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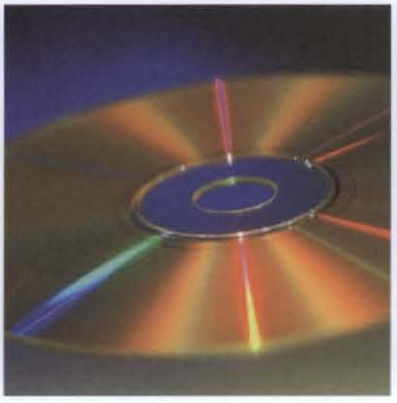
Variations in initial acceptance and continued adherence to wearing hip protectors:

Are they explained by factors other than staff attitude?

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Summary

Background

Hip fractures are an important consequence of falling. Methods of preventing hip fractures include:

1. reducing the risk of falling,
2. strengthening (or maintaining the strength of bones) through osteoporosis treatment and prevention, and
3. through the use of hip protectors.

Cluster-randomised trials indicate that for those living in residential care and nursing homes with a high risk of hip fracture, a programme of providing hip protectors appears to reduce the incidence of hip fractures.

The East Kent Hip Protector Project investigated a programme to introduce hip protectors into 17 selected residential care homes across 5 PCGs in East Kent. This work found initial acceptance of hip protectors of 51%, and continued adherence amongst those who accepted and wore the hip protectors at least once of 29% (24 hour adherence rate) and 37% (daytime adherence rate). Large variations in the adherence rates between homes were found; they varied from 0% to 80%.

Impressions obtained by the investigators were that support for the promotion of hip protectors varied substantially across the homes. Consequently, it was hypothesised that staff attitude and support affects initial acceptance and continued use of hip protectors.

Purpose

A new study involving primary data collection would be required to investigate this hypothesis. Before such a study is considered, it was proposed to investigate other potential reasons for the variations - using the data from the East Kent Hip Protector Project.

Research question

Can factors other than staff knowledge and attitude explain the variation between homes in initial acceptance and continued adherence to wearing hip protectors?

Methods

Residents were offered hip protectors and an assessment to identify modifiable risk factors for falls. Whether the resident refused, or the staff member refused the hip protectors on the resident's behalf, was described firstly across all homes, and then disaggregated by home.

Person-level factors were investigated to see if they could explain the variations between the residential care homes in East Kent in (a) initial acceptance and (b) continued adherence. The factors were: age, gender, months in residence at the home, long-term problems (ie. arthritis, stroke, diabetes, Parkinson's disease), postural hypotension, hypertension, dizziness, ability to transfer, help / supervision with walking, assistance with stairs, use of walking aids, use of a wheelchair, vision problems, continence problems, history of falls or fractures, and fear of falling / falls efficacy.

The following home-related factors were also investigated to see if they could explain the variations in initial acceptance and continued adherence: number of beds in the home, number of residents at baseline, history of fractured neck of femur over the previous 4 years and during the last year, average number of admissions to hospital, and PCG area.

Statistical analysis

In order to investigate the variation between the homes in initial acceptance, all of the individual-level variables were entered into a mixed-model logistic regression analysis, and backward elimination was used to remove the least significant term at each iteration. This was continued until all terms left in the model were significant at the 20% level. Then the home-related variables were entered into the model, and the process repeated. The results for all terms remaining in the model were reported. This was repeated for continued adherence, but using mixed-model multiple linear regression rather than logistic regression.

The effect of the factors on the between-home variability in initial acceptance and continued adherence rates were tabulated and presented graphically.

Results

Key results from this work are:

Initial acceptance

1. 299 residents were offered hip protectors, and in 146 instances they were refused (Figure 1). Figure 2 shows the pattern of initial acceptance and reasons for rejection of hip protectors by residential care home.

Figure 1: Rate of initial acceptance of hip protectors, with reasons for not accepting.

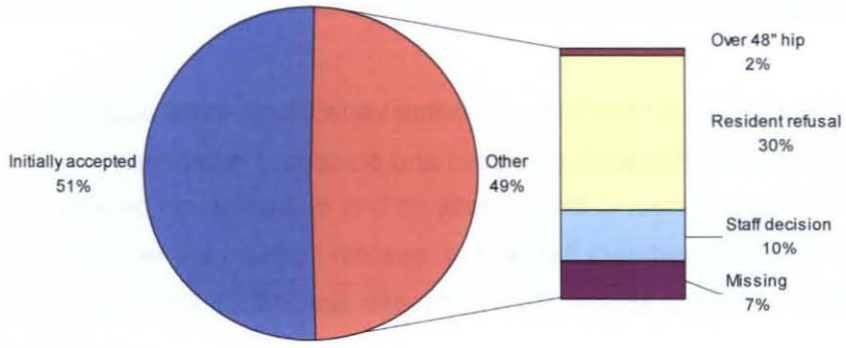
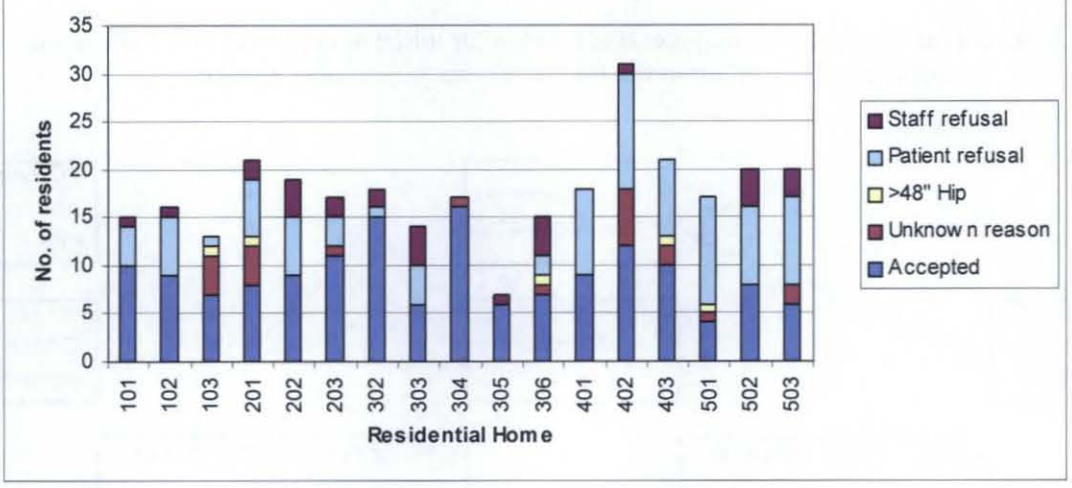


Figure 2: Patterns of acceptance and reasons for rejecting hip protectors



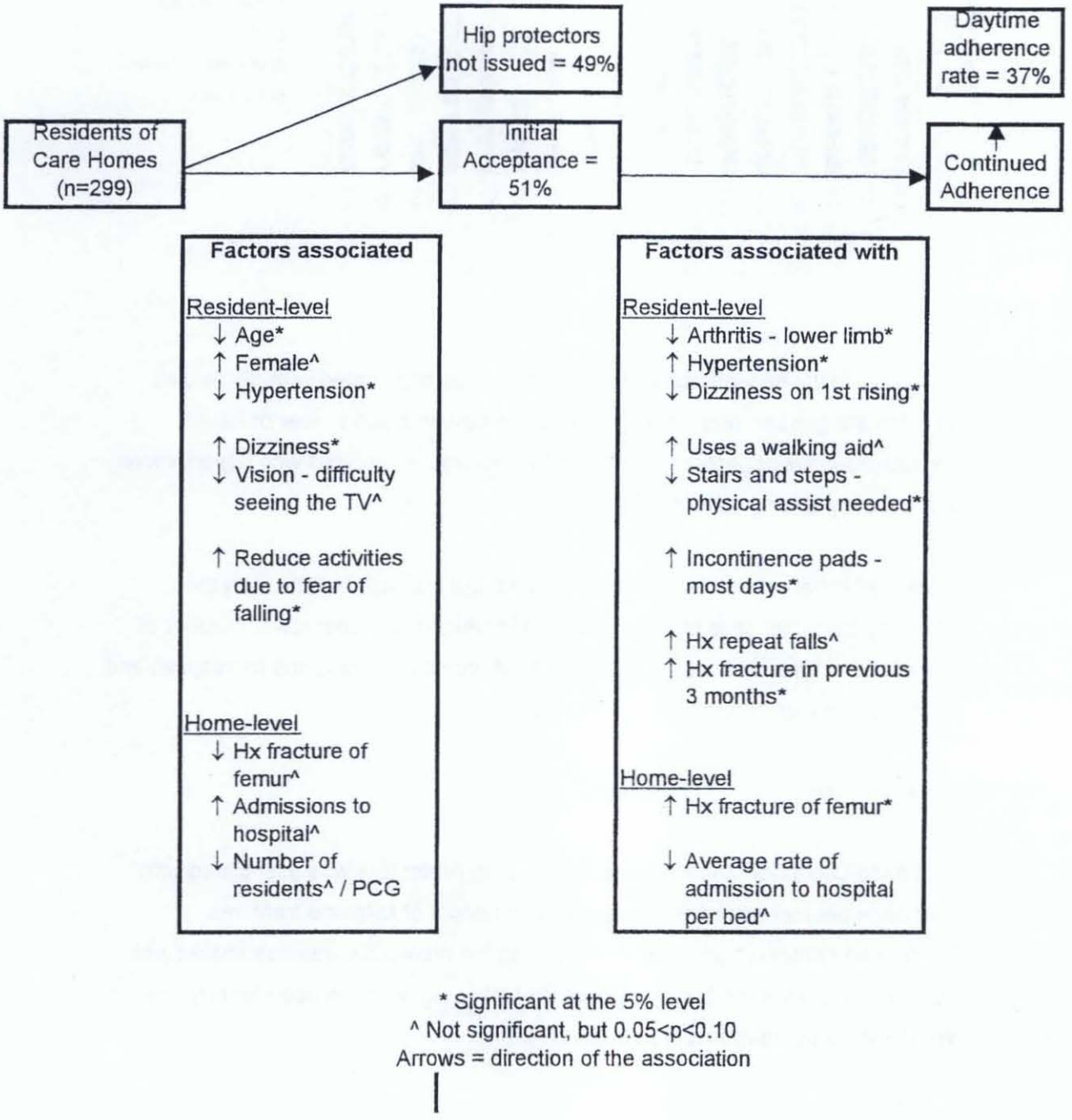
2. Increased initial acceptance of hip protectors was associated with decreased age, female gender, dizziness, and reduced activities due to fear of falling. Decreased initial acceptance of hip protectors was associated with hypertension, and difficulty seeing distant objects.

3. Increased initial acceptance was associated, but not significantly, with the following characteristics of the care home in which they lived: lower number of recorded fractured femurs, increased rate of previous admissions to hospital, and a smaller number of residents in the home.

Continued adherence

4. Increased continued adherence to wearing hip protectors was associated with hypertension, incontinence, and a previous history of falls and fractures. Decreased continued adherence to wearing hip protectors was associated with arthritis of the lower limb(s), dizziness on first rising, and the need for physical assistance with stairs and steps.

Figure 3: Resident-level and home-level risk factors for initial acceptance and continued adherence identified in the mixed effects regression models



* Significant at the 5% level
^ Not significant, but 0.05<p<0.10
Arrows = direction of the association

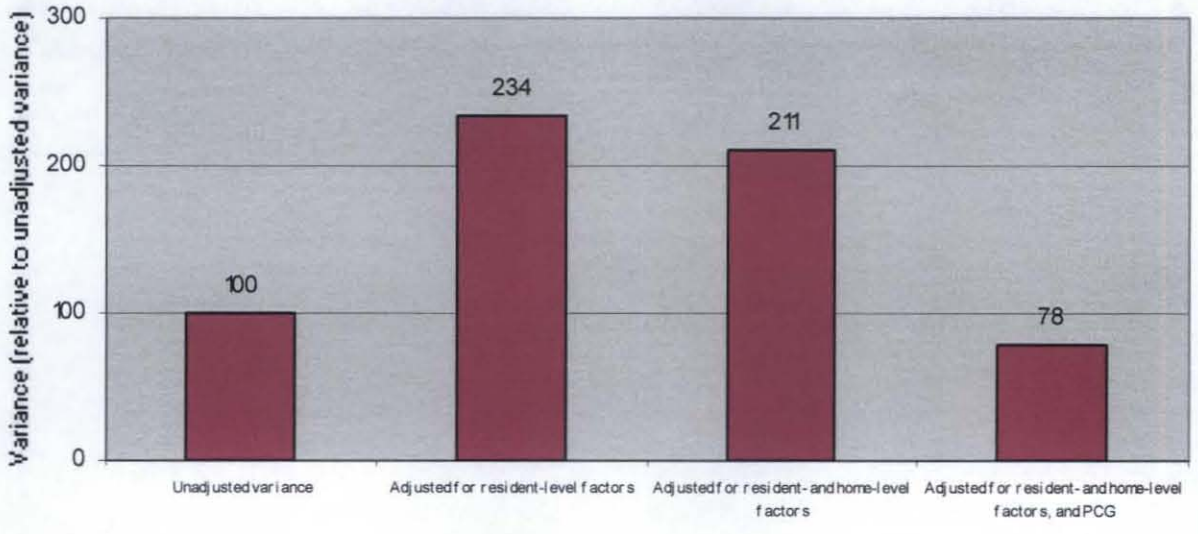
5. Increased initial acceptance was associated with the following characteristics of the care home in which they lived: higher number of recorded fractured femurs, and decreased rate of previous admissions to hospital.

