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RESEARCH PAPER

An intervention to increase physical activity in care home residents: results of a cluster-randomised, controlled feasibility trial (the REACH trial)

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Abstract

Background: Care home (CH) residents are mainly inactive, leading to increased dependency and low mood. Strategies to improve activity are required.
Design and setting: Cluster randomised controlled feasibility trial with embedded process and health economic evaluations. Twelve residential CHs in Yorkshire, United Kingdom, were randomised to the MoveMore intervention plus usual care (UC) ($n = 5$) or UC only ($n = 7$).
Participants: Permanent residents aged ≥65 years.
Intervention: MoveMore: a whole home intervention involving all CH staff designed to encourage and support increase in movement of residents.
Objectives and measurements: Feasibility objectives relating to recruitment, intervention delivery, data collection and follow-up and safety concerns informed the feasibility of progression to a definitive trial. Data collection at baseline, 3, 6 and 9 months included: participants' physical function and mobility, perceived health, mood, quality of life, cognitive impairment questionnaires; accelerometry; safety data; intervention implementation.
Results: 300 residents were screened; 153 were registered (62 MoveMore; 91 UC). Average cluster size: MoveMore: 12.4 CHs; UC: 13.0 CHs. There were no CH/resident withdrawals. Forty (26.1%) participants were unavailable for follow-up: 28 died (12 MoveMore; 16 UC); 12 moved from the CH. Staff informant/proxy data collection for participants was >80%; data collection from participants was <75%; at 9 months, 65.6% of residents provided valid accelerometer data; two CHs fully, two partially and one failed to implement the intervention. There were no safety concerns.
Conclusions: Recruiting CHs and residents was feasible. Intervention implementation and data collection methods need refinement before a definitive trial. There were no safety concerns.

Keywords: staff training, physical activity, older people, long-term care, cluster randomised feasibility trial

Key Points

- Many care home (CH) residents are inactive, leading to increased dependency and low mood.
- There are known benefits of maintaining/increasing levels of physical activity/decreasing sedentary behaviour in CH residents.
- We developed a whole-home intervention (MoveMore) designed to encourage and support CH residents' movements in daily routines.
- We undertook a cluster-randomised trial to explore the feasibility of trial processes and delivering MoveMore.

Introduction

There are over 400,000 residents of care homes (CHs) in the United Kingdom [1]. Research suggests that the majority of residents spend their time inactive (79–87% of the time sedentary) [2, 3], despite the known benefits of maintaining (or increasing) levels of physical activity (PA) and decreasing sedentary behaviour [4]. Sedentary behaviour may have a detrimental effect on a number of parameters related to health [5], including cardiovascular risk [6], physical function [7, 8] and quality of life [9, 10]. For CH residents in particular, substantial levels of sedentary behaviour may lead to pressure sores, contractures, cardiovascular deconditioning, urinary infections and increased dependence on staff. Our extensive review [11] reports the feasibility of implementing programmes focused on enhancing PA in CHs but many were resource intensive and provided by external agents (for example exercise classes). An alternative approach would be to create a whole-home initiative to enhance routine activity among residents.

We have undertaken a programme of research to develop and preliminarily test strategies to enhance PA in the daily life routines of CH residents to improve their physical, psychological and social well-being: the Research Exploring Physical Activity in Care Homes (REACH) programme. We report here the final study: a cluster randomised controlled feasibility trial (cRCT), including a summary of the embedded process evaluation. A cost-effectiveness evaluation and detailed exploration of the PA and sedentary behaviour data are not reported here. The overall aims were to explore the feasibility of delivering a whole-home intervention ('MoveMore'), designed to encourage and support CH residents to move more in daily routines, and to explore the feasibility of trial processes to inform the design of a future definitive trial [12].

A full description of trial objectives can be found in Forster *et al*. [12]. Briefly, this paper reports trial objectives around: CH and resident recruitment; follow-up rates; feasibility of collecting outcome data through the use of questionnaires (physical function, mobility and physiological well-being) and accelerometers (PA and sedentary behaviour); preliminary estimate of effectiveness of the intervention in improving PA levels; intervention delivery; residents' outcomes and safety data.

Methods

A full description of trial procedures is provided in Forster *et al*. [12].

Trial design

A feasibility parallel-group cRCT comparing CHs (clusters) randomised to either MoveMore plus usual care (UC) or UC only. A cRCT was chosen as MoveMore was a whole-home intervention designed to increase movement levels of all residents. The study was reviewed and approved by the UK National Research Ethics Service (REC reference 15/EE/0125).

Study setting/clusters

We aimed to recruit 12 residential CHs (or units of CHs) within North and West Yorkshire through different recruitment strategies (reported in [13]).

Participants

Following screening of all residents, through discussions with CH manager and staff, baseline data were collected from all eligible (aged ≥65 years, permanent resident within the home, not terminally ill or bed-bound/cared for in bed, not taking part in, or planning to take part in, another trial that conflicted with the MoveMore intervention or data collection during the course of their involvement in the trial) and consenting residents. An assessment of capacity to consent to taking part in the study for eligible residents was undertaken by the manager or nominated deputy or by the researcher if capacity was unknown. Written informed consent for data collection was sought from those with capacity. Assent was sought from a personal consultee, or nominated consultee, where no personal consultee could be identified, for those lacking capacity [12].

Randomisation and allocation concealment

Randomisation was undertaken once residents within a CH had consented and were registered, and all baseline assessments were completed. CHs were randomised in a 1:1 ratio using a computer-generated minimisation program

incorporating a random element, stratified on characteristics expected to be correlated with intervention delivery and outcome evaluation: CH size (small/medium ≤40 residents; large >40 residents); presence/absence of an activity co-ordinator.

CH staff were not blinded to allocation but researchers administering and collecting the outcome measures had no role in the intervention and were not informed of CHs' allocation. Efforts were made to ensure that they remained blind to allocation, including maintaining separate office locations for 'blinded' and 'unblinded' researchers and requesting that CHs did not disclose their allocation to these researchers.

Intervention

The intervention was developed through a systematic process of intervention mapping [14] (Appendix 1 is available in *Age and Ageing* online). During this process 'physical activity' was conceptualised as 'movement' as a more appropriate term for CHs and their residents. MoveMore was designed to encourage and support residents to move more in their daily life, facilitated by changing the organisational routines and practices of the CH. Implementation involves a systematic approach to embedding the intervention in routine care, remaining flexible to be adapted to each CH's needs.

