Published in final edited form as:
Br J Sports Med. 2009 February ; 43(2): 114–119. doi:10.1136/bjsm.2008.049361.

Initiating and maintaining resistance training in older adults: a social cognitive theory-based approach

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Abstract

Numerous research studies performed in "lab-gyms" with supervised training have demonstrated that simple, brief (20–30 min) resistance training protocols performed 2–3/week following the American College of Sports Medicine's guidelines positively affect risk factors associated with heart disease, cancers, diabetes, sarcopenia and other disabilities. For more than a decade, resistance training has been recommended for adults, particularly older adults, as a prime preventive intervention, and increasing the prevalence of resistance training is an objective of *Healthy People 2010*. However, the prevalence rate for resistance training is only estimated at 10–15% for older adults, despite the leisure time of older adults and access to facilities in developed countries. The reasons that the prevalence rate remains low include public health policy not emphasising resistance training, misinformation, and the lack of theoretically driven approaches demonstrating effective transfer and maintenance of training to minimally supervised settings once initial, generally successful, supervised training is completed. Social cognitive theory (SCT) has been applied to physical activity and aerobic training with some success, but there are aspects of resistance training that are unique including its intensity, progression, precision, and time and place specificity. Social cognitive theory, particularly with a focus on self-regulation and response expectancy and affect within an ecological context, can be directly applied to these unique aspects of resistance training for long-term maintenance.

A decade ago, reviews of research on the health benefits of resistance (strength) training indicated that it was a prime preventive intervention for people over 55 and the elderly.[1] Studies had shown that brief, whole body resistance training protocols consistent with current American College of Sports Medicine guidelines[2] performed two to three times per week could increase strength and muscle mass and, hence, decrease the risk of sarcopenia, normalise blood pressure in high normal people, reduce insulin resistance, marginally reduce intraabdominal fat, marginally increase resting metabolic rate in men, reduce age-associated loss of bone mineral density, and improve work capacity.[3,4] Dramatically, it was noted that about 2 decades of age-associated loss of strength and muscle mass could be regained in about 2 months of resistance training.[3]

However, reviews at that point also stressed that resistance training had minimal effects on other coronary heart disease risk factors[3] more positively affected by aerobic training. In

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Competing interests: The authors are primarily research faculty at their institutions and have no other outside financial interests that will directly benefit from publication of this article.

addition, it was believed that resistance training could further contribute to age-associated arterial stiffness, further increasing the risk for coronary heart disease.

Reviews of research studies primarily conducted in supervised "lab-gyms" during the last 8 years[5] have indicated that such concerns appear *not* to be supported well by empirical studies. Resistance training following ACSM guidelines appears not to increase arterial stiffness.[6–8] Resistance training can, in fact, positively affect many risk factors for heart disease.[9, 10] The most recent research suggests that an important role for resistance training is improving and maintaining vascular health[7, 10–12] and resistance training is an important treatment component for diabetes.[13] Resistance training with older people also can reduce markers of oxidative stress,[14] has been found to increase antioxidant enzyme activity,[15] and may even reverse gene expression affected by age and exercise so that the transcriptional signature pattern may resemble that of a younger person.[16] In addition, resistance training has potential as an important intervention in the prevention of some cancers, as an adjunctive treatment for cancer survivors given muscle atrophy and loss of strength,[17] for maintaining functional strength for daily activities,[18] and now is central to physical activity and public health recommendations for older adults.[19]

Most importantly, research generally shows that the different health benefits of resistance training can be achieved with a single brief protocol taking 20–30 minutes, two to three times per week. In other words, there generally are not different protocols to affect and improve different mechanism and functions. As a safety precaution, older adults are advised to use more moderate resistance and more repetitions,[2, 19] though still training at high intensity. Such an approach also is effective for younger people, especially given proper interpretation of the size principle as described later.[2] A simple, brief protocol based on the principles of progressive overload, recovery, and adaptation (these RT principles are discussed in more detail in a later section) when consistently followed will produce a myriad of health benefits. Differential outcomes are more attributable to different genetic characteristics[20, 21] and to adherence and motivation than to differences in protocols.[22] Recent reviews[2, 22, 23] suggest that the greater volume and frequency of training used by strength athletes may not be necessary. However, the issue is less salient from a public health perspective, where the goal is to provide a minimal, though effective, intervention for many people.