Points (2) to (5) above are illustrated in Figure 3.

Variation between homes

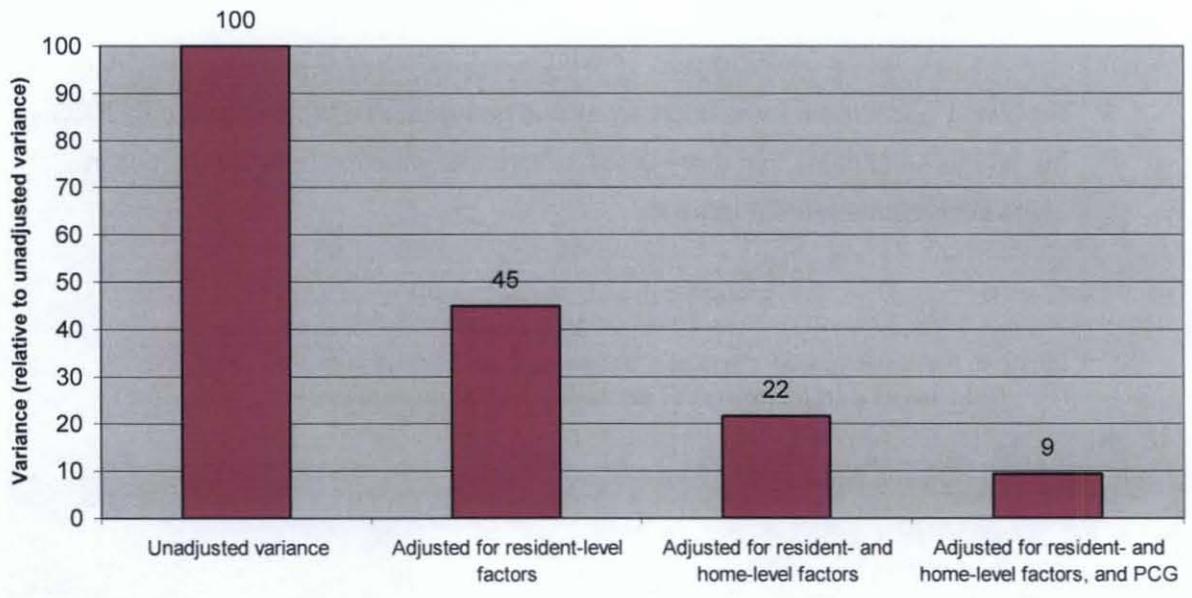
6. Following adjustment for resident-level and home-related factors, including PCG, the analysis indicates that there is still substantial variation between homes in initial acceptance rates (Figure 4).

Figure 4. Percentage of variance between homes explained by resident-level and home-level factors - initial acceptance.



7. The variation between homes in continued adherence rates appears to be almost completely explained by these resident-level and home-related factors (Figure 5).

Figure 5. Percentage of variance between homes explained by resident-level and home-level factors - continued adherence.



Discussion

1. There is less certainty about the effectiveness of hip protectors following the publication (since March 2001) of individually randomised trials.

2. Nevertheless, cluster-randomised trials indicate that, for those living in institutional care with a high background incidence of hip fracture, a programme of providing hip protectors appears to reduce the incidence of hip fractures.

3. Initial acceptance and continued adherence to wearing hip protectors has been a problem in most studies, including the East Kent Hip Protector Project

4. This work has identified resident-level and home-related factors associated with initial acceptance of and continued adherence to wearing hip protectors.

5. It also found that:

    a. following adjustment for resident-level and home-related factors, including PCG, the analysis indicates that there is still substantial variation between homes in initial acceptance rates.
    b. the variation between homes in continued adherence rates appears to be almost completely explained by these resident-level and home-related factors.

6. The substantial variation between homes in initial acceptance rates, after adjusting for resident-level and home-related factors, could be due to staff or resident knowledge and attitude in respect of hip protectors.

7. In respect of the continued adherence to wearing hip protectors, it appears that differences between homes in staff knowledge and attitudes, may not be such important factors.

Implications for future research

As a result of this work, I have made the following 2 recommendations:

- Work to investigate the effect of residential care staff knowledge and attitude on initial acceptance seems justified.
- Work to investigate the effect of staff knowledge and attitude on continued adherence to wearing hip protectors is now questionable in the light of these results.

Acknowledgement

I would like to thank the National Patient Safety Agency for funding this work. I would also like to thank Alison Knox and the Canterbury Hip Protector Project Team for permission to use their data.

Variations in initial acceptance and continued adherence to wearing hip protectors:

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1. Background

Falling amongst older people is a significant problem.[1 2 3 4 5] Approximately 30% of people aged 65 and over living in the community fall each year, half of those do so repeatedly, and an estimated 50% of people aged 85 and over fall each year.[1 6 7 8 9 10] The rate of falling amongst those living in institutions (excluding acute hospitals) has been estimated at 50%, with 10-25% suffering severe consequence.[11 12] One of the most serious consequences of falling is fractured neck of femur (hip fracture).[8] The vast majority of fractured hips result from a fall. [13] Around 1-2% of community-dwelling older people and 5-7% of nursing home residents fracture their hip each year.[8 14 15] The service cost of treatment and care of an older person with a hip fracture has been estimated at over £12,000 during the first year following hip fracture, at 1995/6 costs.[3] More recently, the cost of a hip fracture has been estimated at over £21,000 [16]. Estimated 1-year mortality ranges from 12% to 25%, and less than half of surviving patients recover their pre-fracture levels of physical functioning.[17 18 19 20]

The principal ways of preventing hip fracture are: prevention of falls, ensuring bones are strong enough to withstand the impact following a fall, and / or protecting the hips with pads which absorb or deflect much of the energy away from the vulnerable area.[21] This

work focuses on the latter of these interventions. Direct impact on and around the hip is the cause of the majority of hip fractures.[13 22 23 24 25 26]

Hip protectors are a very important means of protecting older people from hip fracture, and are particularly beneficial to those who are at high risk of falling or who have brittle bones (osteoporosis). This work is based on a re-analysis of project data collected in 1999 [27] (see Appendix 1). The practical work for this project was initiated in the context of the trials published up to 1999, included in the 2000 Cochrane review.[28] This review reported that in five randomised controlled trials involving 1742 persons in nursing homes, only one person had a hip fracture whilst using hip protectors. [28] Additionally, Kannus and colleagues [29] reported that 4 hip fractures occurred whilst hip protectors were worn in their mixed geriatric population amongst 1034 falls, whereas 9 occurred amongst 370 falls whilst hip protectors were not worn, a 5-fold risk of fracturing.

At that time, national guidelines that were commissioned by the Department of Health in England recommended that: "Hip protectors should be offered to all nursing home residents".[30] There had been six published trials that provided evidence for the effectiveness of hip protectors in preventing hip fracture in nursing home (high-risk) populations.[31 32 33 34 35 36] A further trial reported an estimated reduction in hip fractures of 60% in a mixed population of people living in geriatric long-stay facilities and people living at home supported by health care centres.[29]

Most studies have found that many older people are unwilling to wear hip protectors. For those that indicate they are willing to try them, a number change their minds when confronted by the hip protector, some forget to wear them, and some give up wearing them altogether. Increasing acceptability and maintaining adherence are important goals, therefore. Adherence rates in nursing homes of 44-90% have been reported.[31 32 33 34 35 37] An estimate of regular wearing of hip protectors in a nursing home has been as low as 24%[31] and in 'rest homes' as low as 30%.[38] In a mixed geriatric population (long stay facility, or home care) the adherence rate was 48%.[29]

Like nursing home residents, people living in residential care homes are at substantially greater risk of falling than their counterparts living in the community. Consequently,

initiatives to prevent hip fracture within residential care homes are also justified. An evaluation of hip protector use, amongst people living in residential care homes in East Kent Health Authority area of SE England who were offered them, found that only 51% indicated that they would wear hip protectors if issued. Hip protectors were then issued to those who consented; however, a further 16% did not wear them at any time. The 24-hour recorded adherence rate for those who were issued with hip protectors and who wore them at least once was 29%. This varied from 38% in the morning to 3% at night. Some have recommended wearing hip protectors 24 hours a day if the person is getting up two or more times during the night.[39] One study found, however, that the majority of falls occur during the day.[36]

Daytime adherence rates varied across residential care homes from 0% to 80%. The impression that was obtained during contact with the homes was that support for the promotion of hip protectors by the staff of the homes varied substantially, and that the best rates were obtained where the staff actively supported their use. This finding suggests a potentially fruitful avenue for investigation. It was hypothesised that carers who promote the use of hip protectors achieve high adherence. Conversely, it was hypothesised that older people living with carers who do not promote, or are negative towards, the wearing of hip protectors have much lower adherence rates.

Purpose and aim of this research

We are interested in identifying whether variations in the initial acceptance of, and subsequent use of hip protectors, amongst residents of care homes is related to residential care home staff attitude, and their promotion of hip protector usage. Before setting up a special study to investigate this question, it was recognized that data from the East Kent project could be used to eliminate many person-related and some home-related effects on the initial acceptance of, and subsequent use of, hip protectors. If, after these effects have been eliminated, there still appears to be marked variation between homes, then this would give strong justification to set up a special study to investigate staff attitude.

The aim of this study, therefore, was to identify whether person-level and the home-related factors, measured in the East Kent Hip Protector Project, explained the variation in rates, between residential care homes, of initial acceptance of hip protectors, or the continued adherence to their use.

2. Methods

Type of study

Prospective cohort study, with 6 months follow-up.

Population

The target population for this work was people aged 65 years and over living in residential care homes with 20 or more beds in the East Kent Health Authority area.

Selection of homes:

The Social Services inspectorate supplied a list of every residential care home in East Kent. The list was used to identify homes that had provision for 20 or more beds. Homes that were dual registered (for residential and nursing home clients), or were offering specific care for learning disability or mental health difficulties, were excluded. The list of eligible homes was organised within Primary Care Groups (PCG), and three homes within each PCG were selected sequentially from the list that had the highest frequency of fractured neck of femur over the previous 5 years. A further two homes were selected within one PCG, who had additional staff available to support the audit project. These had the next highest frequency of fracture neck of femur within the PCG.

A description of the characteristics of the residents from the homes that were included in this study was presented in a previous report, [27] reproduced here as Appendix 1.

The intervention

Within the East Kent audit project, every resident within the 17 homes was offered a fall-risk assessment, with referral as necessary, re-assessment, medication review, and three pairs of SAFEHIP® hip protectors. The process included:

- contact with all staff involved
- consent from GPs and home owners/managers for the study procedures
- verbal consent from the residents who took part
- meetings with all primary care and residential care staff in the study areas
- teaching of care staff in homes about falls risk and assessment
- visit to homes to talk to residents about the project

- offers of hip protectors to residents who consented, and provision to those who accepted
- an assessment to identify modifiable risk factors for falls with referral to other services as appropriate
- medication review and modification by pharmacists in conjunction with the GP.

These are described in more detail in Appendix 1.

Primary outcome variables

Three main outcome variables were the focus of this study:

1. Reported reason for non-supply of hip protectors
2. Initial acceptance: Whether the initial offer of hip protectors was accepted or rejected – collected at baseline.
3. Continued adherence: Proportion of sessions that the hip protectors were reported to be worn during the day (morning, afternoon, and evening), This was estimated from diaries by counting the number of sessions that a person wore hip protectors divided by the number of sessions the protectors were available to wear (ie. from when the hip protectors were issued to the end of the study period or the end of follow-up, whichever was sooner).

Explanatory variables investigated

Resident-level: -

Age
Gender
Months in residence at the home
Long-term problems (ie. arthritis, stroke, diabetes, Parkinson's disease)
Postural hypotension
Hypertension
Dizziness
Ability to transfer
Help / supervision with walking
Assistance with stairs
Use of walking aids

Use of a wheelchair
Vision
Continence problems
History of falls or fractures
Fear of falling

Home-related: -

Number of beds in the home
Number of residents at baseline
History of fractured neck of femur
Average number of admissions to hospital
Primary Care Group area.

Statistical analysis

There were 299 residents who were offered hip protectors, along with an assessment to identify modifiable risk factors for falls. Whether the resident refused, or the staff member refused the hip protectors on the resident's behalf, was described firstly across all homes, and then disaggregated by home.

Initial acceptance

Resident-level factors

The associations between each of the resident-level factors and the initial acceptance of hip protectors were investigated initially using bivariate analyses (chi-squared tests, Wilcoxon rank sum tests, or t-tests as appropriate). For the resident-level factors listed, the independent associations between each factor and initial acceptance were investigated using logistic regression analysis.

