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The effectiveness of the Healthworks Staying Steady community-based falls prevention exercise programme to improve physical function in older adults: A 6-year service evaluation.

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Abstract

Background

Falls prevention exercise programmes are evidence-based and recommended for improving physical function in older adults. However, few service evaluations exist to assess the effectiveness of community-delivered interventions in practice.

Methods

We conducted a six-year, retrospective evaluation of the community-delivered Staying Steady programme (Healthworks, United Kingdom). Staying Steady is a 27-week, tailored strength and balance programme delivered in a group setting (1-hour, once/week) and at home (30-40 minutes, 2-3 times/week). Participants were referred by healthcare professionals, or self-referred, due to a history or risk of falling. Routinely collected outcome measures (30-second chair stand, Timed Up and Go, four-stage balance test, and patient reported outcomes; including 'fear of falling' and 'ability to manage health') were analysed. Factors associated with programme completion were reported. The intervention effect on physical function was analysed in subgroups: participants used arms to chair-stand or a walking-aid at both ('aided'), neither ('unaided'), or one assessment timepoint ('aided at baseline only' or 'aided at follow-up only').

Results

There were 1,426 referrals; 835 (67.3%) participants enrolled on to the Staying Steady programme, 406 (32.7%) declined, 185 (13.0%) were inappropriately referred and excluded from analysis. After enrolling, 451 (54.0%) participants completed, and 384 (46.0%) dropped out. Chair stand performance improved in participants who were unaided (n = 264; median 2.0 [1.0, 4.0] repetitions; P <0.001), or aided at baseline, follow-up or both (n = 170, P <0.05). Timed Up and Go performance improved in the unaided (n = 387; median -3.1 [-5.4, -1.4] s, P

41   <0.001), and aided at baseline only (n = 32; median -4.9 [-10.8, -3.4] s, P <0.001) groups. Four-

42   stage balance performance improved (n = 295; median 1.0 [0.0, 1.0] points, P <0.001). After

43   programme completion, participants self-reported an improved ability to manage their health

44   and daily activities, improved confidence, and a reduced fear of falling. Presence of chronic

45   obstructive pulmonary disease, fear of falling, prescribed nutritional support, disability and

46   social deprivation influenced non-completion of Staying Steady.

47   <u>Conclusions</u>

48   Completing Staying Steady improved physical function in older adults. Methods to encourage

49   retention of participants from groups associated with low uptake and adherence should be

50   investigated.

51   **Key words**: healthcare, health inequality, service evaluation, falls, exercise, strength, balance

52   **Abbreviations**

53   4SBT – four-stage balance test

54   ABC – Activities-specific Balance Confidence

55   BMI – body mass index

56   CHD – coronary heart disease

57   CI – confidence interval

58   CS – chair stand

59   FaME – Falls Management Exercise

60   FRAT – Falls Risk Assessment Tool

61   IMD – Index of Multiple Deprivation

62 IQR – interquartile range

63 MDC – minimal detectable change

64 NHS – National Health Service

65 NUTH – Newcastle upon Tyne Hospitals

66 PROMs – patient reported outcome measures

67 RR – relative risk

68 TUG – Timed up and go

69 UK – United Kingdom

70 USA – United States of America

71

72 **1. Introduction**

73 Deteriorating muscle strength and physical function increases the incidence of falling,

74 hospitalisation (1) and healthcare costs in older adults (2). In the United Kingdom (UK) and

75 the United States of America (USA), guidelines recommend the implementation of

76 multifactorial interventions to prevent falls in older people, including an individually

77 prescribed strength and balance exercise program (3-5). When delivered using best practice

78 protocols, Public Health England estimates that evidence-based falls prevention programmes

79 generate a societal return on investment (i.e. health and social care-related monetary savings

80 plus gains in quality adjusted life years, compared to usual care) of between £1.97 and £7.43,

81 per £1.00 of delivery costs (6). Furthermore, pooled evidence from randomised controlled trials

82 supports the use of exercise interventions to improve muscle strength, balance, and gait speed

83 (7) and reduce incidence of fall in adults aged ≥ 60 years (8). These data are promising;

84   however, few service evaluations have assessed the effectiveness of these interventions in the

85   UK (9-12) or globally (13). Importantly, evaluation of community-delivered exercise

86   programmes at a local level, using routinely collected data, has greater ecological validity than

87   data collected in randomised controlled trials (14).

88   Staying Steady is a community-delivered falls prevention programme in the North-east of

89   England, adapted from the Falls Management Exercise (FaME) intervention (15, 16). Staying

90   Steady initially included four eight-week blocks, alternating group-based and home-based

91   exercise sessions (17). A small (n=5) mixed methods evaluation of this delivery format

92   reported Staying Steady group session adherence of ~80% and positive narrative accounts from

93   the participants, citing improved mental and physical health (17). Participant reports coincided

94   with objectively measured improvements in strength, balance and physical function, however,

95   statistical analyses were not performed (17). Currently, Staying Steady consists of one-hour

96   group-based sessions delivered once per week over 27 weeks. To help participants meet the 50

97   hours of exercise recommended to reduce fall risk (18), group-based sessions are supplemented

98   with home exercises to be completed two to three times per week, for a maximum of 30 to 40

99   minutes per session. The effectiveness of the current Staying Steady programme in improving

100   outcomes related to physical function, goal setting, and factors associated with attrition,

101   requires evaluation in a larger cohort. This would enable identification of strengths and

102   weaknesses of the programme and may provide an evidence base for more widespread

103   implementation of community-run falls prevention exercise programmes. The aim of this

104   single centre retrospective service evaluation, conducted in the North-east of England, was to

105   assess the effectiveness of the Staying Steady programme in practice, to improve physical

106   function and assess patient reported outcome measures (PROMs) and factors associated with

107   attrition in older adults who are at risk of falling.

1.1 Objectives

Primary objective

- Evaluate the effectiveness of the Staying Steady exercise programme at a local level to improve physical function (30-second chair stand [CS], timed up and go [TUG], and four-stage balance test [4SBT] performance) in older adults at risk of falling.

Secondary objectives

- Evaluate adherence to, attrition from, and safety of, the Staying Steady exercise programme.
- Understand whether baseline demographics impacted attrition and outcome variables.
- Evaluate PROMs, goal setting and participant evaluation of the programme

2. Methods

2.1 Study design

This is a non-experimental, retrospective service evaluation. Healthworks is a community health charity, independent to the National Health Service (NHS), commissioned by multiple organisations including Newcastle City Council and the Newcastle upon Tyne Hospitals (NUTH) NHS Foundation Trust. The Staying Steady programme was first commissioned in April 2010 through the NUTH Trust. Data were collected between January 2015 and April 2021 by Healthworks practitioners as part of standard service delivery of Staying Steady and for audit and evaluation. Participant data were anonymised, stored and analysed by the research team on Healthworks property. Ethical approval was provided by the Northumbria University Health and Life Sciences ethics committee (reference 34401). Permission was granted by Healthworks to audit, evaluate and publish these data. Participants gave informed consent for Healthworks to store their data for monitoring and evaluation purposes. The academic team

131 ensured that legal and ethical standards were met by performing the evaluation in collaboration

132 with Healthworks and in accordance with guidance from the general data protection regulation

133 (GDPR) (Article 89.1) and National Institute for Health Science Research UK (NIHR) (19);

134 namely, the processing of healthcare data without consent is permitted for scientific or

135 statistical reasons if data are anonymised and unidentifiable.

136 2.2 Sample

137 Anonymised secondary data from participants at five community leisure centres in four

138 locations in the North-east of England were included for analyses. Participants with a

139 documented referral to the Healthworks "Staying Steady" community programme between

140 January 2015 and April 2021, were included in this service evaluation. Data were extracted

141 from records at Healthworks between May 2021 and September 2021.

142 Participants registered at a Newcastle upon Tyne GP could be referred based on one or more

143 of the following criteria:

144 • Feel unstable and unbalanced

145 • Fear of falling

146 • History of falls

147 • Low bone density and / or family history of osteoporotic fracture

148 Participants needed to be able to mobilise independently with or without the use of a walking

149 aid and have the cognitive ability to follow instructions. Staying Steady practitioners used the

150 Falls Risk Assessment Tool (FRAT; 20), functional ability and medical history records to

151 confirm the participants suitability. Safety to participate was continually assessed by trained

152 practitioners during their first three exercise sessions. Participants withdrawn from the

153 programme due to safety concerns during early exercise sessions or assessments were

154 considered an 'unsuitable referral' (Figure 1). For example, participants might be withdrawn

155 and referred elsewhere due to a medical condition that contraindicates exercise (21) or very

156 poor, deteriorating physical function. Other examples of unsuitable referrals include where the

157 Staying Steady referral criteria have not been met, or where the referred person would benefit

158 from a more advanced exercise programme due to having a higher fitness level than the target

159 Staying Steady participant.

160 *{Please insert Figure 1 here}*

161 <u>2.3 Intervention</u>

162 Staying Steady is an individually tailored 27-week group exercise programme involving one-

163 hour sessions, weekly (Table 1). Group exercise sessions were led by exercise practitioners at

164 a community health charity (Healthworks, UK). Delivery of the programme was in fixed

165 blocks, i.e., Staying Steady started Week One on a set date and continued for the next 27-

166 weeks. After the 27-week programme was delivered, Staying Steady started again at Week One

167 for new referrals. It was not essential that new participants enrolled at Week One, they could

168 join at any time. However, these participants still finished on Week 27 and therefore had a

169 shorter programme duration. Exercise sessions started with a 10-minute warm up, followed by

170 aerobic, strength and balance exercises. Alternative lower intensity options, typically chair-