Overall, prior and more recent research suggests the importance and uniqueness of brief, relatively infrequent progressive resistance training for favourably affecting many mechanisms associated with disease prevention, health promotion, and daily functioning.

Even though these many health benefits can be accrued from a limited time investment, in the USA only a small percentage of people over 55 (10% to 15%)[24] reported performing any strengthening activities. Because national surveys use general queries for obtaining information about participation in "strengthening exercises",[24] it is likely that the percentage of people consistently and appropriately performing progressive resistance training is less than commonly reported. Increasing resistance training to 30% is an objective of the USA's *Healthy People 2010*.[25]

REASONS FOR MINIMAL PREVALENCE

There are at least three interrelated reasons why only a small minority of people over 55 consistently engage in resistance training, a decade after resistance training was recommended for people over 55.[1] The reasons are (a) the emphasis of public health policy; (b) perceived barriers to resistance training, such as perceived complexity and difficulty of resistance training, misinformation about expected outcomes, and negative associations with resistance training; and (c) the lack of a theoretical model of resistance training that can guide initiation and long-term maintenance. After briefly reviewing the first two reasons for limited participation in resistance training, extended sections will discuss how the evolving constructs of social cognitive theory can be applied to address issues and barriers for initiating and maintaining resistance training.

Emphasis of Public Health

A major impetus for promoting exercise in the population came from prospective studies showing a strong inverse association between fitness and all-cause mortality[26] and the protective benefits of fitness in the face of other risk factors.[27] Data suggested that increasing the fitness of the least and poorly fit people by 1–2 METs could substantially reduce the risks for those groups. The primary early findings and focus revolved around aerobic capacity and aerobic training. There was minimal interest in resistance training.

Given a largely sedentary population in developed countries and an apparent continuum of health benefits from physical activity (PA) to structured aerobic exercise, however, a consensus was reached[28] that public health policy and programmes should focus on promoting moderate-intensity PA such as walking 30 minutes most days of the week. Within this context, PA typically is less intense, less structured, and less goal-directed than formal exercise.

Subanalyses from major trials have suggested that meeting minimal PA guidelines helps prevent weight gain and worsening of body fat, blood pressure, lipids, and insulin resistance.[29] By way of contrast, however, a direct experimental test of PA guidelines showed that even exceeding the volume of PA guidelines by 50% only increased peak absolute oxygen consumption by ⅓ to ½ MET and had minimal to no effects on other coronary heart disease risk factors.[30] These recent studies suggest that PA such as walking, particularly brisk walking,[31] clearly has some, though modest, risk reduction benefits[32] but can be seen as a minimum or "floor" prescription for the general population.

Experimental studies to promote PA have shown positive results in early or initiation phases. However, continued contact has been required to produce even small effects at follow-up points.[32] At follow-up, aerobic capacity has been increased by ⅓ to ½ MET compared with baseline, but with some modest changes in other health-related measures.[33–35] As noted in a review,[32] there is a need to focus research on theory-based strategies to better maintain PA.

Because PA can deliver only some health benefits even if fully maintained, there also is a need to shift a proportion of public health resources to such areas as developing effective ways to promote and maintain resistance training.

PERCEIVED BARRIERS TO RESISTANCE TRAINING

Resistance training at times has been presented, even by professional organisations, as complex, time-consuming, and requiring heavy resistance.[36] On the contrary, the principles of training are relatively simple. As described previously,[2] based on the original size principle of motor unit recruitment,[37] it appears that it is intensity defined as the degree of momentary effort and not absolute external force that is important for optimising motor unit recruitment. In practice this means that moderate resistance used with good form, a longer time under tension, and training to fatigue of a muscle group can result in a high level of motor recruitment and can provide an appropriate resistance training stimulus.[38] Indeed, effective protocols can be completed in 20–30 minutes, 2–3/week.