There was a problem of missing responses for many of the variables. To address this problem, before carrying out the logistic regression analyses, all multi-categorical variables were dichotomized in the manner indicated in table 1. Each of the categorical

variables were coded to (0,1), where 1 represented 'Yes' or problem present, and 0 represented 'No' or problem absent. (This was with the exception of gender - coded 1 for male and 2 for female.) Missing responses were coded to the intermediate value of 0.5, on the assumption that these missing values would equally likely have taken the value 0 or 1. In the analysis, these recoded variables have been used predominantly as categorical variables, but have occasionally been treated as quantitative variables.

All of these variables were entered into a logistic regression analysis, and backward elimination was used to remove the least significant term at each iteration. Elimination of factors continued until all terms left in the model were significant at the 20% level of significance. The results for all terms remaining in the model were reported.

Home-related factors

Associations between the home-related factors and the initial acceptance of hip protectors were firstly investigated using simple bivariate statistical methods. Then, all the home-related factors were entered into the logistic regression as separate terms in the model. It was hypothesized that there would be a monotonic relationship between the home-related factors and initial acceptance. For example, it was hypothesized that a history of admissions to hospital is associated with initial acceptance such that the larger the rate of admission to hospital, the larger the initial acceptance rate. Stepwise backward elimination was used to remove the least significant terms from the model so that only those that were significant at the 20% level of significance were retained.

Following this, the effect of introducing firstly PCG, then 'home' itself into the model was investigated. This was done initially using the usual logistic regression analysis, treating PCG and home as 'fixed effects', in order to investigate whether there was any variability between homes not explained by the 5 home-related variables (described in the previous paragraph). This was then followed with a mixed-model analysis in which variation between homes was treated as a 'random effect'. The reported estimates of effects from this last model were regarded as the most valid.

Continued adherence

A similar approach to the analysis described above was used to investigate the association between resident- and home-related factors and the daytime continued adherence for people who were issued with hip protectors. The difference is that continued adherence is a continuous measure (ie. a percentage) rather than a binary outcome. Consequently, the methods that were used to analyses this outcome were:

- t-tests, Mann-Whitney U-tests and correlations to investigate the bivariate associations;
- multiple linear regression modeling (rather than logistic regression) for the multivariable analysis.

The effect of the resident factors, and then the effect of resident and home factors, on the between-home variability in initial acceptance and continued adherence rates were tabulated.

Ethical Approval

This was obtained from the research ethics committee of the University of Kent School of Social Policy, Sociology, and Social Research prior to the start of this research.

3. Results

Each of the 299 residents was offered hip protectors, and in 146 instances (49%) they were refused. Amongst these 146, the resident refused in 90/146 (62%), it was a staff decision in 29/146 (20%), and in 5/146 (3%) the resident was over 48" hip (too large for the available hip protectors). For 22 residents (15%), no reason was given (Figure 1). Figure 2 shows the pattern of initial acceptance and reasons for rejection of hip protectors by residential care home. The analysis described below investigates these rates of initial acceptance further.

Figure 1: Rate of initial acceptance of hip protectors, with reasons for not accepting.

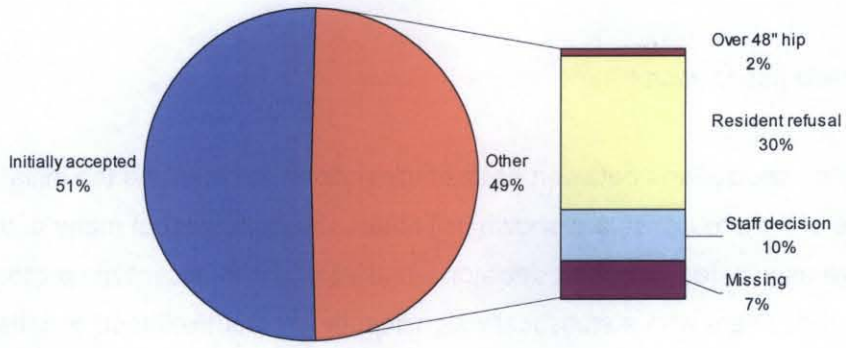
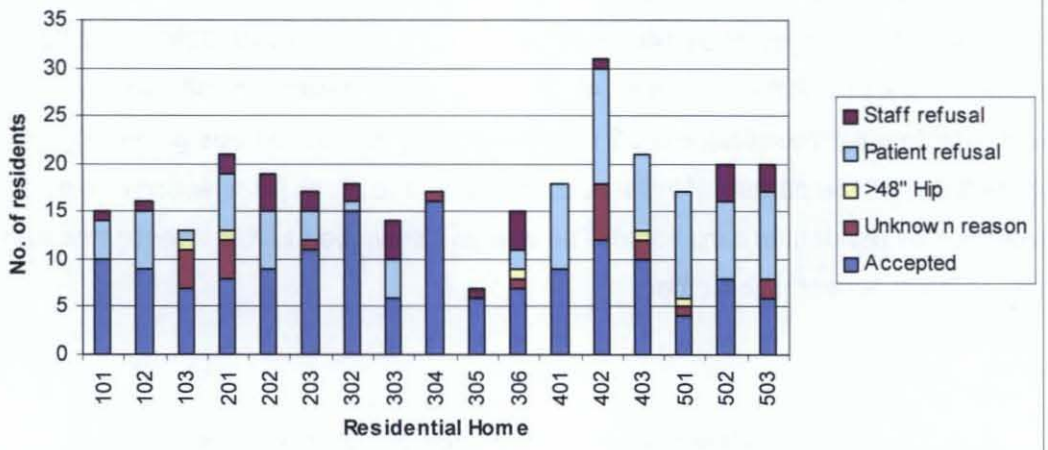


Figure 2: Patterns of acceptance and reasons for rejecting hip protectors



3.1 Initial acceptance

3.1.1 Bivariate associations

The bivariate associations between each of the resident factors and the initial acceptance of hip protectors are shown in Table 1. This shows that many of the resident factors were associated with their decision whether or not to accept hip protectors when initially offered. There was a statistically significantly greater likelihood of initial acceptance in the following subgroups: those who were younger, had diabetes, reported dizziness, used a wheelchair, were fearful of falling, and whose daily activities were affected by a fear of falling. Surprisingly, the uptake of hip protectors was less in people who reported difficulties with their vision.

Table 1: Associations between each of the resident factors and initial acceptance of hip protectors

Variable	N	Compare	Means/Proportions	t-test[a]/ Chi-squared	p-value	
Age	278	Issued vs NI	85.4 vs 87.4	2.50(t)	0.01	↓
Gender	298	F vs M	128/238 vs 24/60	3.64	0.06	↑
Months in residence at the home	299	Issued vs NI	30.2 vs 32.9	0.64(t)	0.52	
Ln (months in res home + 1)	299	Issued vs NI	2.93 vs 2.79	- 0.97(t)	0.33	
Arthritis – Lower limb	281	Y vs N	65/93 vs 94/188	2.61	0.11	
Arthritis – other	281	Y vs N	54.92 vs 96/189	1.55	0.21	
Parkinson's	281	Y vs N	9/18 vs 141/263	0.09	0.77	
Stroke	281	Y vs N	23/40 vs 127/241	0.32	0.57	
Diabetes	281	Y vs N	18/25 vs 132/256	3.82	0.05	↑
Postual hypotension	206	Y vs N	18/34 vs 100/172	0.31	0.58	
Hypertension	277	Y vs N	8/20 vs 110/186	2.70	0.10	
Diziness on first rising	277	Y vs N	22/34 vs 127/243	1.86	0.17	
Dizziness standing quickly	277	Y vs N	26/48 vs 123/229	0.00	0.95	
Dizziness any other time	277	Y vs N	30/42 vs 119/235	6.20	0.01	↑
Ability to transfer	241	Supervision vs OK	42/65 vs 96/176	1.97	0.16	
Walking/gait/balance	238	Unsteady vs OK	52/90 vs 86/148	0.00	0.96	
Difficulty with stairs and steps	238	Assist vs OK	65/102 vs 72/136	2.78	0.10	
Walking aid?	277	Y vs N	87/152 vs 62/125	1.61	0.20	
Wheelchair?	277	Y vs N	69/107 vs 80/170	8.02	0.005	↑
Visual acuity – print	208	Difficulty vs OK	10/28 vs 108/180	5.82	0.02	↓
Visual acuity – television	213	Difficulty vs OK	6/21 vs 116/192	7.84	0.005	↓
Visual acuity – immediate surroundings	216	Difficulty vs OK	3/13 vs 1231/203	6.67	0.01	↓
Rise to toilet at night >1 times	281	Most nights vs OK	70/123 vs 80/158	1.10	0.30	
Worry won't make it to the toilet	281	Worry vs OK	17/30 vs 133/251	0.15	0.70	
Wetting/dribbling	281	Most days vs OK	41/68 vs 109/213	1.72	0.19	
Wear pads	281	Most days vs OK	61/101 vs 89/180	3.12	0.08	↑
Fallen in the last 3 months	281	Y vs N	46/76 vs 104/205	2.14	0.14	
3 or more falls	279	Y vs N	14/19 vs 135/260	3.37	0.07	↑
Fractures in the last 3 months?	281	Y vs N	3/5 vs 147/276	Fishers exact	1.00	
Fear of falling?	213	Moderate vs OK	39/53 vs 84/160	7.25	0.007	↑
Effect on activities?	195	Many vs OK	23/27 vs 90/168	9.54	0.002	↑
Falls efficacy – score 1[b]	121	Issued vs NI	67.2 vs 86.4	4.76(t)	0.000	↓
Falls efficacy – score 2[b]	121	Issued vs NI	57.7 vs 67.2	2.17(t)	0.03	↓

a (t) designates that a t-test was used, otherwise the chi-squared test was used, with the exception of 'Fractures in the last 3 months'.

b The higher the score, the more confident the resident.

3.1.2 Fixed effects model

Resident-level factors

Those factors for which the results suggest that they were independently associated with initial acceptance of hip protectors are shown in Table 2. These results show some similarities and differences to those shown in Table 1. Table 2 shows those variables whose associations with initial acceptance were unlikely to be due to chance or due to confounding with other measured resident-level factors, that is for: age, gender, postural hypotension, hypertension, dizziness, difficulties with walking or balance, seeing the television with difficulty, and the reduction of normal activities due to fear of falling.

The results suggest that the following were more likely to initially accept hip protectors: women, people who reported dizziness, and people who had cut down their activities due to fear of falling. Those who were classified hypertensive, and those who reported having difficulty watching the TV because of their vision were less likely to initially accept hip protectors. As people got older, they were less likely to initially accept hip protectors. The other associations (associations with postural hypotension and problems with walking or balance) appear to have resulted from the pattern of missing values (eg. those least likely to have responded to the question on walking or balance were less likely to initially accept hip protectors).

Table 2: Patient factors for which the results suggest that they are independently associated with initial acceptance of hip protectors (n=278) - fixed effects model

Variable	Chi-squared	df	p	OR	95% Confidence Limits
Age	6.40	1	0.01	0.95[a]	(0.91, 0.99)
Female sex	3.86	1	0.05	2.00	(1.00, 4.01)
Postural hypotension	7.17	2	0.03	0.69	(0.30, 1.62)
Hypertension	6.22	1*	0.01	0.27	(0.10, 0.75)
Dizziness	5.80	1*	0.02	2.67	(1.20, 5.92)
Dizziness standing quickly	4.54	2	0.10		
Physical help / supervison with walking, unsteady when turning	5.66	2	0.06	0.99	(0.53, 1.84)
Great difficulty seeing (with glasses) the televison	8.50	2	0.01	0.20	(0.07, 0.60)
Fear of falling resulting in 3 or more activities cut down	11.82	2	0.003	5.40	(1.56, 18.69)

*The pattern of missing values is such that there is perfect confounding with another variable for the missing value category and so 1 degree of freedom is lost.

a. OR=0.95 indicates an approximate 5% reduction in initial acceptance rates for each years increase in age.

Home-related factors

Bivariate associations between the home-related factors and initial acceptance were investigated.

- There was a significant difference between PCG (chi-squared=21.45, df=4, p<0.001)
- There was a significant difference between home (chi-squared=40.12, df=16, p=0.001)
- There was a suggestion that those from smaller homes, with fewer residents at baseline, were more likely to initially accept hip protectors than those from larger homes.
- The bivariate investigation suggested no associations between initial acceptance and history of fractured femur for the home, or for history of admission to hospital for the home.

These findings are very preliminary and were investigated further within the regression analyses.

The home-related factors (except PCG and home) were entered into the logistic regression model described above, and following stepwise backward elimination, three home-related factors remained in the model that were significantly associated with initial acceptance of hip protectors in the fixed effects model. These were the number of residents at baseline, number of residents with a fractured neck of femur in the previous 4 years, and average number of admissions to hospital in the previous 4 years (Table 3). Associated with a greater likelihood of accepting hip protectors were: a smaller number of residents, history of a smaller number of hip fractures, and a greater average number of admissions to hospital in the previous 4 years.

The addition of a term in the model to represent PCG resulted in a significant improvement in fit (Chi-squared=18.13, df=4, p=0.001). There was confounding between PCG and size of home. With the introduction of the term representing PCG, the association between number of residents at baseline and initial acceptance was eliminated.