The MoveMore programme (Appendix 1 is available in *Age and Ageing* online) was to be implemented over 3 months and required staff to: review current practice (observations); develop goals and action plans to effect change (reflection and action planning); act (pursue action plans) and review and evaluate progress. Implementation was supported through several strategies including identification of an intervention lead and core team in each home; provision of a manual, including an 'Ideas Bank' of resources to assist staff in getting started and keeping going; a series of three interactive workshops provided individually to each home.

Intervention delivery

Details of the workshops (including date, length of time, location, attendance, designation of staff) were recorded, a contemporaneous record of the monthly and *ad hoc* contact with the CHs (implementation enhancement) was kept and a review of documentary data relating to the cyclical process of change over time (observation, action planning and review sheets) was undertaken at each follow-up. Details of the intervention implementation process were also collected as part of the process evaluation, which utilised a mixed-methods comparative case study design [15–18] (Appendix 2 is available in *Age and Ageing* online).

Usual care

UC, defined as normal care delivered within the setting, continued in both arms. No restrictions were imposed on current practices or on homes undertaking additional development or training as part of UC.

Researchers looked for evidence in the homes for display of materials (posters, leaflets, etc.) related to movement. As part of the process evaluation, ethnographic observations were conducted to record patterns of movement in all homes. We also recorded changes in staff profile and other aspects of the CH context to understand changes in UC over the trial period.

Outcomes

Residents

The following were administered at baseline, 3, 6 and 9 months post CH randomisation by a blinded researcher and are reported here:

Resident self-reported data

- Six-item cognitive impairment test: (6-CIT) [19]
- Geriatric Depression Scale (GDS) [20]
- Perceived health: EuroQol EQ-5D-5L questionnaire [21]
- Quality of life: Dementia Quality Of Life questionnaire [22]; World Health Organization Quality of Life - OLD questionnaire (three questions) [23]

With staff informant

- Physical function and mobility: Physical activity and mobility in residential care (PAM-RC) [24],[1] Barthel index (BI) [25, 26],[1] Functional Ambulation Classification (FAC) [27]; Elderly Mobility Scale (EMS) [28] (includes two physical assessments)
- Charlson Comorbidity Index [29]
- Perceived health: EuroQol EQ-5D-5L proxy-version questionnaire [21]
- Quality of life: DEMQoL proxy-version [22] (only if resident unable to complete)
- Health care resource use

The researchers also collected data on deaths, moves out of the CH, hospitalisations (also collected through NHS Digital data) and falls on a monthly basis via a telephone call with the home.

Accelerometry

To allow for the objective measurement of PA, residents were asked, at each data collection time point, to wear an ActiGraph wGT3X-BT accelerometer [Actigraph, Pensacola, Florida] on the hip, during waking hours for 7 days [12].

CH level data

CH managers were asked to provide information on CH demographics, the staff and resident profile of the home and

1 Collected anonymously for all residents at screening to establish, at the level of the care home, the physical activity profile, participation in activities of daily living/self-care and ambulatory capacity.

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anonymous home-level data relating to hospital admissions, general practitioner (GP) call-outs, mortality rates and falls.

Sample size

Although formal power calculations for feasibility studies are not usually undertaken, 12 CHs with an average of 8–12 residents provides sufficient statistical power to detect a standardised effect size of 0.50 across the outcome measures, assuming a Type I error rate of 0.20. An increased Type I error rate acknowledges that we are making a preliminary and non-definitive randomised comparison of the intervention with UC while providing the ability to detect that the intervention is promising and warrants further evaluation.

Statistical methods

All analyses and data summaries were conducted using SAS v9.4 on the intention-to-treat population, defined as allocation at randomisation, regardless of non-compliance with the protocol or withdrawal from the study. Recruitment uptake and follow-up, intervention delivery, compliance with accelerometer wear, assessment of outcome measures and safety were summarised using descriptive statistics and confidence interval (CI) estimation rather than by using formal hypothesis testing, with the exception of the planned preliminary estimate of effectiveness.

For outcome data, questionnaire outcomes and levels of PA and sedentary behaviour, cluster-level analysis was used to account for the small number of clusters and small sample size per cluster [30]. Point estimates were calculated in each arm and used to obtain a difference estimate of the unadjusted intervention effect. Corresponding 95, 80 and 67% CIs were also estimated. Point estimates for accelerometer data were only estimated for participants who provided valid data (i.e. $\geq$ 8 h 25 min on $\geq$4 days) with non-wear being defined as periods of at least 120 min of consecutives zero counts [12].

Progression to a definitive trial

Thresholds for specific outcomes were pre-defined to inform the feasibility of progressing to a definitive cRCT (Table 1).

Results

Recruitment rate and baseline characteristics

392 CHs were screened, recruited and randomised over a 16-month period, between June 2015 and September 2016: 13 consented; 12 (7.0% of eligible) were randomised (5 MoveMore; 7 UC) (Figure 1).

300 residents were screened for eligibility between October 2015 and August 2016. 278 residents were eligible, 159 (57.2%) consented/had consultee agreement and 153 were registered to the study (Figure 1). The mean (SD) length of time between the process of starting resident screening and completing the registration of residents was 64.3 (13.5)

Table 1. Pre-specified progression criteria and observed results

Feasibility outcome	Pre-specified progression criteria			Feasibility trial	
	Green	Amber	Red	Observations	Status
Recruitment					
• Number of CHs recruited	12	10	<10	12	Green
• Number of screened residents eligible and who consent to take part in the trial	≥20%	≥10%	<10%	159 consented (53% of 300 screened)	Green
• Average number of residents in each CH recruited to the trial	≥10	≥8	<8	12.75	Green
Intervention delivery					
Proportion of intervention CHs completing the series of three workshops and completing at least one observation review and one action plan review	≥75%	≥50%	<50%	60%	Amber
Data collection and follow-up at 9 months					
• Proportion of residents providing usable accelerometer data	≥75%	Not specified	Not specified	65.6%	Amber/Red
• Proportion of residents having reported outcome measures from either themselves or a proxy	≥75%	≥65%	<65%	Staff informant/proxy: >75% Resident-reported: <55%	Green Red
• Loss to follow-up at 9 months	≤25%	≤35%	<35%	26.1%	Amber
Safety concerns in the view of the Programme Steering Committee	None	None	Major	None	Green

Green = proceed to randomised controlled design; amber = review randomised controlled design and/or intervention delivery, then proceed; red = stop and do not proceed with current trial design and/or intervention and implementation).

