A group-based exercise and behavioural maintenance intervention for adults over 65 years with mobility limitations: the REACT RCT

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Scientific summary

The REACT RCT

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Scientific summary

Introduction

With increasing age, there is a population-wide decline in physical function. In total, 44% of state pension-age adults in the UK are classified as disabled. The most common form of disability is mobility-related disability (67%). This is a major public health issue significantly reducing the independence and quality of life of older adults, while also contributing to high health-care and social care costs and increased mortality. Reduced gait speed and low levels of physical activity are key markers of frailty, which places an increased pressure on health-care systems worldwide.

The REtirement in ACTion (REACT) study was an effectiveness trial designed to offer real-world, low-cost, tailored exercise and social support to communities of older adults at risk of mobility limitations in the UK.

We hypothesised that, compared with a control arm, participants allocated to the 12-month physical activity and behavioural maintenance intervention would have significantly better lower limb physical function after 24 months' follow-up.

Methods

Study design

REACT was a pragmatic, multicentre, two-arm, single-blind, parallel-group randomised controlled trial with an internal pilot phase and comprehensive process and economic evaluations. Participants were recruited from three study sites in England: Bath and Bristol, Birmingham, and Devon. Ethics approval was provided by the NHS South East Coast-Surrey Research Ethics Committee (15/LO/2082). The trial registration number is ISRCTN45627165.

Participants

Participants were community-dwelling adults, aged ≥ 65 years, not in full-time employment and scoring between 4 and 9 (inclusive) on the Short Physical Performance Battery (SPPB). These criteria identify people who have mobility limitations but are still ambulatory, and include people classified as frail (SPPB score of 4–7) and pre-frail (SPPB score of 8–9) by the European Medicines Agency. We excluded people who were unable to walk across a room, were living in residential care, were awaiting hip or knee surgery, were receiving radiation therapy or chemotherapy, had recent heart or spinal surgery or had severe illness that would prevent participation.

We recruited through letters of invitation from general practitioners (GPs) or third-sector/charity organisations and through local media and by word of mouth. We targeted a socioeconomically and ethnically diverse sample that included participants from urban, rural and semirural locations.

Randomisation and masking

Participants meeting the study inclusion criteria were randomised either to the physical activity and behavioural maintenance intervention or to the control arm using a centralised randomisation website. We used a minimisation algorithm to balance groups by study site, age group (65–74 years, ≥ 75 years), sex and baseline functional ability (SPPB score of 4–7 or 8–9). During the internal pilot, the randomisation ratio was 2 : 1 (favouring the intervention) to enable early feasibility testing of intervention engagement. The main trial randomisation was 1 : 1. Throughout the study, 39 couples or pairs of close friends who were both eligible were randomised together to minimise contamination between study arms.

Researchers collecting the primary outcome data (SPPB), statisticians and the senior research team were blinded to group allocation.

Procedures

The intervention arm received a 12-month exercise and behavioural maintenance programme delivered in community centres by qualified exercise professionals. The programme was delivered in three progressive phases: (1) adoption (weeks 1–8), (2) transition (weeks 9–24) and (3) maintenance (weeks 25–52). Established behaviour change techniques (BCTs) were used to enhance motivation, to make realistic plans for sustainable activity, to pre-empt and overcome barriers, to engage social support and to promote self-monitoring and self-regulatory techniques to support the maintenance of behaviour change. The exercise sessions were delivered twice per week for 12 weeks, reducing to once per week for a further 40 weeks, to groups of around 15 participants. The exercise sessions were designed to improve lower limb muscle strength and balance. Exercise prescription and progression methods were based on the functional requirements of each individual:

- Adoption. Each participant received a 30-minute individualised, face-to-face introductory session, and participated in two 60-minute group-based exercise sessions per week, which were followed by 20 minutes of social time with refreshments to encourage social interaction and promote session attendance.
- Transition. A 45-minute interactive behavioural maintenance session delivered by session leaders was added to one of the two weekly exercise sessions. These sessions were designed to encourage a 'social club' atmosphere and long-term maintenance of an active lifestyle, including ongoing exercise classes, home-based exercise, neighbourhood walking and active travel. They incorporated BCTs derived from social cognitive theory, self-determination theory and the skills for maintenance model. After week 12, the exercise session frequency reduced to once per week, with an expectation that participants found an hour per week to exercise at home or in the neighbourhood, or to attend a local exercise session.
- Maintenance. The maintenance stage focused further on home- and neighbourhood-based activities while continuing with a weekly centre-based physical activity session followed by a 20-minute social session. The frequency of the 45-minute behavioural maintenance sessions was reduced to once per month, and these sessions focused on enacting participants' action plans for physical activity outside the REACT programme.

