



Original Article

Self-selected intensity, ratings of perceived exertion, and affective responses in sedentary male subjects during resistance training

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Abstract. [Purpose] This study examined the exercise intensity and psychophysiological responses to a self-selected resistance training session in sedentary male subjects. [Subjects and Methods] Twelve sedentary male subjects (35.8 ± 5.8 years; 25.5 ± 2.6 kg·m²) underwent four sessions at 48-h intervals: familiarization; two sessions of one repetition maximum test and a resistance training session in which they were told to self-select a load to complete 3 sets of 10 repetitions of chest press, leg press, seated rows, knee extension, overhead press, biceps curl, and triceps pushdown exercises. During the latter, the percentage of one repetition maximum, affective responses (feeling scale), and rating of perceived exertion (OMNI-RES scale) were measured. [Results] The percentage of one repetition maximum for all exercises was >51% (14–31% variability), the rating of perceived exertion was 5–6 (7–11% variability), and the affective responses was 0–1 point with large variability. [Conclusion] Sedentary male subjects self-selected approximately 55% of one maximum repetition, which was above the intensity suggested to increase strength in sedentary individuals, but below the recommended intensity to improve strength in novice to intermediate exercisers. The rating of perceived exertion was indicative of moderate intensity and slightly positive affective responses.

Key words: Adherence, Guidelines, Pleasure/displeasure

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INTRODUCTION

Resistance training (RT) is indicated to increase muscle fitness, improve athletic performance, and prevent and treat disease^{1, 2}). To achieve the benefits derived from RT, the American College of Sports Medicine (ACSM) recommends that subjects perform RT at a specific intensity based on external load (percentage of one repetition maximum [1RM])^{1, 2}). This model of prescription is based on two pillars, namely safety and effectiveness. However, Ekkekakis, Parfitt, and Petruzzello³) stated that a prescription might be effective and safe, but if very few people want to follow it, then its public-health relevance becomes questionable. In a broad review regarding aerobic exercise³), they found an increasing body of evidence linking affective responses to exercise and adherence. Therefore, the authors suggest that exercise prescription should not only rely upon effectiveness and safety but also consider the pleasure/displeasure people felt³).

In fact, the hedonic theory considers affective responses to behavior as determinants of future actions⁴); in other words, they influence decisions regarding whether an activity is repeated⁵). In this sense, hedonic theory has been supported by

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studies of aerobic exercise in which positive affective responses predict more time spent exercising⁶⁻⁸). In this regard, studies have suggested that individuals self-regulate their own exercise to a preferred intensity^{9, 10}. An extensive body of literature with aerobic exercise has demonstrated that self-selected intensity reached or exceeded the minimum level recommended by the ACSM to improve health, particularly in sedentary individuals¹⁰⁻¹⁴). Additionally, this method may improve the exercise experience through increased perceived autonomy¹⁵) and pleasure, thus contributing to increasing individuals' chances of repeating the activity^{4, 6-8, 16}). In fact, these studies have shown that the pleasure responses are higher in self-selected than in imposed intensity^{11, 17}), even if this imposed intensity is the same as that the subjects self-selected¹⁵) or a little higher (10%)^{10, 12}).

However, the relationship between self-select intensity and the recommendations of the ACSM in RT as well as the affective responses to it have been poorly studied. The first report was by Glass and Stanton¹⁸), who found a self-selected load ranging from 42–57% of 1RM in five exercises in young male and female novice weightlifters. In addition, Focht compared self-selected and imposed intensity in young untrained female subjects and found that ratings of perceived exertion (RPE) and load were higher for imposed intensity (75% of 1RM) than for self-selected intensity (~56% of 1RM) in four exercises¹⁹). Furthermore, Ratamess et al. found that young female subjects who trained with a personal trainer self-selected ~51.4% of 1RM, with a higher RPE compared to ~42.3% for female subjects who trained without a personal trainer in four exercises²⁰). Elsangedy et al. recently showed that older sedentary females self-selected an intensity of 33–51.4% of 1RM in eight exercises²¹). Two recent studies showed that active male subjects and trained female subjects self-selected an intensity of 37–58% and 57% of 1RM in four exercise sessions, respectively^{22, 23}).

