Motivators and barriers for older people participating in resistance training: A systematic review

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Abstract:

Regular participation in resistance training is important for older people to maintain their health and independence, yet participation rates are low. The study aimed to identify motivators and barriers to older people participating in resistance training. A systematic review was conducted including quantitative, qualitative and mixed-method studies. Searches generated 15,920 citations from six databases, with 14 studies (n=1,937 participants) included. In total, 92 motivators and 24 barriers were identified. Motivators specific to participating in resistance training included preventing deterioration (disability), reducing risk of falls, building (toning) muscles, feeling more alert and better concentration. Looking too muscular and thinking participation increased the risk of having a heart attack, stroke or death, despite the minimal likelihood of these occurring, were barriers. The analysis indicates that increasing participation in resistance training among older people should focus on the specific benefits valued by older people and the dissemination of accurate information to counter misperceptions.

Keywords: Aging, ageing, strength training, weight training, motivators, barriers, systematic review.

INTRODUCTION

The number of older adults (60 years and over) in the United States (US) is projected to double to more than 88 million by 2050 (Vincent & Velkoff, 2010), and one in four people in Australia, or more than six million adults, will be 65 years or over by 2056 (Australian Bureau of Statistics, 2009). As the proportion of older people in many countries grows, it is particularly important for this population to maintain their health and fitness to remain living independently and enjoy a high quality of life. For older people, being physically active for 150 minutes per week is recommended (World Health Organization, 2015) and is associated with improved functional mobility, reduced falls, better health related quality of life and cognitive and mental health (Hupin et al., 2015; A. Taylor et al., 2004).

Physical activity guidelines also suggest that older people participate in strength or resistance training for at least two days a week (Australian Government Department of Health, 2014; World Health Organization, 2015). This is within the minimum 150 minutes guideline and can include activities such as weight training, push-ups and using resistance bands (Australian Government Department of Health, 2014; Office of Disease Prevention and Health Promotion, 2008; World Health Organization, 2015). However, some guidelines are more stringent, such as the recommendation in the United States for older people to undertake at least 150 minutes of moderate intensity aerobic activity "and" also participate in muscle-strengthening activities two or more days a week (Centers for Disease Control and Prevention, 2015).

Resistance training, also known as strength or weight training, increases muscle strength and endurance, reduces sarcopenia, improves bone density (thereby assisting in combating the effects of osteoporosis), improves levels of function necessary for conducting activities of daily living, and reduces the signs and symptoms of arthritis, diabetes, obesity, and depression (Chodzko-Zajko et al., 2009; Liu & Latham, 2009). Exercise (particularly strength and balance training) has also been established as an effective intervention to prevent or reduce

falls for older people living in the community, including those who are at higher risk of falling, and those in hospital or residential care (Cameron et al., 2012; Gillespie et al., 2012).

Although resistance training confers many benefits, there is a small proportion of older people participating on a regular basis. In the United States, 13.5% of people aged 55 years and over and 7.6% over the age of 75 participate in strength training at levels that comply with the US National guidelines (National Center for Health Statistics, 2015). These figures are similar to those in Germany where 10-15% of older people (60 years and over) participate in strength training (Mayer et al., 2011). In Australia, 7-12% of those aged 55 years and over participate in strength training (Humphries, Duncan, & Mummery, 2011; Merom et al., 2012). Because of the small proportion of older people participating in resistance training, a detailed understanding of the barriers and motivators relevant to older people's participation in strength training is required to ensure appropriate exercise promotion strategies are implemented.

In four systematic reviews focusing on physical activity in general (Allender, Cowburn, & Foster, 2006; Baert, Gorus, Mets, Geerts, & Bautmans, 2011; Capel, Schniiert, Snow, & Vyas, 2015; Molanorouzi, Khoo, & Morris, 2015), motivators and barriers have been identified for the oldest old (80 years and above), adults (30-64 years), and the young (18-30 years). The most common motivators were social, health benefits, losing or maintaining weight, developing skills, obligation, achievement, enjoyment and fun, reducing stress and building self-esteem (Allender et al., 2006; Baert et al., 2011; Capel et al., 2015; Molanorouzi et al., 2015). The most common barriers were lack of time, bad weather, cost, lack of energy, poor self-esteem, poor health, pain, fear of being active and feeling tired (Allender et al., 2006; Baert et al., 2011; Capel et al., 2015; Molanorouzi et al., 2015).

While these studies have identified motivators and barriers to being physically active, different forms of exercise may have specific motivators and barriers that are different to those reported for physical activity in general. In particular, these factors may vary considerably by age group, with older people, for example, potentially experiencing different motivators and

barriers for specific forms of activity relative to other population segments. To assist in this process, the objectives of the present study were to review the available evidence to identify factors that constitute motivators and barriers to community-dwelling older people participating in resistance (strength) training programs, and to report the quality indicators of the included studies.

METHOD

Eligibility Criteria

The review was limited to studies meeting the following eligibility criteria:

- Participants: people living in the community aged 60 years and over representing at least 50% of the study sample
- Intervention/Program: for RCTs more than 50% of the intervention time spent on resistance training; for all other studies participants must be involved or not currently involved but considering involvement in resistance training
- Outcomes of interest: motivators and barriers to participation in resistance training
- Methodological approaches/Study design: quantitative research, randomized trials, uncontrolled evaluations, qualitative research, mixed-methods
- Language: studies written in English.

Information Sources and Search Strategy

Six databases (CINAHL, PsycInfo, Medline (ProQuest), PubMed, SPORTDiscus (EBSCO) and Scopus) were searched for articles published between January 1975 and March 2015 that met the eligibility criteria. No unpublished data, books, theses or conference presentations/posters were searched. Reference lists from eligible studies were searched to identify any additional relevant studies. Keywords were used to search in the titles and abstracts of the papers. Table 1 outlines the search strategy undertaken in Medline (ProQuest). Dependent on the database, language and syntax were changed. For example, in PubMed the

title and abstract could be searched simultaneously, but this was not possible for all of the databases. Where it was not the case, only abstracts were searched.

Study Selection

Study selection was undertaken in three stages. Stage one involved one author (KF) scanning titles and excluding studies that did not meet the criteria. In stage two, KF fully screened all abstracts and excluded studies that did not meet the inclusion criteria. In stage three, full articles were read by two authors (KF and EB) to confirm that papers met all criteria. In cases where disagreement occurred, KF and EB discussed whether the article met each of the inclusion criteria until consensus was reached. The PRISMA statement for reporting systematic reviews was used to ensure the methodology and results were conducted and reported systematically (Liberati et al., 2009).