171 based exercises, were provided for particularly deconditioned participants, the need for this

172 was subjectively determined by a trained exercise practitioner. Initially, the different exercise

173 modes were completed separately, allocating approximately 10 minutes each to aerobic,

174 strength and balance training. Later, aerobic, strength and balance exercises were combined in

175 a circuit. Progression was achieved by increasing the number of repetitions, the amount of time

176 completing an exercise or the number of rounds in a circuit. More difficult exercises, such as

177 press-ups, tandem or single-leg stands were introduced as participants progressed through the

178 programme. All exercise sessions ended with a cool down and stretching. To support

179 participants to meet the recommended 50-hour dose of exercise (18), similar progressive home-

180 based exercises were prescribed. Home-based exercises were recommended to be performed

181 two to three times per week, for 10 to 20 minutes per session, and progress to a maximum of

182 30 to 40 minutes per session. The Staying Steady programme included two practitioner

183 delivered education sessions. The first education session (week nine) covered fall risk factors,

184 risk reduction and recovery strategies. Content from the first education session was reiterated

185 in a second education session (week 18), and participants were given information about local

186 exercise programmes to encourage long-term exercise engagement after completion of Staying

187 Steady.

188 *{Please insert Table 1 here.}*

189 <u>2.4 Outcomes</u>

190 Outcome measures were assessed at baseline and 27-weeks (Table 1). Goal setting and

191 evaluation questionnaires were developed in-house and PROMs were adapted from the Patient

192 Reported Outcome Measures in England Data Dictionary version 3.4 (22). Outcome data are

193 missing for some participants due to the retrospective study design and changes to

194 Healthworks' routine data collection around 2017. For evaluation purposes, where previously

195 assessed items were later removed from standard practice, these variables were excluded from

196 analysis or grouped with the most similar equivalent in the updated format (Supplementary

197 Material 1, eTable 1 and eTable 2 in Additional File 1).

198 <u>2.4.1 *Participant characteristics*</u>

199 Participants who self-referred reported presence of disability, medication, balance and

200 functional ability, falls history and history of collapse, adapted from the FRAT(20). Where

201 available, a full medical summary, provided in the referral, was used to report participant

202 characteristics. When this was unavailable, a patient-reported medical history related to

203 cardiovascular, pulmonary, musculoskeletal, neurological and psychological issues from an in-

204   house triage questionnaire was used. Participant age (years), sex, postcode (socioeconomic

205   index), stature (m), mass (kg), medication and medical history were recorded. The term cardiac

206   disease refers to any heart-related medical condition reported in the medical summary or

207   medical history. Risk for coronary heart disease (CHD) was defined by presence of ≥1 risk

208   factor, including diabetes, hypertension, or dyslipidaemia, in the absence of a cardiac diagnosis.

209   <u>2.4.2 *30-second chair stand (CS) test*</u>

210   Participants completed as many CSs as possible in 30 seconds, without using their arms for

211   support (unaided) (23). If necessary, participants pushed themselves into a standing position

212   using their hands on the chair or a walking aid (aided). The 30-second CS test is a measure of

213   physical function and proxy for leg strength assessment in older adults (23). Community-

214   dwelling older adults who complete <11 repetitions in 30 seconds are at increased risk of falling

215   (24).

216   <u>2.4.3 *Timed up and go test (TUG)*</u>

217   The time taken to rise from a chair, walk three metres in a straight line, turn, and return to the

218   seated start position is recorded in seconds (25). Where possible, participants performed the

219   TUG without using their arms or a walking aid (unaided). If necessary, participants used a

220   walking aid, pushed themselves into a standing position or used the wall for balance (aided).

221   Inability to complete the TUG in <15 seconds is associated with increased risk for

222   hospitalisation, difficulty in activities of daily living and multiple falls, compared to older

223   adults who completed the TUG in ≤12 seconds (26).

224   <u>2.4.4 *Four-stage balance test (4SBT)*</u>

225   The 4SBT comprises four foot positions, held up to 10 seconds each: (1) parallel, (2) semi-

226   tandem, (3) tandem, (4) and one-legged stance (27). The highest level held for 10 seconds was

227   recorded as the participants score. The 4SBT was included as an outcome measure by

228 Healthworks from 2017 onwards, explaining the lower number of cases for this variable

229 relative to the other primary outcome measures. Inability to complete the tandem stand (stance

230 3) for 10 seconds indicates increased fall risk falling (28).

231 *2.4.5 Patient reported outcome measures*

232 Participants selected a response from a five-point Likert-scale to the following prompts: (1)

233 how I feel about managing my health, (2) How I feel about managing my daily activities, (3)

234 my fear of falling, (4) my confidence when walking outside, and (5) my social network, adapted

235 from the Patient Reported Outcome Measures in England Data Dictionary version 3.4 (22).

236 Some participants selected more than one response from the Likert scale; here the lowest

237 number response was recorded for analysis. See eTable 1 (Additional File 1) for previous

238 iterations of the PROMs questionnaire used by Healthworks.

239 *2.4.6 Goal setting and evaluation*

240 Goal setting questionnaires were developed in-house by Healthworks (Supplementary Material

241 1 in Additional File 1). Before 2017 participants could select one primary goal from the list.

242 From 2017, participants chose as many goals as they wished from an amended list.

243 Questionnaires provided to participants were updated during changes to standard delivery of

244 the programme, implemented around 2017 with the approval of a steering group and

245 commissioners of the community health charity (Healthworks).

246 Participants reviewed the programme and their self-reported progress in a final in-house

247 questionnaire (eTable 2 in Additional File 1).

248 2.5 Data analysis

249 Anonymised data from Healthworks records were transferred to a spreadsheet (Microsoft

250 Excel, Office 365) by EJ. Statistical analyses were performed using SPSS (v27, IBM, Chicago,

251 USA). Histograms and QQ-plots were visually assessed to determine the distribution of data.

252   Categorical data are reported as frequency and percentage. Quantitative descriptive statistics

253   are reported as median and interquartile range (IQR). Wilcoxon signed-rank tests assessed pre-

254   to post-intervention change in CS, TUG, 4SBT performance, PROMs, and sub-analyses of

255   primary outcomes (1) following removal of participants with the least (1st decile) and most

256   (10th decile) amount of time in weeks between baseline and follow-up assessments, and (2) by

257   sub-groups of chronic diseases. All outcomes were assessed using complete case analysis

258   (pairwise deletion) because: imputation of outcome data can distort the results (29), missing

259   TUG and CS results for completers were negligible (<5%) (30), and the absence of variables

260   was independent of their value ("missing completely at random") and will not introduce bias

261   to the analyses (30, 31). The intervention effect on physical function was analysed and reported

262   by grouping participants; 'aided' if they used arms to chair-stand or used a walking-aid, or

263   'unaided' if not. Participants who used arms to chair-stand or used a walking-aid at baseline

264   but not follow-up are described as 'aided at baseline only', and where the reverse was true

265   'aided at follow-up only'. The minimal detectable change (MDC) value for the 30-second CS

266   and the TUG are 3.9 repetitions (32) and 1.8 seconds (33) in older adults, respectively.

267   Statistical significance was set at P <0.05.

268   Index of Multiple Deprivation (IMD) was calculated from address postcodes using 2019 UK

269   Government data (34). The IMD rank is reported in national reference deciles, where deciles

270   one and 10 represent the most and least deprived 10% of areas, respectively (35). To create a

271   categorical value, IMD deciles were dichotomised at the median to create two groups of high

272   (<5th decile) or low (≥5th decile) deprivation. Using postcodes, the distance (km) between the

273   participants addresses and the Healthworks centre to which they were referred was calculated

274   using an online tool (freemaptools.com).

275   We identified three potential outcomes following referral to Staying Steady: declined (no

276   attendance), dropout (attended ≥1 Staying Steady session and dropped out before registering

277 any follow-up outcome measures), and complete (present until the end of the programme and

278 completed ≥1 follow-up outcome measure). We investigated the influence of baseline

279 characteristics on starting and/ or completing Staying Steady, using Chi-squared (X^2;

280 categorical variables), Mann Whitney-U tests (continuous and ordinal variables) and binomial

281 regression. Declined potential participants who were inappropriately referred (detailed in

282 section 2.2) were removed from the analysis as they do not represent the target cohort for this

283 evaluation. The effect size for significant associations is reported using Phi (ϕ), interpreted as

284 follows: very strong ($\phi > 0.25$), strong ($\phi > 0.15$ and ≤ 0.25), moderate ($\phi > 0.10$ and ≤ 0.15), weak

285 ($\phi > 0.05$ and ≤ 0.10), or no association ($\phi \leq 0.05$; 36). Stepwise binomial logistic regression

286 with backwards elimination based on the likelihood ratio was performed to assess factors

287 influencing the referral outcome when grouped as completers versus non-completers (dropouts

288 and declined referrals, both separately and combined). Likelihood ratio is the strongest test for

289 the statistical contribution of individual variables to a model and is preferred over the Wald

290 statistic where continuous independent variables are investigated (37). All baseline variables

291 were included in the full regression models, excluding those with a substantial amount of

292 missing data (>40%; body mass index [BMI], self-referral questions [detailed in Table 2], goal

293 setting) (30). The Box-Tidwell Test confirmed the assumption of linearity between the

294 continuous independent variables (age, IMD rank and distance from venue) and the logit of the

295 outcome. Other assumptions of logistic regression (binary dependent variable and

296 independence of observations) were met. Relative risk (RR) with 95% confidence interval (CI)

297 was calculated for interactions from the logistic regression, using 2×2 contingency tables of

298 outcome against covariates.