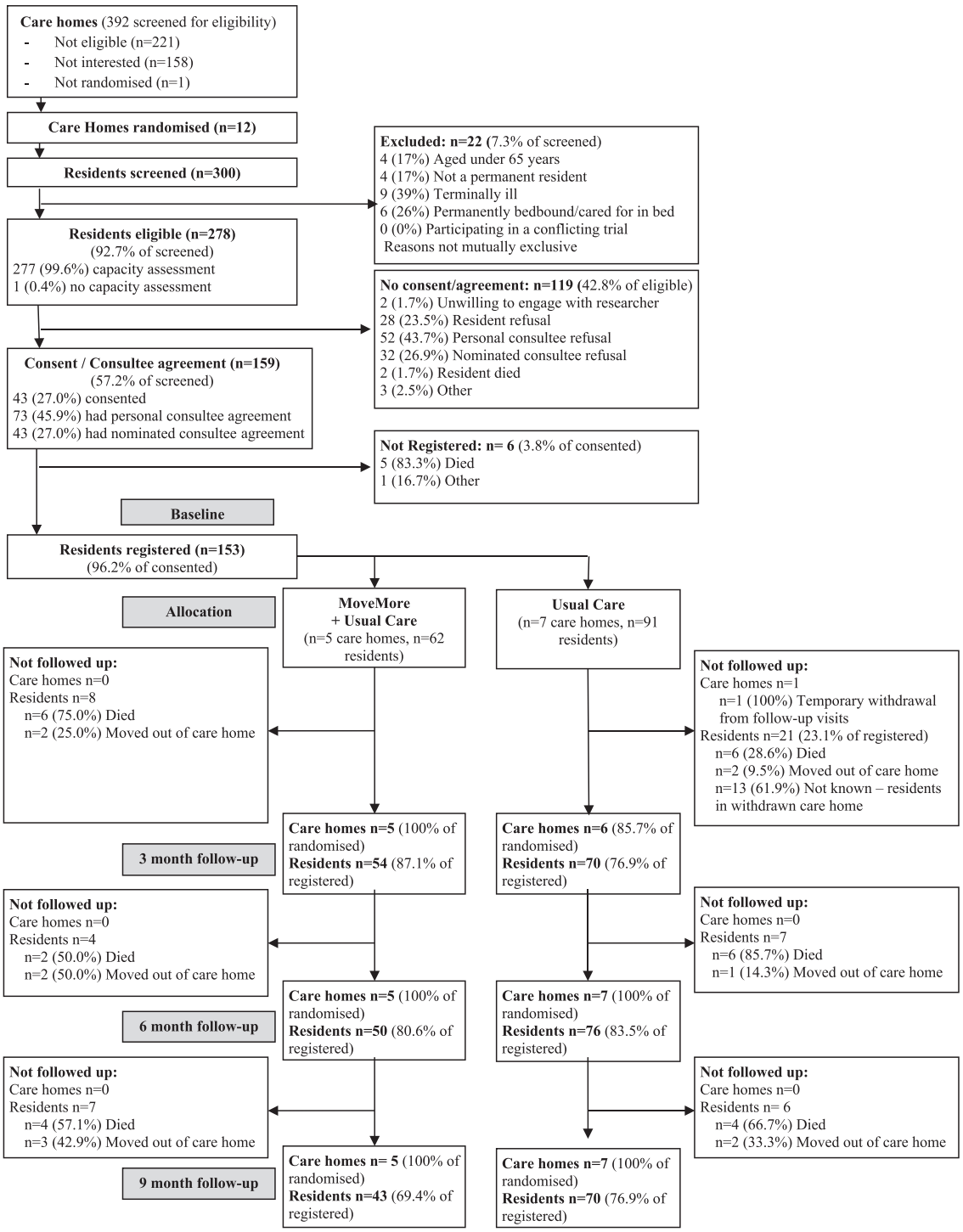

Figure 1. CH and resident screening, recruitment and follow-up.

days (range 50–97 days). The average number of residents recruited per CH was 12.75 (range 6–22; 12.4 MoveMore; 13.0 UC). The proportion of eligible residents who were registered was also similar between the arms (54.9% MoveMore; 55.2% UC).

We recruited similar proportions of residents with (43/72–59.7%) and without (116/203—57.1%) capacity to consent (Figure 1). The proportions of residents without capacity to consent recruited via personal and nominated consultees were similar (57.9% and 56.6% respectively).

Participants' baseline characteristics (Table 2) reflected the poorer physical function and increased proportion with history of stroke in the MoveMore arm observed at screening. Additionally, participants in the MoveMore arm had greater cognitive impairment, and there was a higher proportion with at least one comorbidity (Table 2). Despite differences

between arms in screening characteristics, there were no differences in the characteristics of eligible residents who did and did not consent, with the exception of a higher proportion of residents with dementia consenting (69.8% compared to 59.3%) (data not shown), though the proportion of consenting residents with dementia was balanced between arms (Table 2).

Implementation of and adherence to the intervention (intervention delivery)

The five MoveMore CHs received three (or more) scheduled implementation workshops with content largely as planned. Three intervention CHs (60%) completed at least one observation review and action plan. Intervention CHs were categorised as full ($n = 2$), partial ($n = 2$) or failed ($n = 1$) implementers. In the two homes which proceeded to full adoption of MoveMore, following the initial workshop, observations were undertaken in the CH environment; reflected upon in the subsequent workshop to inform action planning; a range of action plans were tried out in the home, and then reviewed. Implemented action plans included incorporating movement in a review of the content of care plans; introducing systems for communicating action on movement, and training and supervision for all staff. Two homes partially implemented the intervention, undertaking some of the process over a lengthy period in fits and starts. In one CH, slow progress was made towards full implementation, in the other action was undertaken by committed care staff in their areas rather than at the level of the CH. One CH failed to implement: although workshops were provided, the CH lead ultimately did not recognise the need for change. The care staff in the team held a contrary view but they lacked the legitimacy and power to take it forward (Appendix 2 is available in *Age and Ageing* online).