However, except for one study²¹), all of these studies^{18-20, 22, 23}) have assessed active or trained samples during self-selected intensity in RT, and responses of sedentary individuals during RT using this approach is lacking. Additionally, only two studies have assessed the affective responses during self-selected intensity RT^{22, 23}). Given that, one of the principal purposes of self-selection is to increase perceived autonomy and control to generate positive affective responses and therefore increase adherence, and this information would be appreciable to guide exercise prescriptions for sedentary individuals. Additionally, the last ACSM position shows little information regarding RT prescriptions for sedentary individuals, stating only that 40–50% of 1RM may be beneficial for this population²). Therefore, it is important to be aware of the intensity at which sedentary individuals exercise as well as the affective responses to self-selecting the intensity in RT. Furthermore, it is not clear how other sedentary populations respond to this training approach. These data may provide valuable insight regarding the prescription of RT and adherence for sedentary individuals. Therefore, the purpose of this study was to evaluate whether sedentary male subjects self-select a sufficient RT load to meet ACSM recommendations for RT and describe its affective and perceived exertion responses.

SUBJECTS AND METHODS

Twelve sedentary male subjects (age, 35.8 ± 5.8 years; height, 1.78 ± 0.07 m; body mass, 81.2 ± 8.7 kg; body mass index [BMI], 25.5 ± 2.6 kg·m⁻²) volunteered to participate in this study. All participants were healthy, classified as sedentary (≤ 1 h/week of physical activity during the previous 6 months), not taking any medication known to influence metabolic or cognitive function, stable body mass (< 2.5 kg net change over the previous three months), and were nonsmokers. Exclusion criteria included one or more positive responses on the Physical Activity Readiness questionnaire; BMI < 18.5 kg·m⁻² or > 29.9 kg·m⁻²; diagnosis of cardiovascular, metabolic, and orthopedic disease; or any other contraindications for physical activity as determined by medical history from the previous 12 months. Subjects were recruited via e-mails sent to large community university and fliers displayed in public places. The Institutional Review Board of Ethics Committee of Federal University of Paraná approved this study (CEP/SD: 1087.012.11.03-CAAE: 0014.0.091.000-11); and after a detailed explanation of the experimental procedures, benefits, and possible risks, written informed consent was obtained from all volunteers.

To describe the affective responses and RPE of acute resistance exercise at a self-selected intensity, sedentary male volunteers completed four experimental sessions on different days. During the first session, individuals underwent medical screening, anthropometric measurements, and familiarization with the experimental procedures. The second and third sessions involved a 1RM testing session for test and re-test interclass correlation assessment at a 48-h interval. During the fourth experimental trial, participants performed three sets of 10 repetitions with a self-selected load for each set and exercise. RPE, affective responses, and the training load of each set and exercise were recorded as the outcome variables.

All the sessions were conducted between 8 and 11 AM under similar environmental conditions (21°C and 55% relative humidity). The participants were instructed to refrain from exercise and avoid caffeine-containing products during the 24 hours prior to the exercise trials.

RPE was obtained immediately after each set during the resistance exercise sessions by using the OMNI-RES scale²⁴), which includes exercise mode-specific pictorial and verbal descriptors distributed along a comparatively narrow decimal numerical range from 0, corresponding to “extremely easy,” to 10, corresponding to “extremely hard,” which facilitates the reporting of exercise intensity during dynamic exercise. During the familiarization session, standard instructions and anchoring procedures were explained. RPE has been conceptualized as a psychobiological configuration of effort sense and has been shown to be valid for use during acute resistance exercise^{25, 26}).

Basic affect (pleasure/displeasure) was assessed using the feeling scale²⁷), an 11-point, single-item, bipolar rating scale

that is commonly used to assess affective responses during exercise. The scale ranges from -5 to +5. Anchors are provided at zero (“neutral”) and at all odd integers, ranging from “very good” (+5) to “very bad” (-5)²⁷. The positive numbers represent pleasure and negative numbers represent displeasure. Subjects were familiarized with the scale using a standard procedure²⁷. The participants were informed and subsequently reminded that the scale measured the affective or emotional component of exercise, that is, whether the sensation of effort during RT felt pleasant or unpleasant rather than the actual level of physical effort or strain.

