Promotion of healthy ageing within a community center through behavior change: health and fitness findings from the AgeWell pilot randomized controlled trial

Abstract

The purpose of this randomized controlled trial was to determine if behavior change through individual goal setting could promote healthy ageing including health and fitness benefits in older adults who attended a community 'AgeWell' Center for 12 months. Seventy-five older adults were randomly allocated to either a control or goal-setting group. Health outcomes were measured at baseline and after 12 months of the participants having access to the Center facilities. The findings demonstrate that participation in the Center in itself was beneficial with improved body composition and reduced cardiovascular risk in both groups ($p<0.05$), and that this kind of community-based resource offers valuable potential for promoting protective behaviors and reducing health risk. However, a specific focus on identifying individual behavior change goals was required in order to achieve increased activity engagement ($p<0.05$) and to bring about more substantial improvements in a range of health, diet and physical function measures ($p<0.05$).

Keywords

Older adults, goal setting, cardiometabolic risk, body composition, exercise

Introduction

There is now a growing body of evidence that illustrates that promoting physical activity has overall health advantages in older adults (Bauman, Merom, Bull, Buchner, & Fiatarone Singh, 2016; Hart, Benavidez, & Erickson, 2017; Hobbs et al., 2013; Hupin et al., 2015; Kell & Rula, 2019; McPhee et al., 2016; Whitehead & Blaxton, 2017). Health benefits of physical activity in older adults are wide ranging and include the more obvious increases in fitness and strength as well as increases in overall quality of life, physical function, balance, cognitive function (Campisi et al., 2019; Choi, Lee, Lee, & Jung, 2017; Daskalopoulou et al., 2017; Gallaway et al., 2017; Ginis et al., 2017; Hart et al., 2017; Nagai et al., 2018; Trudelle-Jackson & Jackson, 2018), and are also linked to reducing risk of falls, developing chronic health conditions and all-cause mortality (Bauman et al., 2016; Gallaway et al., 2017; Hart et al., 2017; Hupin et al., 2015; Ishigaki, Ramos, Carvalho, & Lunardi, 2014; Ruiz et al., 2008; Taylor, 2014). These benefits have been demonstrated from a variety of different types of exercise interventions, from aerobic based programs, weight training and balance to more general combined lifestyle interventions (Mian et al., 2007; Nagai et al., 2018; Roberts, Phillips, Cooper, Gray, & Allan, 2017; Shanahan et al., 2016; Whitehead & Blaxton, 2017). However, a large proportion of older adults do not meet the current minimal guidelines for physical activity to maintain health (Bauman et al., 2016; Nelson et al., 2007; Trudelle-Jackson & Jackson, 2018) and are reluctant to engage in leisure time physical activity (Crombie et al., 2004; McPhee et al., 2016).

Physical activity is not the only lifestyle contributor to healthy ageing. For the purpose of this study we have used the broader definition of healthy ageing as ‘the process of developing and maintaining the functional ability that enables well-being in older age’ which does not specify lack of illness as a factor (Beard et al., 2016; Svantesson, Jones, Wolbert, & Alricsson, 2015; World Health Organization, 2015). Healthy ageing is likely to derive from a combination of factors, which include healthy lifestyles as well as cognitive, physical and social interactions that together promote a healthy later life. Improvements in cardiovascular risk from increasing physical activity, healthy diets and lifestyles (e.g. smoking and alcohol) have large overall benefits in disease prevention and reversing frailty (Bray, Smart, Jakobi, & Jones, 2016; McPhee et al., 2016; Peel, McClure, & Bartlett, 2005; Valencia, Stoutenberg, & Florez, 2014; Wahlqvist & Saviage, 2000). In addition to this, older adults that are more socially active display higher cognitive and physical health (Anderson et al., 2014; Hosokawa et al., 2019; Marioni et al., 2015; Penninkilampi, Casey, Singh, & Brodaty, 2018; Sommerlad, Sabia, Singh-Manoux, Lewis, & Livingston, 2019). In addition, interventions that target cognitive training, especially in conjunction with physical activity have also demonstrated increased quality of life and functional independence (Anstey, Bahar-Fuchs, Herath, Rebok, & Cherbuin, 2013; Carlson et al., 2008; Thom & Clare, 2011).

The combination of physical, cognitive and social activities in older adults, as well as maintaining healthy diets, may demonstrate additional benefits compared to when these are undertaken in isolation (Anstey et al., 2013; Buford, Anton, Clark, Higgins, & Cooke, 2014; Carlson et al., 2012; Peel et al., 2005; Thom & Clare, 2011). Successfully ageing in at least one of these domains assists older individuals to then be more able to be further physically, cognitively and socially active. Thus, this positive spiral helps to enhance their overall health. Additionally, as there is a heterogeneous older adult population, these combined programs will need to be individually tailored within the local environment in order to maximize health benefits on a large scale (Buford et al., 2014; Hobbs et al., 2013).

Thus one of the crucial challenges is to develop large scale beneficial healthy lifestyle interventions that work cost effectively within the community and will be broadly adopted by older adults (Anstey et al., 2013; Opdenacker, Delecluse, & Boen, 2011). Therefore, the challenge going forward is to apply the obtained evidence and to do so using the most effective ways that not only increase health, cognition and fitness in older adults, but also encourage and support older adults to adopt and maintain healthy lifestyles at a population level (Bauman et al., 2016; Hosokawa et al., 2019; Nelson et al., 2007; Peel et al., 2005; Taylor, 2014). In order to achieve this, there is a need for studies that investigate whether practical lifestyle programs that are integrated into everyday life of older adults are both beneficial to the individuals as well as being sustainable and cost effective within our communities. One potentially successful component to improve health is the addition of behavior change to lifestyle interventions, especially if it is individually tailored or includes provision of local opportunities (Hobbs et al., 2013). The inclusion of goal-setting has been shown to enhance motivation and maintenance of healthy lifestyle programs, though the effectiveness in older adults is less clear in part due to lower quality of evidence (Cheng, 2018; French, Olander, Chisholm, & Mc Sharry, 2014; Hobbs et al., 2013; Levack et al., 2016; Nelis, Thom, Jones, Hindle, & Clare, 2018; Rietkerk et al., 2019; Smit, Bouwstra, Hertogh, Wattel, & van der Wouden, 2019). We have previously published evidence for the effectiveness of a goal-setting intervention in a community Agewell Center (Clare et al., 2015; Jones, Kimberlee, Deave, & Evans, 2013; Nelis et al., 2018). Thus, we plan to explore in detail the health and fitness levels of this cohort of healthy adults over 50 years living in a rural community and determine the potential health-related benefits of engaging in an 'AgeWell' Center, with the addition of a behavior change intervention. The AgeWell Center was a community resource center developed specifically for the use and engagement of over 50 year old's living in the local community to partake in a range of different types of activity to increase physical and cognitive activities around a central core of social interaction.