In addition to its perceived complexity, resistance training is also often associated with a drug and hormone-fuelled body-building subculture and bizarre habits and appearance. Many women still fear that if they resistance train, they will become "too big".[39] The actual data are contrary to these beliefs, showing that the mean gain in fat free mass for previously untrained men and women after 6 months of resistance training is about 2 kg.[40] Clearly, effectively promoting correct information about resistance training needs to be a part of any public health effort.

Efforts to promote resistance training must also focus on common time, access, and cost barriers. Many people over 55 in developed countries have no childcare responsibilities, and thus have more leisure time.[41] However, use of time surveys in the USA have indicated that the extra time that adults without childcare responsibilities have is primarily spent watching TV.[41] A mean of about 3.25 h per day is reported for watching TV in this population segment in the USA; a mean of about 15 minutes per day is reported for exercise. Perhaps, some of the time allocated to TV can be used for exercise. In addition to time barriers, access to facilities has been improved. For example, all of the over 2600 YMCAs in the USA serving a wide cross-section of people have resistance training facilities and all offer reduced membership fees or scholarships for people with lower income.[42] The number of health clubs and gyms has reached an all-time high in the USA with over 29 000 and with about 42 million members.[43]

Lack of theory-based rt-promotion studies

The scientific rationale for widely promoting resistance training clearly has become broad and compelling. There also are fewer barriers for engagement in resistance training for people over 55 in developed countries and initial supervised training has been effective. Both environmental and personal resources are available to increase the prevalence rate of resistance training. In addition, studies have shown a high degree of adherence (~90%) and good increases in strength (~35%–40%) in 2½–4 month well-supervised initiation phases. For example, Westcott and Winett[44] showed in a sample of 1644 successive cases using a protocol similar to current ACSM guidelines[2] in a supervised YMCA setting that across gender and age groups participants completed 92% of assigned sessions during a 10 week initiation phase and increased strength by ~35%, decreased systolic blood pressure by ~4.0 mm Hg, gained ~1.5 kg of fat free mass, and decreased body fat by 2%. Men and women and younger and older people showed similar, relative outcomes. Aside from more stringent safety recommendations,[2, 19] healthy older adults do not require protocols that are different in principle from standard protocols used by younger adults. In addition, Lutes and colleagues[45] showed that, with closer supervision and with a more prescriptive and progressive programme, initial strength gains could more than double these usual outcomes.

Despite these positive findings, there are two major scientific limitations that can make public health efforts in this area minimally effective. First, there have been few demonstrations of effective maintenance and "transfer of training" of exercise programmes. Experimental studies to promote PA have shown favourable results in early or initiation phases; however, continued contact has been required to produce even small effects at follow-up points.[32] If the promotion of PA has only been moderately successful then promoting real exercise and particularly resistance training appears to be even more difficult and daunting.

Dunstan and colleagues,[46, 47] working with people with Type 2 diabetes, have performed two of apparently only three studies[48] on transfer of training. After an initial training phase, participants trained either at home or at a community centre facility. Transfer of training involved instruction, some hands-on guidance, and then follow-up phone calls. The primary outcome measure was glycaemic control ($HbA1_c$(AIC)). Only centre-based training showed continued evidence of glycaemic control. Training frequency and intensity decreased at home. However, the studies have a number of problems that constrain conclusions. The actual strength gains (10% to 15%) were far below the mean for initiating resistance training (~35%–40%). Some home-based exercises did not match those exercises used in the initial phase or for assessment. The content of phone contact apparently was not guided by theory, and it is not clear whether more specific and theory-based content could have further increased gains from resistance training at home or at a centre. Nonetheless, Dunstan *et al*[46, 47] clearly did show that such transfer of training is possible.

The second scientific limitation is the lack of a firm theoretical basis for strategies to guide maintenance of resistance training. Few, if any, studies have applied a comprehensive theoretical framework to the initiation and long-term maintenance of resistance training. In the absence of such theoretically based efficacy studies on transfer of training and long-term maintenance, one potential scenario is that through public health efforts more older adults will initiate resistance training and a high percentage will soon discontinue resistance training.