299   *2.5.1 Sample size*

300   This was a retrospective service evaluation and therefore the sample was determined by the

301   number of documented referrals and participant records in the evaluation period. The sample

302   is an outcome of the service evaluation.

303   **3.0 Results**

304   3.1 Participant demographics

305   During the evaluation period, 1,426 referrals were made to Staying Steady, of which 13.0% (n

306   = 185) were considered an unsuitable referral. Of the remaining 1241 referrals, 32.7% (n =

307   406) were declined by the participant (Figure 1). Of the 835 participants who joined Staying

308   Steady, 54.0% (n = 451) completed the 27-week programme. Baseline demographics of the

309   referred participants are shown in Table 2. Due to missing data, the number of participants is

310   listed for individual variables.

311   *{Please insert Table 2}*

312   3.2 Primary outcomes

313   *3.2.1 30-second chair stand (CS) test*

314   There was an increase in the number of repetitions completed by participants who performed

315   the test unaided (n = 264, 60.8%), aided (n = 54, 12.4%), aided at baseline only (n = 94, 21.7%)

316   and aided at follow-up only (n = 22, 5.1%; Figure 2A). An improvement in the number of CS

317   repetitions greater than the MDC ($\geqslant$3.9 repetitions; 32) was achieved by 36.0% (n = 95),

318   24.1% (n = 13), 28.7% (n = 27) and 40.9% (n = 9) of participants who completed the 30-second

319   chair stand unaided, aided, aided at baseline only, and aided at follow-up only, respectively.

320   *3.2.2 Timed up and go test (TUG)*

321   Time to complete the TUG improved in participants who were unaided (n = 387, 89.2%) and

322   aided at baseline only (n = 32, 7.4%), but not in participants who were aided at both timepoints

323   (n = 13, 3.0%; Figure 2B). Two participants (0.5%) completed the TUG unaided at baseline

324   and aided at follow-up and were not analysed. A reduction in TUG time greater than the MDC

325   (⩾1.8s; 33) was achieved by 70.0% (n = 271), 53.8% (n = 7) and 93.8% (n = 30) of participants

326   performing the test unaided, aided, and aided at baseline only, respectively.

327   *3.2.3 Four-stage balance test (4SBT)*

328   There was a median improvement in the score achieved in the 4SBT for 295 participants

329   (Figure 2C).

330   *{Please insert Figure 2}*

331   **3.3 Secondary outcomes**

332   *3.3.1 Sub-analyses of primary outcomes based on time between assessments*

333   The median time between baseline and follow-up assessments for primary outcomes was 25.0

334   weeks (IQR 24.0, 26.0 weeks; minimum 9.0 weeks; maximum 40.0 weeks). Participant

335   referrals did not always align with the beginning of a 27-week programme. Therefore,

336   participants might have joined an ongoing programme mid-way through or completed their

337   baseline assessments before waiting for a new programme to start, explaining the variation in

338   time between the two assessments. Some functional data was recorded prior to the participants

339   referral date by the referring agency or person, such as a physiotherapist. Repeating the analysis

340   after removal of participants from the first (≤20.7 weeks), tenth (≥29 weeks) or unknown decile

341   for time between assessments (n= 119) did not change the significance of the findings (Table

342   3).

343   *{Please insert Table 3}*

344   *3.3.2 Sub-analyses of primary outcomes based on chronic diseases*

345   Medical history was available for 390 (89.4%) completers with pre- and post-intervention data

346   for at least one primary outcome. Most improvements in primary outcomes remained when

347   stratified by chronic disease presence (eTable 3 in Additional File 1). Fewest improvements

348   are reported in participants with heart failure (HF), and with chronic obstructive pulmonary

349   disease (COPD).

350   *3.3.3 Adherence, attrition, and adverse events*

351   Attendance at each session, as a percentage of the number of expected participants, was 76, 80

352   and 83% during the period 2019-20, 2018-19 and 2017-8, respectively. Attrition was 46.0%

353   (Fig 1.) No illness or injury related to the intervention were recorded during the data collection

354   period.

355   *3.3.4 Factors associated with referral outcome*

356   Completers versus non-completers

357   Baseline demographics for completers and non-completers are shown in Table 2. There was no

358   difference in age, proportion of female participants, BMI, distance from the Staying Steady

359   programme venue, ethnicity, or nature of disability (where present), between completers and

360   non-completers. After removal of inappropriate referrals (n = 185), non-completion was

361   associated with a higher incidence of prescribed oral nutritional support ($\phi = -0.089$, P $= 0.003$),

362   COPD diagnosis ($\phi = -0.110$, P <0.001), higher deprivation ($\phi = -0.103$, P <0.001) and setting

363   a goal of feeling stronger ($\phi = -0.079$, P $= 0.031$).

364   Binomial logistic regression of completion versus non-completion, where non-completion

365   combined dropouts and declined referrals, captured 31.3% (n = 389) of selected cases.

366   Following backwards elimination four variables remained in the final model: prescribed oral

367   nutritional support (P = 0.999), fear of falling (P = 0.005), history of stroke or transient

368   ischaemic attack (P = 0.062) and COPD (P = 0.012). The model was significant (P <0.001),

369   explained between 8 (Cox & Snell R square) and 11% (Nagelkerke R squared) of variation in

370   completion status, and accurately classified 64% of cases. Non-completers were more likely

371   than completers to be prescribed oral nutritional support (n = 1135; RR 11.16, 95% CI 1.50,

372   83.07), and diagnosed with COPD (n = 1092; RR 2.43, 95% CI 1.47, 4.00). When baseline fear

373   of falling was classed as high (Likert scale responses one or two) or low (Likert scale responses

374   four or five; detailed in Table 4), non-completers were more likely than completers to have a

375   high fear of falling (n = 608; RR 1.52, 95% CI 1.19, 1.94). The RR for history of stroke or

376   transient ischaemic attack was not significant (n = 1092; RR 1.27, 95% CI 0.98, 1.64).

377   Completers versus dropouts

378   The same regression model, after removal of declined referrals from the non-completers group

379   (i.e., completers versus dropouts), captured 46.1% (n = 385) of cases. The model was

380   significant (P <0.001), explained between 9 (Cox & Snell R square) and 12% (Nagelkerke R

381   squared) of variation in status, and accurately classified 65% of cases. The same four variables

382   remained after backward elimination; compared to completers, participants who started

383   Staying Steady before dropping out were more likely to be prescribed oral nutritional support

384   (n = 767; RR 10.89, 95% CI 1.39, 85.56), diagnosed with COPD (n = 736; RR 2.74, 95% CI

385   1.61, 4.68), and have a high fear of falling (n = 583; RR 1.58, 95% CI 1.23, 2.01). The RR for

386   stroke or transient ischaemic attack was non-significant (n = 736; 1.33, 95% CI 0.99, 1.78).

387   Completers versus declined referral

388   In addition to variables excluded from previous regression models (BMI, self-referral

389   questionnaire responses and goal setting; section 2.5), ethnicity, use of a walking aid at baseline

390   and PROMs were also excluded from this model due to >40% missing data. The model

391 captured 56.4% of cases (n = 483), was significant (P <0.001), explained between 9 (Cox &

392 Snell R square) and 13% (Nagelkerke R squared) of variation in status, and accurately

393 classified 77% of cases. After backward elimination five variables remained: registered

394 disability (P = 0.045), self-identified disability (P <0.001), prescribed oral nutritional support

395 (P = 0.999), being prescribed statins (P = 0.080) and IMD rank (P <0.001). People who declined

396 a referral were more likely than completers to be prescribed oral nutritional support (n = 788;

397 RR 11.41, 95% CI 1.47, 88.73) and live in an area of high deprivation (n = 824; RR 1.43, 95%

398 CI 1.23, 1.66) and less likely to consider themselves disabled (n = 601; RR 0.68, 95% CI 0.53,

399 0.88). The risk for statin prescription (n = 789; RR 0.97, 95% CI 0.86, 1.09) or registered

400 disability (n = 604; RR 1.04, 95% CI 0.77, 1.40) were non-significant.

401 *3.3.5 Patient reported outcome measures*

402 Participants reported an improvement in their ability to manage their health and daily activities,

403 fear of falling and confidence when walking outside, but not in their social network (Table 4).

404 *{Please insert Table 4}*

405 *3.3.6 Goal setting and evaluation*

406 Goals set at the start of Staying Steady are shown in Table 2. Upon evaluation, completers of

407 Staying Steady achieved their goals through the programme completely (n = 224; 60.4%),

408 partially (n = 128; 34.5%) or not at all (n = 19; 5.1%). Most participants reported that Staying

409 Steady made a difference to them (n = 392; 95.8%); fourteen (3.4%) felt that completing

410 Staying Steady made no difference and three (0.7%) were unsure. The education sessions were

411 considered useful by 352 (92.6%) participants, compared to 17 (4.5%) and 11 (2.9%) who did

412 not find the education useful, or did not receive education, respectively. The difficulty of the

413 exercises was considered just right (n = 273; 94.8%), too easy (n = 4; 1.4%) or too hard (n =

414 11; 3.8%), and most responses indicated the exercises were progressive (n = 334; 87.4%). Most

415   completers planned to continue exercising (n = 361; 94.0%). Thirteen participants (3.4%) were

416   unsure, and ten (2.6%) had no plans to continue exercising. Most completers would recommend

417   Staying Steady to others (n = 405; 98.5%).

418   **4. Discussion**

419   This service evaluation aimed to assess the effectiveness of the Healthworks Staying Steady

420   falls prevention programme to improve physical function and PROMs, using routinely

421   collected data. We also assessed goal setting and evaluation of the programme by completers.

422   Primary findings show significant improvements in the 30-second CS, TUG and 4SBT

423   performance. Improvements in these outcome measures are beneficial, as poor physical

424   function is associated with greater dependence in activities of daily living in older adults (38).