Data Collection Process

The following data were extracted from each of the included studies: design, purpose, country, theoretical frameworks (if applicable), sample size, gender percentages, age (mean), exercise status, frequency and nature of the intervention and identification of the motivators and barriers. Where available, information about the duration and dose of the intervention and the study participants' history of participating in resistance training were also recorded.

Study Quality

Two authors (EB, KF) independently used the Cochrane Collaboration tool (Higgins et al., 2011) for assessing "risk of bias" to assess the methodological quality of the randomized controlled trials included in the review. The tool assesses seven different sources of potential bias including sequence generation (method used to generate randomization to produce comparable groups), allocation concealment (how was the randomization concealed), participant and staff blinding, blinding of outcome assessor, incomplete outcome data, selective outcome reporting and other sources of bias, and inter-rater reliability of the tool has

been reported as fair to substantial (Hartling et al., 2012). Risk of bias was assessed at three different levels: "low risk", "unclear risk", or "high risk" of bias (Higgins et al., 2011).

Quantitative studies, other than randomized controlled trials, were assessed independently for quality by two authors (EB, KF) using the National Institutes of Health – quality assessment tool for observational, cohort and cross-sectional studies (US Department of Health and Human Services, 2014). The tool requires assessors to rate 14 areas including research question, study population, recruitment method, sample size, outcome measures, time to see effect, levels of exposure, exposure measures and assessment, multiple exposure assessment, outcome measures, blinding of outcome assessors, follow-up rate and statistical analyses. Assessment for each question included "yes", "no", "cannot determine", "not applicable" and "not reported".

Studies with a qualitative component were assessed independently for quality by two authors (EB, KF) using the qualitative study methodology checklist from the National Institute for Health and Clinical Excellence (National Institute for Health and Care Excellence (NICE), 2013). In accordance with the NICE checklist, only the qualitative component of mixed design studies was assessed. The methodological aspects assessed included theoretical approach, study design, data collection, validity, analysis and ethics. Assessment for each section was categorized as "yes/good", "no/not good" or "not sure/dubious". For the three quality of study assessments where conflicting assessments were made, both authors reassessed the studies and discussed the cases until consensus was reached.

RESULTS

Study Selection

The study selection process is presented in Figure 1. The database searches generated 15,920 citations in total. After removing duplicates within and then across the databases, 2,292 remained. Studies were first screened by title, then abstract and finally by full-text against the review inclusion criteria. After this process, 13 studies were judged to have met the inclusion

criteria. Reference lists of the 13 included studies were then checked, and one additional study was found to meet the criteria. In total 14 articles were therefore included in the review (Damush, Perkins, Mikesky, Roberts, & O'Dea, 2005; Dionigi, 2007; Harada et al., 2011; Henwood, Tuckett, Edelstein, & Bartlett, 2011; Keogh, Rice, Taylor, & Kilding, 2014; Kleppinger, Litt, Kulldorff, Unson, & Judge, 2003; Lin, Lee, Modeste, & Johnson, 2012; Litt, Kleppinger, & Judge, 2002; Liu-Ambrose et al., 2005; Lübcke, Martin, & Hellström, 2012; O'Brien, Dodd, & Bilney, 2008; Picorelli et al., 2014; Rydeskog, Frändin, & Hansson Scherman, 2005; Sims-Gould, Miran-Khan, Haggis, & Liu-Ambrose, 2012).

The 14 included studies covered three geographical regions, the Americas (n=6) (Bopp, Wilcox, Oberrecht, Kammermann, & McElmurray, 2004; Damush et al., 2005; Kleppinger et al., 2003; Litt et al., 2002; Picorelli et al., 2014; Sims-Gould et al., 2012), Europe (n=2) (Lübcke et al., 2012; Rydeskog et al., 2005) and Asia/Australia/New Zealand (n=6) (Dionigi, 2007; Harada et al., 2011; Henwood et al., 2011; Keogh et al., 2014; Lin et al., 2012; O'Brien et al., 2008). Three of the 14 studies were RCTs (Damush et al., 2005; Kleppinger et al., 2003; Litt et al., 2002). Two of the RCTs used a survey to collect data on motivators and barriers to strength training (Damush et al., 2005; Kleppinger et al., 2003), and the third RCT used face-to-face visits to obtain self-report follow-up data (Litt et al., 2002). The four other quantitative studies also used surveys to obtain their data on motivators and barriers (Harada et al., 2011; Keogh et al., 2014; Lin et al., 2012; Picorelli et al., 2014). Bopp and colleagues (2004) utilized a mixed-method approach including both surveys and focus groups. Six studies utilized a purely qualitative approach: four using interviews (Dionigi, 2007; Lübcke et al., 2012; O'Brien et al., 2008; Rydeskog et al., 2005) and two using focus groups (Henwood et al., 2011; Sims-Gould et al., 2012).

Study Participants

The 14 studies reviewed included 1,937 participants (mean of 223 for the quantitative and mixed-method studies, mean of 25 for the qualitative studies). Study sample sizes ranged from

8 to 414 (on-line supplement, Table 1-3). The average age of the participants was 69.9 years with a range of 50 to 94 years (calculated for the 13 studies where data were available). Six studies included only women (Bopp et al., 2004; Kleppinger et al., 2003; Lin et al., 2012; Litt et al., 2002; Picorelli et al., 2014; Sims-Gould et al., 2012), other sample populations included African Americans and Caucasians (Bopp et al., 2004), older people with knee osteoarthritis (Damush et al., 2005), mature age (average age 72 years) Taiwanese students wishing to learn in later life (Lin et al., 2012) and people with Parkinson's Disease (O'Brien et al., 2008).

Quality of Studies

Using the risk of bias tool the assessment of potential bias of the three RCT studies (Damush et al., 2005; Kleppinger et al., 2003; Litt et al., 2002) indicated that all three studies had a number of methodological weaknesses, particularly in the areas of sequence generation, allocation concealment and blinding, because the information was not available within the articles to assess it fully. The three other areas included in the risk of bias tool (incomplete outcome data, selective reporting and "other" areas not included in the above categories) were all considered to have low risk of bias. Overall, the RCTs were viewed as being low to medium quality studies, because the information in half of the categories required to assess quality were not included in these papers and are considered essential for conducting a high quality RCT (i.e. randomization and blinding processes).