Usual care (context)

CHs in the MoveMore arm were on average smaller than the UC homes, although there was greater variation in resident numbers across UC homes during the trial. They were, however, less likely to provide rehabilitation or intermediate care and have telemedicine facilities (Table 2). At baseline, more UC homes had an activity coordinator in place but by the end of the trial proportions were similar in both arms (Table 1, Appendix 3 is available in *Age and Ageing* online). See Appendix 3 available in *Age and Ageing* online for more details of UC.

Follow-up (attrition)

CH and resident retention during the study period were high (73.9% of residents followed-up at 9 months) with no CH or participant protocol violations or withdrawals, although one CH in the UC arm temporarily withdrew from researcher visits at 3 months due to renovations within the home (Figure 1).

Residents not completing follow-up were more likely to be male, have dementia, have no history of stroke, have lower physical function and have greater cognitive impairment (Appendix 4 is available in *Age and Ageing* online).

Assessment of outcome measures

Completion level

Questionnaires undertaken with staff informants had high completion levels that were similar between arms at all time points (Table 1; Appendix 5 is available in *Age and Ageing* online). Completion levels for the EMS, in particular the timed walk and functional reach items, were lower and differed between arms over time (data not shown). The most common reasons for non-completion of these two physical assessment items were that the resident declined, or did not understand what they were being asked to do, or the resident was too frail, unwell or tired to complete them.

Resident questionnaire completion rates were lower than those completed with staff informants, variable (33–74%) and differed between the arms (higher in the MoveMore arm for all questionnaires at all time points) (Table 2; Appendix 5 is available in *Age and Ageing* online). Lack of completion generally related to lack of capacity or cognitive impairment at the time of assessment. The DEMQOL and the 6-CIT had slightly poorer completion rates than the GDS, the WHOQOL-OLD and the EQ-5D-5L.

Staff proxy questionnaire completion rates were high (Table 3; Appendix 5 is available in *Age and Ageing* online).

Outcome estimation

Residents in the UC arm had higher EMS scores at baseline indicating greater mobility, though there was no evidence that this was a significant difference. During the study, scores decreased in both arms with evidence of a difference emerging between the arms from 6 months with scores higher in the UC arm (diff = 3.23 (80% CI: 0.25, 6.22)). BI and PAM-RC scores were significantly higher in the UC arm at baseline. During the study, scores fluctuated in the MoveMore arm and decreased in the UC arm, such that by 9 months there was no evidence of a difference between the arms (Barthel: 2.55 (80% CI −0.43, 5.52); PAM-RC: 2.06 (80% CI −0.28, 4.41) (Table 3).

Accelerometer wear data

At baseline, the proportion of participants agreeing to wear the accelerometer was high in both arms (96.8% MoveMore; 93.4% UC). At 9 months, the proportion wearing the accelerometer in the MoveMore arm was maintained, while in the UC arm the proportion decreased to 71.4% (55% of registered residents at baseline).

The proportion of residents providing useable accelerometer data (i.e. met the minimum wear criteria) differed between the arms at baseline such that the proportion was higher in the UC arm (90.6 versus 81.7%). While the proportion decreased in both arms across the study period, the

Table 2. Baseline characteristics of participating CHs and residents

	MoveMore + UC	UC
CHs	(*n* = 5)	(*n* = 7)
Overall home size (number of beds): mean (SD)	30.0 (2.92)	38.0 (26.26)
Number of beds taking part: mean (SD)	16.0 (8.51)	20.0 (13.84)
Location		
Urban	0 (0%)	2 (28.6%)
Suburban	3 (60.0%)	3 (42.9%)
Semi-rural	2 (40.0%)	1 (14.3%)
Rural	0 (0%)	1 (14.3%)
Ownership		
Local authority	1 (20.0%)	0 (0%)
Independent	2 (40.0%)	3 (42.9%)
Chain	1 (20.0%)	2 (28.6%)
Not-for-profit	1 (20.0%)	2 (28.6%)
CH care provision		
Residential	3 (60.0%)	5 (71.4%)
Residential/nursing	1 (20.0%)	0 (0%)
Residential/nursing/dementia/respite	0 (0%)	1 (14.3%)
Residential/nursing/dementia/intermediate care	0 (0%)	1 (14.3%)
Residential/dementia/respite/intermediate care	1 (20.0%)	0 (0%)
Participating CH/unit care provision		
Residential	3 (60.0%)	5 (71.4%)
Residential/nursing	1 (20.0%)	0 (0%)
Residential/dementia	1 (20.0%)	2 (28.6%)
Rehabilitation/intermediate care facility[a]	1 (20.0%)	1 (14.3%)
Telemedicine facility	3 (60.0%)	1 (14.3%)
Activity co-ordinator in post	3 (60.0%)	5 (71.4%)
Taking part in initiatives to enhance resident care	1 (20.0%)	2 (28.6%)
Resident profile (mean; SD)		
Number of permanent residents	26.0 (7.45)	34.1 (23.32)
Number of permanent self-funded residents	10.8 (8.58)	15.3 (16.76)
Number of temporary residents	2.2 (4.38)	1.0 (1.15)
Staff profile (mean; SD)		
Number of permanent staff	34.2 (11.39)	33.0 (16.05)
Number of agency staff[b]	0.0 (0.00)	0.6 (1.51)
Number of bank staff[b]	2.2 (2.95)	1.8 (1.94)
Number of staff who have face-to-face contact with residents	36.4 (13.52)	24.71 (18.12)
Residents	(*n* = 62)	(*n* = 91)
Age (years) (mean (SD))	87.1 (6.59)	85.7 (7.35)
Gender: female	51 (82.3%)	71 (78.0%)
Diagnosis of dementia	43 (69.4%)	64 (70.3%)
Previous history of stroke	14 (22.6%)	10 (11.0%)
Registered blind	1 (1.6%)	5 (5.5%)
Ethnicity		
White	61 (98.4%)	91 (100%)
Asian	1 (1.6%)	0 (0%)
Other ethnic group	0 (0%)	0 (0%)
Length of stay in the CH (months)		
Mean (SD)	31.2 (36.82)	29.2 (33.77)
Median (IQR)	16.5 (8.0, 42.0)	17.0 (7.0, 37.0)
Funding type[c]		
Continuing Healthcare	0 (0%)	1 (1.3%)
Local authority	26 (59.1%)	39 (51.3%)
Local authority and self-funded	2 (4.5%)	0 (0%)
Self-funded	16 (36.4%)	36 (47.4%)
FAC[d]		
0—Non-functional ambulation	14 (22.6%)	18 (20.0%)
1—Ambulatory dependent for physical assistance (level II)	8 (12.9%)	3 (3.3%)
2—Ambulatory dependent for physical assistance (level I)	7 (11.3%)	8 (8.9%)
3—Ambulatory dependent for supervision	11 (17.7%)	4 (4.4%)
4—Ambulatory independent level surfaces only	12 (19.4%)	32 (35.6%)
5—Ambulatory independent	10 (16.1%)	25 (27.8%)
EMS (score 0–20)[d]		
Mean (SD)	9.3 (6.81)	10.7 (6.69)