Control arm participants attended three 60- to 90-minute healthy ageing workshops over 24 months. These involved no physical activity content.

Measures were conducted at baseline and 6, 12 and 24 months post randomisation in a group setting at local community centres.

Outcomes

The primary outcome was the SPPB score at 24 months. SPPB measures normal gait speed over 4 metres, time for completing a repeated (×5) rise from a chair, and completion of three standing balance tasks of increasing difficulty, yielding a score from 0 to 12.

Secondary outcomes were (1) measures of physical activity derived from wrist-worn accelerometer [GENEActiv Original (Activinsights, Kimbolton, UK)], including moderate to vigorous intensity physical activity (MVPA); (2) time spent in sedentary activities (time spent below the 40-mg threshold minus accelerometer-estimated sleep time); (3) self-reported physical activity [Physical Activity Scale for the Elderly (PASE) questionnaire]; (4) the Mobility Assessment Tool-Short Form (MAT-SF); (5) self-reported adherence to government guidelines on muscle-strengthening activity [Muscle-Strengthening Exercise Questionnaire (MSEQ)]; (6) grip strength; and questionnaire measures of (7) social well-being; (8) sleep quality; (9) hip, knee and ankle joint pain; (10) health-related quality of life; (11) loneliness; (12) cognitive function [using the UK Biobank Healthy Minds assessment process and the Montreal Cognitive Assessment (MoCA)]; and (13) the Falls Efficacy Scale-International.

A full cost-effectiveness analysis, including an estimation of the intervention costs, within-trial changes in quality-adjusted life-years and a model-based lifetime analysis, as well as detailed sensitivity analyses, were conducted. The analyses used the NHS and Personal Social Services perspective. The price year was 2019.

A mixed-methods process evaluation evaluated the fidelity of delivery of the behavioural maintenance programme using a checklist applied to session recordings, qualitative interviews with REACT participants and session leaders, and quantitative testing of hypotheses about the proposed mechanisms of change derived from the REACT logic model.

A nested substudy, led by the Wellcome Centre for Integrative Neuroimaging, University of Oxford, tested the hypothesis that the REACT intervention slows the rate of brain atrophy and cognitive function decline. This was funded by the National Institute for Health and Care Research (NIHR) Oxford Biomedical Centre, University of Oxford, and will be reported elsewhere.

Statistical analysis

The power calculation for the primary outcome (SPPB score) at 24 months was based on the published definition of a minimum clinically meaningful change in SPPB score of 0.5 points. To provide 90% power, this required a sample size of 384 participants per arm (768 participants in total).

The primary comparative analysis was carried out using an intention-to-treat (ITT) approach with due emphasis placed on confidence intervals (CIs). The comparison of primary interest was the difference between the intervention and the control arm on SPPB score at 2-year follow-up (24 months after randomisation). Covariates in the model comprised baseline SPPB scores, age, sex and study site. In addition, we adjusted the estimates for clustering by exercise group within the intervention arm, with control arm participants entered as individual groups. Analyses were conducted in Stata® SE version 15.0 (StataCorp LP, College Station, TX, USA).

Secondary outcome analyses were undertaken using the same approach as for the primary analysis (excluding the sensitivity analyses), using the baseline, 6-month, 12-month and 24-month follow-up data, using linear mixed-regression models. Health-related quality of life, as assessed by EuroQol-5 Dimensions (EQ-5D), will be reported elsewhere as part of the health economic evaluation.