The four cross-sectional studies that were not RCTs were rated "fair" in quality because they met at least half of the criteria, however no studies met all of the criteria assessed against. A number of the questions were more relevant to observational cohorts rather than cross-sectional studies, and in these cases it was recommended by the quality of study tool designers to report the data as "not applicable." Some data may also have not been included due to journal word limits that did not allow authors to provide all methodological details and in these cases "not reported" was assigned to the assessment question. All the studies had clear research questions and three (Harada et al., 2011; Keogh et al., 2014; Lin et al., 2012) of the four studies

described their study populations adequately. Due to the nature of their study (assessing participant adherence rates and functional improvement in two exercise programs (aerobic and resistance training) over 10 weeks with an additional survey exploring adherence specifically), Picorelli and colleagues (2014) conducted the only study that provided a sample size justification, detailed outcome measures and assessor blinding.

The quality of the qualitative studies is presented in accordance with the NICE methodology checklist. The "theoretical approach" (i.e. the approach was appropriate and the studies were clear in what they sought to do), study design (i.e. rigorous methodology used) and methods for collecting data for the qualitative studies (including the mixed-method study, Bopp et al. (2004)) were very good. The role of the researcher was either not described (Dionigi, 2007; Sims-Gould et al., 2012) or unclear (Henwood et al., 2011; Rydeskog et al., 2005) in four studies and the context (participants/setting defined clearly, observations made in sufficient/variety circumstances, context bias considered) was unclear in another three studies (Henwood et al., 2011; O'Brien et al., 2008; Sims-Gould et al., 2012). The ratings indicated the methods were reliable, data analyzed sufficiently and the data deemed 'rich' in the context of all seven studies. The analysis was reliable for all studies except Dionigi (2007), in which it was unclear how many researchers coded and derived themes from the data.

Six studies presented convincing findings. One study's findings were not rated as being clearly described as the themes were too broad to identify barriers and motivators (Sims-Gould et al., 2012). All of the studies reported on findings that were relevant to the aims or objectives and yielded satisfactory conclusions. Three studies (Dionigi, 2007; Lübcke et al., 2012; Rydeskog et al., 2005) did not report ethics committee approval, which prevented determination of whether all ethics issues had been considered.

See supplementary on-line data for tables showing the quality of the studies.

Motivators and Barriers

Tables 2 and 3 present the complete list of motivators and barriers to strength training identified in the studies. The list is divided into three sections using the socioecological framework as a guide (McLeroy, Bibeau, Steckler, & Glanz, 1988). This framework helps to understand whether the motivators or barriers are at the individual, social or environmental level and to better identify strategies that can improve participation in resistance training (Bhatnagar, Shaw, & Foster, 2015). Overall, 92 motivators and 24 barriers were identified. Each study identified and analyzed motivators and barriers in a different manner. As a result it was not possible to compare these in relation to importance or weighting, therefore the motivators and barriers are reported with reference to the study that identified them and how often they were identified by the included studies.

Theoretical Frameworks.

Only five of the 14 studies described a theoretical framework. Of the studies that did, two used Social Cognitive Theory (Damush et al., 2005; Lübcke et al., 2012), one of which also used the Transtheoretical Model of Behavior Change (TTM) (Lübcke et al., 2012). Lübcke and colleagues used the two frameworks to thematically inform their analyses because the TTM model helped to explain behavioral change and individuals' readiness to act and, social cognitive theory explored self-efficacy. The Theory of Planned Behavior (Lin et al., 2012), Grounded Theory (O'Brien et al., 2008) and the Social Learning Model (Litt et al., 2002) were utilized by just one study each.

Individual-level Factors.

There were 64 individual-level motivators and 18 individual-level barriers across the 14 studies. Thirteen of the 14 studies identified at least one individual-level motivator. Seven studies found the physical health benefit of experiencing an increase in strength to be the most common motivator (Bopp et al., 2004; Dionigi, 2007; Henwood et al., 2011; Lübcke et al., 2012; O'Brien et al., 2008; Rydeskog et al., 2005; Sims-Gould et al., 2012). The next most

frequently described motivators were general health benefits (Damush et al., 2005; Henwood et al., 2011; Lin et al., 2012; Lübcke et al., 2012; Picorelli et al., 2014), improved balance (Dionigi, 2007; Henwood et al., 2011; Keogh et al., 2014; Rydeskog et al., 2005; Sims-Gould et al., 2012), physical function benefits (Damush et al., 2005; Dionigi, 2007; Henwood et al., 2011; Keogh et al., 2014; O'Brien et al., 2008) and preventing deterioration (Bopp et al., 2004; Henwood et al., 2011; Lin et al., 2012; O'Brien et al., 2008; Rydeskog et al., 2005).

The most commonly reported mental health benefits, included being more alert, having better concentration and stimulating the mind (Bopp et al., 2004; Henwood et al., 2011; Lin et al., 2012; Rydeskog et al., 2005), general mental fitness benefits (Damush et al., 2005; Dionigi, 2007; Keogh et al., 2014; O'Brien et al., 2008) and improved wellbeing (Damush et al., 2005; Dionigi, 2007; Keogh et al., 2014; Lübcke et al., 2012). Social benefits reported included support from family, spouse, friends and health professionals and feeling a sense of belonging (Bopp et al., 2004; Damush et al., 2005; Henwood et al., 2011; Keogh et al., 2014; Lin et al., 2012; Litt et al., 2002; Picorelli et al., 2014; Sims-Gould et al., 2012). Being able to participate in resistance training even though other types of exercise were not possible for health reasons was not mentioned frequently but appears specific to resistance training (Rydeskog et al., 2005).

Only four of the studies identified the 18 barriers to participating in strength training (Bopp et al., 2004; Keogh et al., 2014; Kleppinger et al., 2003; Lin et al., 2012). Fifteen different barriers were identified by Bopp and colleagues alone. The most commonly reported barriers included poor health (Bopp et al., 2004; Keogh et al., 2014), pain (Bopp et al., 2004; Kleppinger et al., 2003), tiredness/fatigue (Bopp et al., 2004; Kleppinger et al., 2003) and lack of willpower (Bopp et al., 2004; Lin et al., 2012). Two barriers, becoming too muscular and perceived risk of having a heart attack, stroke or death while undertaking resistance training (Bopp et al., 2004), appeared specific to participating in resistance training and may not be found in general physical activity reviews.

Social Factors.

Twelve social motivational factors and two barriers were identified across 13 of the studies, the Kleppinger et al. (2003) study being the only one that did not identify any. The most frequently identified motivator was the gaining of social benefits (also mentioned at an individual level) (Damush et al., 2005; Dionigi, 2007; Henwood et al., 2011; Lübcke et al., 2012; O'Brien et al., 2008; Rydeskog et al., 2005), followed by social support and encouragement from peers or staff (Henwood et al., 2011; Keogh et al., 2014; Lin et al., 2012; Picorelli et al., 2014; Sims-Gould et al., 2012) and giving participants a sense of belonging (Lin et al., 2012; Lübcke et al., 2012; Rydeskog et al., 2005; Sims-Gould et al., 2012). Social support and encouragement from a spouse (Damush et al., 2005), family (Bopp et al., 2004; Lin et al., 2012), friends (Damush et al., 2005; Lin et al., 2012) or health professionals (Damush et al., 2005; Lin et al., 2012) were each mentioned in one or two studies. Harada and colleagues (2011) found observing others being active was a motivating factor for their participants. Only two social barriers were identified in the included studies: family and/or work obligations/responsibilities and a lack of social support (Bopp et al., 2004).