During the first session, all subjects underwent anthropometric measurements and a familiarization session with the experimental procedures. The familiarization process included teaching the participants adequate lifting techniques for each exercise. Subjects were also familiarized with the process of selecting a preferred load. Each participant was asked to self-select the load to complete three sets of 10 repetitions²⁰. Additionally, the participants received instructions regard the utilization of the RPE OMNI-RES scale and the feeling scale. In the second session, the 1RM was performed for seven different exercises by using machines in the following order: 1) chest press, 2) leg press, 3) seated rows, 4) knee extension, 5) overhead press, 6) biceps curl, and 7) triceps pushdown.

The 1RM was determined using a previously validated testing procedure²⁸. First, the participants received instructions regarding the adequate lifting technique for each exercise before starting the 1RM tests. The subjects then warmed up by performing a few repetitions with lighter loads. The first attempt was approximately 50% of the participant’s estimated 1RM load. Subsequently, the participant was given 5 minutes of passive recovery, and another attempt at applying progressively heavier loads followed by recovery was performed until the subject could not complete a repetition through the full range of motion. The increase in load was based on the ease with which the previous trial was performed. The determination of 1RM for each exercise tested never took more than five attempts, not including the warm-up. These stipulations concerning the amount of attempts executed were necessary to prevent any fatigue effect on the result. If participants perceived that they could perform 10 repetitions with the designated load, the trial attempt was quickly ended. This procedure ensured that the participants would spare themselves from any unnecessary muscular fatigue, allowing a most accurate 1RM determination.

The participants performed two 1RM test sessions for all exercises at 48-h intervals to determine the interclass correlation coefficients. Test-retest reliabilities for the 1RM assessment were 0.97, 0.84, 0.99, 0.94, 0.96, 0.97, and 0.98, respectively; no significant differences were found ($p>0.05$) between the test and retest values for any of the measurements. Muscular strength for the 1RM was chest press= 68.5 ± 16.6 kg; leg press= 202.5 ± 37.4 kg; seated row= 72.8 ± 21.6 kg; knee extension= 100.4 ± 11.6 kg; overhead press= 44.0 ± 14.1 kg; biceps curl= 48.3 ± 12.3 kg; and triceps pushdown= 64.2 ± 10.4 kg.

At least 48 hours after the end of the 1RM session, the participants underwent a self-selected bout of resistance exercise. For each exercise, the participants performed three sets of 10 repetitions with 2 minutes of passive recovery between each set.

Participants were asked to self-select the load to complete three sets of 10 repetitions²⁰. Before initiating the first set, the participants selected a weight and performed a few repetitions to gauge the load. The individuals were permitted to choose the load lifted for each set during the self-selected bout. The investigators provided no additional information that could have created bias in the weight selection. RPE, affective response, amount of resistance (kg), and number of repetitions completed were recorded after each set.

The reliability of the 1RM test was analyzed as described by Hopkins²⁹ using intra-class correlation coefficients. Descriptive statistics was used. The values are expressed as means and standard deviation or individual data. Values of %1RM, RPE, and affective responses are displayed as the mean of the 3 sets for each exercise. We also calculated the coefficient of variation of the %1RM, RPE, and affective responses as the ratio between the standard deviation and the mean to better describe the self-selected intensity.

RESULTS

As shown in Table 1, the absolute load did not change over the three exercise sets, although the individuals were allowed to change the load selected at each set. Similarly, the participants used the same relative load for the three sets (data not shown).