As an exploratory analysis, the effects of several predefined factors were further investigated, and these are presented. These included the stratification variables (age categories: 65–74 years and ≥ 75 years; sex; and study site: Bath/Bristol, Devon, Birmingham), as well as comorbidity levels at baseline (none or one chronic medical conditions vs. two or more chronic medical conditions), health-related quality of life, socioeconomic subgroups (using education, home ownership and quintiles of area deprivation), history of falls (recorded fall or not during 6 months prior to baseline) and the uptake of any co-interventions during the 24-month study period.

To examine the association between dose and response, we conducted subgroup analyses for participants attending ≥ 50% and ≥ 75% of the REACT programme sessions.

Intervention costs were estimated by identifying key resources (programme co-ordination, REACT session leader time and expenses, venue hire, equipment, consumables, and programme-specific training for REACT session leaders) and assigning values to the resources used. The data were collected by the REACT session leaders and trial manager. Costs were estimated per REACT group and then divided by the average group size.

Results

Between June 2016 and September 2017, 3116 people were telephone screened (of whom 1077 were not eligible) and 1214 attended for baseline screening. Of these, 804 were found to be eligible and 777 were randomised (410 to the intervention arm and 367 to the control arm). The number of participants included in the primary analysis at 24 months was 628 (80.8%), comprising 334 (81.5%) in the intervention arm and 294 (80.1%) control subjects. The mean age of the participants was 77.6 years [standard deviation (SD) 6.8 years], 66.2% of participants were female, 95.1% were white and the mean baseline SPPB score was 7.37 (SD 1.56). Baseline characteristics were similar between the two study arms, although the prevalence of multimorbidity was higher in the intervention arm (47% vs. 39%). The sample was similar to the UK population aged over 65 years in terms of ethnicity and area deprivation, although with some under-representation of men (33.9% vs. 45.6%).

At the 24-month follow-up, the mean SPPB score (adjusted for baseline SPPB score, age, sex, study site and exercise group) was significantly higher in the intervention arm (mean 8.08, SD 2.87) than in the control arm (mean 7.59, SD 2.61), with an adjusted mean difference of 0.49 (95% CI 0.06 to 0.92; $p = 0.014$). Of the 410 participants allocated to the intervention arm, 16.1% did not engage with any of the intervention sessions (non-starters), 19.0% attended < 50% of the sessions offered, 20.2% attended 50–74% of the sessions offered and 44.6% attended ≥ 75% of the sessions offered. In the case of participants allocated to the intervention arm who started the programme, the mean percentage of sessions attended was 67.7% (95% CI 65.1% to 70.4%). An association between dose and response was observed, with an adjusted mean difference in SPPB score of 0.64 (95% CI 0.23 to 1.05; $p = 0.002$) for those attending ≥ 50% of intervention sessions and of 0.81 (95% CI 0.38 to 1.23; $p < 0.001$) for those attending ≥ 75% of sessions.

The SPPB score was significantly higher in the intervention arm than in the control arm at 6 months (adjusted mean difference 0.68, 95% CI 0.39 to 0.96; $p < 0.001$) and 12 months (adjusted mean difference 0.77 points, 95% CI 0.40 to 1.14; $p < 0.001$). Self-reported physical activity was significantly higher in the intervention arm than in the control arm at 6 months (adjusted mean difference in PASE score of 16.3, 95% CI 6.78 to 25.9; $p = 0.001$), 12 months (adjusted mean difference 10.8, 95% CI 3.18 to 18.5; $p = 0.006$) and 24 months (adjusted mean difference 10.7, 95% CI 2.62 to 18.8; $p = 0.010$). Self-reported engagement in muscle-strengthening exercise showed a similar pattern, with highly significant differences ($p < 0.001$) at all three follow-up time points. Accelerometer data indicated a substantial difference favouring the intervention group at 12 months for total MVPA (adjusted mean difference 3.11 minutes per day, 95% CI 0.00 to 6.23; $p = 0.05$) and MVPA accumulated in bouts of at least 10 minutes (1.24 minutes per day, 95% CI 0.22 to 2.26; $p = 0.018$). This equates to a difference of 22 minutes per week of unbouted MVPA. Significant differences favouring the intervention arm were also observed in the Short Form questionnaire-36 items physical component score (at 6 and 12 months), hand-grip strength (at 12 months) and the MAT-SF self-reported lower limb physical functioning scale (at 6, 12 and 24 months). Sensitivity analyses, including imputation of missing values and not adjusting for clustering by exercise group, did not substantially change the pattern or significance of the results.