Environmental Factors.

There were 16 environmental motivational factors and four environmental barriers presented across 11 of the studies. Three studies did not include reference to any environmental factors (Bopp et al., 2004; Kleppinger et al., 2003; Litt et al., 2002). The availability of organized exercise was the most common environmental motivating factor (Damush et al., 2005; Henwood et al., 2011; Lübcke et al., 2012; Sims-Gould et al., 2012), followed by having access to facilities or equipment (Damush et al., 2005; Harada et al., 2011; Lübcke et al., 2012), being able to exercise at their own pace and choose the exercises they want to do (Lin et al., 2012; Lübcke et al., 2012; Rydeskog et al., 2005) and going to a specialized “seniors gym” or a facility with a program specific to the population group (Lübcke et al., 2012), such as a program for people with “Parkinson’s Disease” (O'Brien et al., 2008). Four environmental

barriers to participating in strength training were described in the Bopp and colleagues' (2004) study. These included a lack of availability of exercise facilities, moving away from the area, geographical isolation, and lack of availability of strength training programs designed for older people (Bopp et al., 2004). No other studies described environmental barriers to participating in strength training.

DISCUSSION

This systematic review identified 92 motivators and 24 barriers to participating in resistance training for older people (60 years and over) living in the community. While many of these are commonly identified barriers and motivators for general physical activity among members of this age group, some factors appear to be specific to resistance training. For example, individual-level psychological factors such as the perceived risk of a heart attack, stroke or death, and fear of looking too muscular were identified as specific barriers to participation in resistance training. Physical benefits explicitly reported as reasons to participate in resistance training included improved ability to complete daily activities, preventing deterioration and disability and decreasing the risk or fear of falling. Other factors motivating older people were building and toning their muscles, reducing the feeling of isolation and assisting in maintaining relationships and commitments. Some very specific mental function benefits to participating in resistance training were identified, including being more alert, having better concentration and stimulating the mind. Another identified motivator was the suitability of resistance training for those unable to do other forms of exercise.

The majority of the 92 motivators identified were individual-level (n = 64) compared to social (n = 12) and environmental factors (n = 16). The most common individual-level factors were increasing strength and balance, improving health and physical function and preventing deterioration. These factors differ from those previously identified among younger populations undertaking resistance training, such as pregnant women and younger people with cerebral

palsy. These groups reported weight loss, body image and reducing fatigue to be important motivators (O'Dougherty et al., 2008; Petrov Fieril, Fagevik Olsén, Glantz, & Larsson, 2014; Taylor, Dodd, McBurney, & Kerr Graham, 2004). Unfortunately, it was not possible to explore the motivators within and between the included studies for differing older age groups (i.e. young seniors 60-70 years and the very old 80-90 years) because these studies discussed motivators and barriers for the total sample, or separated the samples into groups such as adherers and non-adherers (not age groups/ranges). Given muscle strength declines with age and physical limitations are more common, further research is needed to determine whether there are differences in reasons for participation in resistance training between age subgroups (60-70 years, 70-80 years, 80+ years).

Fifty-eight of the motivators identified by Baert et al. (2011) in their systematic review of studies looking at the motivators for physical activity in the oldest old (studies had to include people aged over 79 years) were also identified in the current review. These included factors such as improved physical/health benefits, reduced pain, better mental health, staying independent and improved confidence. Baert and colleagues did not, however, include improving balance and strength, which was identified in eight of the studies in the current review and appears more relevant to resistance training. Mental health benefits such as improved concentration and stimulating the mind were reported as individual-level motivators in the present review. Other systematic reviews have reported mental health benefits. For example, Franco and colleagues (2015) found physical fitness assisted older people (aged 60 years and over) to stay mentally alert and able to face the day. However, improved concentration and stimulating the mind have not been noted as benefits of being physically active in general and appear to be specific to a subgroup of exercise options for older people, including resistance training.

Having good staff or peer support and social benefits were the most commonly identified social motivating factors for resistance training in the present review and were

consistent with those found by Baert et al. (2011) for older people participating in any physical activity and by Taylor et al. (2004) for younger people with cerebral palsy participating in strength training. In addition, older people feeling like they had a sense of belonging and observing others participating in resistance training were motivators found in this review to be specifically relevant to older people participating in resistance training.

In the present review, exercising at one's own pace, being able to choose which exercises to complete and attending a specialized gym or program such as those for "seniors" or people with "Parkinson's Disease" were environmental factors found to be specific to this population in the context of resistance training. Other identified environmental factors appear to be common to older people engaging in any type of physical activity, such as having easy access to the facility, good transport options, encouragement by knowledgeable staff, affordability, and the program characteristics meeting the needs of older people (Baert et al., 2011).

Six studies included only females (Bopp et al., 2004; Kleppinger et al., 2003; Lin et al., 2012; Litt et al., 2002; Picorelli et al., 2014; Sims-Gould et al., 2012) and there were a number of motivational factors reported specific to these studies. Preventing osteoporosis, increased longevity and strengthening the heart were factors identified by females as were improved concentration, relieving stress, for relaxation and to improve spirituality. Having a social aspect such as because family and friends participate or that they liked group exercise were also included, as was convenient location and attention and supervision by staff (Bopp et al., 2004; Kleppinger et al., 2003; Lin et al., 2012; Litt et al., 2002; Picorelli et al., 2014; Sims-Gould et al., 2012). A study by Wright and colleagues reported the prevalence of osteoporosis in American females (50 years and over) in 2010 to be 15.4% compared to 4.3% in males (Wright et al., 2014). It may be expected therefore that more females would be aware of the disease and the potential bone benefits associated with resistance training and be participating in resistance training for this reason. Gender differences also exist in terms of greater longevity for women

(World Health Organization, 2014), this may also influence the rate of female participation at more advanced ages than males.

Only four studies identified barriers to older people participating in strength training programs and all identified barriers were similar to those found in studies looking at general physical activity/exercise among older people. Individual-level and social barriers included poor health, pain, feeling tired (Burton, Lewin, & Boldy, 2013; Fuller, Stewart Williams, & Byles, 2010), lacking time (Baert et al., 2011; Cohen-Mansfield, Marx, & Guralnik, 2003; Nicholson et al., 2012), social support and family or work obligations (Franco et al., 2015; Sjörs, Bonn, Trolle Lagerros, Sjölander, & Bälter, 2014).