(Continued)

Table 2. Continued

	MoveMore + UC	UC
Median (IQR)	12.0 (3.0, 15.0)	13.0 (4.0, 16.0)
Barthel[e] (score 0–20) mean (SD)	9.2 (4.87)	11.6 (5.96)
PAM-RC[f] (score 0–21) mean (SD)		
Total score	9.1 (4.92)	11.5 (5.45)
Ability domain score	5.9 (2.75)	7.1 (2.95)
Activity domain score	3.2 (2.42)	4.5 (2.91)
GDS[g]		
Mean (SD)	4.1 (3.11)	3.9 (3.07)
Median (IQR)	4.0 (2.0, 6.0)	3.0 (1.5, 5.0)
WHOQoL[h] mean (SD)		
Q1	3.5 (1.04)	3.1 (1.43)
Q2	3.7 (0.77)	3.3 (1.19)
Q3	3.5 (0.90)	2.9 (1.19)
DEMQoL[i] mean (SD)		
Resident completed *(score 0–112);* 29th score	90.5 (13.56); 2.3 (0.58)	93.3 (11.35); 2.2 (0.88)
Proxy completed *(score 0–124);* 32nd score	96.6 (9.31); 2.0 (0.66)	97.2 (8.70); 2.1 (0.63)
EQ5D-5L[j] mean (SD)		
Resident completed; visual analogue score	0.75 (0.23); 70.6 (18.74)	0.80 (0.22); 69.5 (21.07)
Proxy completed; visual analogue score	0.60 (0.26); 73.8 (16.62)	0.69 (0.24); 71.3 (20.02)
6-CIT[k]	18.6 (8.12)	16.4 (8.27)
Medical history[l]		
Dementia or Alzheimer's	45 (72.6%)	64 (70.3%)
Cerebrovascular disease or transient ischemic disease	16 (25.8%)	10 (11.0%)
Rheumatic or connective tissue disease	18 (29.0%)	0 (0.0%)
Diabetes	12 (19.4%)	8 (8.8%)
Cancer (lymphoma, leukaemia, solid tumour)	10 (16.1%)	5 (5.5%)
Congestive heart failure	9 (14.5%)	6 (6.6%)
Renal disease	11 (17.7%)	4 (4.4%)
Pulmonary disease	7 (11.3%)	6 (6.6%)
Gastric or peptic ulcer	5 (8.1%)	1 (1.1%)
Peripheral vascular disease or bypass	3 (4.8%)	3 (3.3%)
Hemiplegia	5 (8.1%)	0 (0.0%)
Metastatic solid tumour	3 (4.8%)	1 (1.1%)
Myocardial infarction	2 (3.2%)	2 (2.2%)
Diabetes with end organ damage	2 (3.2%)	0 (0.0%)
HIV or AIDS	0 (0.0%)	1 (1.1%)
Mild liver disease	1 (1.6%)	0 (0.0%)
Comorbidities[l]		
0 comorbidities	3 (4.8%)	15 (16.5%)
1 comorbidity	18 (29.0%)	50 (54.9%)
2 comorbidities	15 (24.2%)	20 (22.0%)
2+ comorbidities	26 (41.9%)	6 (6.6%)

Numbers and percentages are presented unless otherwise stated [a]The CH in the MoveMore+UC arm at baseline which offered rehabilitation/intermediate care had four beds, while the home in the UC arm offering this facility had 35 beds. [b]Agency and bank staff who have worked in the CH for a minimum of 1 month in the past 6 months. [c]Funding type is not known for 33 registered residents (18 in the Move More arm and 15 in the UC arm). [d]FAC and EMS score were not available for one resident in the UC group. Higher EMS scores indicate greater mobility. In the presence of missing item scores, overall EMS scores have been prorated if 50% or more of the 7 items were complete. [e]Higher Barthel scores indicate greater self-care ability. In the absence of missing items scores, overall individual scores have been prorated if 50% or more items were complete. [f]Higher PAM-RC scores indicate greater physical ability and activity. The ability domain (max score 10) comprises two questions; one around mobility and one around balance. The activity domain (max score 11) comprises three questions: walking frequency, outdoor mobility and wandering. [g]Scores 0–5 classed as normal with scores 5–15 indicative of depression. In the presence of missing items score, overall scores have been prorated if 50% or more of items were complete. Scores were not available for 20 (32.3%) residents in MoveMore+UC (MM + UC) and 47 (51.6%) in UC (UC). [h]Three items from the WHOQoL-OLD were used in the trial and are rated on a five-point scale with higher scores indicating better quality of life. Q1 scores were not available for 27 (43.5%) residents in MM + UC and 52 (53.6%) in UC. Q2 and Q3 scores were not available for 28 (45.2%) residents in MM + UC and 55 (56.7%) in UC. [i]Higher scores indicate better quality of life. In the presence of missing items scores, overall scores have been prorated if 50% or more of items were complete. DEMQoL proxy results are provided only for those with no resident completed results. 88 residents do not have resident completed scores (31 (50.0%) in MM + UC; 57 (62.6%) in UC); 82 (26 in MM + UC, 56 in UC) of these residents had proxy completed scores. [j]Index scores range from −0.281 indicating worst health state to 1.000 which indicates perfect health. Scores were not available for 20 (32.3%) residents in MM + UC and 43 (47.3%) residents in UC. The Visual Analog score represents overall rated health and was not available for 29 residents in MM + UC and 49 in UC. Proxy scores were not available for one resident in MM + UC. [k]Higher scores indicate greater impairment. Scores were not available for 29 (46.8%) of residents in MM + UC and 55 (60.4%) of residents in UC. [l]Based on the Charlson Comorbidity Index. Number (percentage) of residents with a confirmed diagnosis of the condition is reported.