SOCIAL COGNITIVE THEORY

Social cognitive theory[49, 50] and its constructs self-efficacy, outcome expectancy, and self-regulation have often been applied to physical activity and, to some extent, endurance training.[32] There are, however, minimal studies that have applied SCT for the initiation and maintenance of resistance training.[13]

SCT can form a firm theoretical basis for effectively promoting resistance training if:

- the critical role of self-regulation is understood and specific self-regulation procedures applied;
- environment and ecological considerations such as access and comfort in settings and personal resources become central to interventions;
- affective responses to resistance training are assessed and training protocols modified to maintain positive affective and, hence, immediate, favourable consequences of resistance training;
- special attention is paid when constructing longer-term behavioural maintenance programmes to consider the course of training and the rate of achieving outcomes, with programmes tailored to given ecological factors and affective responses to protocols.

Self-regulation

Bandura[49, 50] noted that for voluntary physical activity or exercise the implementation of self-regulation tactics (planning, self-monitoring, goal setting, self-incentives) was central to change. Primarily for PA and moderate-intensity aerobic exercise, the field has, however, largely focused on self-efficacy and the shaping of such activities as walking. Even brisk walking, however, is for most people a simple activity that requires minimal or no skill development. What has been found is that it is self-efficacy, not for the motor actions of walking, but rather for the self-regulation skills involved in walking that is critical.[51] This distinction shifts the focus of interventions to comprehensive self-regulation interventions in contrast to shaping a behaviour such as walking. However, as Maes and Karoly[52] noted in their review of PA and self-regulation, few such comprehensive interventions have ever been implemented.

It appears likely that, for resistance training, self-efficacy for performing the behaviour, self efficacy for self-regulation and self-regulation skills may be qualitatively different from those for PA. There simply is far more precision and effort involved in resistance training than in PA or even some forms of endurance training such as jogging at a steady state. While lifting heavy resistance is not a requirement for increasing strength and muscular hypertrophy,[2] resistance training does need to be challenging, progressive, and intensive as defined by degree of momentary effort.[2] For example, an appropriate area of self-efficacy is confidence in the ability not only to move the resistance on a leg press machine, but to move the resistance while keeping to repetition form and duration, and to be able to consistently create an overload every several training sessions by marginally increasing repetitions, resistance, time under load, or some combination of these variables. Confidence in the ability to perform in this way with 8–10 exercises in a protocol, not just one exercise, is another critical area. The ability to perform in a way to effectively resistance train requires harnessing cognitive (knowing what to do), motivational (wanting to perform), and behavioural (execution) factors.

Maintaining a programme of brisk walking requires self-regulation skills, such as consistent planning and goal-setting; however, because resistance training is more restricted by time and place and because performance is exacting, it is likely that self-regulation is of even greater importance in resistance training than for PA. Resistance training needs to be scheduled. There need to be rest days between sessions. The most basic principle of resistance training involves the ability to induce a marginal overload within the context of a higher-intensity stimulus (defined as degree of momentary effort, and not necessarily the amount of resistance[2]). Optimally, precise form should be followed, including for each movement's range of motion and repetition duration. This requires paying close attention in a training session. If there are not precision and uniformity in performance, then it is much more difficult after a brief initial phase of neuromuscular learning to assess progress and assign new resistance or repetition goals for subsequent workouts.

Training sessions need to be monitored. A progression algorithm, albeit a simple one, needs to be used that fits into the monitoring approach of actual performance in a training session and that can be attached to short-term and long-term goals. Based on outcomes from a session and a simple progression algorithm, the next training session needs to be planned. Initially, instruction and guidance from a trainer can facilitate all these self-regulation tactics. In order for a person to later train with minimal or no supervision in the long term, the simple principles of resistance training should be clearly understood and self-regulation skills need to be consistently implemented. Self-regulation entails scheduling, monitoring training, setting short and long-term goals, cognitive and behavioural focus within a session on proper form and effort, providing self-feedback and self-incentives relative to personal goals, and planning the next session.

These points are made to illustrate that the critical aspects of effective resistance training are a good match for SCT, particularly self-regulation. While the skills appear to be complicated, studies show people can learn to effectively resistance train in 10–12 week supervised programmes following simple guidelines and procedures.[44, 45] However, it is clear that the process may be more complex and requires more focus and effort than simply PA walking. Initial training sessions, therefore, should feature modelling, practice, and feedback from qualified trainers.