The main aim of this study is therefore to determine whether engagement in an over 50s community Center for 12 months can improve the health and fitness profiles of community-dwelling older adults. The secondary aims are to determine if promotion of behavior change through a goal-setting intervention results in additional health and fitness benefits in older adults who attend a community AgeWell Center for 12 months compared to those without the additional goal-setting and if there was an impact of physical activity attendance on these health outcomes.

Methods

Participants

Community-living adults aged over 50 years were recruited through the attendee list of a newly established community called the AgeWell Center, in the village Nefyn, Gwynedd, UK. The Center was set up for the purposes of the trial, which offered a range of activities (e.g. fitness, line dancing, tai chi, art, cooking and computer classes) and opportunities for social interaction. Local community-dwelling individuals attending the Center were invited to participate until the target sample size (n=75; Clare et al., 2012) was reached (65 females, 10 males), with five participants lost to follow-up. Sample size calculation was based on anticipated attendance rates. All individuals attending the Center were eligible for inclusion in the study. There were no other inclusion/exclusion criteria. All participants provided written informed consent.

Study design

This small-scale 12-month randomized controlled trial has previously been detailed (Clare et al., 2012; Clare et al., 2015). The trial was a goal-setting intervention that was applied to a group of community living older adults, n=75, that attended the first year of the community resource Center for over-50s in a rural community. The sample size for this feasibility study was based on anticipated attendance rates at the Center. The participants were invited to join the study when they attended the center. After volunteering to partake in the study they were assessed at baseline prior to being randomly allocated to one of two goal-setting interventions or a control group. The main trial findings ascertained that the two goal-setting groups, one with additional bi-monthly telephone mentoring, resulted in similar cognitive and general health benefits. With the primary aim of this study's analysis being to determine if adding goal-setting, of either type, was of greater health benefit than that of the control, i.e. attending the center alone, the two goal-setting groups thus were merged for the analysis of the health outcomes in this study. A range of health and fitness outcome measures were recorded at baseline and after 12 months of the individuals using the Center. All participants had access to Center facilities and resources throughout the trial period and were free to engage in activities of their personal choice either within or external to the Center. The findings of the trial were intended to support the estimation of critical parameters and optimal selection of outcome measures for future, larger-scale trials. The study protocol was approved by the relevant University ethics committee. The trial was registered with Current Controlled Trials, reference ISRCTN30080637 (Clare et al., 2012).

Goal setting intervention

After baseline assessment, the participants were randomly assigned to either a control or one of two goal setting groups, as mentioned above. Once the baseline assessments were completed, random allocation via concealed envelopes was undertaken by NWORTH, the Bangor Clinical trials unit, using a sequentially randomized dynamic adaptive computer algorithm (Russell, Hoare, Whitaker, Whitaker, & Russell, 2011) and incorporating stratification by gender (though with block randomization for couples). For the purpose of this health-focused study, the participants that were randomized into either of the goal setting interventions were pooled into one group to determine the overall benefit of goal setting *per se*, as discussed above. The control group (n = 27) had an interview in which information about Center facilities was discussed. The participants undertaking goal-setting (n = 48) had a structured interview in which they were invited to set up to five individual behavior change goals relating to physical, cognitive and social activity, health and diet. The interviews were conducted using the Bangor Goal Setting Interview process (Clare et al., 2012). Half of these participants (n = 24) were followed up via bi-monthly telephone mentoring to review progress of the selected goals and to encourage success. All interviews were conducted by the same person. For the health and fitness findings of the current analysis, the two goal setting groups were combined and will subsequently be referred to as the 'GS combined' group.

Outcome measures

A primary outcome measure of the trial was engagement in physical activity (via the PASE questionnaire) (Washburn, McAuley, Katula, Mihalko, & Boileau, 1999). Secondary analysis of health assessments included anthropometric data for body mass index (BMI), body composition for body fat percentage (Tanita corp., Tokyo, Japan), waist circumference and waist-to-hip ratio, blood pressure, and blood sampling for total cholesterol and total cholesterol-to-HDL ratio. Calculation of 10-year CVD risk could then be determined using the QRISK2 score (Hippisley-Cox et al., 2008).

Several physical function tests were conducted. These covered agility, strength, balance and flexibility using the timed up and go, 30-second sit to stand, back scratch, and sit and reach tests from the Senior Fitness Test manual (Rikli & Jones, 2012). These tests were assessed after instruction and practice attempts as per the instruction manual. In addition, handgrip strength measured three times on each side (Jamar, IL, USA) (Peters et al., 2011) and the 30-second one-legged balance test with eyes open and closed

(Mian et al., 2007) were assessed. The best score from either right or left side was used for analysis from the back scratch, balance and handgrip tests (Lohne-Seiler, Kolle, Anderssen, & Hansen, 2016; Mian et al., 2007; Rikli & Jones, 2012). Predicted aerobic capacity was estimated from a step test that has been validated and used in a variety of populations, consisting of stepping up a 10 inch step for 3 minutes per stage, for up to a maximum of 3 stages of increasing stepping speed (Cooney et al., 2013; Siconolfi, Garber, Lasater, & Carleton, 1985). Participants were also asked to give a subjective rating of their health as used in the English Longitudinal Study of Ageing (Banks et al., 2019), detail their smoking history and alcohol consumption as well as complete the Mediterranean Diet Adherence Screener (MEDAS) (Schroder et al., 2011) to assess their adherence to a type of healthy diet.

Assessors for all outcome measures were blinded to the group allocation of the participants both at baseline and post intervention. The same assessors were used for the specific outcome measures at baseline and post intervention. All participants received either the GS combined or the control treatment as allocated.

