A case for considering age and sex when prescribing rest intervals in resistance training

A CASE FOR CONSIDERING AGE AND SEX WHEN PRESCRIBING REST INTERVALS IN RESISTANCE TRAINING

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Commentary

Abstract:

Current resistance training position stands recommend that rest interval duration in resistance training should be prescribed based on the training goal and exercise selection. However, these recommendations are mostly extrapolated from studies that included young men as participants. Therefore, they cannot be generalized to all age groups and all resistance training programs. Herein, two overlooked, but possibly important factors for rest interval prescription are discussed: (1) age, and (2) sex of the individual. Acute studies indicate that older adults, as compared to young adults, require a shorter duration rest interval to achieve recovery between sets. Due to the sex differences in fatigability, it can be speculated that men need a longer duration rest interval than women to maintain high levels of performance. Both sex and age may be relevant variables when determining rest interval duration in resistance exercise and should not be overlooked by exercise practitioners in program design.

Key words: *intensity, skeletal muscle, repetition maximum, exercise, training, intervals*

Introduction

Rest intervals are most commonly defined as the time dedicated to recovery between sets and exercises (Baechle & Earle, 2000). The current American College of Sports Medicine position stand (ACSM, 2009) suggests employing longer duration rest intervals (>three minutes) when training for muscular strength gains, moderate rest intervals (60-90 seconds) when training for muscular hypertrophy, and short rest intervals (<60 seconds) when training for muscular endurance. In addition to the training goal, the position stand suggests that rest intervals might depend on exercise selection. Longer rest intervals are recommended for multi-joint exercises, while shorter rest intervals are deemed sufficient for single joint exercises (ACSM, 2009). These guidelines are mostly inferred from studies that included young men as participants and thus cannot necessarily be generalized to performance in women (Ahtiainen, Pakarinen, Alen, Kraemer, & Häkkinen, 2005; Pincivero, Lephart, & Karunakara, 1997; Robinson, et al., 1995; Willardson & Burkett, 2008). In addition to sex, the age of an individual might be a consideration when designing training programs. Specifically, some studies suggest that older individuals might require different resistance exercise prescription when compared to the young (Bickel, Cross, & Bamman, 2011). Therefore, current recommendations cannot universally be generalized to all age groups and all resistance training programs since several variables need to be considered when prescribing rest interval duration. Herein, two overlooked, but likely important factors for rest interval prescription are discussed: (i) age, and (ii) sex of the individual.

Age

Age is commonly classified as follows: (i) children (0-10 years), (ii) adolescents (10-18 years), (iii) young adults (19-39 years), (iv) middle-aged adults (40-64 years), and (v) older adults (≥65 years) (Grgic, Mikulic, Podnar, & Pedisic, 2017). Acute studies indicate that the rest interval duration needed to achieve recovery in resistance training might differ based on the age of the individual. Theou, Gareth, and Brown (2008) observed that older women (71±4 years), compared to younger women (22±2 years), required a shorter rest interval duration to obtain full muscular strength recovery between sets of eight repetitions (i.e., 30 vs. 60 seconds, respectively). These findings are further supported by Bottaro, Russo, and de Oliveira (2005) who demonstrated that untrained older men (66±4 years) achieved full recovery after four repetitions of unilateral knee extension exercise by employing a brief rest interval of 30 seconds, although there was no comparison with recovery in younger individuals in this study.

Subsequently, Bottaro et al. (2010) carried out a study that compared differences in recovery rates between older (80±11 years) and younger untrained men (24±3 years), and noted that the younger individuals did not recover fully after one- and two-minute rest periods when performing three sets of 10 repetitions with an associated decline in peak torque. However, older men achieved full quadriceps recovery within two minutes of rest. When comparing fatigability between young (24±2 years) and older adults (70±5 years), Ditor and Hicks (2000) reported that older adults were significantly less fatigable, as assessed by the voluntary fatigue index (i.e., the percentage of force reduction from baseline). Recovery of force might be important from a muscular strength standpoint as it allows training with higher loads, which might translate to higher strength gains due to the principle of specificity (Mattocks, et al., 2017). Based on these acute results, it can be surmised that older individuals may require shorter rest intervals to achieve recovery. Such findings might in part be explained by the shift towards an increase in type I fibers and atrophy of type II muscle fibers, both reported to occur with ageing; an event that is occurring due to a mixture of factors (Charette, et al., 1991). Type I muscle fibers are known to be less fatigable than type II muscle fibers, which might reduce the recovery needs between sets in resistance training for older adults (Schiaffino & Reggiani, 2011).