Table 3. Comparison of questionnaire scores by arm at each time point

	Time Point	MoveMore +UC		UC		Mean difference (CI: 95%, 80%, 67%)[a]
		n/*N*[b]	Mean (SD)	*n*/*N*[b]	Mean (SD)	
Questionnaires completed by the researcher with staff informants						
Elderly Mobility Scale[c]	Baseline	62/62	9.3 (6.81)	90/91	10.7 (6.69)	2.10 (−2.75, 6.95) (−0.89, 5.09) (−0.13, 4.33)
	3 months	52/54	9.3 (6.76)	70/70	10.1 (6.74)	1.42 (−2.62, 5.47) (−1.05, 3.90) (−0.42, 3.26)
	6 months	50/50	8.8 (7.13)	71/76	10.6 (6.89)	3.23 (−1.62, 8.08) (0.25, 6.22) (1.00, 5.46)
	9 months	42/43	8.9 (7.21)	68/70	9.8 (6.55)	3.31 (−2.66, 9.28) (−0.37, 6.99) (0.56, 6.05)
Barthel Index[d]	Baseline	62/62	9.2 (4.87)	91/91	11.6 (5.96)	3.07 (−0.11, 6.26) (1.11, 5.04) (1.61, 4.54)
	3 months	52/54	9.6 (5.54)	70/70	10.1 (6.05)	1.41 (−2.59, 5.40) (−1.03, 3.85) (−0.41, 3.23)
	6 months	50/50	8.2 (5.92)	73/76	10.4 (6.26)	3.40 (−1.20, 8.01) (0.57, 6.24) (1.29, 5.52)
	9 months	42/43	8.4 (5.92)	69/70	9.5 (6.55)	2.55 (−2.29, 7.38) (−0.43, 5.52) (0.33, 4.77)
Physical Activity and Mobility in Residential Care Scale[e]	Baseline	62/62	9.1 (4.92)	91/91	11.5 (5.45)	2.67 (−0.70, 6.03) (0.60, 4.74) (1.12, 4.21)
	3 months	51/54	9.4 (5.12)	69/70	11.4 (6.24)	1.70 (−2.01, 5.42) (−0.57, 3.98) (0.01, 3.40)
	6 months	50/50	8.9 (5.55)	75/76	10.6 (5.81)	1.88 (−1.53, 5.28) (−0.22, 3.97) (0.31, 3.44)
	9 months	42/43	9.1 (5.40)	63/70	10.4 (6.31)	2.06 (−1.75, 5.87) (−0.28, 4.41) (0.31, 3.81)
Physical Activity and Mobility in Residential Care Scale (ability)[f]	Baseline	62/62	5.9 (2.75)	91/91	7.1 (2.95)	1.18 (−0.39, 2.75) (0.21, 2.15) (0.46, 1.90)
	3 months	51/54	5.8 (2.64)	69/70	6.6 (3.02)	0.77 (−0.92, 2.47) (−0.27, 1.81) (−0.001, 1.54)
	6 months	50/50	5.7 (2.94)	75/76	6.6 (3.20)	0.87 (−0.99, 2.74) (−0.28, 2.02) (0.02, 1.73)

(Continued)

Table 3. Continued

	Time Point	MoveMore +UC		UC		Mean difference (CI: 95%, 80%, 67%)[a]
		n/*N*[b]	Mean (SD)	*n*/*N*[b]	Mean (SD)	
	9 months	42/43	5.9 (3.08)	63/70	6.2 (3.32)	0.77 (−1.28, 2.81) (−0.49, 2.03) (−0.17, 1.71)
Physical Activity and Mobility in Residential Care Scale (activity)[g]	Baseline	62/62	3.2 (2.42)	91/91	4.5 (2.91)	1.49 (−0.56, 3.54) (0.23, 2.75) (0.55, 2.43)
	3 months	51/54	3.6 (2.75)	69/70	4.8 (3.51)	0.93 (−1.25, 3.12) (−0.40, 2.67) (−0.06, 1.93)
	6 months	50/50	3.2 (2.90)	75/76	4.0 (3.02)	1.00 (−0.87, 2.87) (−0.15, 2.15) (0.14, 1.86)
	9 months	42/43	3.2 (2.55)	63/70	4.2 (3.34)	1.29 (−0.62, 3.21) (0.11, 2.47) (0.41, 2.17)
Questionnaires completed by the researcher with the resident						
Geriatric Depression Scale[h]	Baseline	42/62	4.1 (3.11)	44/91	3.9 (3.07)	0.26 (−3.14, 3.66) (−1.82, 2.34) (−1.29, 1.81)
	3 months	40/54	4.5 (3.70)	33/70	3.9 (3.11)	−1.21 (−3.71, 1.28) (−2.71, 0.28) (−2.32, −0.11)
	6 months	37/50	4.2 (3.34)	37/76	3.5 (3.08)	−1.06 (−3.16, 1.03) (−2.33, 0.21) (−2.00, −0.12)
	9 months	29/43	3.2 (2.36)	32/70	2.2 (1.94)	−0.82 (−2.14, 0.51) (−1.62, −0.01) (−1.41, −0.22)
World Health Organization Quality of Life questionnaire for elderly persons (Question 1)[i]	Baseline	35/62	3.5 (1.04)	39/91	3.1 (1.43)	−0.41 (−1.30, 0.48) (−0.95, 0.13) (−0.81, −0.01)
	3 months	36/54	2.9 (1.30)	26/70	3.0 (1.48)	0.12 (−0.59, 0.82) (−0.30, 0.54) (−0.19, 0.43)
	6 months	33/50	2.9 (1.28)	33/76	3.4 (1.48)	0.55 (−0.50, 1.60) (−0.08, 1.19) (0.08, 1.02)
	9 months	30/43	3.3 (1.26)	32/70	3.4 (1.36)	0.28 (−0.49, 1.04) (−0.19, 0.74) (−0.07, 0.62)
World Health Organization Quality of Life questionnaire for elderly persons (Question 2)[i]	Baseline	34/62	3.7 (0.77)	36/91	3.3 (1.19)	−0.22 (−0.95, 0.51) (−0.67, 0.23) (−0.55, 0.12)
	3 months	38/54	3.2 (1.17)	26/70	3.5 (1.10)	0.40 (−0.30, 1.10) (−0.02, 0.82) (0.09, 0.71)