Analyses

Analysis was conducted with IBM SPSS 26. Health outcomes were assessed in two ways. Firstly, initial and follow-up scores were compared using paired t-tests, and effect sizes (Cohen's d) were calculated. Secondly, analysis of covariance with baseline scores entered as the covariate was used to assess between-group differences in follow-up scores and calculate effect sizes using the contrast estimates divided by the square root of the error mean square term. The contrast estimated the benefit of GS combined over the control group.

All variables were examined for homogeneity of variance (Levene's Test), normality of residuals (Shapiro-Wilk Test) and homogeneity of regression slopes. Two measures violated the homogeneity of variance assumption: Up and go; total cholesterol. Results for the Up and Go test and total cholesterol, therefore, should be interpreted with caution.

Results

At baseline the cohort recruited into the study (87% female; 68.2 ± 7.9 years, range 51-84 years; 162.3 ± 8.0 cm; 76.6 ± 13.9 kg; mean ± SD) were found to have a physical functional ability within normal age range and the majority (85.0%) rated their health at the time as good or very good. The participants also rated their health compared to others mostly as average (45%), above average (43%) or excellent (7%), with only 5% rating their health as below average. However, on entry to the study, 43% were classed as obese and another 37% as overweight; 56% were either hypertensive or on medication for hypertension (average blood pressure was 139/79 mmHg); and 83% either had high cholesterol or were on medication for high cholesterol. The average 10-year CVD risk was 19.7 ± 10.5% (moderate risk) with 20% at low risk, 36% moderate risk and 44% at high risk. Of the participants, 28 stated that they had long standing illnesses, including three that had type 2 diabetes, and one with rheumatoid arthritis. Their fitness was low (17.9 ± 3.9 ml/kg/min, n=47) with 35% not able to complete the first stage of the step test.

Of the 75 participants, five participants were lost to follow-up (attrition rate of 6.7%) and 69 attended the Center during the year and participated in the Center activities. The participants attended 34 ± 36 sessions on average (range 0 – 131), from a range of different activities organized at the Center (0-13 different types of activities per person, mean = 2.7 ± 2.5 activities). Of this, the participants attended 29.6 ± 27.0 physical activity sessions, 20.6 ± 22.3 art and craft sessions and 11.5 ± 11.0 cognitive activities over the 12 months. The GS combined group attended slightly more sessions over the year (effect size 0.22), with greater attendance in cognitive activities (e.g. computer classes) ($p<0.05$) and tended to have greater participation in physical activity classes ($p<0.08$) than the Control group, see Table 1.

Insert Table 1

Over the year, 27 participants attended the Center for 20 or more physical activity sessions (mean 46 ± 22 sessions vs 2 ± 3 sessions in the group that attended <20 physical activity sessions). At the end of the 12 months the group that had attended more physical activity sessions had better flexibility (back scratch improvements of 2.0 ± 5.8 vs. -0.7 ± 6.3 cm), were stronger (handgrip improved 3.2 ± 4.8 vs. 0.5 ± 4.9 N) and had attended a greater variety (4 ± 3 vs. 2 ± 1) and total number (64 ± 34 vs. 15 ± 21) of activities than the other group (*p*<0.05). Only six participants had attended on average more than one physical activity session per week at the Center (range 71-109 sessions) in the 12-month period.

After the 12 months both the GS combined and Control groups improved either in body weight or body composition measures, with Controls displaying a decreased weight and BMI (*p*<0.05) and GS combined a decrease in body fat (*p*<0.05, see Table 2), with no difference in effects sizes between the groups in body composition. Although in general both groups were still classified as overweight, fewer were classed as obese (43% at baseline vs 30% at follow-up). Likewise, both groups observed similar improvements in their CV risk profile (QRISK2 score: *p*<0.05, Table 2), with greater numbers being placed on medication for high blood pressure (36% at follow-up vs 26% at baseline). Of the other measures recorded for cardiovascular health, total cholesterol and diastolic blood pressure showed greater improvements in the GS combined group in comparison to the Control group (*p*<0.05). Participants at follow-up rated their health as good (91% rated their health as 'pretty good' or 'very good'). This was despite 20 participants at follow-up stating that they had been diagnosed with a new illness since baseline (7/27 of Controls and 13/48 in the GS combined group), and 36% stating their activities were limited compared to 25% at baseline. In terms of diet (as assessed via MEDAS) neither group changed their dietary habits. However, the GS combined group did decrease the amount of alcohol consumed per week compared to the Control group (*p*<0.05, Table 2).

Insert Table 2

The physical activity levels and fitness of both groups was unchanged after the 12 months, assessed by PASE questionnaire and aerobic capacity testing, respectively (Table 2). In terms of physical function, only the GS combined group improved in some of the measures, with the other measures remaining unaltered in both groups (see Table 2). The GS combined group demonstrated improvements in their lower body strength

/ power, as assessed from the greater number of chair 'sit to stands' ($p<0.05$), their ability to balance with their eyes open ($p<0.05$), and in their physical function/agility they were slightly faster in the time it took them to do the 'up and go' test in comparison to the control group who tended to be slower at follow-up ($p<0.05$).

Discussion

The results of this present study indicate that older adults who attend a community center facility, which offers a wide range of activities, can improve their cardiovascular and physical health. Specifically, older adults who were able to choose to participate in a variety of activities that were offered demonstrated improvements in their body composition and their overall cardiovascular health, as observed by a significant reduction in the QRISK2 score, a global score for CVD risk. Importantly, the present study also shows that the addition of individualized goal setting can increase participation in both cognitive and physical activities and thus result in even further improvements in health outcomes. Older adults who set SMART goals experienced improvements in body composition by reducing their body fat percent, improve their cardiovascular disease risk by improving their total cholesterol, diastolic blood pressure and lowering their alcohol intake, as well as enhancing their physical function by not only improving their lower body strength, but also improving their agility and balance.

Obesity is now classed as a global health problem and is a key player in the etiology of cardiovascular disease and other chronic conditions (Akil & Ahmad, 2011). In older adults, obesity is not only associated with other conditions such as metabolic disease and cancer, but also with functional limitation, disability and a poor quality of life (Valencia et al., 2014). The older adults in the present study who engaged with the community center activities were able to improve their body composition profile and reduce their overall CVD risk. Although we monitored adherence to the Mediterranean diet, which was observed not to change over the intervention, the participants may have made other diet changes not recorded. In addition to this, older adults who took part in setting specific goals for themselves were not only able to improve their body fat percentage and CVD risk but also significantly improved aspects of their physical function and cardiovascular health. The present study suggests the beneficial effects in older adults that attend a community center and employing goal setting strategies have on improving body composition, cardiovascular health and functional ability.