Table 3: Patient and home factors for which the results suggest that they are independently associated with initial acceptance of hip protectors (n=278)

		Fixed effects model(#)					Random effects model				
Factors	Variable	Chi-squared	df	p	OR*	95% Confidence Limits	Chi-squared	df	p	OR*	95% Confidence Limits
Resident	Age*	5.02	1	0.02	0.95	(0.91, 0.99)	4.86	1	0.03	0.95	(0.90, 0.99)
	Sex	4.68	1	0.03	2.21	(1.08, 4.54)	3.01	1	0.08	1.97	(0.92, 4.23)
	Postural hypotension	7.29	2	0.03	0.54	(0.22, 1.32)	3.13	2	0.21	0.43	(0.16, 1.14)
	Hypertension	6.06	1(+)	0.01	0.26	(0.09, 0.76)	6.49	1(+)	0.01	0.21	(0.07, 0.70)
	Dizziness	5.59	2	0.06	2.66	(1.17, 6.06)	5.18	1($)	0.02	2.86	(1.16, 7.06)
	Dizziness standing quickly	3.47	1(+)	0.06	0.39	(0.14, 1.05)	3.56	1($)	0.06	0.34	(0.11, 1.04)
	Physical help / supervison with walking, unsteady when turning	3.20	2	0.20	1.05	(0.55, 2.01)	2.25	2	0.32	1.16	(0.59, 2.28)
	Great difficulty seeing (with glasses) the televison	8.06	2	0.02	0.18	(0.06, 0.59)	5.57	2	0.06	0.23	(0.06, 0.81)
	Fear of falling resulting in 3 or more activities cut down	16.01	2	0.000	5.25	(1.53, 18.04)	20.56	2	0.000	9.21	(2.31, 36.71)
Home	Number of residents at baseline*	6.55	1	0.01	0.90	(0.84, 0.98)	3.02	1	0.08	0.88	(0.75, 1.02)
	Number of residents with fractured necks of femur in previous 4 years*	7.22	1	0.007	0.13	(0.03, 0.58)	3.18	1	0.07	0.08	(0.01, 1.28)
	Average number of admissions to hospital in previous 4 years*	7.69	1	0.006	6281	(12.98, 3,038,288)	3.44	1	0.06	41233	(0.55, 3,085,563,081)
	Home						4.192	1	0.04	0.898^	(0.04, 1.76)

#This model only included fixed effects. Random effects such as home and PCG were not considered

* For continuous variables, the odds ratio relates to a unit increase in the variable.

+The pattern of missing values is such that there is perfect confounding with another variable for The missing value category and so 1 degree of freedom is lost.

$ The random effects model failed to converge with the inclusion of the missing value category.

^ Estimate of the between home variability in initial acceptance rate.

The further addition of the term for 'home' in the model as a fixed effect also resulted in a significant improvement in fit (Chi-squared=20.32, df=11, p=0.04).

This analysis was exploratory in nature and was used to investigate whether staff-related effects were possible.

3.1.3 Mixed effects model

The results of the mixed effects analysis are also shown in table 3. This analysis included the same resident and home terms as presented in the fixed effects model, the only difference was that the variation between home was included in the model as a random effect.

Similar results to the fixed effects analysis were apparent for resident-level factors; however a change in statistical significance was apparent for the factors: 'postural hypertension', for 'dizziness', and for 'difficulty seeing the television'. There were significant independent associations between initial acceptance and the following variables: age, hypertension, dizziness, and the effect of fear of falling on activities. There were strong suggestions of associations with gender and difficulty seeing the television.

The results suggested that the following were more likely to initially accept hip protectors: women, people who reported dizziness, and people who had cut down their activities due to fear of falling. Those who were classified hypertensive, and those who reported having difficulty watching the TV because of their vision were less likely to initially accept hip protectors. As people got older, they were less likely to initially accept hip protectors. No significant associations were found in this model with postural hypotension and problems with walking or balance.

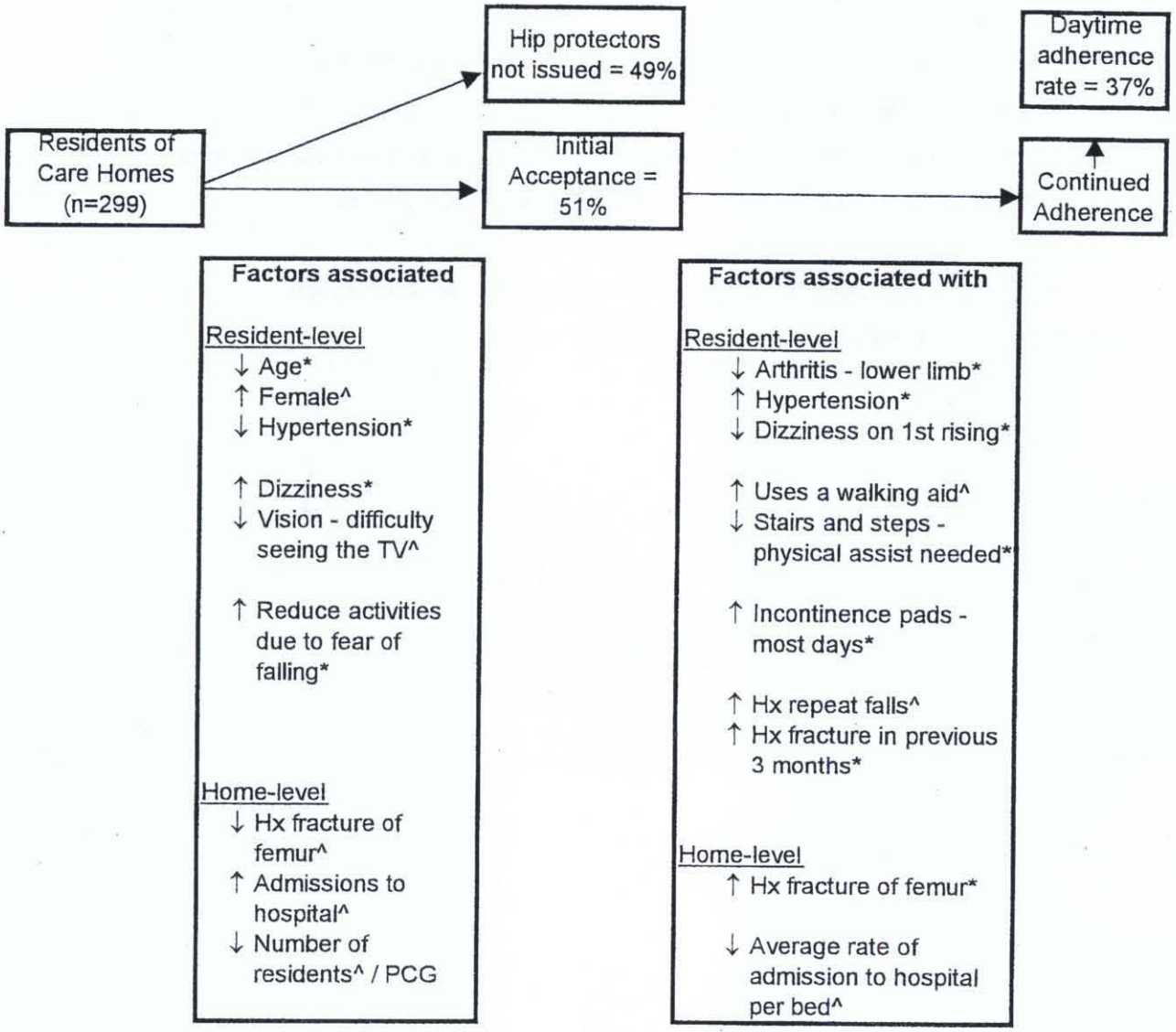
Unlike the fixed effects analysis, no statistically significant associations (at the 5% level) were found between initial acceptance and the home-related factors. Nevertheless, there was a strong suggestion of associations between the same three home-related factors

and initial acceptance as in the fixed effects model, namely number of residents at baseline, number of residents with a fractured neck of femur in the previous 4 years, and average number of admissions to hospital in the previous 4 years (Table 3). Associated with a greater likelihood of accepting hip protectors were: a smaller number of residents, history of a smaller number of hip fractures, and a greater average number of admissions to hospital in the previous 4 years.

The addition of a term in the model to represent PCG gave a significant improvement in fit (Chi-squared=12.19, df=4, p=0.02). There was confounding between PCG and size of home. With the introduction of the term representing PCG, the association between number of residents at baseline and initial acceptance was eliminated.

A summary of the associations between the factors and initial acceptance, from the mixed effects regression analysis, is shown in Figure 3.

Figure 3: Resident-level and home-level risk factors for initial acceptance and continued adherence identified in the mixed effects regression models



* Significant at the 5% level
^ Not significant, but 0.05<p<0.10
Arrows = direction of the association

3.1.4 Effect of resident- and home-related factors on the variation between homes.

Table 4 and Figure 4 show that the variance between homes in initial acceptance rates (proportion of people who accepted hip protectors when initially offered) increased when homes were standardised according to resident-level characteristics. The inclusion of home-related factors in the model reduced the variance slightly. The further inclusion of PCG into the model resulted in a model that explained 22% of the variance between homes. Consequently, a large amount of variation between homes remained once the resident-level and home-related factors had been accounted for. Staff-related reasons for this variability are still possible.

Figure 4. Percentage of variance between homes explained by resident-level and home-level factors - initial acceptance.

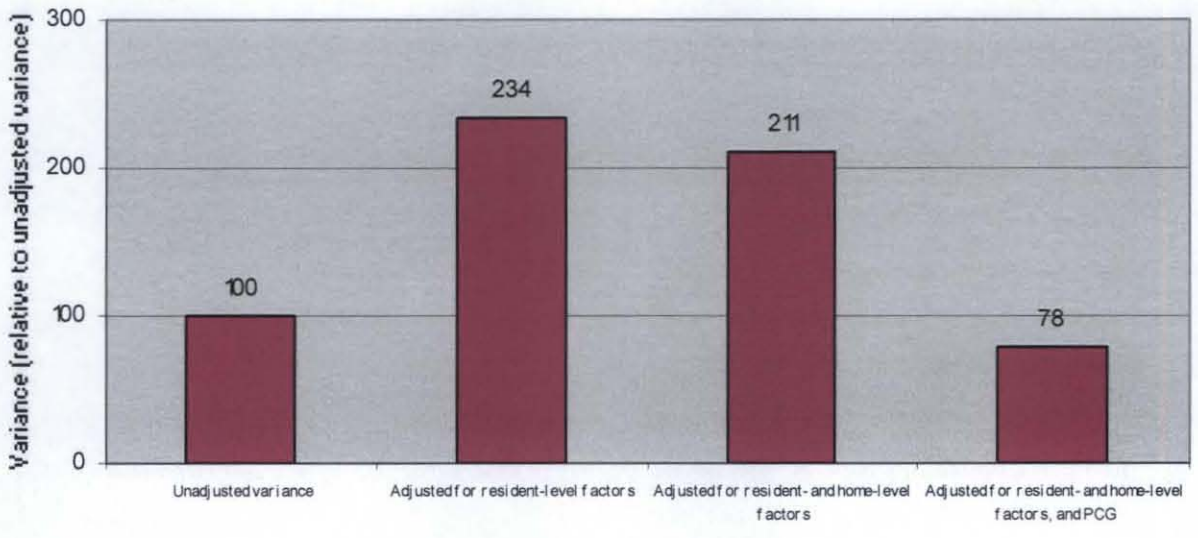


Table 4: Percentage of variance explained by resident-level and home-level factors

Outcome	Factors	Variance	se	% variance explained
Initial acceptance	Raw variance	0.426	0.239	0
	Resident only	0.998	0.468	-134
	Resident and home	0.898	0.439	-111
	Resident, home, & PCG	0.334	0.731	22
Continued adherence [sqrt(day rate)]	Raw variance	1.687	1.042	0
	Resident only	0.757	0.544	55
	Resident and home	0.366	0.399	78
	Resident, home, & PCG	0.159	0.32	91

3.2 Continued adherence

3.2.1 Bivariate associations

The analysis was firstly restricted to the sub-sample of residents who initially agreed to accept the hip protectors, and hence to whom hip protectors were issued (n=153). These data showed two main characteristics:

1. there were a substantial number of people who did not wear hip protectors at all and so the distribution of wearing rates showed a spike at 0%
2. otherwise, the data was positively skewed.

Although no normalising transformation will be effective with these data, a square root transformation was used to reduce the problem of skewness. These transformed data were used in the bivariate analyses.

A second analysis was then restricted to the sub-sample of people who ever wore hip protectors during the period of follow-up. Again the data was skewed, but the spike at 0% wearing rate, described at (1) above, was removed. The use of a square root transformation created an outcome whose distribution was symmetric and had the appearance of a uniform distribution. These transformed data were also used in the bivariate analysis. The results of these are shown in Table 5.

The results of the bivariate analyses were similar for both of the sub-samples described above. The statistical properties of the latter were more attractive and so the subsequent analysis was restricted to residents who were issued with hip protectors and who used them at least once during follow-up.