Only one environmental barrier, a lack of age-appropriate programs, was specific to participating in resistance training. The other three environmental barriers have also been reported in studies identifying motivators and barriers to participating in any type of physical activity, and included a lack of exercise facilities, moved away and living in the country (regional/rural areas) which creates feelings of isolation (Baert et al., 2011; Bopp et al., 2004; Keogh et al., 2014).

There were only three barriers that were not specific to the female only studies. These were living somewhere new (moved away), cost and poor health. All other barriers were found to have been identified only by females due to the majority having been identified in the Bopp and colleagues study, which had a female only study population. Further research is required to identify barriers to resistance training for older males and also those wishing to participate in mixed sessions at centers/gymnasiums (males and females combined).

Given the demonstrated importance of regular resistance training (minimum twice weekly) to maintaining health and wellbeing of older people, (Chodzko-Zajko et al., 2009; Frontera & Bigard, 2002; Seguin & Nelson, 2003), local governments, gymnasiums and councils should consider providing targeted (age-appropriate) services for this population. This could include staff training and knowledge of normal changes in performance of resistance

training by older people and appropriate prescription and progression of exercise based on assessment and health status. To be attractive to older people, these services could be promoted by focusing on the positive attributes of resistance training that have been identified as motivators by older people. This could include such factors as increasing muscle strength to improve health and physical functioning, preventing functional decline or deterioration and disability, providing a sense of belonging, feeling more alert and having better concentration and stimulating the mind.

Strengths and Limitations

The rigorous approach to conducting the systematic review was a strength of the study, including the use of different tools to assess the quality of the various methods utilized in the included articles. Overall, the methodological quality of the qualitative studies was good while the quality of the RCTs was low to medium and the cross-sectional (quantitative) studies was fair. The main issue identified with the RCTs was a high risk of selection and performance bias. The quality of the cross-sectional studies was somewhat hard to assess as three of the four studies did not use a pre and post data collection design (Harada et al., 2011; Keogh et al., 2014; Lin et al., 2012). Therefore, in accordance with the quality assessment tool used, the evidence provided by these studies was deemed to be fair (US Department of Health and Human Services, 2014).

A limitation of the studies included in the review was that participants lived in a limited range of locations and predominantly in Anglo-Saxon countries, particularly North America (Bopp et al., 2004; Damush et al., 2005; Kleppinger et al., 2003; Litt et al., 2002; Sims-Gould et al., 2012) and Australia/New Zealand (Dionigi, 2007; Henwood et al., 2011; Keogh et al., 2014; O'Brien et al., 2008). Only two studies were from Asia (Harada et al., 2011; Lin et al., 2012) and Europe (only Sweden) (Lübcke et al., 2012; Rydeskog et al., 2005) respectively. The generalizability of the findings to older people living in different countries, and different situations within them, is therefore uncertain. It is possible that other motivators and barriers

would be identified by older people living in different cultural, social and geographical contexts. Further research in different settings is required.

A second limitation of the review was the focus on the frequency of motivators and barriers mentioned in the included studies, rather than their importance. The 14 studies included in the review presented results in various ways, which limited the ability to determine the relative or absolute importance of each factor per study for this review.

CONCLUSION

Fourteen studies were found that have specifically looked at the motivators and barriers to resistance training in older adults. Large numbers of motivators identified in the studies were also common to studies on physical activity more generally, however some were specific to resistance training. The most frequently identified reasons for commencing and continuing resistance training were health related, such as increasing strength and balance, and improving health and physical function. However, the most important and unique motivators specific to older people participating in resistance training appear to be related to age (longevity), health status and being able to live independently. Examples included preventing deterioration and disability, having the ability to complete daily activities, and decreasing the risk of falling. To increase older people's participation in resistance training, specific barriers need to be overcome. In particular, it appears important to provide more age appropriate programs that allow individuals to choose the type, pace and intensity of the exercises they wish to engage in, especially when they first begin training.

It is recommended that health professionals delivering resistance programs to older people, should not only consider promoting the benefits of improved strength but should also focus on improved health and physical functioning, a sense of belonging, feeling more mentally alert and having better concentration. The beliefs that the training will make someone

too muscular or result in a heart attack, stroke or death also need to be dispelled, particularly in women.

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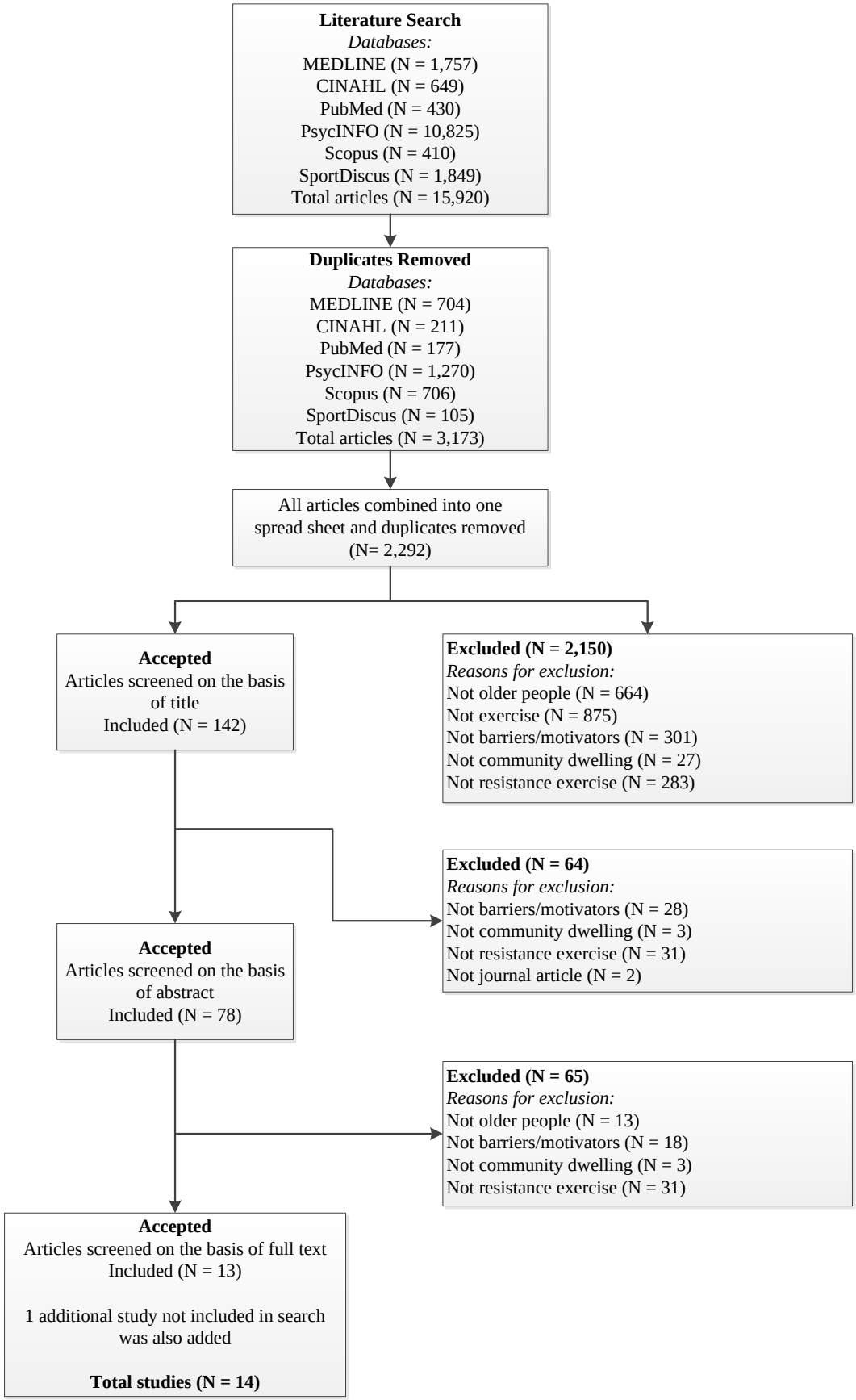