There is a growing body of evidence that suggests regular exercise can improve muscular strength and functional ability in older adults (Chou, Hwang, & Wu, 2012; Fragala et al., 2019; Morse et al., 2005; Roberts et al., 2017; Trudelle-Jackson & Jackson, 2018). This is certainly true for the older adults who underwent goal setting in the current investigation with increased attendance in physical activities in the center that lead to improvements in lower body strength (sit to stand), agility (8 foot up & go) and balance being observed. This improved strength and functional ability is fundamental as it allows older adults to maintain their independence for years to come. Gill et al (2016) carried out the LIFE study (Lifestyle Interventions and Independence for Elders), one of the longest and largest trials of physical activity in older adults to date. Results from this trial showed that older adults who take part in regular exercise can recover quicker from functional limitations and maintain their independence for longer (Gill et al., 2016). The above beneficial effects contribute to the improved quality of life that is often experienced when older adults exercise regularly (Kell & Rula, 2019).

Improvements in muscle strength and function are also likely to reduce future risk of falls. Falls in older adults are considered to be a significant public health problem that can impact on morbidity and mortality and result in significant costs to health and social services (World Health Organization, 2008). Falls can occur due to a variety of extrinsic factors, such as the home environment, and intrinsic factors, such as impaired vision, cognitive deficiencies and muscle weakness and impaired balance (Klenk et al., 2017). There is a growing body of evidence that suggests that the most effective interventions for preventing falls focus on lower limb muscle strengthening and balance training. A systematic review of randomized controlled trials published from 2002 to 2012 concluded that increasing lower limb strength can significantly reduce number of falls in older adults (Ishigaki et al., 2014). The interventions in this systematic review typically investigated community dwelling older adults and included muscle strengthening exercises, activities of daily living, balance training and muscle stretching. The older adults in the present study who took part in the center activities likely completed a combination of these activities over the 12 months (Tai-Chi, Nordic walking, line dancing, aerobics/fitness class). Thus, it likely that the improved lower body muscle strength and agility observed in the older adults of the present study, with the aid of goal setting, could reduce their risk of falls in the future.

Despite improvements in physical function, aerobic capacity remained unchanged in both groups in the current study. Typically, aerobic capacity as measured by VO_2max/peak steadily declines as we age, approximately 8-10% per decade for healthy older adults (Talbot, Metter, & Fleg, 2000). It is thought that this decline could accelerate to 20-25% in healthy adults over 70 years of age (Hollenberg, Yang, Haight, & Tager, 2006). Thus, it is encouraging that attending the center alone and engaging in the physical activities offered by the center resulted in the maintenance of physical fitness (aerobic capacity) in this older population one year on. The literature on the benefits of regular exercise and improving physical fitness in older adults is indisputable. Yet, despite the growing body of evidence that supports this, 3.2 million people die each year from causes attributable to being physically inactive (World Health Organization, 2010). As we age our arteries become stiffer, and this increase in arterial stiffness causes an increase in blood pressure. More than two thirds of adults over the age of 65 years are thought to be hypertensive (Oliveros et al., 2020; Pimenta & Oparil, 2012). Hypertension is thought to increase the risk of developing many chronic conditions common in older adults which include cardiovascular disease, heart failure, stroke, and chronic kidney disease (Oliveros et al., 2020; Pimenta & Oparil, 2012). However, regular exercise can help reduce the risk of developing these conditions in later life by improving blood pressure (Herrod et al., 2018; Oliveros et al., 2020; Wewege, Thom, Rye, & Parmenter, 2018). It must be highlighted again that older adults in the current investigation actually improved their cardiovascular disease risk (QRISK2) despite being one year older. Additionally, we observed a greater number of participants being medicated for high blood pressure at follow-up, suggesting that greater awareness of their health and being proactive regarding their health goals could have facilitated this. This improvement in cardiovascular disease risk is likely multifactorial and probably due to regular center attendance and the goal setting sessions resulting in the improvements on body composition, alcohol intake, total cholesterol, blood pressure and its control.

Interestingly, the participants in the current study generally rated their health as high. This was despite the other health measures as discussed above being poor. The participants' physical function scores were however, within the normal age ranges. It is unclear as to whether this cohort of older adults benchmark their health to others of similar age or are generally happy with their overall health. Previous studies have observed associations with increased self-rated health and higher perceived quality of life and physical health (Henchoz et al., 2017; Kell & Rula, 2019; Svantesson et al., 2015). However, exercise interventions, especially of low intensity, may not necessarily change people's quality of life ratings (Chou et al., 2012) and other factors beyond physical health may be involved in how older adults perceive their overall health (Chen, While, & Hicks, 2015; Henchoz et al., 2017; Strawbridge, Wallhagen, & Cohen, 2002). Also, older adults with chronic conditions may still perceive that they are ageing successfully (Strawbridge et al., 2002). Interestingly, goal-setting has previously been shown to be important for aiding outcome expectations of older adults (Nelis et al., 2018; Rietkerk et al., 2019).

In 2012 the World Health Organization launched a campaign to promote healthy ageing and emphasized the importance of "adding life to years". The current study has demonstrated that this is achievable and that the community center program outlined in the current investigation is an effective way to help older adults adopt and maintain a healthy lifestyle. Our finding that both groups improved their health by attending the community center is also encouraging due to the evidence supporting the association of an increase in social contact, especially with friends in late-middle age, with a decrease in the risk of dementia (Sommerlad et al., 2019), whilst those with poor social engagement have a higher dementia risk (Penninkilampi et al., 2018). Previous research has demonstrated that community centers increase social wellbeing (Jones, Kimberlee, Deave, & Evans, 2013) and encourage social participation in older adults who regularly attend, thus contributing to maintenance of activities of daily living (Hosokawa et al., 2019). Social engagement is thought to lower dementia risk by increasing cognitive reserve and/or due to the social contact affecting subsequent improved health behaviors (Penninkilampi et al., 2018; Sommerlad et al., 2019). Thus, interventions such as the AgeWell study, where older adults are enabled to choose their own activities in a community center, increase the opportunities for spontaneous, organic social engagement that are more likely to extend beyond the length of the intervention. The current shift to highlight prevention strategies to decrease dementia and greater public health approaches to increasing health in older adults is supported by the current study.