Only the results for daytime wearing rate (rather than the 24-hour wearing rates) are presented in Table 5. However, the results of the bivariate analyses were inspected for both the wearing rate across 24 hours and the daytime wearing rate. The associations with the resident factors were similar for both outcomes.

Table 5 shows the results of both a parametric (t-test, Pearson's correlation) and non-parametric (Wilcoxon rank sum test, Spearman's correlation) analysis. Again, the results were similar. The analysis to identify independent factors in the subsequent parts of the analysis used parametric methods. It is reassuring, therefore, that there is consistency in the results of the parametric and non-parametric analyses in Table 5.

The results in this table suggest positive associations between wearing rates and the following variables – hypertension, supervision when transferring, vision problems (immediate surroundings), and history of fracture in the previous 3 months – and inverse associations with arthritis, with dizziness, and with assistance with stairs and steps.

3.2.2 Fixed effects model

Resident-level factors

In the multivariable analysis, I used the square root of the daytime wearing rate as the dependant variable. Resident-level factors were identified from the total set, using backward elimination. Factors were retained in the model if their association with the daytime usage rate had a p-value of less than 0.20. Those factors for which the results suggested that they were independently associated with continued adherence are shown in Table 6.

These results show some similarities and some differences to those shown in Table 5. Table 6 shows those variables whose associations with continued adherence were unlikely to be due to chance or due to confounding with other measured resident-level factors, that is for: number of months in the residential home, arthritis of the lower limb, hypertension, dizziness on first rising, physical help needed with stairs and steps, used a walking aid, used continence pads on most days, history of falling 3 or more times in the previous 3 months, and history of fracture in the previous 3 months. There was an association between reported history of stroke and continued adherence that was not statistically significant at the 5% level.

Table 6: Patient factors for which the results suggest that they are independently associated with continued adherence with hip protectors (n=128) - fixed effects model

Variable	Analysis of variance*			Test of coefficient (presence / absence of factor)*		Estimated increase in daytime wearing rate due to the factor#	
	F	df	p	t	p	B	95% confidence limits
Months in the residential home	5.28	1,106	0.02	-2.30	0.02	0.129^	(-0.030, 0.288)
Athritis - lower limb	6.48	1,106	0.01	-2.54	0.01	-12.2	(-23.0, -1.4)
Previous stroke	3.65	1,106	0.06	1.91	0.06	14.2	(-1.2, 29.6)
Hypertension	5.36	2,106	0.006	2.55	0.01	26.1	(5.2, 47.1)
Dizziness	1.22	1,106	0.27	1.10	0.27	4.3	(-8.4, 17.0)
Dizziness on first rising	3.96	1,106	0.05	-1.99	0.05	-17.4	(-34.5, -0.2)
Physical help / supervison with walking, unsteady when turning	3.03	2,106	0.05	0.71	0.48	3.4	(-9.6, 16.3)
Stairs and steps - physical assistance needed	7.21	2,106	0.001	-3.63	0.0004	-22.9	(-34.8, -11.0)
Uses a walking aid	5.51	1,106	0.02	2.35	0.02	11.7	(-0.5, 23.9)
Great difficulty seeing (with glasses) the televison	3.25	2,106	0.04	0.78	0.44	12.3	(-28.5, 53.2)
Great difficulty seeing (with glasses) the immediate surrounds	1.70	2,106	0.19	1.54	0.13	42.0	(-10.3, 94.4)
Uses continence pads most days	4.41	1,106	0.04	2.10	0.04	10.6	(-1.3, 22.4)
Fallen 3 or more times in the previous 3 months	4.97	2,106	0.009	1.97	0.05	17.8	(1.0, 34.6)
Fracture in the previous 3 months	5.62	1,106	0.02	2.37	0.02	36.0	(-2.6, 69.5)

* Based on a model with the square root of the day rate as the dependent variable. This model has better statistical properties than the model for (day rate).
# Based on a model with day rate as the outcome. This gave essentially the same terms in the model with similar p-values as square root (day rate), but was a more approximate analysis.
^ Estimated increase in the rate of use of hip protectors for every additional month resident in the home.

The results suggested that the following wore hip protectors for a longer time: those with hypertension, who used a walking aid, who wore continence pads most days, who were repeat fallers, and who had recently sustained a fracture. Those who reported arthritis in their lower limb, had dizziness on first rising, and who needed physical assistance with stairs and steps wore their hip protectors less on average. The results also suggested that the longer the person stayed in the home, the less frequently they wore hip protectors. For the variables that were retained in the analysis but showed a high p-value (low significance) for the test relating to the comparison of wearing rates between people with the factor present and people with the factor absent (columns 5 and 6 in Table 6), this could have resulted from the pattern of missing values.

It should be noted that for some of the variables associated with daytime wearing rate, very few residents exhibited the trait that was associated with wearing rate (ie. very few of the residents had had repeat falls, or fractures).

The estimated increase in daytime wearing rate due to the factor, if causal (with 95% confidence limits) is shown in the last two columns of table 6.

Home-related factors

Bivariate associations between the home-related factors and daytime usage rates were investigated and the following was found:

- There was no significant difference between PCG ($F=1.345$, $df=4,130$, $p=0.26$)
- There was a significant difference between homes ($F=1.853$, $df=15,119$, $p=0.035$)
- There was a suggestion of an association between size of home and daytime wearing rates.
- There was a suggestion that there was an association between history of fractured femur to residents from the home and daytime wearing rate.
- The bivariate investigation suggested no association between history of admission to hospital of residents from the home and average daytime wearing rate.

These findings are very preliminary and were investigated further in the regression analyses.

The home-related factors (except PCG and home) were entered into the regression model described above, and following stepwise backward elimination, two statistically significant home-related factors remained in the model – namely number of residents with a fractured neck of femur in the previous 4 years, and average rate of admission to hospital per bed in the previous 4 years (Table 7). These results suggest that, given a resident has started to wear hip protectors, higher continued adherence is associated with a history of a higher numbers of hip fractures for the home, and with a history of a lower number of admissions to hospital for the home.

The addition of a term in the model to represent PCG resulted in some improvement in fit; however, this was not statistically significant ($F=1.91$, $df=4,108$, $p=0.11$).

The addition of the term for 'home' in the model as a 'fixed effect' resulted in no evidence of an improvement in fit ($F=1.04$, $df=10,98$, $p=0.42$). This suggests that the resident- and home-related factors explained most of the variation in daytime wearing rates between homes.

This analysis is exploratory in nature to identify whether staff-related effects were possible. The results of this analysis are likely to over-state the level of statistical significance of the home-related factors, and this was investigated in the mixed effects analysis, reported below.

3.2.3 Mixed effects model

Resident-level factors

Those factors for which the results suggest that they were independently associated with continued adherence in the mixed effects model are shown in Table 7. This table shows those variables whose associations with continued adherence were unlikely to be either due to chance, or due to confounding with other measured resident-level factors, that is for: arthritis of the lower limb, hypertension, dizziness, physical help needed with stairs and steps, used a walking aid, used incontinence pads most days, history of falling 3 or more times in the previous 3 months, and history of fracture in the previous 3 months.

The results suggest that the following wear hip protectors for a longer time: those who had hypertension, who used a walking aid, who reported using incontinence pads most days, who were repeat fallers and who had recently sustained a fracture. Those who reported arthritis in their lower limb, reported dizziness on first rising, and who needed physical assistance with stairs and steps wore their hip protectors less on average. For the variables that were retained in the analysis but showed a high p-value in Table 7 - for the comparison in wearing rates between the people who had the factor present and those for whom it was absent of the factor - this could have resulted from the pattern of missing values. It should be noted that for some of the variables associated with daytime wearing rate, very few residents exhibited the trait that was associated with wearing rate (ie. very few of the residents had had repeat falls, or fractures).

Table 7: Resident and home factors for which the results suggest that they are independently associated with continued adherence with hip protectors (n=128)

		Fixed effects model#					Random effects model				
									Estimated increas in daytime wearing rates due to the factor$		
Variable		F	df	p	B	se	Chi-squared	df	p	B*	se	95% confidence limits
Resident	Months in the residential home	3.01	1,104	0.09	-0.442	0.255	3.53	1	0.06	-0.085	0.081	(-0.244, 0.074)
	Athritis - lower limb(+)	5.33	1,104	0.02	-1.155	0.500	6.52	1	0.01	-11.5	5.3	(-21.9, -1.0)
	Previous stroke(+)	2.17	1,104	0.14	1.090	0.739	2.70	1	0.10	10.0	7.7	(-5.0, 25.0)
	Hypertension	5.41	2,104	0.006	2.380	0.969	12.98	2	0.002	26.2	10.1	(6.5, 45.9)
	Dizziness(+)	1.39	1,104	0.24	0.695	0.589	1.78	1	0.18	4.6	6.2	(-7.5, 16.7)
	Dizziness on first rising(+)	3.75	1,104	0.06	-1.529	0.790	4.61	1	0.03	-15.9	8.6	(-32.7, 1.0)
	Physical help / supervison with walking, unsteady when turning	3.52	2,104	0.03	0.398	0.595	7.61	2	0.02	3.8	6.2	(-8.3, 15.8)
	Stairs and steps - physical assistance needed	4.56	2,104	0.01	-1.564	0.574	9.77	2	0.01	-16.2	6.1	(-28.1, -4.3)
	Uses a walking aid(+)	3.43	1,104	0.07	1.064	0.575	4.19	1	0.04	9.0	6.1	(-2.9, 20.8)
	Great difficulty seeing (with glasses) the televison	1.56	2,104	0.22	1.238	1.901	4.06	2	0.13	15.7	19.7	(-23.0, 54.4)
	Great difficulty seeing (with glasses) the immediate surrounds	1.72	2,104	0.18	4.299	2.427	4.06	2	0.13	42.7	25.7	(-7.6, 93.0)
	Uses continence pads most days(+)	6.00	1,104	0.02	1.337	0.546	7.37	1	0.01	13.3	5.7	(2.0, 24.5)
	Fallen 3 or more times in the previous 3 months	3.73	2,104	0.03	1.405	0.782	9.05	2	0.01	15.1	8.2	(-1.1, 31.2)
	Fracture in the previous 3 months(+)	7.27	1,104	0.01	4.243	1.573	8.74	1	0.003	44.0	16.3	(12.1, 75.9)
Home	Number of residents with fractured necks of femur in previous 4 years*	6.55	1,104	0.01	0.659	0.257	4.81	1	0.03	6.5	3.8	(-0.8, 13.9)
	Average rate of admissions to hospital per bed in previous 4 years*	3.97	1,104	0.05	-49.222	24.691	3.23	1	0.07	-445	361	(-1162, 262)
	Home						0.31	1	0.57	72.7^	55.1	

#This model only included fixed effects. Random effects such as home and PCG were not considered

* For continuous variables, the coefficient B estimates the increase in wearing rate for each unit increase in the variable.

+The pattern of missing values is such that there is perfect confounding with another variable for the missing value category

$ Based on a model with day rate as the outcome. This gave essentially the same terms in the model with simliar p-values as for the outcome 'square root (day rate), but was a more approximate analysis.

^ Estimate of the between home variance in daytime adherence rates.

Home-related factors

The home-related factors were included in the regression model described above. Following stepwise backward elimination, two home-related factor remained in the model – number residents who had sustained a fractured neck of femur in the previous 4 years, and average rate of admission to hospital per bed in the previous 4 years. Only the former was significant at the 5% level. These results suggest that, given a resident has started to wear hip protectors, homes with higher numbers of hip fractures over the previous 4 years are associated with wearing hip protectors for a greater proportion of the time. The addition of terms to represent PCG to this model indicated it was not statistically associated with daytime wearing rate (Ch-squared=2.743, df=4,108, p=0.60).

It should be noted that there is mutual confounding between the home-related variables, such that the introduction of the term 'average number of admissions to hospital' instead of the two variables shown in Table 7 gave almost as good a fit. If one were to use this new model rather than the one described above, I would conclude that, on average, the higher the number of historical admissions to hospital from the home, the higher the usage rate of hip protectors amongst those who had initially accepted hip protectors.