The mixed findings on secondary outcomes indicate that the effects of the intervention were limited to lower limb physical function and did not extend to substantial increases in physical activity or other domains of physical function (e.g. grip strength). The secondary outcome analyses were exploratory, with no adjustment for multiple testing, and should be interpreted accordingly.

During the study, 95 events were classified as serious adverse events. Only one (a hip fracture following a fall during an exercise session) was related to the study.

The full 12-month REACT programme was estimated to cost £622 per participant. The intervention plus usual care was cost-effective compared with usual care alone over the 2-year time period of REACT. In the base-case scenario analysis, the intervention saved £103 in NHS/Personal Social

Services (PSS) costs per participant with a quality-adjusted life-year (QALY) gain of 0.04 within the 2-year trial window. Lifetime horizon modelling estimated that further cost savings and QALY gains were accrued up to 15 years post randomisation.

In qualitative interviews, participants reported that they enjoyed the programme, and they reported better mental and social well-being, emphasising their higher physical confidence, improved motivation and feeling more outgoing. Improved social connectedness and bonding with REACT groups were key outcomes for the intervention group, who also highlighted improvements in mobility, strength, balance, walking, fitness, sleep and physical independence. Themes identified at 24 months largely mirrored those reported at 6 and 12 months. However, whereas the 6- and 12-month interviews found that social support was a key reason for engaging in REACT, at 24 months individual-level factors, such as perceived benefits, were more prominent themes in explaining physical activity maintenance. Key components of the REACT programme that positively influenced maintenance of physical activity at 24 months were (1) techniques for managing slips/lapses, supporting habit change and resolving sources of tension around increasing physical activity; (2) the person-centred delivery style to build autonomy/intrinsic motivation; and (3) the group-based delivery promoting social connectedness.

The quantitative process evaluation confirmed that, compared with control subjects, participants in the intervention arm reported experiencing greater benefits from exercising in terms of their physical, mental and social well-being. The hypothesis that increased exposure to the intervention will be associated with positive changes in competence, relatedness, enjoyment and perceived benefits (hypothesis 5c) was supported in relation to muscle-strengthening exercise only. Increased exposure to the intervention was associated with positive changes in psychosocial determinants for muscle-strengthening exercise 12 months after baseline, but not with changes in determinants of MVPA.

Taken together, the qualitative and quantitative process evaluations broadly supported the logic model for the REACT intervention. They identified several ways that the intervention and its implementation could be improved. These included possible changes to the logic model (from the qualitative and quantitative studies) and changes to delivery processes (from the intervention fidelity and qualitative studies).

The trial analyses did not show an impact on quality of life. However, the more sophisticated, time-integrated approach used in the health economic analysis revealed a significant difference in EQ-5D (as well as a saving in health-care costs). Indeed, the health economic analysis indicated that the increases in physical function observed were associated with substantial quality-of-life and health economic benefits, both within the 24-month trial window and across a lifetime horizon.

Although the overall results for REACT were positive, the process evaluation indicated, as with most service-based interventions, that there was considerable scope for improvement by session leaders in the facilitation of important self-regulation processes and social/relatedness-building processes during the delivery of the behavioural maintenance programme. To some extent, this may have been mitigated by mutual support among participants and self-delivery of some of the intended processes within the groups during the exercise sessions. However, future implementation of the REACT intervention should aim to improve the training and delivery of the programme accordingly.

Conclusion

Among older adults with mobility limitations, lower limb physical function after 24 months' follow-up was significantly better among those who participated in the REACT 12-month, community-based group physical activity and behavioural maintenance programme than in the control arm.

Higher intervention effects were associated with increased programme attendance, with once-weekly exercise or more being associated with clinically meaningful benefit. The REACT intervention was cost-saving from an NHS/PSS perspective within a 2-year window, with further cost-savings and QALY benefits estimated in the longer term.

Trial registration

This trial was registered as ISRCTN45627165.

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