The only two longitudinal studies performed in older adults that compared adaptations to different rest intervals support the notion that older adults might benefit from shorter rest intervals. Villanueva, Lane, and Schroeder (2015) used a resistance training protocol comprised of four to six exercises per session, performed in two to three sets with four to six repetitions per set (not performed to muscular failure). The authors observed that training with a one-minute rest between sets is superior to resting for four minutes for gains in muscular strength, body composition, and functional performance. In resistance-trained older women (66±4 years), Jambassi Filho et al. (2017) reported no significant differences in muscle activity, isometric, or dynamic muscle strength between groups that rested for one minute and three minutes following an eight-week resistance training intervention. In other words, equal effects were observed for both groups; however, the one-minute rest interval group had a shorter total training time, thus providing greater training efficiency. While future longitudinal studies comparing adaptations to rest intervals between age groups are warranted, these initial findings indicate that older adults might efficiently recover during shorter rest intervals. Shorter rest intervals will reduce the duration of training sessions and might facilitate long-term adherence to resistance training in older adults as lack of time is commonly cited as the reason for poor exercise adherence (Heesch & Masse, 2004). However, it should also be noted that reducing the rest interval duration can lead to acute increases in the rating of perceived exertion (Farah, et al., 2012), which should be taken into account, especially when working with resistance training naïve individuals.

Sex

In addition to age, sex can also be a modifying variable in the determination of rest interval duration. Men and women have different rates of fatigability and neuromuscular performance that are likely due to sex differences in anatomy and physiology (Hunter, 2014). Although based on a limited sample size, there is evidence that, when compared to women, men have larger muscles and greater proportional area of type II muscle fibers (Staron, et al., 2000). These muscle fibers are reported to have a two-fold larger calcium uptake than type I muscle fibers (Li, et al., 2002). There is a significant relationship between the proportional area of type II muscle fibers and calcium activity, which together might be related to muscle mechanics (Gollnick, Körge, Karpakka, & Saltin, 1991; Hunter, et al., 1999; Madsen, Franch, & Clausen, 1994). This could be significant from a fatigue standpoint, as some evidence indicates that women have slower calcium kinetics from the sarcoplasmic reticulum than men; possibly explaining the sex differences in fatigability (Hunter, 2014). In addition, for some muscle groups, women may have greater muscle perfusion, which can increase blood supply to the activated muscle during exercise, thus delaying fatigue and facilitating training with shorter rest intervals (Hunter, 2014). These physiological differences, besides the possible differences in lipid source utilization between sexes (Roepstorff, et al., 2002), might be the primary reasons why women are less fatigable than men during both isometric and dynamic exercise of a similar intensity (Hunter, 2014). Taken together, it could be suggested that sex is an important variable in exercise prescription.

Acute resistance training studies support this notion as they indicate that women require shorter rest intervals between sets to maintain performance compared to men. This concept is best illustrated by the work of Ratamess et al. (2012), who reported that, during an upper-body resistance exercise with a rest interval of one minute, women were able to perform 10, nine and eight repetitions during sets one, two and three, respectively. Men, also resting for one minute, performed 10, seven and four repetitions during the three sets of bench press (Figure 1). Celes et al. (2010) observed similar differences between men and women for lower body exercise (i.e., isokinetic knee extensions), demonstrating that both males and females required two minutes of rest between sets to fully recover quadriceps strength. However, for muscular strength observed at 180°/s, a rest interval of one minute allowed sufficient recovery in women but not in men. Based on these acute findings, it can be hypothesized that women, compared to men, might benefit from a shorter duration rest intervals.