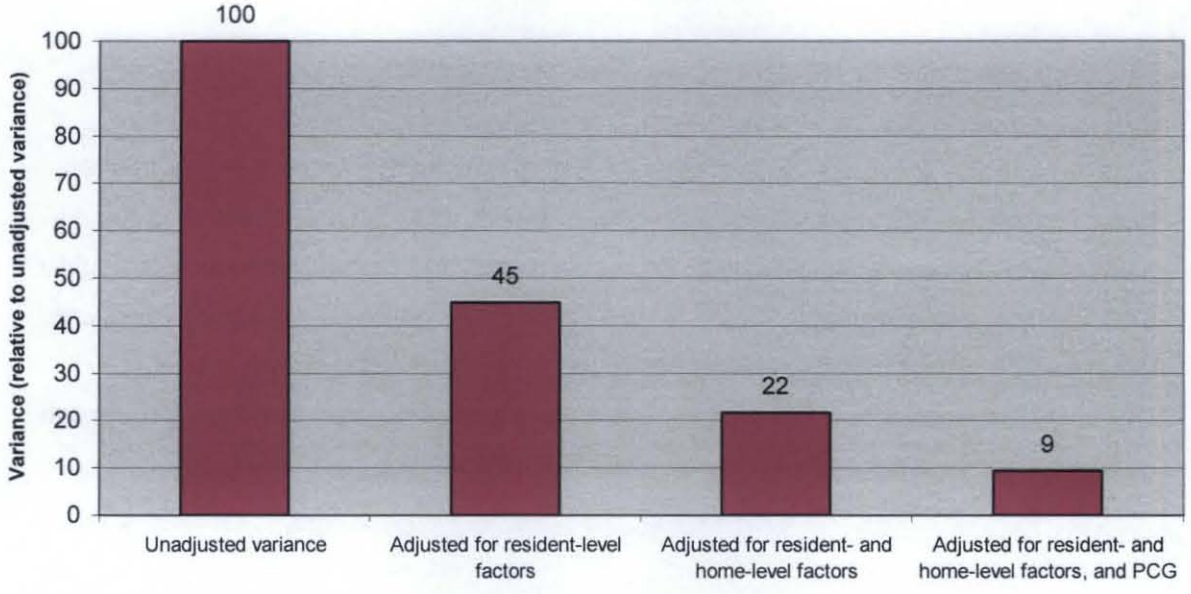
The last 3 columns of Table 7 give estimates of the increase in the adherence rate during the day that was due to the factor, if causally related to daytime wearing rate. For example, the table shows that the estimated increase in daytime wearing rates for people with hypertension was 26%, whereas the decrease in wearing rates for people with arthritis of the lower limb was 11%.

A summary of the associations between the factors and initial acceptance, from the mixed effects regression analysis, is shown in Figure 3.

3.2.4 Effect of resident- and home-related factors on the variation between homes.

Table 4 and Figure 5 shows that 55% of the variance between homes in continued adherence rates was explained by resident-level factors, and 78% was explained by resident-level and home-related factors combined. The addition of PCG into the model explained a further 13% of the variance, ie. a total of 91%. Residual variation between homes was very small for these last two models.

Figure 5. Percentage of variance between homes explained by resident-level and home-level factors - continued adherence.



4. Discussion

Amongst the 146 residents to whom hip protectors were not initially provided, in 62% they were refused by the resident, 20% they were refused by the staff, and for 3% the resident's hip size was too large for the available hip protectors. No reason for refusal was recorded for the remainder.

Figure 3 shows a summary of the associations between resident- and home-related factors, initial acceptance and continued adherence. These associations are discussed in section 4.1 below.

Following adjustment for resident-level and home-related factors, including PCG, the analysis indicates that there is still substantial variation between homes in initial acceptance rates (Figure 4). This residual variation may be due, in part, to staff-related factors. However, the variation between homes in continued adherence rates appears to be almost completely explained by these resident-level and home-related factors (Figure 5). The previously suggested reason for this variation in continued adherence rates was that it might be due to differing levels of support for hip protectors amongst staff of homes. [27] It appears from the results of this current work, however, that the variation can be explained by resident-level and home-related factors other than staff support.

4.1 Factors associated with initial acceptance and continued adherence

4.1.1 Initial acceptance

Demography

I found that as age increased, the likelihood of initial acceptance decreased. I also found that women were more likely to accept hip protectors than men. Others have found that increased age was associated with increased refusal rates [37] and that female gender is associated with increased receptivity to hip protectors [40 41].

Medical problems

I found that there were significant associations between hypertension, dizziness and initial acceptance. People who reported dizziness were more likely to initially accept the hip protectors. Those who were classified as hypertensive were less likely to accept hip protectors. I found no other work that investigated associations with these factors.

Mobility problems

I found no independent associations between mobility problems and initial acceptance of hip protectors. Other studies found that in-home mobility problems, home modifications for health reasons, and worse balance, and being physically disabled were factors that appeared to increase receptivity to hip protector wearing [40 42].

Continence

I found no association between markers of incontinence and initial acceptance. In a study using focus groups of 29 staff in private hospitals and rest homes in New Zealand, staff had concerns that hip protectors would be difficult to manage with heavily incontinent patients / residents [43]. However, in terms of workload, staff felt that hip protectors were worth the effort to prevent hip fractures and to prevent the resulting increased workload that hip fractures would cause.

Senses

From my study, there was a strong suggestion that people who reported having difficulty seeing the television were less likely to initially accept hip protectors. I found no other work that investigated the association between visual problems and initial acceptance.

Fear of falling

I found that falls efficacy (reduced activities due to fear of falling) was associated with increased rates of initial acceptance. Fear of falling was found by Hindso (1998) to be positively associated with initial acceptance [42].

Falls / fracture history

I found no independent association between falls or fracture history and initial acceptance of hip protectors. In contrast, two studies found associations between falls history, or greater risk of falling, and acceptance [42 41], and another found an association between previous unintentional injury and acceptance [40].

Home-related factors

I found no statistically significant associations between home-related factors and initial acceptance. Nevertheless, there was a strong suggestion of associations between the following three home-related factors and initial acceptance: number of residents at baseline, number of residents with a fractured neck of femur in the previous 4 years, and average number of admissions to hospital in the previous 4 years. Associated with a greater likelihood of accepting hip protectors were: a smaller number of residents, and a greater average number of admissions to hospital in the previous 4 years. Also, homes with an increased history of hip fracture were found to have, on average, a smaller level of initial acceptance of hip protectors. Could this counter-intuitive association be a staff-related phenomenon? One hypothesis to explain this is based on the skill, attitude and caring of staff. Where these are negative, one might expect higher rates of hip fracture and lower acceptance rates.

I found a significant association between PCG and initial acceptance when PCG is included as a fixed effect and no random effects term for home is included. If this is real, then it would imply that there are factors other than size of the home, history of admission and history of hip fractures that influence initial acceptance. There was

confounding between PCG and the team member responsible for liaison with the homes. This is one explanation for the effect.

Barriers and promoters

My study was not designed to explore barriers and promoters of hip protectors; however, several studies have investigated these. One study identified older people's inherent conservatism as a barrier to wearing hip protectors [44]. Other barriers to acceptance included perceived discomfort, their appearance, extra effort to wear hip protectors, proper fitting, and cost [45 43 37 46 47 41]. In their study using focus groups, men were more concerned about comfort, and women about appearance [43]. All the residents / patients were concerned that the garment would be too tight.

In a study employing focus groups of hospitalised older women, most said that they would not use hip protectors because they believed themselves not at risk of hip fracture [45]. Likewise, in Hindso's (1996) study of 38 inpatients in an orthopaedic department who were offered hip protectors before discharge, more than half of the 13 who refused them did not consider themselves at high risk of subsequent hip fracture [42]. This reason was also cited in other studies for non-acceptance [37 36]. In a study of community-dwelling older people who had recently sustained a hip fracture and were in hospital, a quarter of patients did not believe that hip protectors would be effective in preventing a further hip fracture [48].

Nevertheless, in the Cameron (1994) [45] study, 70% of members of the focus groups indicated that they would wear hip protectors if they were available. In the Myers (1995) study, 70% of the people interviewed said they would be willing to wear hip protectors if a doctor prescribed them [48].

As noted by Kurrle (2003) [49]:

> "The Health Belief Model postulates that if an older woman felt that she was at high risk of hip fracture, and she believed that hip protectors were effective in preventing hip fracture, then she would be more likely to wear hip protectors than

> an individual who did not hold these beliefs. Concern about the serious consequences of suffering a hip fracture, and the belief that there are no barriers to the use of hip protectors would also be likely to improve adherence with the use of hip protectors."

Also from the Myers (1995) study, patients who reported willingness to wear hip protectors were more likely to perceive the cause of their fall as due to intrinsic factors (eg. legs giving way) than extrinsic (eg. slip or trip due to environmental hazard) [48].

In a nursing home study, a major reason for not wearing hip protectors was being bedridden [34].

Continued adherence

Demography

I found no independent associations between continued adherence and age or gender in this study. Kurrle (2003) also found no association with age, but Hindso (1998) found a negative association [49] [42]. One previous study found a positive association with female gender [41].

Medical conditions

I found significantly increased adherence rates for those with hypertension and significantly reduced rates for those with arthritis of the lower limb, and dizziness. I have found no other studies which have investigated these associations; however, in one study it was suggested that the putting on of hip protectors may be more difficult for people with musculoskeletal or central nervous system disorders which, if the case, affected adherence rates [31].

Mobility

I found a positive association between the use of walking aids and continued adherence (not statistically significant), and an independent association between problems with stairs and steps and reduced adherence rates (statistically significant). These appear somewhat contradictory. Interestingly, another study found indicated contradictory results: both (a)decreased risk of fracture due to immobility and (b) improvements in mobility have been given as reasons for non-adherence to their use [42].

Incontinence

I found that the use of incontinence pads on most days was associated with increased adherence rates. Consistent with this, in one previous study, staff of nursing homes felt the garment, which held incontinence pads in place, assisted with the management of incontinence [46]. In contrast, others found that incontinence was a limiting factor for wearing hip protectors [50 47 51 52]. In studies of residents of care homes, worsening of incontinence was noted in some participants due to difficulties with toileting when wearing hip protectors, and the need for frequent laundering was cited as a barrier to continued adherence [47 53 49].

Cognition

I was not able to investigate the association between cognitive impairment and continued adherence. Others have identified impaired cognition as a factor associated with reduced wearing rates [50 36 51]. On the other hand, one study found higher adherence in those with cognitive impairment who are at high risk of falling [54] and a further study in 6 Japanese nursing home noted that once residents with dementia had become established in their use of hip protectors, they continued to wear them habitually [55]. A further study found no association between cognitive status and adherence in residents of care homes [49]. However, in the same study it was found that some residents with dementia became agitated wearing unfamiliar or uncomfortable undergarments and these residents tried to remove the hip protectors. Agitation due to wearing the hip protectors has also been observed in some participants with Alzheimer's disease [56].

Fear of falling

I found no independent association between fear of falling or falls efficacy and continued adherence. In contrast, one previous study found that people who had greatest fear of falling tended to be more adherent [50].

Falls / fracture history

I found that people who had a history of falling and / or a history of fracture in the recent past were more likely to be adherent. This is consistent with a previous studies that found that those who experienced significant injury following a fall, who had reported a fall, and who were at greater risk of falling, showed greater adherence [50 57 41 58]. In their trial, Lauritzen and colleagues speculate that hip protectors were worn preferentially by recurrent fallers, who were in turn given more encouragement by staff [31]. In contrast, one study found no association between history of hip fracture, or number of falls, and adherence [49].

Home –related (excluding staff-related factors)

I found that adherence was significantly higher in the homes that had experienced more fractured femurs in the previous 4 years, but that there has a suggestion that homes with reduced admissions rates to hospital had better adherence. I found no significant association between the number of residents and wearing rates.

In one study, nursing home residents have been found to have greater adherence than those in hostel care [51]. Whereas in another, no difference in adherence was found between nursing home and hostel residents [49]. Higher staff-resident ratios / higher staff workloads were felt to be the reasons for this in the former study.

Kurrle (2003) found that there was better adherence in facilities where there was more than one resident wearing hip protectors [49]. This could be attributed to a reinforcing effect of peers who were also wearing hip protectors.

Barriers and promoters

My study was not designed to investigated barriers and promoters for the continued wearing of hip protectors; however, several studies described below were.

In his review, van Schoor (2002) identified a number of different barriers / promoters of adherence [59]. Associated with non-adherence were: poor fit, discomfort, the extra effort and time needed to wear the protectors (especially for those suffering urinary incontinence), physical weakness (especially in the upper limbs), and illness (eg. dementia). Increased adherence was associated with: younger age, softer hip protectors, lower grip strength, a positive perception (of appearance, comfort, and usefulness of the hip protector), and a history of falling.

Comfort, laundering ability, appearance, and poor fit were reported by older people to be important factors that affect adherence [48 38 42 60 61]. Discomfort from the hip protector was given as the main reason for non-adherence in a study of nursing home residents - with aches, pains and tenderness reported by 12% of participants [41]. In a study of older people discharged from hospital to their own home, 60% of those who stopped wearing hip protectors within a week gave discomfort as a reason, and 15% gave pain over a fracture site as the reason [61]. A small study in a nursing home found problems with laundering, but no complaints about comfort [46]. Similarly, a study of users' experience found the hip protectors comfortable, and also commented favourably on quality, and ease of laundering of the garment [47]. Additionally, in this study, the users believed the hip protectors to be effective. In a small Finnish study, none of the 12 residents of a nursing home who wore hip protectors complained about appearance, or comfort of the hip protectors. Nevertheless, both staff and residents complained that the garments were too tight, interfering with toileting [37].

In a nursing home study where 24-hour wearing was promoted, participants who were not adherent reported that the hip protectors were hot, felt cumbersome, were uncomfortable in bed, and increased the need for help when using the toilet [33]. This is consistent with other studies where it was found that dressing and toileting was found to be a problem for the group wearing hip protectors [60 53]. Others also found that difficulties

(time and effort needed) managing the hip protectors was a reason given for non-adherence [38 42 59].