Environment

While "environment" always has been a part of SCT, a criticism of SCT is that environment is not well articulated[53] and interventions are delivered in the absence of understanding an individual's ecology.[54] A more ecologically focused SCT includes these environmental influences: 1. social support from significant other people; 2. daily schedule and responsibilities; conflicts with exercise time; 3. affordability and ease of access to an adequate facility; 4. comfort level within the facility; 5. adequate initial instruction and guidance; 6. sufficient rest for recovery and adequate nutrition. These environmental factors could facilitate or hinder consistent effective resistance training and also clearly can play a pivotal role in maintaining resistance training after an initiation phase. Most importantly, for an intervention, these sets of environmental factors can be assessed and interventions better fitted to an individual's ecology.[54] Environmental factors also are not set in stone and are potentially malleable. For example, problem-solving strategies can be used to help people rearrange schedules and to find more affordable and comfortable training settings.

Affect

One other set of individual level variables that until recently has not been a focus of many health behaviour interventions is affective responses to engaging in the health behaviour, including the dimensions of pleasure and displeasure and positive or negative arousal states. With resistance training, these responses include anticipatory affect for engaging in resistance training, affect while engaged in resistance training, and affect when a session is completed. Affect at any of these points is not seen as simply global. For example, a person may not look forward to or like the effort involved in resistance training. However, the same person may eagerly anticipate making progress in a training session and experience a high level of positive affect in a session when there is evidence of progress. Affect is seen as a main “driver” of the behaviour.[55] Negative affect will lead to low adherence and termination. Positive affect will reinforce self-regulation skills and actual performance in a reciprocal way such as further strengthening the use of self-regulation skills that, in turn, lead to better outcomes and more positive affect. Affect before, during, and after exercise involves an iterative process that also is potentially malleable. For example, small changes in a resistance training protocol that still maintain its integrity but better fit an individual’s goals could enhance affect at all points. More positive affect could then increase both motivation for and actual performance of resistance training, which leads to performance that more closely approaches goals, which, in turn, leads to a further enhancement of affect.

The dynamic study of affect in exercise has been relatively limited[56–58] even though from learning theory perspectives the immediate consequences of performing a behaviour, such as positive or negative affect, predict future behaviour. Such consequences could be represented in the SCT construct of outcome expectancies (OE). However, OE has been shown to be an inconsistent predictor of exercise behaviours.[59] This may be because OE has often focused on much delayed outcomes such as changes in health that may or may not be readily apparent or motivating. An expansion of the OE construct that includes response expectancy[55] could capture the importance of affect. Response expectancy theory indicates that affective, cognitive, and behavioural concomitants and outcomes of performing a behaviour then form expectancies for that behaviour that increase or decrease the likelihood of subsequently performing a set of behaviours such as resistance training.

Affective responses to specific behaviours also contribute to self-efficacy formulations and then influence subsequent engagement in the behaviour. For example, comprehensive assessment of self-efficacy includes the capability of performing specific behaviours as well as the likelihood of continued engagement given concomitant affective responses to that behaviour. Unpleasant or aversive affective responses should lead to lower self-efficacy while positive affective responses should increase self-efficacy.

Because resistance training inherently involves “hard” to “very hard” effort, maintaining at least positive affect in the face of such effort seems particularly important. A dynamic approach can be taken where affect is tracked before, during, and after resistance exercise. Based on an individual’s preferences and experience, changes can be made in a basic protocol that may, if not optimise affect, at least maintain positive affect and continued actual performance. A number of changes such as order of exercises, time between exercises, repetition duration, number of repetitions, or exercise machines used, surprisingly, have marginal effects on actual outcomes[22] but may improve affect and, hence, training consistency and effort. Maintaining positive affect seems important to reduce the probability of lapsing and lower adherence particularly because self-efficacy and response expectancies partially determine actual responses.[55] For example, if a person expects positive affective outcomes during and after exercise, the person is likely to continue to exercise and have positive affect as an actual outcome.

A number of systems such as the "Coach Approach" used in YMCAs do focus on affective responses to exercise and do provide individual goals and feedback.[56] However, there appear to be no RCTs of those systems focused on long-term maintenance.

