significant differences, though there was a trend towards benefit from intervention, in line with others [**14**]. This multifactorial intervention strategy incorporated well-established interventions for recognised fall risk factors with additional comprehensive assessments and interventions for cardiovascular risk factors, which is novel. The groups were well matched for baseline characteristics such as age, gender, previous history of falls and fall-related injuries or hospitalisations.

Most successful randomised interventional studies have been predominantly primary prevention [**11–13**], although the PROFET study, which was conducted in A&E, included 30% of subjects with recurrent falls and demonstrated benefit from intervention [**14**].

The trial design was limited by a lack of comparative data on fall risk factors in the control population. Had this group received multifactorial assessment, there would have been an ethical obligation to treat identified abnormalities. We were unable to assess whether any improvements in fall risk factors in the intervention subjects also occurred with controls. The multifactorial design means it is not possible to discern the effects of any single intervention on the primary outcome.

Thirty-three (21%) of the control group received some form of specialist falls assessment including cardiovascular assessment and day hospital physiotherapy. Despite this significant contamination of the control population, the intervention group still derived greater benefit from structured assessment and intervention. Provision of specialised falls clinics is now a requirement of the National Service Framework for Older Persons [**36**]. Multifactorial interventions are considered to be most effective in reducing fall frequency and the number of fallers, but require considerable input from a variety of skilled professionals [9, **10**]. Falls and syncope are the commonest reasons for older persons to attend A&E [**4**]. The volume of attendees with these symptoms is such that evidence-based stratified care pathways for the management of fallers are mandatory to ensure the appropriate use of limited resources. One of the principal sites for falls screening and sources of referral to falls services is A&E. This study will assist those developing falls services to appropriately triage fallers attending A&E.

Multifactorial intervention appears to be less effective in the cognitively impaired [**17**]. This study shows that in cognitively intact community-dwelling older recurrent fallers, intervention can reduce falls. The benefits are smaller than in subjects with single falls or fewer fall risk factors, but nonetheless a reduction in fall burden per subject has been shown. As with other studies, we were insufficiently powered to detect an associated reduction in fractures, but the trend was consistent with previous work and strengthens the case for secondary fall prevention intervention.

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Contributors: J.D. was the principal investigator and co-ordinated the project under the supervision of J.B. and R.A.K. P.D. provided expertise for physiotherapy and occupational therapy sections of the trial protocol. J.D. collected the data and analysed it in conjunction with I.N.S. All authors contributed to the study protocol and paper preparation. J.D. and R.A.K. wrote the paper. R.A.K. is guarantor. We wish to thank the Wellcome Trust and Northern and Yorkshire NHS Executive for funding the study.

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Conflicts of interest

All authors declare they have no conflicts of interest.

Note

Please note: the extensive list of references supporting this paper has meant that only the most important are listed here and are represented by bold type throughout the text. The full list of references is available as supplementary data on the journal website (http://www.ageing.oupjournals.org) as Appendix 2.

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