Figure 1. Study selection flow chart

Table 1

Search strategy (according to Medline (ProQuest) terminology)

1	resist* train* ti,ab.
2	strength train* ti,ab.
3	weight train* ti,ab.
4	progress* resist* ti,ab.
5	1 or 2 or 3 or 4
6	barrier* ti,ab.
7	motivate* ti,ab
8	facilitat* ti,ab
9	belie* ti,ab.
10	deter* ti,ab
11	6 or 7 or 8 or 9 or 10
12	old* ti,ab.
13	elder* ti,ab.
14	age* ti,ab.
15	aging ti,ab.
16	12 or 12 or 14 or 15
17	community ti,ab.
18	5 and 11 and 16 and 17

Note. ti is title, ab is abstract

Table 2

Motivators for older people participating in resistance training

Motivators
Individual-level
Physical
Physical fitness benefits including strength, endurance, flexibility, balance and coordination(Bopp et al., 2004; Dionigi, 2007; Henwood et al., 2011; Lübcke et al., 2012; O'Brien et al., 2008; Rydeskog et al., 2005; Sims-Gould et al., 2012)
Health benefits including revitalization(feel younger), improved energy, sleep, appetite, pleasurable body sensations, increased longevity (Dionigi, 2007; Henwood et al., 2011; Kleppinger et al., 2003; Lübcke et al., 2012; O'Brien et al., 2008; Rydeskog et al., 2005)
Physical functioning benefits including walking ability, ease of daily activities, independence, prevent deterioration, disability prevention, decreased risk/fear of falling (Damush et al., 2005; Dionigi, 2007; Henwood et al., 2011; Keogh et al., 2014; O'Brien et al., 2008)
Good health (Kleppinger et al., 2003)
Health scare (Sims-Gould et al., 2012)
Reduce and/or control pain/injury/illness including arthritis, preventing osteoporosis, strengthening the heart, no pain/limitations (Bopp et al., 2004; Damush et al., 2005; Kleppinger et al., 2003)
Appearance benefits (Rydeskog et al., 2005), weight management and build/tone muscles (Bopp et al., 2004; Henwood et al., 2011)
Psychological
Mental function benefits (Bopp et al., 2004; Dionigi, 2007; O'Brien et al., 2008; Picorelli et al., 2014; Rydeskog et al., 2005) including improved alertness, concentration, stimulates the mind and relieves stress/relaxing
Mental health benefits (Bopp et al., 2004; Henwood et al., 2011; Lin et al., 2012; Rydeskog et al., 2005) including, mood, positive outlook, confidence, self-esteem, ‘feel good’, sense of accomplishment/satisfaction, reduced feeling of isolation, emotional problems not interfering with daily activities,

maintaining independence and ability to maintain relationships

Improved wellbeing

Readiness for exercise (Litt et al., 2002), exercise self-efficacy (Litt et al., 2002; Lübcke et al., 2012), enjoy exercising (Damush et al., 2005; Picorelli et al., 2014), increased knowledge, awareness and efficacy using gym equipment (Dionigi, 2007)

Other

Scheduled time for exercise (Damush et al., 2005; Henwood et al., 2011), creates routine (Lübcke et al., 2012; Rydeskog et al., 2005), means of getting out (Rydeskog et al., 2005), level of prior exercise (Litt et al., 2002), past experience with exercise (lengthy history) (Sims-Gould et al., 2012), suitable when unable to do other forms of exercise (Rydeskog et al., 2005), learn more about strength training (O'Brien et al., 2008), challenge to improve (Henwood et al., 2011), aid in research (Damush et al., 2005; Henwood et al., 2011; O'Brien et al., 2008; Sims-Gould et al., 2012), financial reimbursement (Damush et al., 2005), given incentive gift (Lin et al., 2012), enough time (Lübcke et al., 2012), right time/time to focus on self (Sims-Gould et al., 2012), improved spirituality (Picorelli et al., 2014)

Social

Social benefits (Damush et al., 2005; Dionigi, 2007; Henwood et al., 2011; Lübcke et al., 2012; O'Brien et al., 2008; Rydeskog et al., 2005)

Social support and encouragement including peers and staff, spouse, family, friends and health professional (doctor) , increase social activity (Lin et al., 2012; O'Brien et al., 2008), sense of belonging (Lin et al., 2012; Lübcke et al., 2012; Rydeskog et al., 2005; Sims-Gould et al., 2012), observing others being active (Harada et al., 2011), family/friends participate in strength training

Environment

Organized exercise opportunity (Damush et al., 2005; Henwood et al., 2011; Lübcke et al., 2012; Sims-Gould et al., 2012)

Access to exercise facility and/or equipment (Damush et al., 2005; Harada et al., 2011; Lübcke et al., 2012), convenient location (Lin et al., 2012), travel distance (Damush et al., 2005)