425   Most improvements in physical function remained significant after results were stratified by

426   presence of chronic diseases except for HF and COPD, where fewer improvements in physical

427   function were observed. Factors impacting attrition included presence of COPD, prescribed

428   oral nutritional support, fear of falling, social deprivation and self-identified disability.

429   4.1 Primary outcomes

430   *4.1.1 30-second chair stand test*

431   Greater leg strength is associated with improved quality of life (39) and reduced fall risk (40).

432   We reported improved median CS performance in participants who completed the Staying

433   Steady programme. In comparison, others report no difference in CS performance between

434   patients who attended a 16-week falls prevention programme embedded in primary care,

435   compared to a usual care control group (41). Notably, the multicomponent falls prevention

436   programme assessed by Siegrist and colleagues dedicated six, one-hour sessions to

437   strengthening exercises over the 16-week intervention period (41). A strength training

438   component was included in every Staying Steady exercise session, this may indicate the

439   importance of adequate training volume to gain significant improvements in physical function

440   in adults at risk of falling.

441   Although statistically significant, we report median improvements in CS not exceeding the

442   MDC of 3.9 repetitions (32). The proportion of participants demonstrating an improvement

443   greater than the MDC ranged between 24 and 41% for the CS. However, the magnitude of the

444   effect is likely to be underestimated in the 94 participants who needed a walking aid at baseline,

445   but not follow-up. Enabling someone to stand unaided, when they were previously unable to,

446   is likely to have a meaningful impact on their quality of life which is not captured by the number

447   of repetitions completed in a specified time. In this context, the change in CS ability might still

448   be considered meaningful for these participants, despite the increase in repetitions falling short

449   of the MDC.

450   Twenty-two participants completed the CS unaided at baseline but with assistance at follow-

451   up. The introduction of walking aids after participants were previously able to stand

452   independently suggests declining functional performance, which could translate to a loss of

453   independence in everyday life. Possible reasons for this can be speculated to be deteriorating

454   health, loss of confidence or inconsistent judgement, or instructions from supervising

455   practitioners.

456   *4.1.2 Timed up and go test*

457   Poor performance in the TUG predicts adverse health outcomes in older adults (26).

458   Meaningful improvements in the TUG were achieved by participants who completed both

459   assessments unaided and who needed a walking aid at baseline only. Improvements greater

460   than the MDC were achieved by 70.0 and 93.8%, respectively (33). No statistical improvement

461   in TUG time was seen in thirteen participants who used a walking aid at both timepoints,

462   although the small sample size limits the certainty of this outcome. Interestingly, around half

463   (53.8%) of participants in this group demonstrated an improvement in the TUG greater than

464   the MDC. In comparison, following a previous 16-week falls prevention programme, only

465   24.6% of participants demonstrated an improvement greater than the MDC despite an

466   improvement of any magnitude being reported in 89.3% of participants (11). The greater

467   proportion of participants in the present evaluation achieving a meaningful improvement might

468   be due to use of different population-specific estimates for the MDC. Alternatively, the longer

469   duration of the Staying Steady programme might facilitate greater improvements in physical

470   function.

471   *4.1.3 Four-stage balance test*

472   In the present evaluation, median balance score increased from level two to level three,

473   indicating a reduction in number of participants at high risk of falling (28). Others report that

474   higher baseline Activities-specific Balance Confidence (ABC) Scale score predicted

475   improvements in 4SBT level following a falls prevention intervention (42). The 16-item ABC

476   Scale captures the participants self-reported confidence in maintaining their balance and

477   stability in various everyday environments, including walking outside the house and

478   transferring to or from a car (43). Although the ABC Scale was not used in this evaluation,

479   completers of Staying Steady reported improved confidence when walking outside and reduced

480   fear of falling (Table 4), which might infer improved balance confidence. Although only

481   baseline confidence was previously associated with improved balance (42), presently both

482   confidence-related PROMs and 4SBT score were improved post-intervention. Therefore, it is

483   unclear whether better balance is consequential of improved confidence or vice versa in this

484   cohort.

485   4.2 Impact of chronic disease on functional outcomes

486   Improved CS ability was evident for most subgroups when stratified by chronic diseases,

487   excluding in people with HF and COPD. Sub-group analyses for the unaided TUG remained

488   significant for all groups. Finally, 4SBT scores remained significant when results were

489   stratified by chronic diseases, except in participants with HF. Due to the small sample of

490   participants with HF and COPD, it is difficult to make inferences into the reason for this lack

491   of change.

492   4.3 Factors associated with non-completion

493   Regular exercise attenuates age-related deterioration of muscle strength (44), and reduces falls

494   (45), morbidity, and mortality risk (46). To successfully recruit and retain older adults into

495   exercise interventions, we need to understand the factors that influence participation.

496   People who declined a referral more frequently lived in an area of high deprivation than

497   completers of Staying Steady (35). The influence of social deprivation on poor exercise uptake

498   is likely to be multifactorial (47, 48). Importantly, low socioeconomic status is associated with

499   increased mortality risk (49) and an exaggerated loss in age-related physical function (50)

500   compared to higher socioeconomic status, indicating a greater need for intervention in the

501   former group. Therefore, the results of this study indicate a perpetuation of the Inverse Care

502   Law, whereby health-related interventions are accessed least by those with the greatest need

503   (51). However, the referred participant's perception of their need for intervention is also

504   important to consider. We found that people who declined a referral were less likely than

505   completers to consider themselves disabled. Mobility-related physical disability in older adults

506   can be preventable (52). Thus, falls prevention interventions are often implemented to

507   minimise the impact of disability or dependency in everyday activities. Therefore, the decision

508   to decline a referral might result from a perception of the intervention as unnecessary if the

509   participant is already able to live independently.

510   Presence of COPD was associated with dropping out of Staying Steady. Low quadricep

511   strength (53) and aerobic capacity (54) increase mortality risk in people with COPD. Both

512 variables can potentially be improved with exercise (55), highlighting the importance of

513 encouraging exercise uptake in these patients. In addition, fear of falling and prescribed oral

514 nutritional support influenced non-completion of Staying Steady. Both undernutrition and fear

515 of falling are associated with the frailty phenotype (56), suggesting that the most frail

516 participants are more likely to drop out of exercise interventions. Importantly, frailty can be

517 prevented with regular exercise participation (56). Therefore, strategies to retain these

518 participants in long-term exercise programmes should be investigated.

519 4.4 Acceptability of the intervention

520 Uptake on to Staying Steady (~67% of appropriately referred participants) was lower than

521 average uptake (81%) of exercise referral schemes in Northumberland, UK (57). The reason

522 for most declined referrals was not recorded (41%). The most cited reason for declining a

523 referral was that the participant did not want to engage with the service (Figure 1). Potential

524 reasons for this lack of engagement have been discussed (section 4.3). Evaluation of Staying

525 Steady by completers was overwhelmingly positive (section 3.3.6) and no adverse events

526 associated with Staying Steady were recorded during the evaluation period. However, the

527 reason for most participant drop-outs is unknown (65%). In the absence of follow-up data for

528 non-completers, we cannot exclude that some participants might have dropped out following

529 an adverse intervention effect. The observed dropout, by our definition of completing

530 measurements at baseline but not at follow-up, was similar to Orton and colleagues (12) who

531 reported 348 people at baseline and 203 at follow-up.

532 4.5 Strengths and limitations

533 This evaluation involves a large sample of data collected during routine practice, representing

534 the effectiveness of Staying Steady at a local level. Recent service evaluations have

535 demonstrated the effectiveness of falls prevention programmes based on the FaME intervention

536 to improve physical function (11, 12). The present study complements and extends the findings

537   of existing service evaluations, by providing novel insight into the influence of morbidity on

538   outcome measures and into demographic characteristics influencing attrition and adherence.

539   Limitations include the risk of selection bias that could result in an over-estimation of the effect

540   of the Staying Steady programme. The nature of a retrospective service evaluation is that

541   follow-up data on those who dropped out is unavailable, therefore the effect of the intervention

542   in this group is unknown. However, the intervention was effective in those that completed the

543   programme and we have been able to identify characteristics of those more likely to drop out.

544   The latter can be used to identify the people more likely to drop out to better understand how

545   the service can be changed to meet their needs. Another potential source of bias could be

546   missing data, however, this issue is mitigated by absent data being missing completely at

547   random (30), and therefore unlikely to introduce bias. We acknowledge that some outcome

548   measures may not be tested as rigorously as we would expect in a controlled study, for example,

549   the use of hands to assist with the chair stand may not be accepted methods observed in

550   controlled trials. However, we consider our findings to be pragmatic and more realistic of the

551   target population, as recruitment of older adults with functional limitations to community-

552   delivered exercise programmes is of utmost importance. Furthermore, our findings reflect

553   standard practice in community-delivered exercise programmes allowing us to highlight good

554   practices and recognise areas that require further consideration. Finally, Healthworks aimed to

555   deliver 50 hours of exercise intervention over 27 weeks. Approximately 25 hours were

556   expected to be undertaken at home. This was not monitored so compliance cannot be

557   determined. This may explain some of the variation in responses to the exercise programme.

558   4.6 Implications for practice and future research

559   Overall, Staying Steady appears an effective community-based initiative to engage older adults

560   in falls prevention exercises, resulting in positive outcomes and no reported safety issues.

561   Future research should investigate strategies to encourage adherence in people from areas of

562 high deprivation, with COPD and presenting with frailty-related issues. In practice, continued

563 compliance with guidelines for falls prevention programmes is recommended. Guidelines

564 recommend flexibility in programme delivery to accommodate participant needs (3). The

565 importance of adherence to this guideline in practice is demonstrated by the lack of

566 improvement in outcome measures seen sub-groups of participants with HF and COPD.