MAINTENANCE

There are other considerations specific to exercise training. Both for aerobic and resistance training, for a previously untrained person, the rate of improvement is most pronounced within the first several to 6 months.[2] Resistance training lends itself to specific and quantifiable feedback, i.e., resistance and repetitions in an exercise. During initial training months, actual strength gains show a large range dependent upon genetic factors associated with strength, muscular hypertrophy, and recovery, and the ability to adapt to a specific stimulus.[2] Most people will exhibit at least noticeable strength increases.[21] This progress then can contribute to positive affect, and can feed back to reinforce various facets of self-regulation.

After an initial training period, the rate of improvement for most people will markedly decrease.[2] This suggests that for maintaining resistance training factors other than progress from training may become more prominent. Support from others, reworking exercise training time in light of changes in family and work responsibilities, ease of access, comfort in a facility, and the knowledge of principles and the ability to make modest changes in a basic protocol to enhance personal preferences, goals, and affect while still retaining the integrity of resistance training may be factors that continue to make the overall experience of resistance training satisfying. As Rothman *et al*[60] and Jeffery *et al*[61] have suggested in related health behaviour areas, *it is likely the actual satisfying experience with a behaviour that is associated with continuing the behaviour*.

In addition, few health behaviour interventions have shown maintenance in the absence of longer-term, generally faded, contact. Duration of treatment seems to be an important contributor to maintenance. But, as suggested by Rothman *et al*[60] and Perri and Corsica,[62] longer-term contact will likely be more effective if such contact revolves around theory-based strategies that are geared toward specific issues with maintaining behaviours such as environmental impediments, practice of self-regulation skills, and satisfaction with actual outcomes.[63]

What is already known on this topic

Many studies conducted in "lab-gyms" have shown that time-efficient resistance training protocols performed 2–3/week positively affect mechanisms associated with chronic diseases and disabilities. Resistance training is a central public health recommendation for older adults but only a small percentage of older adults perform resistance training.

What this study adds

Very few studies have focused on long-term, less supervised training in community settings. A theoretical approach to maintaining resistance training is presented that is based on social cognitive theory with special consideration of the dynamic nature of resistance training, self-regulation strategies, affective responses to training, and ecological facilitators and barriers to training.

Interestingly, in this light, the very qualities of resistance training that appear to make it a difficult set of behaviours to maintain can make resistance training a very enjoyable autotelic, flow experience that is intrinsically reinforcing, and hence more likely to be maintained. These qualities include a degree of challenge and effort, focused attention, goal setting, immediate feedback, and personal control over the set of behaviours.[64]

These final points suggest a new direction for health behaviour interventions. Rather than attempting to keep people adhering to behaviours they find aversive, an unlikely possibility, maintenance programmes can focus on tailoring programmes so that engaging in specific health behaviours such as resistance training is intrinsically reinforcing.

CONCLUSION

SCT-based intervention for initiating and maintaining resistance training with older adults should use in concert all these constructs with an appreciation of their specific application to resistance training. Effective programmes will likely be dynamic and iterative. A relatively brief initiation period can allow for neuromuscular adaptations and learning of proper form, other in-session self-regulation techniques, and principles of training. Then frequent assessments of each person can allow for tailoring of basic protocols over extended periods of time based on progression and responsiveness, self-efficacy, goals, preferred self-regulation strategies within and outside sessions, affective responses, social and physical characteristics of settings, and changes in personal resources or circumstances. Presently, there appear to be few, if any, SCT-based research programmes and studies focused on long-term maintenance of resistance training. Initial efficacy studies should aim to demonstrate that high-fidelity SCT-based interventions with extended but faded contact that use algorithms reflecting SCT constructs and principles of exercise training[2] produce greater maintenance and better health-related outcomes than more generic long-term or standard interventions and that self-regulation and affect mediate such outcomes.

Acknowledgments

This project was supported in part by a career development award to Dr Williams (Scholar) from the NIH/NICHD, in part by ASPIRES awards to Dr Winett from Virginia Tech, and a KO1 award from the NIH/NIDDK to Dr Davy.

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