(Continued)

Table 3. Continued

	Time Point	MoveMore +UC		UC		Mean difference (CI: 95%, 80%, 67%)[a]
		n/*N*[b]	Mean (SD)	*n*/*N*[b]	Mean (SD)	
	6 months	36/50	3.1 (1.17)	35/76	3.4 (1.35)	0.49 (−0.34, 1.33) (−0.01, 1.00) (0.12, 0.87)
	9 months	30/43	3.4 (1.10)	33/70	3.5 (1.42)	0.33 (−0.29, 0.95) (−0.05, 0.71) (0.05, 0.61)
World Health Organization Quality of Life questionnaire for elderly persons (Question 3)[i]	Baseline	34/62	3.5 (0.90)	36/91	2.9 (1.19)	−0.32 (−1.18, 0.55) (−0.85, 0.22) (−0.71, 0.08)
	3 months	37/54	3.2 (1.01)	28/70	3.1 (1.18)	0.11 (−0.56, 0.78) (−0.29, 0.51) (−0.19, 0.41)
	6 months	36/50	3.1 (1.19)	33/76	3.2 (1.21)	0.14 (−0.41, 0.69) (−0.19, 0.47) (−0.11, 0.39)
	9 months	30/43	3.2 (0.97)	33/70	3.6 (1.27)	0.49 (0.03, 0.95) (0.21, 0.77) (0.29, 0.70)
Dementia Quality of Life tool[j]	Baseline	31/62	90.5 (13.56)	34/91	93.3 (11.35)	−1.24 (−20.62, 18.15) (−13.08, 10.61) (−10.06, 7.59)
	3 months	35/54	88.2 (12.41)	28/70	93.6 (11.39)	5.16 (−4.33, 14.65) (−0.52, 10.84) (−0.96, 9.36)
	6 months	36/50	89.4 (11.85)	34/76	94.1 (9.89)	5.24 (−0.94, 11.42) (1.49, 8.98) (2.46, 8.02)
	9 months	29/43	92.1 (11.35)	28/70	94.1 (10.59)	1.83 (−3.26, 6.92) (−1.25, 4.92) (−0.46, 4.12)
EuroQol EQ5D-5L[k]	Baseline	42/62	0.75 (0.23)	48/91	0.80 (0.22)	0.05 (−0.13, 0.23) (−0.06, 0.16) (−0.03, 0.13)
	3 months	38/54	0.69 (0.22)	30/70	0.78 (0.23)	0.12 (−0.07, 0.31) (−0.001, 0.23) (0.03, 0.20)
	6 months	37/50	0.71 (0.24)	36/76	0.79 (0.24)	0.10 (−0.05, 0.25) (0.01, 0.19) (0.03, 0.17)
	9 months	29/43	0.77 (0.22)	33/70	0.78 (0.27)	0.05 (−0.11, 0.21) (−0.05, 0.15) (−0.02, 0.13)
Six-Item Cognitive Impairment Test[l]	Baseline	33/62	18.6 (8.12)	36/91	16.4 (8.27)	−0.29 (−7.21, 6.64) (−4.52, 3.94) (−3.44, 2.86)

(Continued)

Table 3. Continued

	Time Point	MoveMore +UC		UC		Mean difference (CI: 95%, 80%, 67%)[a]
		n/*N*[b]	Mean (SD)	*n*/*N*[b]	Mean (SD)	
	3 months	27/54	18.5 (7.87)	23/70	14.0 (7.49)	−3.57 (−9.41, 2.27) (−7.06, −0.07) (−6.15, −0.98)
	6 months	31/50	17.6 (7.59)	26/76	13.6 (9.50)	−2.76 (−8.47, 2.94) (−6.22, 0.69) (−5.33, −0.20)
	9 months	26/43	17.1 (7.98)	23/70	14.6 (7.94)	−2.02 (−7.38, 3.34) (−5.27, 1.23) (−4.43, 0.39)

[a]80 and 67% CIs are narrower than 95% CI because as the precision of the CI increases (i.e. the CI width decreases) the reliability of the CI containing the true mean difference decreases. Differences and CIs not adjusted for baseline scores. [b]Represents the number of completed questionnaires (fully completed or prorated where applicable) out of the number of residents available for follow-up. [c]Score 0–20; higher score = greater mobility. [d]Score 0–20; higher score = greater self-care ability. [e]Score 0–21; higher score = greater physical ability and activity. [f]Score 0–10. [g]Score 0–11. [h]Score 0–15; score ≥5 indicative of depression. [i]Score 1–5; higher score = greater quality of life. [j]Score 0–112; higher score = better quality of life. [k]Index value −0.281 to 1.000. [l]Score 0–28; higher scores = greater impairment.

decrease was more marked in the UC arm with 60% of residents meeting the minimum wear criteria at 9 months compared with 72.5% in the MoveMore arm. Overall, 65.6% of residents provided usable accelerometer data at 9 months (Appendix 6 is available in *Age and Ageing* online).

The numbers of registered residents wearing an accelerometer and achieving the minimum wear time criteria required for analysis did not meet the pre-specified progression criterion and were deemed insufficient to conduct a formal cluster-level analysis to provide a robust preliminary estimate of effectiveness.

Levels of physical activity and sedentary behaviour

At baseline, residents in both arms spent more than 85% of their time sedentary (mean (SD): MoveMore arm 91.4% (4.7%); UC arm 86.6% (10.0%))—on average more than 11 and a half hours per day (Table 4). They therefore spent very little time undertaking any PA (Table 4): average 1 h 7 min (8.5% of accelerometer wear time) in the MoveMore arm and 1 h 53 min (13.4% of accelerometer wear time) in the UC arm.