Table 1. Absolute load (kg) used during the resistance training session at a self-selected intensity (mean \pm SD)

Exercise	First set	Second set	Third set	Mean \pm SD
Chest press	37.2 \pm 18.4	37.2 \pm 18.4	37.2 \pm 18.4	37.2 \pm 18.4
Leg press	116.7 \pm 31.7	115.0 \pm 33.2	115.0 \pm 33.2	115.6 \pm 32.6
Seated rows	42.0 \pm 17.3	42.0 \pm 17.3	42.0 \pm 17.3	42.0 \pm 17.3
Knee extension	52.5 \pm 13.7	51.7 \pm 12.9	51.7 \pm 12.9	51.9 \pm 13.1
Overhead press	23.5 \pm 9.2	23.8 \pm 9.4	23.8 \pm 9.4	23.7 \pm 9.3
Biceps curl	28.4 \pm 8.7	28.4 \pm 8.7	28.2 \pm 9.2	28.3 \pm 8.9
Triceps pushdown	36.7 \pm 9.6	36.7 \pm 9.6	36.7 \pm 9.6	36.7 \pm 9.6

The mean %1RM and coefficient of variation for the exercises were: chest press= $51.2 \pm 15.8\%$ (CV=0.309); leg press= $57.5 \pm 12.7\%$ (CV=0.221); seated row= $56.6 \pm 12.1\%$ (CV=0.214); knee extension= $51.6 \pm 10.9\%$ (CV=0.211); overhead press= $53.3 \pm 8.8\%$ (CV=0.165); biceps curl= $58.5 \pm 8.5\%$ (CV=0.145); and triceps pushdown= $56.7 \pm 9.6\%$ (CV=0.169). The mean percentage of 1RM for all exercises was $>51\%$, although there was quite large inter-subject variability of 14–31%.

Mean RPE and coefficient of variation were chest press= 5.3 ± 0.5 (CV=0.094); leg press= 6.2 ± 0.6 (CV=0.097); seated row= 5.7 ± 0.5 (CV=0.088); knee extension= 6.2 ± 0.7 (CV=0.113); overhead press= 6.5 ± 0.7 (CV=0.108); biceps curl= 6.4 ± 0.7 (CV=0.109); and triceps pushdown= $5.8 \pm 0.4\%$ (CV=0.069). The mean RPE for all exercises was 5–7 with an inter-subject variability of 7–11%.

Mean affect and coefficient of variation were chest press= 1.1 ± 0.5 (CV=0.455); leg press= 0.4 ± 0.4 (CV=1.00); seated row= 1.1 ± 0.6 (CV=0.545); knee extension= 0.3 ± 0.3 (CV=1.00); overhead press= 0.3 ± 0.6 (CV=2.00); biceps curl= 0.1 ± 0.7 (CV=7.00); and triceps pushdown= $1.1 \pm 0.6\%$ (CV=0.545). The mean affective responses for all exercises was 0–1 point, but there was large inter-subject variability ($>45\%$). The huge variability is likely due to fact that in some exercises, such as the overhead press and biceps curl, three and two individuals showed negative affective responses, respectively.

DISCUSSION

This study aimed to evaluate whether sedentary male subjects would self-select a load in RT that meets the ACSM's recommendations and describe its affective and perceived exertion responses. Our results showed that when sedentary male subjects are allowed to self-select the load during RT, they choose a load approximately 55% of 1RM, which is below the recommended intensity to improve strength in novice to intermediate exercisers, but above the intensity suggested to increase strength in sedentary male subjects. RPE was indicative of moderate intensity and slightly positive affective responses. However, it should be noted that there was large inter-subject variability for self-selected %1RM and affective responses. Investigations regarding the influence of self-selected and imposed exercise intensity (recommended) on physiological, perceptual, and affective responses during aerobic exercise have increased in recent years¹⁰. However, although some researchers have investigated physiological and perceptual responses during resistance exercise^{18–23}, this is the first study to describe perceived exertion and affective responses during a self-selected bout of acute resistance exercise in sedentary male subjects.