The combined goal-setting group in the present study attended more cognitive and physical activity sessions than that of the control group. It is likely that they attended more of these sessions due to setting their own achievable goals across these domains. We have previously reported that goal-setting in this group was observed to be beneficial for the participants and that they found the experience to be motivating and empowering (Nelis et al., 2018). There are also positive indicators that this type of protocol could be adapted for larger scale public health approaches using community centers. Goal-setting approaches embedded into community centers may assist in overcoming the challenge of finding more effective ways to apply current evidence in order to encourage and support older adults to adopt and maintain healthy lifestyles (Anstey et al., 2013; Bauman et al., 2016; Jones et al., 2013; Nelis et al., 2018).

The strengths of the current study involve the intervention being placed in a ‘real-life’ setting and allowing the participants their own choice of activities, with robust research design and assessment. However, inherent to allowing participants the flexibility of choice, there was no overarching ‘control’ of what activities the participants were involved in or offered. On average the current participants only undertook a small number of physical activity classes at the Center (average less than once per week). However, the addition of goal setting to a community center environment may have increased the uptake of certain activities, especially across cognitive and physical domains, as demonstrated by the settings Combined group partaking in more physical and cognitive activities than that of the Control group. Only six participants attended more than 52 physical activity sessions over the year, thus analysis was conducted on those that attended 20 or more sessions versus those that attended less than 20 physical activity sessions.

The participants that attended the greater physical activity sessions had greater flexibility and strength than the others after the intervention. It would be interesting to determine if attendance of the community center is maintained long after this intervention had been completed. Other potential limitations to the study include the possibility of cross-talk between the goal setting groups and the control group and the fact that the study was not powered for all the health-related outcomes presented. A further possible limitation in measuring aerobic capacity could be due to the submaximal test chosen, as approx. a third of participants could not finish the first stage of the test. Though this test has been validated for clinical populations, for example rheumatoid arthritis (Cooney et al., 2013).

In conclusion, these findings demonstrate that participation in the community center itself was beneficial for the health of older adults, and that this kind of community-based resource offers valuable potential for promoting protective behaviors and reducing health risk. However, while the two groups benefitted from participation in Center activities, a specific focus on identifying individual behavior change goals was required in order to achieve increased activity engagement and to bring about more substantial improvements in health and physical function. The 'AgeWell' model for incorporating goal setting to improve health outcomes of older adults living in the community offers a practical solution for larger-scale public health interventions.

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References

Akil, L., & Ahmad, H. A. (2011). Relationships between obesity and cardiovascular diseases in four southern states and Colorado. *J Health Care Poor Underserved, 22*(4 Suppl), 61-72. doi:10.1353/hpu.2011.0166

Anderson, N. D., Damianakis, T., Kroger, E., Wagner, L. M., Dawson, D. R., Binns, M. A., . . . Cook, S. L. (2014). The benefits associated with volunteering among seniors: a critical review and recommendations for future research. *Psychol Bull, 140*(6), 1505-1533. doi:10.1037/a0037610

Anstey, K. J., Bahar-Fuchs, A., Herath, P., Rebok, G. W., & Cherbuin, N. (2013). A 12-week multidomain intervention versus active control to reduce risk of Alzheimer's disease: study protocol for a randomized controlled trial. *Trials, 14*, 60. doi:10.1186/1745-6215-14-60

Banks, J., Batty, G., Coughlin, K., Deepchand, K., Marmot, M., Nazroo, J., . . . A Zaninotto, P. (2019). English Longitudinal Study of Ageing: Waves 0-8, 1998-2017. [data collection]. from UK Data Service

Bauman, A., Merom, D., Bull, F. C., Buchner, D. M., & Fiatarone Singh, M. A. (2016). Updating the Evidence for Physical Activity: Summative Reviews of the Epidemiological Evidence, Prevalence, and Interventions to Promote "Active Aging". *Gerontologist, 56 Suppl 2*, S268-280. doi:10.1093/geront/gnw031

Beard, J. R., Officer, A., de Carvalho, I. A., Sadana, R., Pot, A. M., Michel, J. P., . . . Chatterji, S. (2016). The World report on ageing and health: a policy framework for healthy ageing. *Lancet, 387*(10033), 2145-2154. doi:10.1016/s0140-6736(15)00516-4

Bray, N. W., Smart, R. R., Jakobi, J. M., & Jones, G. R. (2016). Exercise prescription to reverse frailty. *Appl Physiol Nutr Metab, 41*(10), 1112-1116. doi:10.1139/apnm-2016-0226

Buford, T. W., Anton, S. D., Clark, D. J., Higgins, T. J., & Cooke, M. B. (2014). Optimizing the benefits of exercise on physical function in older adults. *Pm r, 6*(6), 528-543. doi:10.1016/j.pmrj.2013.11.009

Campisi, J., Kapahi, P., Lithgow, G. J., Melov, S., Newman, J. C., & Verdin, E. (2019). From discoveries in ageing research to therapeutics for healthy ageing. *Nature, 571*(7764), 183-192. doi:10.1038/s41586-019-1365-2

Carlson, M. C., Parisi, J. M., Xia, J., Xue, Q. L., Rebok, G. W., Bandeen-Roche, K., & Fried, L. P. (2012). Lifestyle activities and memory: variety may be the spice of life. The women's health and aging study II. *J Int Neuropsychol Soc, 18*(2), 286-294. doi:10.1017/s135561771100169x

Carlson, M. C., Saczynski, J. S., Rebok, G. W., Seeman, T., Glass, T. A., McGill, S., . . . Fried, L. P. (2008). Exploring the effects of an "everyday" activity program on executive function and memory in older adults: Experience Corps. *Gerontologist, 48*(6), 793-801.