Specific to program characteristics including exercising difficulty (Damush et al., 2005), can exercise at own pace/choose exercises (Lin et al., 2012; Lübcke et al., 2012; Rydeskog et al., 2005), structure (Henwood et al., 2011; Keogh et al., 2014), gym atmosphere (Dionigi, 2007; Keogh et al., 2014),

specialized; “senior gym” (Lübcke et al., 2012; Rydeskog et al., 2005), “Parkinson’s disease exercise program” (O'Brien et al., 2008), group exercise (Picorelli et al., 2014)
Staff/instructor characteristics including access to staff (Damush et al., 2005), staff knowledge (Keogh et al., 2014), interaction (Dionigi, 2007), competence (Lübcke et al., 2012), supervision (Picorelli et al., 2014), attention (Sims-Gould et al., 2012)

Table 3

Barriers to older people participating in resistance training

Barriers
Individual-level
Physical
Poor health (Bopp et al., 2004; Keogh et al., 2014), risk of injury/pain (Bopp et al., 2004), pain (Bopp et al., 2004; Kleppinger et al., 2003), tired/fatigue (Bopp et al., 2004; Kleppinger et al., 2003)
Psychological
Lack of willpower (Bopp et al., 2004; Lin et al., 2012), lack of positive attitude (Bopp et al., 2004), low self-efficacy (Bopp et al., 2004), lack of enjoyment (Bopp et al., 2004), too old (Bopp et al., 2004), fear of looking too muscular (Bopp et al., 2004), risk of heart attack/stroke/death (Bopp et al., 2004), emotional problems that interfere with daily living (work, social etc.) (Kleppinger et al., 2003) nervous/depressed (Kleppinger et al., 2003)
Other
Lack of time (Bopp et al., 2004; Lin et al., 2012), lack of knowledge (Bopp et al., 2004), inconvenient (Bopp et al., 2004), cost (Bopp et al., 2004; Keogh et al., 2014), exercise is not a priority (Bopp et al., 2004)
Social
Family and/or work obligations/responsibilities (Bopp et al., 2004), lack of social support (Bopp et al., 2004)
Environment
Lack of exercise facilities (Bopp et al., 2004), moved away (Keogh et al., 2014), geographical location (Bopp et al., 2004), lack of age appropriate programs (Bopp et al., 2004)

On-line Supplementary Data

On-line supplement Table 1

Study Characteristics for Focus Groups

Study, Design Framework	Study Purpose	RT dose (FITPRO), location.	Sample Size; % female; age (years); specific population
Bopp, et al. (2004) United States Cross-sectional *FG and Survey-*	Examine factors influencing strength training (ST) in older rural women.	PA measured using (PASE) (Washburn, Smith, Jette, & Janney, 1993). ST definition: exercises to increase muscle strength and endurance, such as lifting weights or push ups.	FG: 39; 100%; 67.5 ± 9.2 years; 16 African American, 23 Caucasian. Survey: 102; 100%; 70.59 ± 9.21 years; 42 African American, 60 Caucasian
Henwood, et al. (2011) Australia	Investigate the benefits older individuals attribute to RT and the motivational tactics they employed to undertake it.	3 groups; G1: involved in a high-intensity PRT intervention 2/week for 20 weeks, 7 exercises targeting major muscle groups performed on exercise machines at 8RM. G2: previously involved in a high-intensity RT intervention 2/week for 8 weeks, 7 exercises targeting major muscle groups using machine weights for 3 sets of 8 reps at 35, 55, and 75% 1RM. G3: contemplating involvement in RT intervention at a uni gym.	≥65 years; G1: 6; 33%; 67-77 years; G2: 6; 50%; 69-81 years; 4 continued training in 18 months since intervention. G3: 6; 50%; 65-79 years; volunteers interested in aging research (No previous RT)
Sims-Gould et, al. (2012) Canada	Why women joined an exercise program (uptake) and continued (adherence).	12 months: 1/week RT, 2/week RT or Balance and tone (BAT) exercise for 60 min at community or research center. 10 min warm-up, 40 min progressive and high-intensity RT 2 sets of 6-8 reps, 10 min cool down.	84; 100%; 69.6 years

*Note***.** FG, Focus Group; PASE, Physical Activity Scale for the Elderly; RCT, Randomized Control Trial; RT, Resistance Training; ST, Strength Training.

1 On-line supplement Table 2

2 *Study Characteristics for Surveys and RCT*

Study, Design Framework	**Study Purpose**	**RT dose (FITPRO), location.**	**Sample Size; % female; age (years); specific population**
Damush, et al. (2005) United States RCT Secondary analysis of RCT evaluating the efficacy of ST. SCT	Explore personal, social, and environmental motivators to join and continue participating in ST.	Supervised ST or flexibility class, 2/week. Facility-based exercise was gradually tapered after 3 months. After 1 year transferred to home-based exercise program with booklets and a videotape to guide. 5 min walking warm up. 4 exercises targeting all major muscle groups, 3 sets of 8-10 reps, gradual intensity progression. 5 min cool down.	Baseline: 191; 56.5%; 68.71 ± 7.47 years. 12 months: 125; 53%; 67.55 ± 7.55 years 53% with Radiographic knee osteoarthritis
Harada et al. (2011) Japan Cross-sectional	Examine the relationship between ST behavior and perceived environment.	Regular ST: ≥ 2/week, action or maintenance. Not regular ST: pre contemplation, contemplation or preparation.	293; 50.5%, 68.2 ± 2.8 years; 54 (18.4%) regular ST.
Keogh, et al. (2014) New Zealand Cross-sectional	Study 2: examine current participants' perceptions about the benefits of the never2old Active Ageing programme. Study 3: programme retention rates, reasons cited for those discontinuing.	12 fitness centers offering the never2old Active Ageing programme. 12 week Group based RT, 60 min, 2/week, with progression of difficulty and load. 5-10 min warmup. 8 exercises targeting major muscle groups 1-2 sets of 8-12 repetitions. 5-10 min cardiovascular exercise. 5-10 min cool down stretches.	Study 2: 150; 63%; 72 ± 7 years Study 3: 264; 65%; 72 ± 4 years
Kleppinger, et al. (2003) United States RCT	Determine if health perceptions could identify women more likely to	2 year RT program, 3/week 5 min warmup, resistance exercise, 15 min abdomen/lower back exercises, 5 min cool down. Lower body RT: 4 weight loaded (progressively increased) exercises,	189; 100%; 67.4 ± 4.8 years ; estrogen-taking, postmenopausal, not engaged in