567 4.7 Conclusion

568 The Healthworks Staying Steady exercise programme improved 30-second CS, TUG and

569 4SBT performance, in a mixed morbidity cohort of older adults at risk of falling in the

570 Northeast of England. High satisfaction with the programme is evident through participant

571 evaluation of Staying Steady. However, the reasons for a lack of improvement in primary

572 outcomes for people with HF and COPD should be further investigated. Finally, efforts to

573 recruit and retain participants from groups associated with low uptake and adherence are

574 essential.

575

576 **Declarations**

577 Ethics approval and consent to participate

578 Ethical approval was provided by the Northumbria University Health and Life Sciences ethics

579 committee (reference 34401). Permission was granted by Healthworks to audit, evaluate and

580 publish these data. Participants gave informed consent for Healthworks to store their data for

581 monitoring and evaluation purposes. The academic team ensured that legal and ethical

582 standards were met by performing the evaluation in collaboration with Healthworks and in

583 accordance with guidance from the general data protection regulation (GDPR) (Article 89.1)

584 and national institute for health science research UK (NIHR) (19). Where, the processing of

585 healthcare data without consent is permitted for scientific or statistical reasons if data are

586 anonymised and unidentifiable.

587 <u>Consent for publication</u>

588 Not applicable

589 <u>Availability of data and materials</u>

590 The data sets analysed during the current study are available from the corresponding author on

591 reasonable request and with permission of Healthworks. The data sets analysed during the

592 current study are not publicly available because ethics approval for this service evaluation was

593 granted with the condition that published data would be generalised and individual participant

594 data would not be published.

595 <u>Competing interests</u>

596 MA and PC were employed by Healthworks during the period evaluated in this manuscript.

597 Whilst MA and PC were involved in data collection and facilitated access to participant

598 records, they were not involved in the data extraction or analysis. EJ, PO, SN, SG and AO have

599 no competing interests to declare.

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601 No funding was provided for this service evaluation.

602 <u>Authors' contributions</u>

603 EJ: methods, data extraction, analysis and interpretation of data, drafting of the manuscript,

604 revising and editing. PO: methods, analysis, and interpretation of data. PC and MA: acquisition

605 of data and resources. SN and SG: interpretation, revising and editing, supervision. AO:

606 conception of the study, methods, interpretation of data, revising and editing, supervision. All

607   authors read and approved the final manuscript and agree to be accountable for their own

608   contributions.

612   <u>Authors' information</u>

613   Not applicable.

614

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794

List of tables

804

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Additional Files:

File name: Additional File 1_Staying Steady.docx

Content of Additional File 1:

Supplementary Material 1: Goal setting questionnaires provided to participants at the start of the Healthworks Staying Steady 27-week falls prevention programme.

eTable 1. Patient reported outcome measures completed by participants of the Healthworks Staying Steady 27-week falls prevention programme.

eTable 2. Follow-up questionnaires given to participants who completed the Healthworks Staying Steady 27-week falls prevention exercise programme. Follow-up questionnaires and answers were updated from 2017 and are therefore, presented separately by date.

eTable 3. Baseline and follow-up physical function data for participants who completed the Staying Steady 27-week falls prevention programme, stratified by presence of chronic disease

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819
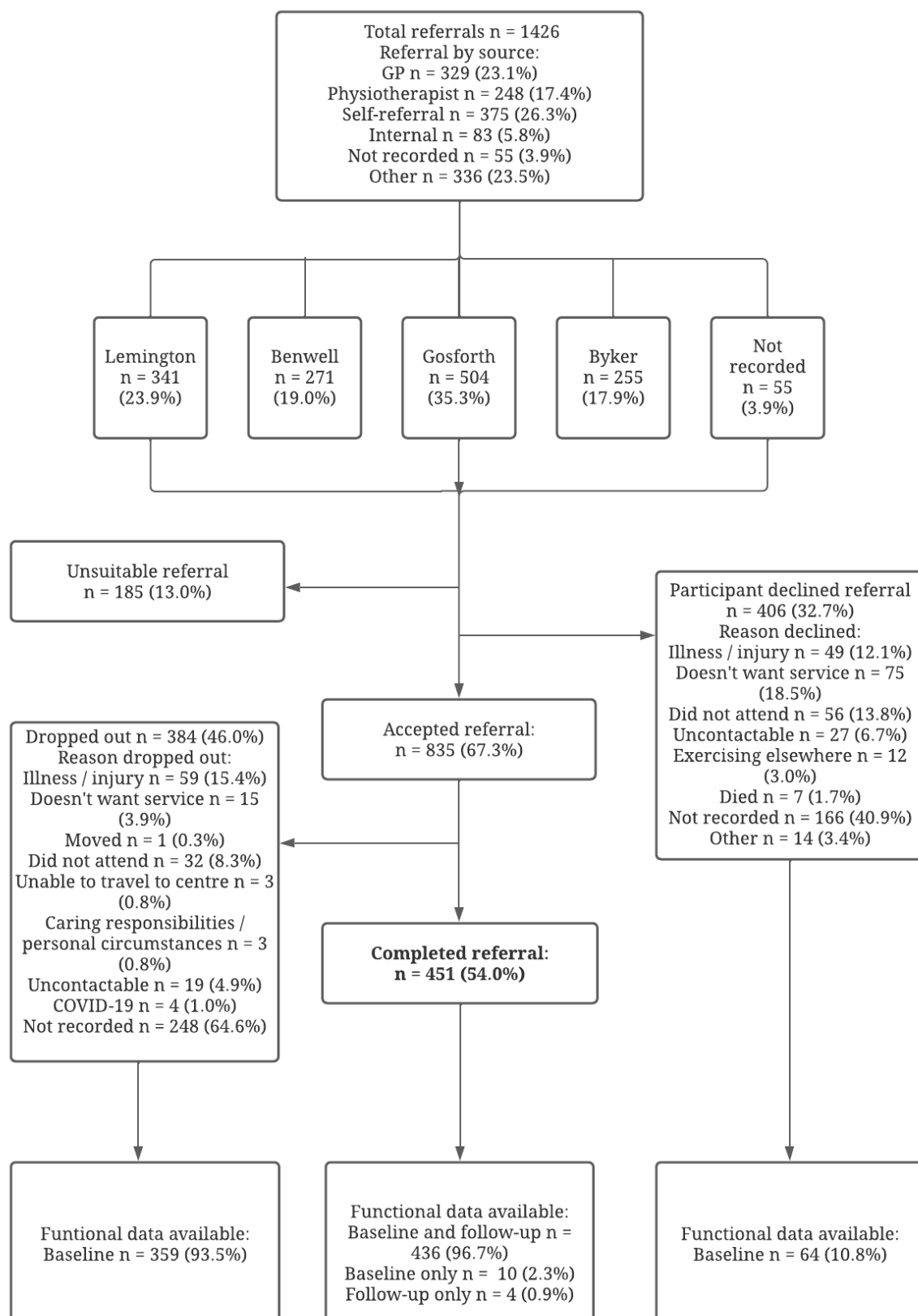
820   Figure 1. Flowchart of referrals to the Staying Steady falls prevention exercise programme at

821   Healthworks Newcastle, between January 2015 and April 2021. Frequencies are represented

822   as a percentage of the number of participants in the level above, except where individual

823   reasons for declines and dropouts are listed. These represent percentages of the participants

824   who declined or dropped out, respectively.

825
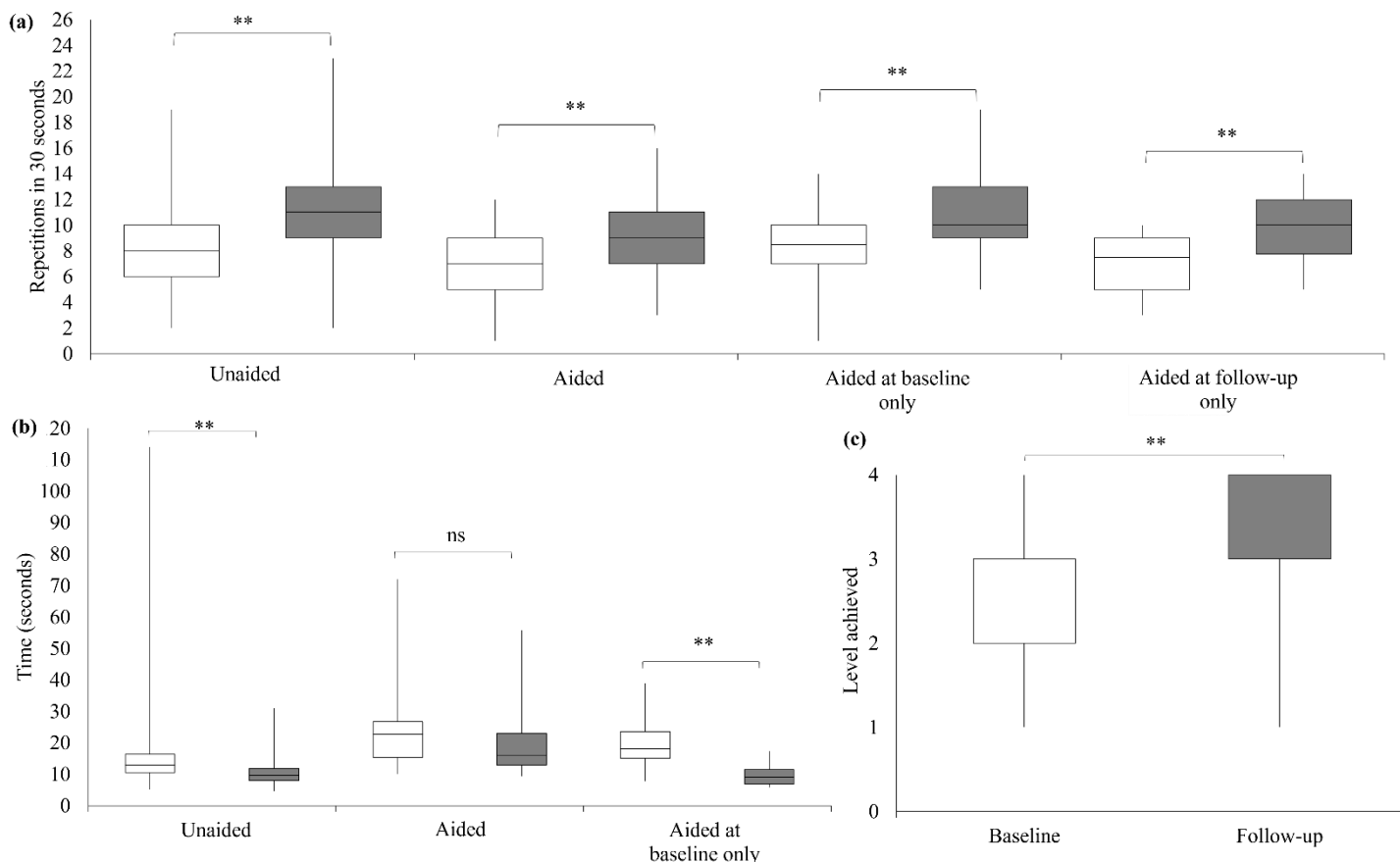
826   Figure 2. Baseline (white box plots) and follow-up (grey box plots) primary outcome data for