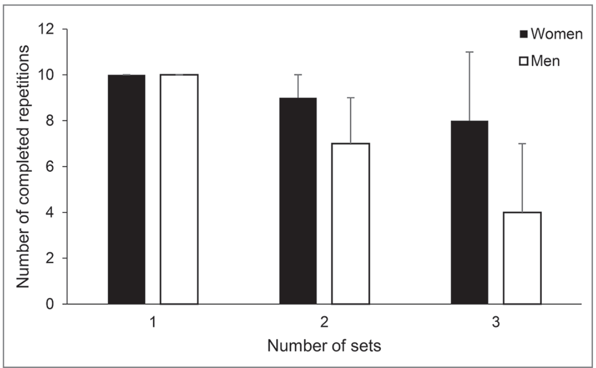

Figure 1. Number of completed repetitions by women and men in the three sets of the bench press exercise with a rest interval duration of one minute as presented by Ratamess, et al. (2012).

An unpublished 12-week intervention in 23 untrained women conducted by Reed-Hardison (1998) showed that the group that trained with 30-second rest intervals increased lower body strength to a greater extent compared to the group that trained with 90-second rest intervals. Moreover, upper body strength in the 30-second rest interval group increased by 40% compared to 30% in the 90-second rest interval group; albeit, the differences between the groups for the upper body did not reach statistical significance. Although the study was not published, its methodological aspects were deemed to be of good quality and similar, or even of higher quality as compared to the other peer-reviewed studies on the topic of rest intervals (Grgic, Schoenfeld, Skrepnik, Davies, & Mikulic, 2018). While women may benefit from shorter rest intervals, it also should be noted that limiting rest intervals to 20 seconds during a lower-body resistance training program has been shown to produce inferior muscular strength adaptations compared to 80-second rest intervals. In a five-week intervention, Hill-Haas, Bishop, Dawson, Goodman, and Edge (2007) reported that women who rested for 20 seconds increased strength by 9%, whereas those that rested for 80 seconds increased muscular strength by 46%, even when matched for total training volume. These findings suggest that at a certain point the rest interval duration can be too short, and may hinder gains in strength. Nonetheless, rest of 80 seconds (which is still shorter than the three minutes of rest between sets recommended by the ACSM, 2009) between sets was sufficient to achieve robust gains in muscular strength.

For men, the opposite seems to be the case. Both Schoenfeld et al. (2016) and de Salles et al. (2010) reported that training with a longer rest interval duration (i.e., three and five minutes, respectively) was superior for gains in muscular strength compared to a one-minute rest interval. The findings for strength are likely explained by more "practice" with heavier loads in the longer duration rest interval groups, because, when training with shorter rest intervals, the load needs to be reduced to maintain the desired repetition range. Besides strength, Schoenfeld et al. (2016) observed greater muscular hypertrophy (in some, but not all muscle groups) in the three-minute vs. one-minute rest interval group; a finding that also contradicts current resistance training guidelines (ACSM, 2009). These findings on hypertrophy could be related to a greater muscle protein synthesis response that occurs when training with longer duration rest intervals (McKendry, et al., 2016). While the area of the importance of sex in prescribing rest interval duration is an interesting one, at present, there have been no published longitudinal studies that would directly compare the effects of rest intervals of varying duration on muscular adaptations between sexes. Thus, this area remains speculative and should be explored in future studies given the current paucity of evidence. Future studies might investigate this issue by including two mixed-sex groups that would train with different rest intervals, and sex difference could be explored by plotting the results separately for men and women.

As the body of evidence continues to increase, it is essential to revisit and reanalyze current resistance exercise recommendations. It seems that prescribing rest intervals merely on the training goal and exercise selection could be too simplistic, as other factors also need to be taken into account. While the evidence is still emerging, both age and sex might be relevant variables that should be considered in program design. Despite a logical rationale, longitudinal studies directly exploring this topic are needed to provide clarity on the topic. Given the gaps in literature, future research should seek to compare the effects of rest intervals of varying duration on muscular adaptations between young and older individuals. Furthermore, future studies should endeavor to elucidate how the acute differences in fatigability between sexes might impact long-term adaptations to rest intervals of different durations.

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