Chen, Y., While, A. E., & Hicks, A. (2015). Self-rated health and associated factors among older people living alone in Shanghai. *Geriatr Gerontol Int, 15*(4), 457-464. doi:10.1111/ggi.12298

Cheng, W. L. (2018). The effects of mutual goal-setting practice in older adults with chronic illness. *Geriatr Nurs, 39*(2), 143-150. doi:10.1016/j.gerinurse.2017.07.007

Choi, M., Lee, M., Lee, M. J., & Jung, D. (2017). Physical activity, quality of life and successful ageing among community-dwelling older adults. *Int Nurs Rev, 64*(3), 396-404. doi:10.1111/inr.12397

Chou, C. H., Hwang, C. L., & Wu, Y. T. (2012). Effect of exercise on physical function, daily living activities, and quality of life in the frail older adults: a meta-analysis. *Arch Phys Med Rehabil, 93*(2), 237-244. doi:10.1016/j.apmr.2011.08.042

Clare, L., Hindle, J. V., Jones, I. R., Thom, J. M., Nelis, S. M., Hounsome, B., & Whitaker, C. J. (2012). The AgeWell study of behavior change to promote health and wellbeing in later life: study protocol for a randomized controlled trial. *Trials, 13*(1), 115-115. doi:10.1186/1745-6215-13-115

Clare,L.,Hindle,J.V.,Thom,J.M.,Nixon,J.A.,Cooney,J.,Jones,C.L.,... Whitaker, C.J. (2015). The Agewell trial: A pilot randomised controlled trial of a behaviour change intervention to promote healthy ageing and reduce risk of dementia in later life. BMC Psychiatry, 15, 25. doi:10.1186/s12888-015-0402-4

Cooney, J. K., Moore, J. P., Ahmad, Y. A., Jones, J. G., Lemmey, A. B., Casanova, F., . . . Thom, J. M. (2013). A Simple Step Test to Estimate Cardio-Respiratory Fitness Levels of Rheumatoid Arthritis Patients in a Clinical Setting. *International Journal of Rheumatology, 2013*, 1-8. doi:10.1155/2013/174541

Clemens, S., Phelps, A., Oldfield, Z., Blake, M., Oskala, A., Marmot, M., ::: Nazroo, J. (2019). English Longitudinal Study of Ageing: Waves 0-8, 1998-2017. (30th ed.). [data collection] UK Data Service. SN: 5050. doi:10.5255/UKDA-SN-5050-17

Crombie, I. K., Irvine, L., Williams, B., McGinnis, A. R., Slane, P. W., Alder, E. M., & McMurdo, M. E. (2004). Why older people do not participate in leisure time physical activity: a survey of activity levels, beliefs and deterrents. *Age Ageing, 33*(3), 287-292. doi:10.1093/ageing/afh089

Daskalopoulou, C., Stubbs, B., Kralj, C., Koukounari, A., Prince, M., & Prina, A. M. (2017). Physical activity and healthy ageing: A systematic review and meta-analysis of longitudinal cohort studies. *Ageing Res Rev, 38*, 6-17. doi:10.1016/j.arr.2017.06.003

Fragala, M. S., Cadore, E. L., Dorgo, S., Izquierdo, M., Kraemer, W. J., Peterson, M. D., & Ryan, E. D. (2019). Resistance Training for Older Adults: Position Statement From the National Strength and Conditioning Association. *J Strength Cond Res, 33*(8), 2019-2052. doi:10.1519/jsc.0000000000003230

French, D. P., Olander, E. K., Chisholm, A., & Mc Sharry, J. (2014). Which behaviour change techniques are most effective at increasing older adults' self-efficacy and physical activity behaviour? A systematic review. *Ann Behav Med, 48*(2), 225-234. doi:10.1007/s12160-014-9593-z

Gallaway, P. J., Miyake, H., Buchowski, M. S., Shimada, M., Yoshitake, Y., Kim, A. S., & Hongu, N. (2017). Physical Activity: A Viable Way to Reduce the Risks of Mild Cognitive Impairment, Alzheimer's Disease, and Vascular Dementia in Older Adults. *Brain Sci, 7*(2). doi:10.3390/brainsci7020022

Gill, T. M., Guralnik, J. M., Pahor, M., Church, T., Fielding, R. A., King, A. C., . . . Miller, M. E. (2016). Effect of Structured Physical Activity on Overall Burden and Transitions Between States of Major Mobility Disability in Older Persons: Secondary Analysis of a Randomized Trial. *Ann Intern Med, 165*(12), 833-840. doi:10.7326/m16-0529

Ginis, K. A., Heisz, J., Spence, J. C., Clark, I. B., Antflick, J., Ardern, C. I., . . . Rotondi, M. A. (2017). Formulation of evidence-based messages to promote the use of physical activity to prevent and manage Alzheimer's disease. *BMC Public Health, 17*(1), 209. doi:10.1186/s12889-017-4090-5

Hart, P. D., Benavidez, G., & Erickson, J. (2017). Meeting Recommended Levels of Physical Activity in Relation to Preventive Health Behavior and Health Status Among Adults. *J Prev Med Public Health, 50*(1), 10-17. doi:10.3961/jpmph.16.080

Henchoz, Y., Botrugno, F., Cornaz, S., Bula, C., Charef, S., & Santos-Eggimann, B. (2017). Determinants of quality of life in community-dwelling older adults: comparing three cut-offs on the excellent-to-poor spectrum. *Qual Life Res, 26*(2), 283-289. doi:10.1007/s11136-016-1394-3

Herrod, P. J. J., Doleman, B., Blackwell, J. E. M., O'Boyle, F., Williams, J. P., Lund, J. N., & Phillips, B. E. (2018). Exercise and other nonpharmacological strategies to reduce blood pressure in older adults: a systematic review and meta-analysis. *J Am Soc Hypertens, 12*(4), 248-267. doi:10.1016/j.jash.2018.01.008

Hippisley-Cox, J., Coupland, C., Vinogradova, Y., Robson, J., Minhas, R., Sheikh, A., & Brindle, P. (2008). Predicting cardiovascular risk in England and Wales: prospective derivation and validation of QRISK2. *Bmj, 336*(7659), 1475-1482. doi:10.1136/bmj.39609.449676.25

Hobbs, N., Godfrey, A., Lara, J., Errington, L., Meyer, T. D., Rochester, L., . . . Sniehotta, F. F. (2013). Are behavioral interventions effective in increasing physical activity at 12 to 36 months in adults aged 55 to 70 years? A systematic review and meta-analysis. *BMC Med, 11*, 75. doi:10.1186/1741-7015-11-75