827   the (a) 30-second chair stand, (b) Timed up and go, and (c) Four-stage balance test. Participants

828   were grouped based on whether they used arms to chair-stand or used a walking-aid at both

829   timepoints ('aided'), neither timepoint ('unaided'), at baseline but not follow-up ('aided at

830   baseline only'), or at follow-up but not baseline ('aided at follow-up only'). Box plots represent

831   the median, 25th and 75th percentile. Vertical lines represent minimum and maximum values.

832   **P <0.001; ns = not significant at P <0.05. Numerical values shown in Table 3.

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835 Table 3 Overview of the Healthworks Staying Steady 27-week falls prevention exercise

836 programme.

Time point	Duration	Exercise / activity
Baseline assessments		• 30-second chair stand
		• Timed up and go
		• Four-stage balance test
		• Patient reported outcome measures
		• Goal setting
All exercise sessions	10 mins	• Warm-up with mobility exercises
	10 mins	• Cool down
Exercise 1 to 8	5 to 10 mins each	• Aerobic
		• Strength
		• Balance
Education 1	60 mins	• Fall risk factors and fall recovery
Exercise 9 to 16	8 to 10 mins each	• Aerobic
		• Strength
		• Balance
Education 2	60 mins	• Summary of Education 1
		• Continuing exercise after Staying Steady
Exercise 17 to 24	15 to 20 mins	• Aerobic and strength circuits (6 exercises, 2-3 rounds)
	6 mins	• Balance exercises

Follow-up assessments	30-second chair stand - Timed up and go - Four-stage balance test - Patient reported outcome measures - Participant self-evaluation of progress and evaluation of the Staying Steady programme

837

838   Note. Baseline and follow-up outcome measures collected as part of standard practice and

839   typical group-based exercise session content are detailed.

Table 4 Baseline demographics of participants referred to the Staying Steady 27-week falls prevention programme.

Variable	All		Completers		Non-Completers		P-value [a]	P-value [b]
	n	% or median (IQR)	n	% or median (IQR)	n	% or median (IQR)		
Age (years)	1417	80.0 (73.0, 85.0)	448	80.0 (74.0, 84.0)	969	80.0 (72.0, 86.0)	0.879	0.810
Female	1000	70.1%	327	72.5%	673	69.0%	0.182	0.283
Body mass index (kg/m^2)	526	26.8 (23.8, 31.2)	179	27.2 (23.8, 32.1)	347	26.6 (23.7, 30.9)	0.653	0.481
Index of Multiple Deprivation (decile)	1370	5.0 (2.0, 8.0)	437	6.0 (3.0, 9.0)	933	4.0 (2.0, 8.0)	<0.001**	<0.001**
Distance from programme venue (km)	1308	1.87 (1.14, 2.68)	436	1.81 (1.12, 2.81)	873	1.89 (1.17, 2.65)	0.731	0.435
Ethnicity	851							
White (any White background)	809	95.1%	264	96.0%	545	94.6%	0.820	0.767
Mixed British	12	1.4%	3	1.1%	9	1.6%		
Other mixed background	6	0.7%	2	0.7%	4	0.7%		
Asian / Asian British	24	2.8%	6	2.2%	18	3.1%		
Disability								

Registered as disabled	304	29.0%	112	25.6%	192	31.5%	0.038*	0.140
Self-identify as disabled	477	46.0%	198	45.1%	279	46.7%	0.603	0.840
Mobility-related disability	411	39.2%	165	37.6%	246	40.3%	0.369	0.555
Hearing-related disability	142	13.5%	63	14.4%	79	12.9%	0.507	0.504
Sight-related disability	86	8.2%	36	8.2%	50	8.2%	0.990	0.818
Learning-related disability	15	1.4%	6	1.4%	9	1.5%	0.884	0.788
Other disability	49	4.7%	22	5.0%	27	4.4%	0.652	0.596
Medical history	1264						
Cardiac disease	430	34.5%	128	31.8%	302	35.8%	0.171	0.256
Heart failure	55	4.4%	15	3.3%	40	4.7%	0.418	0.307
Coronary heart disease	243	17.0%	78	19.4%	165	19.5%	0.951	0.948
At risk for coronary heart disease	532	42.7%	175	43.5%	357	42.3%	0.681	0.912
Stroke / transient ischemic attack	251	20.1%	68	16.9%	183	21.7%	0.050	0.070
Chronic obstructive pulmonary disease	108	8.7%	18	4.5%	90	10.7%	<0.001**	<0.001**
Osteopenia / osteoporosis	240	16.8%	75	18.7%	165	19.5%	0.709	0.847
Chronic kidney disease	374	26.2%	119	29.6%	255	30.2%	0.826	0.949

Medication	1290							
Cardiac glycoside	32	2.5%	13	3.9%	19	2.2%	0.324	0.223
ACE inhibitor	329	25.5%	99	23.6%	230	26.5%	0.264	0.241
Statin	761	59.0%	254	60.5%	507	58.3%	0.452	0.578
Beta-blocker	348	27.0%	104	24.8%	244	28.0%	0.213	0.224
Nitrates	139	10.8%	39	9.3%	100	11.5%	0.231	0.253
Oral nutrition support	23	1.8%	1	0.2%	22	2.5%	0.004**	0.003**
Self-referral questions								
Falls in the last 12 months (n)	514	1 (0,3)	188	1 (0,3)	326	1 (0,3)	0.842	0.773
Prescribed ≥4 tablets per day	539							
Yes	416	77.2%	144	72.7%	272	79.8%	0.061	0.156
Presence of balance issues	536							
Yes	502	93.7%	185	93.9%	317	93.5%	0.855	0.578
Able to rise from a chair unaided	532							
Yes	253	47.6%	98	50.0%	155	46.1%	0.389	0.691

History of blackout in previous 12 months	526							
Yes	66	12.5%	27	13.8%	39	11.8%	0.490	0.103
Able to stand unaided for five minutes	44							
Yes	30	68.2%	3	60.0%	27	69.2%	0.677	0.845
Goal setting	782							
Reduce fear of falling	456	58.3%	233	57.2%	223	59.5%	0.530	0.893
Feel stronger	453	57.9%	220	54.1%	233	62.1%	0.022*	0.031*
Feel more stable	578	74.0%	299	73.5%	279	74.6%	0.718	0.862
Feel more confident out and about	531	68.0%	270	66.3%	261	69.8%	0.302	0.682
Socialise more	219	28.0%	100	24.6%	119	31.7%	0.026*	0.078
Feel fitter	52[c]	27.1%	37	29.8%	15	22.1%	0.246	0.270
Feel more able to manage my health	21[c]	10.9%	17	13.7%	4	5.9%	0.097	0.103

Note. Number of cases are listed for individual variables due to missing data. "Non-completers" represents declined referrals and those who dropped out following ≥1 session. "Completers" were present until the end of the programme and registered ≥1 follow-up outcome measure. IQR = interquartile range. [a] P-value for difference between completers and non-completers, including all referrals. [b] P-value for difference between

completers and non-completers, after removal of non-completers who were inappropriately referred (n = 185). [c] n = 192 for this outcome. *P

<0.05 **P <0.01

Table 3. Sub-analyses of primary outcomes measures by time between assessments for completers of the Staying Steady programme.