The ACSM guidelines recommend an intensity of 60–70% of 1RM (moderate to high intensity) in novice to intermediate exercisers and that 40–50% of 1RM (very light to light intensity) for sedentary subjects may be beneficial^{1, 2}. In our study, sedentary male subjects self-selected approximately 55% of 1RM, which met the recommended intensity for sedentary male subjects. In other words, even if we allow sedentary subjects to self-select the load that they want to use to perform the resistance exercise, they will choose a load recommended for improving strength. Additionally, it has been suggested that moderate loading (50–60% of 1RM or less) can be used initially since learning proper form and technique is paramount for novice individuals¹. The %1RM self-selected by sedentary male subjects in this study (51–58%) was similar to that found in novice weightlifters (~42–57%)¹⁸, untrained female subjects (~56%)¹⁹, trained female subjects (~42–51% and 57%)^{20, 23}, and active male subjects (37–58%)²². However, it should be noted that only Elsangedy et al. assessed a sample of sedentary older females (33–51.4%)²¹. Therefore, the relative load self-selected in RT may be sufficient to improve strength in sedentary male subjects and seems consistent across different samples.

The ACSM also recommends a load of 60–70% of 1RM, which corresponds to an RPE of moderate to high intensity². In this study, the mean RPE responses were 5–6 points (with low variability) on a 0–10 scale, which is considered moderate, while the self-selected load was 51–58% of 1RM. Similarly, for a self-selection of 56% of 1RM, untrained females reported an RPE just above “fairly hard”¹⁹. Additionally, it was shown that RPE for imposed intensity is higher than self-selected intensity, probably due to decreased perceived autonomy³⁰, and there is a linear function between RPE responses and relative intensity (%1RM)^{24, 26, 31}. Therefore, if a higher load was applied as suggested by the ACSM, sedentary individuals would perceive this intensity as being harder than they should, consequently increasing exercise attrition and impairing adherence^{19, 32}.

Regarding affective responses, the values on the feeling scale were generally from zero (“neutral”) to positive (“fairly good”). However, there was large inter-subject variability. It is important to note that in two exercises (overhead press and biceps curl), three and two subjects exhibited negative affective responses. To date, only two studies with other samples have shown positive affective responses to self-selected intensity in RT^{22, 23}. In this regard, positive affective responses during exercise could contribute to an individual's adherence to exercise programs^{6–8}. Aerobic exercise results have shown that psychological responses in self-selected intensity are more pleasant than imposed intensity^{11, 33, 34}, even when this imposition is equal¹⁵ or a little higher (10%) than the self-selected intensity^{10, 12}. Moreover, there is a tendency for participants to diverge from the imposed intensity levels in the direction of the preferred levels^{35, 36}. Therefore, based on the results of the negative psychological effects of imposed exercise intensity, we suggest that the same negative emotional responses may be expected after imposed resistance exercise intensity.

From a practical perspective, given that $\geq 50\%$ of subjects that begin an exercise program desist within the first six months³⁷, the present results may be applied to sedentary individuals beginning an RT program. A recent meta-analysis concluded that loads $<60\%$ of 1RM promote substantial increases in muscular strength and hypertrophy in untrained individuals³⁸. Additionally, considering that beginners may become easily discouraged from an exercise routine that elicits negative affect,

the results of this study indicate that a self-selected resistance exercise bout may be more appropriate when adherence is the primary goal since imposed exercise intensity induces less positive or negative affective responses during exercise. After this period, the current ACSM recommendations may be fully applied²). Some limitations of this study warrant mention. Since we included only sedentary male adults, the use of these findings for other populations (e.g., physically active subjects, the elderly, the obese, individuals with chronic diseases) should be made with caution. As this study used a self-selection protocol, the execution speed of motion during RT was not controlled. Additionally, future research should measure the rate of perceived autonomy as well as other psychological responses (e.g., self-efficacy, extroversion, neuroticism, behavioral inhibition) regarding load control during self-selected resistance exercise.

In conclusion, sedentary male subjects self-selected the load during RT of approximately 55% of 1RM, which was above the intensity suggested to increase strength in sedentary individuals but was below the recommended intensity to improve strength in novice to intermediate exercisers. RPE was indicative of moderate intensity and slightly positive affective responses. These findings have a practical significance, demonstrating that the self-selection approach is an interesting method for use at the beginning of a RT program when the primary goal is adherence. Therefore, exercise professionals should consider this strategy to prescribe and/or encourage the RT practice by sedentary subjects.

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