	adhere to exercise, particularly during exercise adoption and maintenance phases	3-4 sets of 10 reps. Upper body RT: 4 theraband stretches and 6–7 dumbbell exercises, 2 sets of 10 reps. *Encouraged to walk at least 45 min each week*	regular heavy RT, or physically active >210 min/week
Lin, et al. (2012) Taiwan Cross-sectional TPB	Explore factors that influence decisions to attend SBT programs	SBT: exercises that increase lower-extremity muscle strength and improve postural control.	221; 100%; 72 years; Taiwanese undergraduate students
Litt, et al. (2002) United States RCT Social Learning Model	Determine the extent to which modifiable social learning constructs predicted long-term adherence to an exercise program.	2 year RT program, 3 x week 5 min warmup, RT, 15 min abdomen/lower back exercises, 5 min cool down. Lower body RT: 4 weight loaded (progressively increased) exercises, 3-4 sets - 10 reps. Upper body RT: 4 theraband stretches, 6–7 dumbbell exercises, 2 sets - 10 reps. 0-2 month: 2 classes/week. Encouraged to walk at least 45 min/week.	189; 100%; 67.4 ± 4.8 years; low bone density, receiving estrogen replacement therapy, not engaged in regular heavy RT
Picorelli et al. (2014) Brazil	Assess adherence rates and identify any associated clinical or functional factors.	10 weeks guided ST, 3/week for 50 min. Progressive increase in load. *Aerobic group also assessed*	151; 100%; 70.7 ± 4.9 years *Aerobic: 231; 100%; 70.4 ± 4.64 years*

*Note***.** RCT, Randomized Control Trial; RT, Resistance Training; SBT, Strength and balance training; SCT; Social Cognitive Theory; ST, Strength Training; TPB, Theory of Planned Behavior.

On-line supplement Table 3

Study Characteristics for Interviews

Study, Design Framework	**Study Purpose**	**RT dose (FITPRO), location.**	**Sample Size; % female; age (years); specific population**
Dionigi (2007) Australia	Determine the perceived psychological benefits, explore the mechanisms underlying the link between exercise & psychological well-being.	Supervised RT (3 upper, 3 lower body exercises at 75% 1RM 8-12 reps) and warm up/down (10 min light aerobic activity and stretching), 2/ week for 12 weeks at university gym.	10; 60%, 67.9 years ; selected from group of 28 volunteers involved in a RT intervention.
Lübcke, et al. (2012) Sweden TTM, SCT	Factors influencing older adults to start and continue to exercise in a seniors gym.	Seniors gym located in a paramedical facility, attended through own initiative. 1st visit - physiotherapist gives introduction and designs individualized exercise program	8; 62.5%, 73.5 years
O'Brien, et al. (2008) Australia	Perceptions of a community-based PRST.	10 weeks PRT, 2/week with group of 6-7 people at community health centre and 1/week at home (printed guide) for 60 min. 6 lower limb and 3 upper limb exercises using therabands, 2 sets of 10-12 reps, progressively increased resistance.	13; 23%; 67.8 ± 7 years ; Parkinson's Disease
Rydeskog, et al. (2005) Sweden *Interview* -	Identify and describe older people's experiences of RT	Voluntary and individualized training on resistance machines >6 months, 1-3/week under the supervision of instructors.	15; 53%; 75 years

*Note***.** PRST, Progressive Resistance Strengthening Program; RT, Resistance Training; SCT; Social Cognitive Theory; ST, Strength Training; TTM, Trans-theoretical Model.

On-line supplement Table 4

Assessment of risk of bias for randomized controlled trials

Study	Selection bias		Performance bias	Attrition bias	Reporting bias	Other bias
	Sequence generation	Allocation concealment	Blinding of participants personnel, outcome assessor	Incomplete outcome data	Selective outcome reporting	Free of other bias
Damush et al. (2005)	?	?	?	+	+	+
Kleppinger et al. (2003)	?	?	?	+	+	+
Litt et al. (2002)	?	?	?	+	+	+

Note. Bias was scored as low risk (+), or high risk (-) or unclear (?) (Higgins et al., 2011).

On-line supplement Table 5

Quality of quantitative studies

Study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Rating
Harada et al. (2011)	+	+	+	-	-	NA	NA	NA	+	NA	+	NA	NA	+	Fair
Keogh et al. (2014)	+	+	+	+	-	NA	NA	NA	NR	NA	NR	NA	NA	NA	Fair
Lin et al. (2012)	+	+	+	+	-	NA	NA	NA	NA	NA	+	NA	NA	+	Fair
Picorelli et al. (2014)	+	-	+	+	+	-	+	NA	+	-	+	+	-	NR	Fair

Note. + = yes, - = no, NA = not applicable, NR = not reported. 1: Was research question clearly stated?; 2: was population specified and defined; 3: was participation rate at least 50%?; 4: were subjects from similar populations?; 5: sample size etc. provided; 6: were exposures measured prior to outcomes?; 7: was timeframe for study sufficient?; 8: were different levels of exposure examined?; 9: were the exposure measures clearly defined, valid, reliable?; 10: was exposure assessed more than once?; 11: were the outcome measures clearly defined, reliable, valid?; 12: were outcome assessors blinded?; 13: was loss to follow-up less than 20%?; 14: were confounding variables measured and adjusted for in analysis? (US Department of Health and Human Services, 2014).

On-line supplement Table 6

Quality of qualitative studies

Study	**1.1**	**1.2**	**2.1**	**3.1**	**4.1**	**4.2**	**4.3**	**5.1**	**5.2**	**5.3**	**5.4**	**5.5**	**5.6**	**6.1**
Bopp et al. (2004)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Dionigi (2007)	+	+	+	+	-	+	+	+	+	?	+	+	+	-
Henwood et al. (2011)	+	+	+	+	?	?	+	+	+	+	+	+	+	+
Lübcke et al. (2012)	+	+	+	+	+	+	+	+	+	+	+	+	+	-
O'Brien et al. (2008)	+	+	+	+	+	?	+	+	+	+	+	+	+	+
Sims-Gould et al. (2012)	+	+	+	+	-	?	+	+	+	+	?	+	+	+
Rydeskog et al. (2005)	+	+	+	+	?	+	+	+	+	+	+	+	+	-

Note. + = yes or good, - = no/not good (not described), ? = unclear. 1.1: is qualitative approach appropriate?; 1.2: study clear in what it seeks to do?; 2.1: is research design/methodology rigorous?; 3.1: was data collection carried out well?; 4.1: is the researcher role clearly described?; 4.2: is context clearly described?; 4.3: were methods reliable?; 5.1: is data analysis rigorous?; 5.2: are the data 'rich'?; 5.3: is the analysis reliable?; 5.4: are findings convincing?; 5.5: are findings relevant to the study?; 5.6: are conclusions adequate?; 6.1: are ethical considerations reported clearly and coherently (National Institute for Health and Care Excellence (NICE), 2013). Bopp et al (2004) was a mixed-methods study.