In a further nursing home study, a major reason for not wearing hip protectors was skin irritation [34]. Consistent with this, in a care home study, irritation or rubbing of the hip protector shields, or tightness of the waistband or of the garment legs meant that a number of participants found it difficult to continue wearing the hip protectors [49]. There is a potential for pressure sores when wearing hip protectors. The intrinsic factors that lead to pressure sores overlap with risk factors for hip fracture [62]. Consequently, the older people who most need hip protectors are most susceptible to pressure sores.

In a study of residents of nursing homes, residents who stopped wearing hip protectors felt that they were not at risk of hip fracture, had a fatalistic approach to the risk, and / or felt too old to care [36].

In another study, those who continued to use hip protectors reported an increased feeling of safety, and a decreased fear of falling [33]. The staff of the nursing home where the study was carried out echoed this. The increase in confidence that resulted from wearing hip protectors was a factor positively associated with adherence [49].

Designs of hip protectors are changing continually. Current designs should be investigated in order to judge whether the factors described above are barriers to continued adherence.

4.2 Staff-related factors and variation between homes

4.2.1 Initial acceptance

Following adjustment for resident-level and home-related factors, including PCG, the analysis that I carried out indicates that there is still substantial variation between homes in initial acceptance rates. This could be due to staff-related factors including their motivation and support for hip protectors.

In the only study I have found of staff attitudes to the initial acceptance of hip protector, staff perceived that extra supervision may be needed to assist residents in dressing and toileting if the resident was using hip protectors, but perceived a trade-off between this and the extra workload associated with a hip fracture [43].

4.2.2 Continued adherence

I found that the variation between homes in continued adherence rates appears to be almost completely explained by resident-level and home-related factors, other than staff attitude. The previously suggested reason for this variation in continued adherence rates was that it might be due to differing levels of support for hip protectors amongst staff of homes[38]. It appears from the results of this current work, however, that the variation can be explained by resident-level and home-related factors other than staff attitude.

On the other hand, some authors have suggested that staff / carer support was important for the regular use of hip protectors [63 44]. It has been suggested that attitude, education and motivation of institution staff may be factors influencing adherence [37]. Institutions where the staff were positively inclined / motivated to the use of hip protectors had higher rates of adherence [41 55]. Kurrle (2003) found a strong association between good quality of care / level of support provided by the staff of the facility and a high level of adherence by residents in that facility. Where support is not available, then adherence is likely to be reduced due to the increased difficulties of putting on hip protectors when dressing and the increased difficulties of toileting when wearing hip protectors [49].

4.3 Evidence of the efficacy of hip protectors

I have explored, both empirically and also via the published literature, those factors that are associated with initial acceptance and continued adherence to hip protectors. It is important to also revisit the evidence for the efficacy of hip protectors, since there have been a number of trials of hip protectors published since the publication of this previous paper (included as Appendix 1).

The publication of several trials since this first paper was prepared has changed the level of certainty regarding the effectiveness of hip protectors. The cluster randomised controlled trials that formed the bulk of the evidence for the previous Cochrane review [28] supported the significant beneficial effect of hip protectors for reducing the incidence of hip fracture. In the updated Cochrane review, a further 7 trials, which employ individual randomisation, have been published, reviewed and incorporated into a meta-analysis. [64] Despite this steadily increasing body of data, the effectiveness of hip protectors is less certain than it seemed from the earlier studies and the earlier review.

The conclusions of this latest Cochrane review are as follows:

> "There is no evidence of effectiveness of hip protectors from studies in which randomisation was by individual patient within an institution, or for those living in their own homes. Data from cluster randomised studies indicates that, for those living in institutional care with a high background incidence of hip fracture, a programme of providing hip protectors appears to reduce the incidence of hip fractures."

5. Key Points

Key points from this work are:

1. There is less certainty about the effectiveness of hip protectors following the publication of individually randomised trials since March 2001

2. Nevertheless, data from cluster-randomised trials indicate that, for those living in institutional care with a high background incidence of hip fracture, a programme of providing hip protectors appears to reduce the incidence of hip fractures.

3. Initial acceptance and continued adherence to wearing hip protectors has been a problem in most studies including the Canterbury Hip Protector project

4. In this study, increased **initial acceptance** of hip protectors was associated with the following characteristics or conditions of the older person: decreased age, female gender, dizziness, and reduced activities due to fear of falling. Decreased initial acceptance of hip protectors was associated with hypertension, and difficulty seeing distant objects.

5. Increased **initial acceptance** was associated, but not significantly, with the following characteristics of the care home in which they lived: lower number of recorded fractured femurs, increased rate of previous admissions to hospital, and a smaller number of residents in the home.

6. Increased **continued adherence** to wearing hip protectors was associated with the following conditions of the older person: hypertension, incontinence, and a previous history of falls and fractures. Decreased continued adherence to hip protectors was associated with arthritis of the lower limb(s), dizziness on first rising, and the need for physical assistance with stairs and steps.

7. Increased **continued adherence** was associated with the following characteristics of the care home in which they lived: higher number of recorded fractured femurs, and decreased rate of previous admissions to hospital.

8. Following adjustment for resident-level and home-related factors, including PCG, the analysis indicates that there is still substantial variation between homes in **initial acceptance** rates. This could be due to staff or resident knowledge and attitude in respect of hip protectors.

9. The variation between homes in **continued adherence** rates appears to be almost completely explained by resident-level and home-related factors investigated in this study. It appears, that differences between homes in staff knowledge and attitudes, may not be such important factors.

Implications for research

As a result of this work, I have made the following 2 recommendations:

- Work to investigate the effect of residential care staff knowledge and attitude on initial acceptance seems justified.

- Work to investigate the effect of staff knowledge and attitude on continued adherence to wearing hip protectors is now questionable in the light of these results.

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ORIGINAL ARTICLE

Hip protector compliance among older people living in residential care homes

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Objectives: To estimate the compliance rates for the use of hip protectors among people living in residential care homes.

Population/setting: People aged 65 years and over living in residential care homes with 20 or more beds in East Kent, south east England.

Methods: Seventeen homes with the highest historical frequency of hip fractures were selected. All residents were offered SAFEHIP hip protectors. Care staff recorded daily hip protector compliance on diary cards over six months. Compliance rates were estimated from the number of sessions (morning, afternoon, evening, night) that a person wore hip protectors.

Results: A total of 153 (51%) out of 299 residents agreed to wear hip protectors The 24 hour compliance rate for those who were issued with hip protectors and wore them at least once was 29%: 37% in the daytime and 3% at night. Daytime compliance rates reduced from 47% for the first month, to around 30% for months 5 and 6.

Conclusion: This study highlights the problems of persuading older people living in residential care homes to wear hip protectors. They have been shown to prevent hip fracture in nursing home (high risk) populations, and a recent trial showed their effectiveness in a mixed geriatric population. People living in residential care homes are also at greater risk of falling and fracturing than their counterparts living in the community. Initiatives to prevent hip fracture within residential care homes are also justified.

Falling among older people is a significant problem.[1–5] Approximately 30% of people aged 65 and over living in the community fall each year, half of those do so repeatedly, and an estimated 50% of people aged 85 and over fall each year.[1 6–10] The rate of falling among those living in institutions (excluding acute hospitals) has been estimated at 50%, with 10%–25% suffering severe consequences.[11 12] One of the most serious consequences of falling is fractured neck of femur (hip fracture).[8] The vast majority of fractured hips result from a fall.[13] Around 1%–2% of community dwelling older people and 5%–7% of nursing home residents fracture their hip each year.[8 14 15] The service cost of treatment and care of an older person with a hip fracture has been estimated at over £12 000 during the first year after hip fracture, at 1995/6 costs.[3] Estimated one year mortality ranges from 12% to 25%, and fewer than half of surviving patients recover their pre-fracture levels of physical functioning.[16–19]

The principal ways of preventing hip fracture are: prevention of falls, ensuring bones are strong enough to withstand the impact after a fall, and/or protecting the hips with pads which deflect much of the energy away from the vulnerable area.[20] This paper focuses on the latter of these interventions. Direct impact on and around the hip is the cause of the majority of hip fractures.[1 3 21–25]

Recent national guidelines, commissioned by the Department of Health in England, recommended that: "Hip protectors should be offered to all nursing home residents".[26] There have been a number of published trials that provide evidence for the effectiveness of hip protectors in preventing hip fracture in nursing home (high risk) populations,[27–32] described in the review by Parker and colleagues.[33] A further trial showed an estimated reduction in hip fractures of 60% in a mixed population of people living in geriatric long stay facilities and people living at home supported by health care centres.[34]

Hip protectors appear highly effective if the older person wears them; however, only a minority of older people appear to find them acceptable. Compliance rates in nursing homes, estimated using a variety of definitions and methods, of 44%–90% have been reported [28–32 35] Estimates of regular wearing of hip protectors in a nursing home has been as low as 24%[27] and in "rest homes" as low as 30%.[36] In a mixed geriatric population (long stay facility or home care) the compliance rate was 48%.[34] Compliance rates are measured in consenting populations. The average rate can be far less if non-consenting older people are taken into account.

Like nursing home residents, people living in residential care homes are at substantially greater risk of falling than their counterparts living in the community. Consequently, initiatives that prevent hip fracture within residential care homes are also justified.

The aims of this work were to estimate compliance rates for the use of hip protectors among people living in residential care homes in East Kent Health Authority area of England (south east England, adjacent to the English Channel). The provision of hip protectors and the investigation of compliance were part of a larger study. Within this broad aim, the particular objectives were as follows:

- To estimate the proportion of people who agreed in principle to wear hip protectors.
- To estimate the 24 hour and daytime compliance rate.
- To describe the variation in compliance over time and by residential care home.

Daytime compliance is of particular interest, since the majority of falls occur during the day.[12] This is consistent with Kannus and colleagues who presented compliance as percentage of waking hours during which the hip protectors were worn,[34] and with Villar and colleagues who monitored compliance through randomly timed visits.[36]

Table 1 Demographic composition of East Kent relative to England, mid-2000

Variable	East Kent	England
Population	614576	49997089
Age (%)		
≥65	19.1	15.6
≥75	9.8	7.4
≥85	2.8	2.0
Female (%)	51	51
Ethnic minorities (from the 1991 census) (%)	1.2	6.5

METHODS

Population

The target population for this work were people aged 65 years and over living in residential care homes with 20 or more beds in the East Kent Health Authority area.

Residential care homes provide accommodation, food, and personal care for different groups of people, including older people. They are staffed by a manager and care staff who, generally, are not professionally qualified. Homes are registered and inspected by county council social services departments. Nursing care is provided in the care home, if necessary, by community nurses. However, older people who are more frail and dependent upon nursing care are cared for in nursing homes.

East Kent is a health authority area in the south east of England and included an estimated 615 000 population (all ages) in mid-2000. It comprises 722 square miles (187 000 hectares), and contains five entire local authorities, and part of one other. It includes a spread of affluence/deprivation, with one local authority in the bottom 25% of deprivation, with the others lying within the interquartile range for the country. It includes two major inland towns, Ashford and the cathedral city of Canterbury, and the coastal towns of Margate, Ramsgate, Deal, Dover, and Folkestone. By far the greatest area of East Kent is, however, farmland. Table 1 gives a summary of the health authorities demographic make-up at mid-2000.

Selecting the sample of homes

The social services inspectorate supplied a list of every residential care home in East Kent. The list was used to identify homes that had provision for 20 or more beds. Homes that were duel registered (for residential and nursing home clients), or were offering specific care for learning disability or mental health difficulties, were excluded. The list of eligible homes was organised within primary care groups (PCG)*, and three homes within each PCG were selected sequentially from the list that had the highest frequency of fractured neck of femur over the previous five years. A further two homes were selected within one PCG, who had additional staff available to support the project. These had the next highest frequency of fracture neck of femur within the PCG.

The intervention

Every resident within the 17 homes was offered a fall risk assessment, with referral as necessary, reassessment, medication review, and three pairs of SAFEHIP hip protectors. (SAHVATEX A/S) The process included:

- Contact with all staff involved.
- Consent from general practitioners and home owners/managers for the study procedures.
- Consent from the residents who took part.
- Meetings with all primary care and residential care staff in the study areas.
- Teaching of care staff in homes about falls risk and assessment.
- Visits to homes to talk to residents about the project.
- Offers of hip protectors to residents who consented.
- An assessment to identify modifiable risk factors with referral to other services as appropriate.
- Medication review and modification by pharmacists in conjunction with the general practitioner.

These are described in more detail below.

Individual letters describing the aims of the study and the proposed methods were sent to the social services inspectorate, general practitioners and other primary care staff, as well as residential home owners/managers. Written consent was obtained from general practitioners in order that assessment, appropriate referrals for problems identified, reassessment, and medication reviews could be undertaken by the project nurses and pharmacists. Consent was obtained from home owners/managers to ensure their cooperation in working with their staff and their residents. A patient information sheet explained every aspect of the project to the residents, and consent was obtained from residents taking part in the study.

Primary care and residential care home staff were each invited to attend a meeting within the PCG area. During the meetings, presentations were given regarding fall and fracture risk, the importance of medication review and the findings from previous research on hip protectors and compliance.

Within each residential home, project nurses carried out a two hour teaching session for care staff on fall and fracture risk and the importance of fall risk assessment. A teaching resource pack was collated and left with the staff. Before the assessment process began, project nurses visited each residential home and spent time in the communal sitting rooms in order to talk with residents. Hip protectors were left in each sitting room in order for residents and their relatives to familiarise themselves with them and to ask any questions.

All residents were offered SAFEHIP hip protectors. The protector is made of an outer shield of polypropylene with an inner plastozote lining and is sewn into special underwear so that it fits snugly over the greater trochanter. Three hip protectors were provided to residents who accepted the offer. This made it possible for one hip protector to be always available for wearing—that is, one for the wash, one to wear, and one available for the next day. Residents were given reassurance that they could change their mind regarding involvement in the study, that they could stop their involvement at any time, and that they could wear the hip protectors as much or as little as they chose. It was explained that a nurse would come to the home each week and assess how they were getting on.

Feedback to residential home owners/managers

Over the project period, residential home owners/managers and care staff received three letters. This informed them of the progress of the project and reminded them of the aims of the project, including the interest shown by local health and social service professionals who work with older people.

Falls risk factor assessment

Every resident was offered a single standardised assessment on entry to the study, to identify modifiable falls risk factors, by one of the project nurses. Two hundred and ninety nine out of 310 residents agreed to the assessment, which included questions on long term medical problems, postural hypotension, dizziness, walking/gait/balance/ability to transfer, vision problems, as

*Primary care in England was organised, during the study period, around primary care groups (PCGs) of general practitioners. East Kent included around 600 000 residents and was served by five PCGs, ranging in size from 100 000 to 160 000 patients.

Table 2 Characteristics of the care home residents as recorded at the baseline assessment

Characteristic	Prevalence (%)
Age (mean, range)	86 (57–102)
Sex (% female)	80
Long term problems	
Arthritis, lower limb	33
History of stroke	14
Diabetes	9
Parkinson's disease	6
Postural hypotension	26
Dizziness	
When first get out of bed	12
When stand up quickly	17
Other	15
Ability to transfer (moving from chair to bed and back again)	
Assistance needed	21
Walking, needs physical help or constant supervision	21
Steps and stairs, needs physical assistance or unable to do physically	54
Use of walking aid	
Any	55
Stick(s)	23
Zimmer frame	29
Walking frame with wheels	5
Use of a wheelchair	
Any time	39
At home	13
When out	30
Difficulty seeing (with glasses if appropriate)	
Print	16
Television	12
Immediate surroundings	10
Cataracts	14
Glaucoma	5
Registered blind/partially sighted	6
Falls and fractures	
Fallen in the last 3 months	27
Fracture in the last 3 months	2

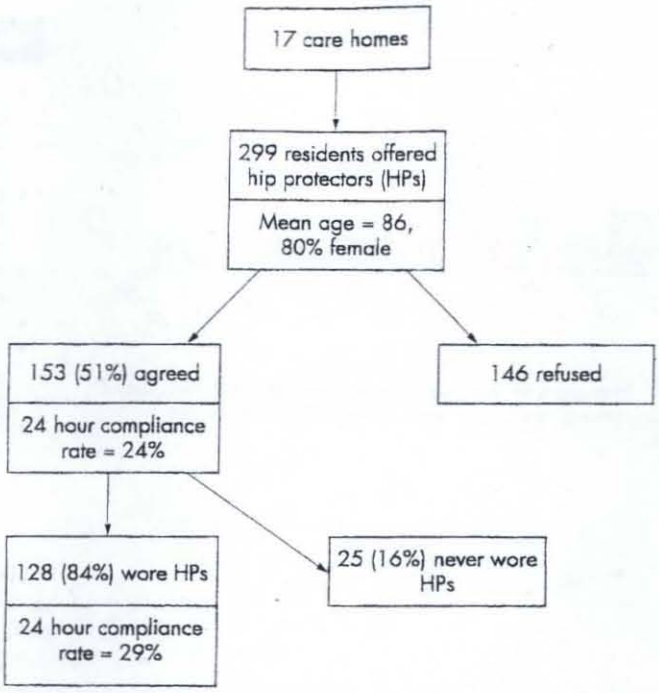

Figure 1 Residents included in the study with their 24 hour compliance rates.

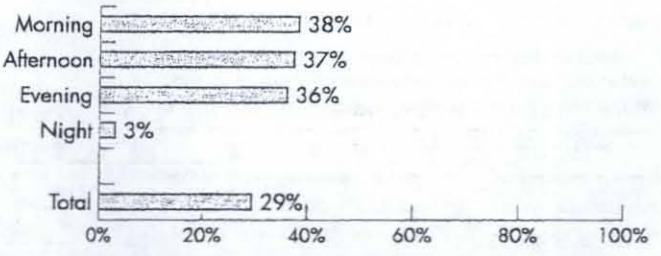

Figure 2 Hip protector compliance rate within residential care homes by time of day among those who were issued with and wore hip protectors.

well as falls history. If a falls risk was identified, referrals to appropriate professionals to modify these risk factors were made by residential home managers in conjunction with the relevant general practitioner. Clinical pharmacists visited each residential home and reviewed the medication for each resident. Changes recommended by the pharmacist that were agreed by the relevant general practitioner were implemented.

As well as an assessment to identify modifiable falls risk factors, project nurses collected relevant demographic information. Additionally, at the start of the study consenting residents were invited to complete a "fear of falling" questionnaire.[17] Each consenting resident was reassessed in the care home by a project nurse after three months using an abridged version of the baseline assessment, to monitor change in risk factor status.

Compliance assessment

Project nurses encouraged specific care staff to take responsibility for the collection of compliance data. Each day was divided into four equal six hour sessions: morning (6:00–12:00), afternoon (12:00–18:00), evening (18:00–24:00), and night (24:00–6:00). Care staff recorded on a standardised A4 collection form whether hip protectors were worn during each session during each day of follow up. One A4 sheet captured compliance information for one patient over the period of one week.

The first assessments of residents took place in March 1999 and follow up ceased in December 1999.

Statistical analysis

The 24 hour compliance rate was estimated by counting the number of sessions that a person wore hip protectors divided by the number of sessions the protectors were available to wear (that is, from when the hip protectors were issued to the end of the study period or the end of follow up, whichever was sooner). Account was taken of the varying lengths of follow up due to death, hospitalisation or loss to follow up for other reasons in the calculation of the compliance rates. The daytime compliance rate was estimated in the same way but was restricted to morning, afternoon, and evening sessions only. Daytime compliance rates were also estimated for each of the first six months of the study, the period when the majority of the older people admitted to the study were followed up.

RESULTS

Seventeen homes were included in the study. The number of residents in each home varied from seven to 31. There were a total of 299 people living in the residential care homes who were invited to wear hip protectors. The characteristics of these residents are shown in table 2. Of these, 153 (51%) agreed to wear them and were issued with hip protectors (fig 1). This varied from 24% to 94% across the homes.

The 24 hour compliance rate for residents who were issued hip protectors was 24%. Among the 153 people who were issued with hip protectors, 25 (16%) people reported never wearing them. In one home, none of the six residents who were issued with hip protectors wore them, and in another home only one out of eight people ever wore them. For the remaining results, the compliance rate is based on those who were issued with hip protectors and who ever wore them.

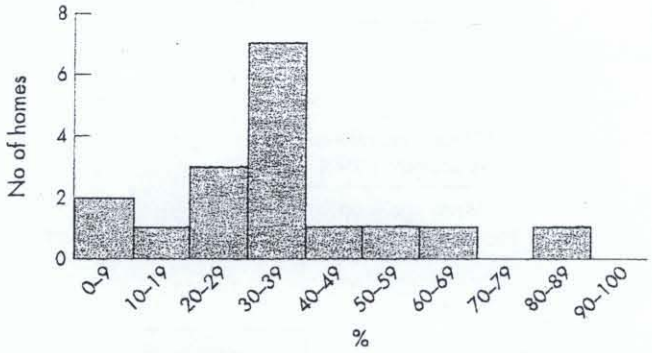

Figure 3 Histogram of daytime compliance rates within residential care homes among those who were issued with and wore hip protectors.

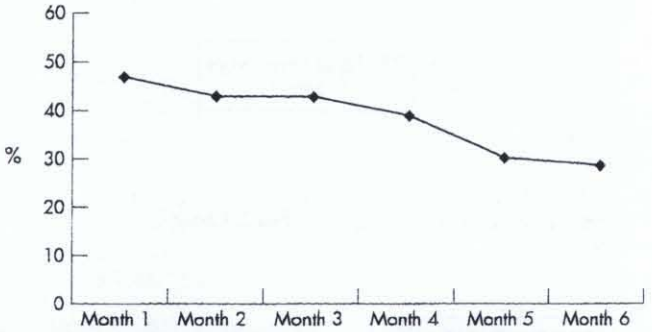

Figure 4 Trends in daytime compliance over the first six months of the study within residential care homes among those who were issued with and wore hip protectors.

The 24 hour compliance rate for those who were issued with hip protectors and wore them at least once was 29% (fig 1). The compliance rates by time of day are shown in fig 2. The daytime compliance rate was 37%. The range of daytime compliance rates across homes was 0%–80%, with a median of 34%, and an interquartile range of 24%–40% (fig 3).

Daytime compliance rates were examined by month and it was found that for the first month of wearing, compliance was 47%. Rates over 40% were obtained for the first three months and these declined to around 30% for months 5 and 6 (fig 4).

DISCUSSION

Only 51% of people living in residential care homes indicated that they would wear hip protectors if issued, and of those, 16% did not wear them at any time. The 24 hour recorded compliance rate for those who were issued with hip protectors and who wore them at least once was 29%. This varied from 38% in the morning to 3% at night. Some have recommended wearing hip protectors 24 hours a day if the person is getting up two times or more during the night.[38] One study found, however, that the majority of falls occur during the day.[32]

The compliance rate could be relatively low due to a failure of care staff to record that hip protectors were being worn. The average daytime recorded compliance rate was 37%, which is similar to a previous published report for residents of rest homes.[36] This previous work used an alternative method of measuring compliance, namely through observation at randomly timed visits to the rest homes once a fortnight.

Hip protectors are a very important means of protecting older people from hip fracture, and are particularly beneficial to those who are at high risk of falling or who have brittle bones (osteoporosis). It has been shown that if an older person wears a hip protector, their annual risk of hip fracture is minimal. In five randomised controlled trials involving 1742 persons in nursing homes, only one person had a hip fracture while using hip protectors.[39] Additionally, Kannus and colleagues reported that four hip fractures occurred while hip protectors were worn in their mixed geriatric population.[34] All studies, including our own, have found that many older people are unwilling to wear hip protectors. For those who indicate they are willing to try them, a number change their minds when confronted by the hip protector, some forget to wear them, and some give up due to problems of fitting and discomfort.[36] Increasing and maintaining compliance, therefore, is an important goal.

When asked, people indicate the following concerns about hip protectors: appearance, comfort, fit, efficacy, ease of laundering, and cost.[40 41] Cameron and Quine reported that probably the most crucial factors for compliance are concerns about the comfort of the hip protector, perception of personal risk of fall and fracture, and a belief by the older person that the fracture is preventable. Promotion to make older people aware of the prevalence, and the causes and consequences of hip fracture might motivate the older person to wear hip protectors despite the extra effort required and the discomfort caused by the protector.[40] Even if the older person agrees to wear hip protectors, there may be difficulties for people who suffer incontinence, as well for people with weakness in their upper limbs who have difficulty pulling the garment down for toileting.[42]

Daytime compliance rate varied across residential care homes from 0% to 80%. The impression that we obtained during contact with the homes was that support for the promotion of hip protectors by the staff of the homes varied substantially, and that the best rates were obtained where the staff actively supported their use. This finding suggests a potentially fruitful avenue for investigation. It is hypothesised that carers who promote the use of hip protectors achieve high compliance. Conversely, it is hypothesised that older people living with carers who do not promote, or are negative towards, the wearing of hip protectors have much lower compliance rates. These hypotheses are supported by work by Ross and colleagues who gave evidence of increased compliance in the use of hip protectors if additional support is given when starting to wear the hip protector.[43] Parkkari and colleagues believe that the attitude of the staff in the institutions was a crucial factor for reaching good compliance in their study.[35] These hypotheses should be investigated further, and if they are found to be true, then a major focus of hip fracture prevention through the use of hip protectors should be the vigorous promotion to the carers of vulnerable older people.

Key points

- Hip protectors are a very important means of protecting older people from hip fracture, and are particularly beneficial to those who are at high risk of falling or who have brittle bones (osteoporosis).
- Only 15% of people living in residential care homes indicated that they would wear hip protectors if issued, and of those, 16% did not wear them at any time.
- The 24 compliance rate for those who were issued with hip protectors and those who wore them was 29%.
- The daytime compliance rate was 37%.
- For the first month of wearing, compliance was 47%, rates over 40% were obtained for the first three months, and these declined to around 30% for months 5 and 6.
- Daytime compliance rate varied across residential care homes fron 0% to 80%. It is hypothesisied that carers who promote the use of hip protectors achieve high compliance.

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