Outcome measure	n	Baseline	Follow-up	P-value	n	Baseline	Follow-up	P-value
		Excluding participants from the first (≤20.7 weeks) and tenth decile (≥29 weeks) for time between assessments [a]			**All completers**			
Chair stand (repetitions)								
Unaided	196	8.0 (6.0, 10.0)	11.0 (9.0, 13.0)	<0.001**	264	8.0 (6.0, 10.0)	11.0 (9.0, 13.0)	<0.001**
Aided	37	7.0 (5.5, 9.0)	9.0 (8.0, 11.0)	<0.001**	54	7.0 (5.0, 9.0)	9.0 (7.0, 11.0)	<0.001**
Aided at baseline only	64	8.5 (6.3, 11.0)	11.0 (9.0, 13.0)	<0.001**	94	8.5 (7.0, 10.0)	10.0 (9.0, 13.0)	<0.001**
Aided at follow-up only	18	6.0 (5.0, 8.3)	10.0 (7.8, 11.3)	<0.001**	22	7.5 (5.0, 9.0)	10.0 (7.8, 12.0)	<0.001**

Timed Up and Go (s)								
Unaided	280	13.0 (10.5, 16.0)	9.7 (8.0, 11.5)	<0.001**	387	13.0 (10.5, 16.4)	9.7 (8.0, 11.9)	<0.001**
Aided	10	21.0 (15.4, 33.3)	16.5 (15.5, 20.9)	0.344	13	22.7 (15.3, 26.7)	16.0 (13.0, 23.0)	0.221
Aided at baseline only	23	18.0 (14.8, 21.1)	12.3 (10.0, 14.3)	<0.001**	32	18.0 (15.0, 23.6)	12.3 (10.0, 14.6)	<0.001**
Four-stage balance test (level)	225	2.0 (2.0, 3.0)	3.0 (3.0, 4.0)	<0.001**	295	2.0 (2.0, 3.0)	3.0 (3.0, 4.0)	<0.001**

Note. Values are median (interquartile range). Participants were grouped based on whether they used arms to chair-stand or used a walking-aid at both timepoints ('aided'), neither timepoint ('unaided'), at baseline but not follow-up ('aided at baseline only'), or at follow-up but not baseline ('aided at follow-up only'). [a] The amount of time between baseline and follow-up assessments was calculated for all completers of Staying Steady. Sub-analyses of primary outcome measures were performed following removal of participants from the first and tenth decile, for the amount of time between assessments. Primary outcome data from all completers are shown in the right-hand column for direct comparison. **P <0.01 between baseline and follow-up

Table 4 Patient reported outcomes from the Healthworks Staying Steady 27-week falls prevention programme.

Domain	Baseline (All)	Baseline (Completers only)	Follow-up (Completers only)	Change
	Median response (IQR) N (%) for individual responses			P-value
How I feel about managing my health				
Total responses	827	419	406	
Median response	4.0 (3.0, 5.0)	4.0 (3.0, 5.0)	4.0 (3.0, 5.0)	<0.001**
1. "I don't feel able to manage"	13 (1.6)	4 (1.0)	6 (1.5)	
2. "It's a struggle and I get a lot of help"	68 (8.2)	30 (7.2)	11 (2.7)	
3. "I get some help from other people"	231 (27.9)	109 (26.0)	89 (21.9)	
4. "I'm okay unless something goes wrong"	305 (36.9)	164 (39.1)	156 (38.4)	
5. "I'm in control and manage well"	210 (25.4)	112 (26.7)	144 (35.5)	

How I feel about managing my daily activities

Total responses	826	417	405	
Median response	3.5 (3.0, 4.0)	4.0 (3.0, 4.0)	4.0 (3.0, 5.0)	<0.001**
1. "I don't feel able to manage"	19 (2.3)	4 (1.0)	3 (0.7)	
2. "It's a struggle and I get a lot of help"	79 (9.6)	34 (8.2)	24 (5.9)	
3. "I get some help from other people"	315 (38.1)	153 (32.4)	116 (28.6)	
4. "I'm okay unless something goes wrong"	241 (29.2)	135 (32.4)	127 (31.4)	
5. "I'm in control and manage well"	172 (20.8)	91 (21.8)	135 (33.3)	

Fear of falling

Total responses	827	418	405	
Median response	4.0 (3.0, 4.0)	4.0 (3.0, 4.0)	4.0 (3.0, 4.0)	<0.001**
1."I hardly go outside now"	81 (9.8)	24 (5.7)	14 (3.5)	
2."I have changed a lot of my activities"	118 (14.3)	56 (13.4)	25 (6.2)	

3. "I have changed some of my activities"	193 (23.3)	94 (22.5)	66 (16.3)	
4. "I worry but won't let it stop me"	375 (45.3)	208 (49.8)	235 (58.0)	
5. "I have no fear of falling"	60 (7.3)	36 (8.6)	65 (14.9)	
My confidence when walking outside				
Total responses	828	419	405	
Median response	3.0 (2.0, 4.0)	3.0 (3.0, 4.0)	4.0 (3.0, 4.0)	<0.001**
1. "I hardly go outside now"	56 (6.8)	20 (4.8)	16 (4.0)	
2. "I have to take someone to help me"	176 (21.3)	72 (17.2)	43 (10.6)	
3. "I only go familiar routes"	233 (28.1)	133 (31.7)	92 (22.7)	
4. "I get nervous sometimes"	264 (31.9)	149 (35.6)	160 (39.5)	
5. "I've got no problem walking outside"	99 (12.0)	45 (10.7)	94 (23.2)	
My social network				
Total responses	828	419	404	
Median response	4.0 (3.0, 5.0)	4.0 (3.0, 5.0)	4.0 (4.0, 5.0)	0.078

1. "I'm alone all the time"	16 (1.9)	2 (0.5)	6 (1.5)
2. "I'm alone frequently"	97 (11.7)	39 (9.3)	31 (7.7)
3. "I'm alone sometimes"	163 (19.7)	85 (20.3)	60 (14.9)
4. "I've got a few good friends"	298 (36.0)	152 (36.3)	162 (40.1)
5. "I've got lots of friends and relations"	254 (30.7)	141 (33.7)	145 (35.9)

Note. **P <0.001. IQR = interquartile range.

Supplementary files

Supplementary Material 1: Goal setting questionnaires provided to participants at the start of the Healthworks Staying Steady 27-week falls prevention programme.

Two versions of the questionnaire are provided, relating to the format used prior to 2017 and from 2017 onwards.

Goal setting questionnaire used by Healthworks for the Staying Steady programme prior to 2017

Participants are asked to choose one goal from the following:

1. I would like to reduce my fear of falling

2. I would like to feel more stable

3. I would like to feel fitter

4. I would like to feel stronger

5. I would like to feel more confident when taking public transport [a]

6. I would like to feel more confident when walking outside [a]

7. I would like to socialise more

8. I would like to feel more able to manage my health

Goal setting questionnaire used by Healthworks for the Staying Steady programme from 2017 onwards

Participants can choose as many as they wish from the following:

1. I would like to reduce my fear of falling

2. I would like to feel more stable

3. I would like to feel stronger

4. I would like to feel more confident out and about

5. I would like to socialise more

Note. Where previously assessed items were later removed from standard practice, these variables were excluded from analysis or grouped with the most similar equivalent in the updated format.

[a] Goals denoted here were grouped under "I would like to feel more confident out and about", to reflect goal number four in the most recent delivery format of Staying Steady.

eTable 1. Patient reported outcome measures ("Current situation") completed by participants of the Healthworks Staying Steady 27-week falls prevention programme.

Domain	Responses prior to 2017	Responses from 2017 onwards
Managing my health	1. I don't feel able to manage 2. It's a struggle but I get by with help 3. I manage with help from others 4. Unless something goes wrong, I manage well 5. I feel in control and I manage well	1. I don't feel able to manage 2. It's a struggle and I get a lot of help 3. I get some help from other people 4. I'm okay unless something goes wrong 5. I'm in control and manage well
Activities of daily living	1. Very poor 2. Poor 3. Average 4. Good 5. Excellent	1. I don't feel able to manage 2. It's a struggle and I get a lot of help 3. I get some help from other people 4. I'm okay unless something goes wrong 5. I'm in control and manage well
Fear of falling	1. Very frightened and I hardly go outside 2. I worry a lot and always think about it	1. I hardly go outside now 2. I have changed a lot of my activities

	3. I've changed some of my activities, but I am ok	3. I have changed some of my activities
	4. I worry about it but it doesn't stop my life	4. I worry but won't let it stop me
	5. I'm not afraid of falling	5. I have no fear of falling
My confidence when walking outside	1. Very poor	1. I hardly go outside now
	2. Poor	2. I have to take someone to help me
	3. Average	3. I only go on familiar routes
	4. Good	4. I get nervous sometimes
	5. Excellent	5. I've got no problems walking outside
My social network	1. I feel alone all the time	1. I'm alone all the time
	2. I feel alone frequently	2. I'm frequently alone
	3. I feel alone sometimes	3. I'm sometimes alone
	4. I feel connected to a few key people	4. I've got a few good friends
	5. I feel connected to lots of people	5. I've got lots of friends and relations

Note. Participants selected one Likert-scale response for each domain from the centre column (prior to 2017) or right column (2017 onwards). Pre-and post- intervention PROMs are presented in Table 4 in the main text. For analysis, responses given prior to 2017 are grouped with their corresponding number in the most recent delivery format.

eTable 2. Follow-up questionnaires given to participants who completed the Healthworks Staying Steady 27-week falls prevention exercise programme.

Question	Answers
Prior to 2017	
Overall, do you feel you have benefited from the Staying Steady programme? [a]	• Yes • No
Did you achieve the goals that you set at the start of the programme? [b]	• Yes • No
Do you have plans to continue exercising?	• Yes • No
Would you recommend the Staying Steady exercise classes to your friends? [c]	• Yes • No
Do you feel the exercises got progressively harder throughout the programme? [d]	• Yes • No
From 2017 onwards	
Have you achieved what you wanted to at the start of the programme? [b]	• Yes • No • Partially
Do you feel Staying Steady has made a difference to you? [a]	• Yes • No
How do you feel it has made a difference	• Free text box
Did you find the education sessions useful?	• Yes • No
Were the exercises:	• Too hard • Too easy

	• Just right
Did they get progressively harder? [d]	• Yes
	• No
Would you recommend Staying Steady to someone else? [c]	• Yes
	• No

Note. Follow-up questionnaires and answers were updated from 2017 and are therefore, presented separately by date. Where previously assessed items were later removed from standard practice, these variables were excluded from analysis or grouped with the most similar equivalent in the updated format. [a, b, c, d] For analysis, variables used prior to 2017 and denoted with a letter were grouped with the corresponding letter variable from 2017 onwards.

eTable 3 Baseline and follow-up physical function data for participants who completed the Staying Steady 27-week falls prevention programme, stratified by presence of chronic disease.

Outcome	Chronic disease								
	All	Cardiac disease	Coronary heart disease	Heart failure	Risk for coronary heart disease	Stroke / transient ischaemic attack	Chronic obstructive pulmonary disease	Osteoporosis / osteopenia	Chronic kidney disease
Chair stand (reps) *Unaided*									
n	264	69	39	6	105	43	7	41	71
Baseline	8.0 (6.0, 10.0)	8.0 (6.0, 10.0)	8.0 (6.0, 10.0)	8.5 (4.8, 10.3)	8.0 (6.0, 10.0)	8.0 (6.0, 10.0)	9.0 (7.0, 11.0)	7.0 (5.0, 9.0)	8.0 (6.0, 10.0)
Follow-up	11.0 (9.0, 13.0)	11.0 (9.0, 13.0)	11.0 (8.0, 12.0)	10.5 (9.5, 12.3)	11.0 (9.0, 12.5)	10.0 (9.0, 12.0)	10.0 (9.0, 11.0)	11.0 (9.0, 12.0)	11.0 (10.0, 12.0)
P	<0.001**	<0.001**	<0.001**	0.063	<0.001**	<0.001**	0.125	<0.001**	<0.001**
Chair stand (reps) *Aided*									

Outcome	Chronic disease								
	All	Cardiac disease	Coronary heart disease	Heart failure	Risk for coronary heart disease	Stroke / transient ischaemic attack	Chronic obstructive pulmonary disease	Osteoporosis / osteopenia	Chronic kidney disease
n	54	19	15	3	18	11	3	10	15
Baseline	7.0 (5.0, 9.0)	7.0 (6.0, 9.0)	7.0 (6.0, 10.0)	5.0 (4.0, 7.0)	6.0 (5.0, 8.3)	7.0 (6.0, 10.0)	12.0 (5.0, 12.0)	7.0 (5.8, 9.3)	7.0 (5.0, 9.0)
Follow-up	9.0 (7.0, 11.0)	10.0 (7.0, 12.0)	10.0 (9.0, 13.0)	5.0 (4.0, 8.0)	9.0 (7.0, 11.3)	9.0 (8.0, 12.0)	12.0 (4.0, 16.0)	10.0 (8.0, 10.3)	10.0 (8.0, 13.0)
P	<0.001**	0.004**	0.022*	1.00	<0.001**	0.016*	1.00	0.070	<0.001**
Chair stand (reps)									
Aided at baseline only									
n	94	25	17	2	41	10	6	16	25
Baseline	8.5 (7.0, 10.0)	8.0 (6.5, 11.0)	8.0 (6.0, 11.0)	5.5 (3.8, 6.3)	8.0 (6.0, 10.0)	7.5 (5.8, 9.3)	10.0 (6.5, 12.3)	8.5 (6.3, 10.8)	8.0 (7.0, 9.5)

Outcome	Chronic disease								
	All	Cardiac disease	Coronary heart disease	Heart failure	Risk for coronary heart disease	Stroke / transient ischaemic attack	Chronic obstructive pulmonary disease	Osteoporosis / osteopenia	Chronic kidney disease
Follow-up	10.0 (9.0, 13.0)	10.0 (9.0, 13.0)	10.0 (9.0, 12.5)	10.0 (7.5, 9.5)	10.0 (8.0, 12.5)	8.0 (7.0, 9.3)	12.5 (10.0, 18.3)	11.0 (8.3, 13.0)	10.0 (8.5, 13.0)
P	<0.001**	0.001**	0.002**	0.500	<0.001**	0.344	0.031*	0.001**	<0.001**
Chair stand (reps) *Aided at follow-up only*									
n	22	12	5	3	6	3	2	3	6
Baseline	7.5 (5.0, 9.0)	8.0 (5.5, 9.0)	7.0 (4.0, 8.0)	8.0 (4.0, 8.0)	5.5 (4.8, 6.8)	9.0 (5.0, 10.0)	6.5 (3.8, 8.3)	8.0 (4.0, 9.0)	6.5 (3.8, 8.3)
Follow-up	10.0 (7.8, 12.0)	11.0 (7.5, 12.8)	11.0 (9.0, 12.5)	5.0 (5.0, 11.0)	9.5 (7.3, 10.3)	10.0 (8.0, 12.0)	9.0 (5.3, 11.3)	7.0 (5.0, 14.0)	9.0 (5.0, 11.0)
P	<0.001**	0.012*	0.063	1.00	0.031*	0.250	0.500	1.00	0.219

Outcome	Chronic disease								
	All	Cardiac disease	Coronary heart disease	Heart failure	Risk for coronary heart disease	Stroke / transient ischaemic attack	Chronic obstructive pulmonary disease	Osteoporosis / osteopenia	Chronic kidney disease
TUG (s) *Unaided*									
n	387	113	69	12	149	52	16	61	104
Baseline	13.0 (10.5, 16.4)	13.2 (11.0, 16.7)	13.3 (11.7, 18.0)	15.1 (11.0, 17.2)	12.9 (10.2, 16.6)	15.0 (11.9, 18.5)	11.6 (9.6, 16.5)	14.0 (11.0, 18.0)	13.4 (10.6, 17.0)
Follow-up	9.7 (8.0, 11.9)	10.0 (8.1, 11.9)	10.7 (8.1, 12.3)	10.8 (9.5, 12.0)	9.5 (8.0, 11.6)	10.9 (8.6, 14.0)	8.6 (6.5, 9.5)	9.9 (8.2, 12.1)	10.2 (8.2, 11.9)
P	<0.001**	<0.001**	<0.001**	0.006**	<0.001**	<0.001**	<0.001**	<0.001**	<0.001**
TUG (s) *Aided*									
n	13	3	1	1	7	2	0	2	5
Baseline	22.7 (15.3, 26.7)	22.7 (17.5,49.2)	/	/	25.0 (13.8, 28.0)	42.9 (10.3, 56.0)	/	38.6 (21.0, 38.8)	25.3 (18.2, 60.6)

Outcome	Chronic disease								
	All	Cardiac disease	Coronary heart disease	Heart failure	Risk for coronary heart disease	Stroke / transient ischaemic attack	Chronic obstructive pulmonary disease	Osteoporosis / osteopenia	Chronic kidney disease
Follow-up	16.0 (13.0, 23.0)	27.0 (12.0, 55.8)	/	/	16.0 (16.0, 18.9)	17.4 (12.0, 15.7)	/	37.3 (14.2, 43.4)	27.0 (17.4, 43.1)
P	0.221	1.00	/	/	0.453	1.00	/	1.00	1.00
TUG (s)									
Aided at baseline only									
n	32	7	4	0	14	10	2	7	5
Baseline	18.0 (15.0, 23.6)	15.7 (14.6, 17.1)	16.8 (9.9, 17.4)	/	19.9 (15.5, 30.8)	15.6 (14.0, 19.3)	18.4 (11.0, 19.0)	18.0 (16.3, 18.7)	17.5 (12.5, 19.5)
Follow-up	12.3 (10.0, 14.6)	12.4 (10.8, 14.0)	11.9 (7.2, 13.6)	/	12.1 (9.8, 15.5)	11.1 (9.7, 13.5)	14.4 (7.5, 15.6)	12.4 (11.5, 13.6)	13.6 (9.1, 14.2)
P	<0.001**	0.016*	0.125	/	<0.001**	0.002**	0.500	0.016*	0.063

Outcome	Chronic disease								
	All	Cardiac disease	Coronary heart disease	Heart failure	Risk for coronary heart disease	Stroke / transient ischaemic attack	Chronic obstructive pulmonary disease	Osteoporosis / osteopenia	Chronic kidney disease
4SBT (level)									
n	295	71	37	9	116	46	16	46	75
Baseline	2.0 (2.0, 3.0)	2.0 (2.0, 3.0)	2.0 (2.0, 3.0)	2.0 (1.5, 3.0)	2.0 (2.0, 3.0)	2.0 (2.0, 3.0)	3.0 (2.0, 3.0)	2.0 (2.0, 3.0)	2.0 (2.0, 3.0)
Follow-up	3.0 (3.0, 4.0)	3.0 (3.0, 4.0)	3.0 (3.0, 3.0)	3.0 (2.0, 3.0)	3.0 (3.0, 4.0)	3.0 (3.0, 3.0)	3.0 (3.0, 4.0)	3.0 (3.0, 4.0)	3.0 (3.0, 4.0)
P	<0.001**	<0.001**	<0.001**	0.727	<0.001**	<0.001**	0.006**	<0.001**	<0.001**

Note. Participants were evaluated separately based on whether they used an aid to perform the test (including a walking aid or used their hands to push themselves up). Values are median (interquartile range). 4SBT= Four-stage balance test; TUG = Timed Up and Go. Participants were grouped based on whether they used arms to chair-stand or used a walking-aid at both timepoints ('aided'), neither timepoint ('unaided'), at baseline but not follow-up ('aided at baseline only'), or at follow-up but not baseline ('aided at follow-up only'). / Denotes insufficient cases for analyses. *P <0.05. between baseline and follow-up. **P <0.01 between baseline and follow-up.