Hollenberg, M., Yang, J., Haight, T. J., & Tager, I. B. (2006). Longitudinal changes in aerobic capacity: implications for concepts of aging. *J Gerontol A Biol Sci Med Sci, 61*(8), 851-858. doi:10.1093/gerona/61.8.851

Hosokawa, R., Kondo, K., Ito, M., Miyaguni, Y., Mizutani, S., Goto, F., . . . Ojima, T. (2019). The Effectiveness of Japan's Community Centers in Facilitating Social Participation and Maintaining the Functional Capacity of Older People. *Res Aging, 41*(4), 315-335. doi:10.1177/0164027518805918

Hupin, D., Roche, F., Gremeaux, V., Chatard, J. C., Oriol, M., Gaspoz, J. M., . . . Edouard, P. (2015). Even a low-dose of moderate-to-vigorous physical activity reduces mortality by 22% in adults aged >/=60 years: a systematic review and meta-analysis. *Br J Sports Med, 49*(19), 1262-1267. doi:10.1136/bjsports-2014-094306

Ishigaki, E. Y., Ramos, L. G., Carvalho, E. S., & Lunardi, A. C. (2014). Effectiveness of muscle strengthening and description of protocols for preventing falls in the elderly: a systematic review. *Braz J Phys Ther, 18*(2), 111-118.

Jones, Kimberlee, R., Deave, T., & Evans, S. (2013). The role of community centre-based arts, leisure and social activities in promoting adult well-being and healthy lifestyles. *Int J Environ Res Public Health, 10*(5), 1948-1962. doi:10.3390/ijerph10051948

Kell, K. P., & Rula, E. Y. (2019). Increasing exercise frequency is associated with health and quality-of-life benefits for older adults. *Qual Life Res, 28*(12), 3267-3272. doi:10.1007/s11136-019-02264-z

Klenk, J., Becker, C., Palumbo, P., Schwickert, L., Rapp, K., Helbostad, J. L., . . . Kerse, N. (2017). Conceptualizing a Dynamic Fall Risk Model Including Intrinsic Risks and Exposures. *J Am Med Dir Assoc, 18*(11), 921-927. doi:10.1016/j.jamda.2017.08.001

Levack, W. M., Weatherall, M., Hay-Smith, J. C., Dean, S. G., McPherson, K., & Siegert, R. J. (2016). Goal setting and strategies to enhance goal pursuit in adult rehabilitation: summary of a Cochrane systematic review and meta-analysis. *Eur J Phys Rehabil Med, 52*(3), 400-416.

Lohne-Seiler, H., Kolle, E., Anderssen, S. A., & Hansen, B. H. (2016). Musculoskeletal fitness and balance in older individuals (65-85 years) and its association with steps per day: a cross sectional study. *BMC Geriatr, 16*, 6. doi:10.1186/s12877-016-0188-3

Marioni, R. E., Proust-Lima, C., Amieva, H., Brayne, C., Matthews, F. E., Dartigues, J. F., & Jacqmin-Gadda, H. (2015). Social activity, cognitive decline and dementia risk: a 20-year prospective cohort study. *BMC Public Health, 15*, 1089. doi:10.1186/s12889-015-2426-6

McPhee, J. S., French, D. P., Jackson, D., Nazroo, J., Pendleton, N., & Degens, H. (2016). Physical activity in older age: perspectives for healthy ageing and frailty. *Biogerontology, 17*(3), 567-580. doi:10.1007/s10522-016-9641-0

Mian, O. S., Thom, J. M., Ardigò, L. P., Morse, C. I., Narici, M. V., & Minetti, A. E. (2007). Effect of a 12-month physical conditioning programme on the metabolic cost of walking in healthy older adults. *European Journal of Applied Physiology, 100*(5), 499-505. doi:10.1007/s00421-006-0141-9

Morse, C. I., Thom, J. M., Mian, O. S., Muirhead, A., Birch, K. M., & Narici, M. V. (2005). Muscle strength, volume and activation following 12-month resistance training in 70-year-old males. *European Journal of Applied Physiology, 95*(2-3), 197-204. doi:10.1007/s00421-005-1342-3

Nagai, K., Miyamato, T., Okamae, A., Tamaki, A., Fujioka, H., Wada, Y., . . . Domen, K. (2018). Physical activity combined with resistance training reduces symptoms of frailty in older adults: A randomized controlled trial. *Arch Gerontol Geriatr, 76*, 41-47. doi:10.1016/j.archger.2018.02.005

Nelis, S. M., Thom, J. M., Jones, I. R., Hindle, J. V., & Clare, L. (2018). Goal-setting to Promote a Healthier Lifestyle in Later Life: Qualitative Evaluation of the AgeWell Trial. *Clin Gerontol, 41*(4), 335-345. doi:10.1080/07317115.2017.1416509

Nelson, M. E., Rejeski, W. J., Blair, S. N., Duncan, P. W., Judge, J. O., King, A. C., . . . Castaneda-Sceppa, C. (2007). Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Med Sci Sports Exerc, 39*(8), 1435-1445. doi:10.1249/mss.0b013e3180616aa2

Oliveros, E., Patel, H., Kyung, S., Fugar, S., Goldberg, A., Madan, N., & Williams, K. A. (2020). Hypertension in older adults: Assessment, management, and challenges. *Clin Cardiol, 43*(2), 99-107. doi:10.1002/clc.23303

Opdenacker, J., Delecluse, C., & Boen, F. (2011). A 2-year follow-up of a lifestyle physical activity versus a structured exercise intervention in older adults. *J Am Geriatr Soc, 59*(9), 1602-1611. doi:10.1111/j.1532-5415.2011.03551.x

Peel, N. M., McClure, R. J., & Bartlett, H. P. (2005). Behavioral determinants of healthy aging. *Am J Prev Med, 28*(3), 298-304. doi:10.1016/j.amepre.2004.12.002

Penninkilampi, R., Casey, A. N., Singh, M. F., & Brodaty, H. (2018). The Association between Social Engagement, Loneliness, and Risk of Dementia: A Systematic Review and Meta-Analysis. *J Alzheimers Dis, 66*(4), 1619-1633. doi:10.3233/jad-180439

Peters, M. J., van Nes, S. I., Vanhoutte, E. K., Bakkers, M., van Doorn, P. A., Merkies, I. S., & Faber, C. G. (2011). Revised normative values for grip strength with the Jamar dynamometer. *J Peripher Nerv Syst, 16*(1), 47-50. doi:10.1111/j.1529-8027.2011.00318.x

Pimenta, E., & Oparil, S. (2012). Management of hypertension in the elderly. *Nat Rev Cardiol, 9*(5), 286-296. doi:10.1038/nrcardio.2012.27

Rietkerk, W., Uittenbroek, R. J., Gerritsen, D. L., Slaets, J. P. J., Zuidema, S. U., & Wynia, K. (2019). Goal planning in person-centred care supports older adults receiving case management to attain their health-related goals. *Disabil Rehabil*, 1-10. doi:10.1080/09638288.2019.1672813

Rikli, R., & Jones, J. (2012). *Senior Fitness Test Manual* (2nd Edition ed.). London: Human Kinetics.