At 9 months, there was a decrease from baseline in the proportion of time spent sedentary among residents in the MoveMore arm, whereas there was no suggestion of an overall change among residents in the UC arm. Although there was no suggestion of a difference between the arms at 9 months, this equates to an average increase in time spent in any intensity of PA of 18 min in the MoveMore arm (10.9% of accelerometer wear time) and 7 min in the UC arm (12.6% of accelerometer wear time) (Table 4).

Safety data

Review of falls, hospitalisations, visits to the Accident and Emergency Department (A&E) and deaths indicated no adverse effects of the intervention. Full details of the safety data are available from the authors.

Discussion

Generalisability and context

We fulfilled our CH recruitment target, recruiting a range of CHs [13]. Eligibility was inclusive as the intervention was designed to benefit most residents in the home. 92.7% of residents were eligible, of whom we recruited 57% (consistent with rates quoted in other studies [31–37]). The recruited residents can be considered a representative sample. Importantly, residents judged to lack capacity to consent—who form a high proportion of the CH population—were recruited equally to the study. There were no withdrawals. We found high levels of sedentary behaviour with concomitant low levels of PA in residents, commensurate with other studies [2, 3, 38].

Limitations

The stratified randomisation process did not achieve balance between arms in the number of CHs due to the small number of clusters randomised. Alternative methods for ensuring balance in sample size should be considered for a definitive trial. Further, there were differences in the populations of screened and recruited residents between the two arms. For the randomisation of CHs in a definitive trial, stratification by baseline stroke, physical function and cognitive impairment of residents should be considered.

Return rates for resident-completed outcomes were low but comparable with other CH studies [39–41]. While proxy returns were higher, these are not necessarily an accurate reflection of residents' viewpoints [42, 43]. Further work is required to clarify the most appropriate measures for this group of people. It was feasible to use accelerometers to measure PA and sedentary behaviour in older CH residents using a tailored and robust data collection protocol and procedures. Administration of accelerometers to participants

Table 4. Time and proportion of time residents spent sedentary and in physical activity

Time point		MoveMore + UC					UC			
	N	Mean (SD) time	80% CI	Mean (SD) proportion of time	80% CI	*N*	Mean (SD) time	80% CI	Mean (SD) proportion of time	80% CI
Sedentary time										
Baseline	49	11 h 38 min (1 h 59 min)	11 h 16 min to 12 h 0 min	91.4% (4.7%)	90.6–92.3%	77	11 h 41 min (2 h 39 min)	11 h 18 min to 12 h 5 min	86.6% (10.0%)	85.2–88.1%
3 months	39	11 h 50 min (1 h 58 min)	11 h 25 min to 12 h 14 min	90.5% (5.5%)	89.4–91.7%	41[a]	11 h 56 min (2 h 19 min)	11 h 27 min to 12 h 24 min	89.1% (10.8%)	87.0–91.3%
6 months	38	11 h 37 min (1 h 58 min)	11 h 12 min to 12 h 2 min	90.3% (5.5%)	89.1–91.5%	46	12 h 20 min (2 h 35 min)	11 h 50 min to 12 h 49 min	88.6% (7.7%)	87.1–90.1%
9 months	29	11 h 31 min (1 h 42 min)	11 h 6 min to 12 h 0 min	89.1% (5.5%)	87.8–90.5%	30	12 h 33 min (2 h 35 min)	11 h 56 min to 13 h 10 min	87.4% (10.8%)	84.8–89.9%
Time per day spent in physical activity										
Baseline	49	1 h 7 min (40 min)	59 min to 1 h 14 min	8.5% (4.7%)	7.7–9.4%	77	1 h 53 min (1 h 35 min)	1 h 39 min to 2 h 7 min	13.4% (10.0%)	11.9–14.9%
3 months	39	1 h 18 min (54 min)	1 h 7 min to 1 h 29 min	9.5% (5.5%)	8.3–10.6%	41[a]	1 h 32 min (1 h 34 min)	1 h 13 min to 1 h 51 min	10.8% (10.8%)	8.7–13.0%
6 months	38	1 h 16 min (47 min)	1 h 6 min to 1 h 26 min	9.7% (5.5%)	8.5–10.9%	46	1 h 36 min (1 h 7 min)	1 h 24 min to 1 h 49 min	11.4% (7.7%)	9.9–12.9%
9 months	29	1 h 25 min (47 min)	1 h 14 min to 1 h 37 min	10.9% (5.5%)	9.6–12.2%	30	2 h 0 min (2 h 16 min)	1 h 27 min to 2 h 32 min	12.6% (10.8%)	10.1–15.2%

[a]One CH withdrew from data collection visits.

was greatly enhanced by the very skilled and experienced research staff who worked flexibly, including at weekends and evenings, leading to one of the largest ever data sets for this population. Residents' compliance with accelerometer wear was similar to comparable studies both at baseline [2, 44, 45] and at follow-up [2] despite the comparative frailty of our population. However, as insufficient participants met the pre-determined minimum wear time criteria, we were unable to make a reliably informed decision on the most appropriate endpoint(s) for future use in a definitive trial.

Delivery of the intervention workshops took far longer than anticipated, although efficiency improved over time through increased contact with the CHs and refinement of the workshop timings. The workshops provided a forum to create a shared understanding of what needed to change and to generate ideas about goals, priorities and creative solutions from different perspectives, although solutions were sometimes difficult to put into practice.

Interpretation and implications for future research

Recruitment of CHs and an unbiased population of frail CH residents (including those deemed to lack capacity to consent) was feasible, although time-consuming (approx. 60 days to recruit residents per CH), as found by other CH studies [39, 46]. Our intervention was implemented, at least in part, in four of the five CHs, demonstrating an appropriate methodology for influencing the care environment. However, further optimisation is required to enhance implementation.

Loss to 9-month follow-up for recruited residents was 26.1% (18.3% died), comparable with other CH studies [34, 39, 40]. The frailty of the population leads to difficulties with longer follow-up periods, so alternative methods of evaluation could be considered [47].

Implications for progression

Progression criteria indicated that recruitment of CHs and residents to the study was feasible. Although intervention delivery was challenging and not achieved in all CHs, it was achievable and safe. Accelerometer and resident-reported outcome data collection rates were not at acceptable levels for progression.

Supplementary Data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

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