Roberts, C. E., Phillips, L. H., Cooper, C. L., Gray, S., & Allan, J. L. (2017). Effect of Different Types of Physical Activity on Activities of Daily Living in Older Adults: Systematic Review and Meta-Analysis. *J Aging Phys Act, 25*(4), 653-670. doi:10.1123/japa.2016-0201

Ruiz, J. R., Sui, X., Lobelo, F., Morrow, J. R., Jr., Jackson, A. W., Sjostrom, M., & Blair, S. N. (2008). Association between muscular strength and mortality in men: prospective cohort study. *Bmj, 337*, a439. doi:10.1136/bmj.a439

Russell, D., Hoare, Z. S., Whitaker, R., Whitaker, C. J., & Russell, I. T. (2011). Generalized method for adaptive randomization in clinical trials. *Stat Med, 30*(9), 922-934. doi:10.1002/sim.4175

Schroder, H., Fito, M., Estruch, R., Martinez-Gonzalez, M. A., Corella, D., Salas-Salvado, J., . . . Covas, M. I. (2011). A short screener is valid for assessing Mediterranean diet adherence among older Spanish men and women. *J Nutr, 141*(6), 1140-1145. doi:10.3945/jn.110.135566

Shanahan, J., Coman, L., Ryan, F., Saunders, J., O'Sullivan, K., Ni Bhriain, O., & Clifford, A. M. (2016). To dance or not to dance? A comparison of balance, physical fitness and quality of life in older Irish set dancers and age-matched controls. *Public Health, 141*, 56-62. doi:10.1016/j.puhe.2016.07.015

Siconolfi, S. F., Garber, C. E., Lasater, T. M., & Carleton, R. A. (1985). A simple, valid step test for estimating maximal oxygen uptake in epidemiologic studies. *Am J Epidemiol, 121*(3), 382-390. doi:10.1093/oxfordjournals.aje.a114010

Smit, E. B., Bouwstra, H., Hertogh, C. M., Wattel, E. M., & van der Wouden, J. C. (2019). Goal-setting in geriatric rehabilitation: a systematic review and meta-analysis. *Clin Rehabil, 33*(3), 395-407. doi:10.1177/0269215518818224

Sommerlad, A., Sabia, S., Singh-Manoux, A., Lewis, G., & Livingston, G. (2019). Association of social contact with dementia and cognition: 28-year follow-up of the Whitehall II cohort study. *PLoS Med, 16*(8), e1002862. doi:10.1371/journal.pmed.1002862

Strawbridge, W. J., Wallhagen, M. I., & Cohen, R. D. (2002). Successful aging and well-being: self-rated compared with Rowe and Kahn. *Gerontologist, 42*(6), 727-733. doi:10.1093/geront/42.6.727

Svantesson, U., Jones, J., Wolbert, K., & Alricsson, M. (2015). Impact of Physical Activity on the Self-Perceived Quality of Life in Non-Frail Older Adults. *J Clin Med Res, 7*(8), 585-593. doi:10.14740/jocmr2021w

Talbot, L. A., Metter, E. J., & Fleg, J. L. (2000). Leisure-time physical activities and their relationship to cardiorespiratory fitness in healthy men and women 18-95 years old. *Med Sci Sports Exerc, 32*(2), 417-425.

Taylor, D. (2014). Physical activity is medicine for older adults. *Postgrad Med J, 90*(1059), 26-32. doi:10.1136/postgradmedj-2012-131366

Thom, J. M., & Clare, L. (2011). Rationale for Combined Exercise and Cognition-Focused Interventions to Improve Functional Independence in People with Dementia. *Gerontology, 57*(3), 265-275. doi:10.1159/000322198

Trudelle-Jackson, E., & Jackson, A. W. (2018). Do Older Adults Who Meet 2008 Physical Activity Guidelines Have Better Physical Performance Than Those Who Do Not Meet? *J Geriatr Phys Ther, 41*(3), 180-185. doi:10.1519/jpt.0000000000000118

Valencia, W. M., Stoutenberg, M., & Florez, H. (2014). Weight loss and physical activity for disease prevention in obese older adults: an important role for lifestyle management. *Curr Diab Rep, 14*(10), 539. doi:10.1007/s11892-014-0539-4

Wahlqvist, M. L., & Saviage, G. S. (2000). Interventions aimed at dietary and lifestyle changes to promote healthy aging. *Eur J Clin Nutr, 54 Suppl 3*, S148-156.

Washburn, R. A., McAuley, E., Katula, J., Mihalko, S. L., & Boileau, R. A. (1999). The physical activity scale for the elderly (PASE): evidence for validity. *J Clin Epidemiol, 52*(7), 643-651.

Wewege, M. A., Thom, J. M., Rye, K. A., & Parmenter, B. J. (2018). Aerobic, resistance or combined training: A systematic review and meta-analysis of exercise to reduce cardiovascular risk in adults with metabolic syndrome. *Atherosclerosis, 274*, 162-171. doi:10.1016/j.atherosclerosis.2018.05.002

Whitehead, B. R., & Blaxton, J. M. (2017). Daily Well-Being Benefits of Physical Activity in Older Adults: Does Time or Type Matter? *Gerontologist, 57*(6), 1062-1071. doi:10.1093/geront/gnw250

World Health Organization. (2008). *WHO global report on falls prevention in older age*. Retrieved from Geneva:

World Health Organization. (2010). *Global recommendations on physical activity for health*. Retrieved from Geneva:

World Health Organization. (2015). *World report on ageing and health*. Retrieved from Geneva, Switzerland: