

Session Rating of Perceived Exertion During High Intensity and Low Intensity Bouts of Resistance Exercise

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ABSTRACT

The purpose of this study was to determine the reliability of a session rating of perceived exertion (RPE) scale to monitor resistance exercise intensity. Subjects (8 men, 9 women) completed 2 trials of acute resistance training bouts in a counterbalanced design. The high intensity resistance exercise protocol consisted of six, ten-repetition sets using 75% of the one repetition maximum (RM) on a Smith machine squat and bench press exercise. The low intensity resistance exercise protocol consisted of three, ten-repetition sets at 30% of 1RM of the same exercises as the high intensity protocol. Both exercise bouts were performed with 2 minutes of rest between each exercise and sessions were repeated to test reliability of the measures. RPE measures were obtained using Borg's CR-10 scale following each set. Also, a session RPE was obtained 30 minutes following each exercise session. Paired t-tests showed a significant difference between the mean RPE values for each intensity level ($p < 0.05$). There was also a significant difference between the session RPE values for each lifting intensity ($p < 0.05$). The intraclass correlation coefficient for the session RPE measure was 0.95 and the coefficient of variation was 17%. It was concluded that the session RPE method is a valid and reliable method of quantifying resistance exercise.

Keywords: Borg category scale, Perceived exertion, Weight lifting, Reliability

INTRODUCTION

The Borg 15-category scale for the rating of perceived exertion (RPE) during physical activity has been widely researched for its use in both clinical and exercise settings. This scale consists of an array of numbers ranging from 6 (no physical exertion at all) to 20 (maximal physical exertion possible). Since the Borg 15-category scale has been so thoroughly researched, it has become the gold standard (of the physical exercise realm) for the rating of perceived exertion in such activities as running and cycling. However, to date this scale has not been evaluated to the same extent for other high intensity exercises such as resistance training. A recent study by Gearhart et al. (2001) showed that the current Borg RPE scale (CR-10) can be used effectively during single set resistance training sessions and that it is a valid measure of exercise intensity. A second study by Gearhart et al. (2002) yielded similar results thus expressing promise to its application of the rating of single set perceived exertion. Currently, however, there have not been any studies that have addressed the issue of the reliability of RPE during resistance training sessions as a whole. In addition, the research done thus far using RPE during resistance exercise has not adequately addressed the efficacy of its use during typical multi-set, higher intensity weight training sessions undertaken by many trainees, particularly athletes (Gearhart et al., 2001).

The purpose of this study was to evaluate the overall effectiveness of using the current Borg RPE scale (CR-10) to measure physical effort during bouts of resistance training exercise, as well as to examine the validity of this scale in rating entire resistance training sessions.

METHODS

Experimental Design and Approach to the Problem

This study used a randomized, crossover design, in which subjects completed two experimental trials twice. For this study, subjects performed sets of a low intensity protocol (LIP), and a high intensity protocol (HIP) for two exercises (the bench press and the squat, respectively). For the purpose of safety and the elimination of possible external variables, which potentially could have affected results, both of these exercises were performed on the

Smith Machine. Each subject came in for a total of five sessions, on nonconsecutive days. Day one consisted of a familiarization session that included informed consent procedures, instruction on the use of CR-10 RPE scale to rate perceived exertion. The subsequent four sessions consisted of two HIP workouts at 75% of their 1-RM and two LIP workouts at 30% of their 1-RM.

Subjects

Seventeen volunteers (8 men, 9 women) between the ages of 18 and 25 were recruited for this study. These volunteers were required to meet the following requirements prior to participation in this study: the subjects were required to not have any skeletal, muscle, cardiovascular, or endocrine limitations; participants were to have been involved in a resistance-training program (of at least two sessions per week) for at least three weeks prior to participation in this study; the participants were to be free of controlled and performance-enhancing drug (e.g., anabolic steroids) for at least one month prior to and for the duration of the study; participants were also required to be nonsmokers.

In addition to the above exclusion criteria, subjects viewed and signed a written informed consent form as per the university's Institutional Review Board prior to participation. All subjects received a standardized physical examination of height, body mass, and percent body composition during the first phase of the study. During the duration of the study subjects were to refrain from exercise 48 hours prior to each testing session, to follow the same diet on each day of each trial, and not to eat for at least 3-4 hours prior to any given testing session. In addition, subjects were instructed to abstain from alcohol and caffeine for a minimum of 24 hours prior to any testing session (Gearhart et al. 2002).

Strength Testing

At least one week prior to the acute resistance exercise protocol, each subject had their (one) repetition maximum (RM) determined on the smith machine squat and smith machine bench press as previously described (Kraemer et al., 1998).

Acute Resistance Exercise Protocol

The high intensity resistance exercise protocol consisted of 6 sets of 10 RM squats (taken as 75% of 1RM) and bench presses with 2 minutes of rest between each set. A similar protocol has been previously used and has shown to result in changes in endocrine function (Hymer et al., 2001). If the subject failed to perform the 10 repetitions on any given set due to fatigue the load was immediately adjusted to permit completion of the remaining repetitions. The low intensity resistance exercise protocol consisted of 3 sets of 10 repetitions at 30% of 1RM of the same exercises as the high intensity protocol with 2 minutes of rest between each exercise.

Rating of Perceived Exertion Measures

During the familiarization session, each subject was given instructions on the use of the modified CR-10 category RPE scale. The session RPE measure, which was developed by Foster et al. (2001), was used to rate the entire workout (Figure 1). A series of anchoring tests was used as previously described by Gearhart et al. (2001) to establish high and low perceptual anchors. In addition, the subject was shown the scale 30 minutes following conclusion of the training bout and asked, "How was your workout?"

Rating	Descriptor
0	Rest
1	Very, Very Easy
2	Easy
3	Moderate
4	Somewhat Hard
5	Hard
6	*
7	Very Hard
8	*
9	*
10	Maximal

Figure 1. Rating of Perceived Exertion Measures Scale

Statistical Analysis

A paired t-test was used to test for differences in RPE among the HIP and LIP. Each subject's RPE values was averaged and compared to his/her session RPE rating. This test was completed to identify if significant differences exist between the session RPE rating and the accumulated RPE ratings obtained during each resistance training session. Interclass correlation coefficients (ICC) and coefficient of variation (CV) were calculated to establish the reliability of the session RPE method.

RESULTS

The paired t-tests showed a significant difference between the mean RPE values for each intensity ($p < 0.05$) (Figures 2 and 3). There was also a significant difference between the session RPE values for each intensity of lifting ($p < 0.05$) (Figure 4). There was no significant difference between the average RPE values and the session RPE values for the squat exercise. However, there was a significant difference between the average RPE value and the session RPE value during each intensity for the bench press exercise ($p < 0.05$).

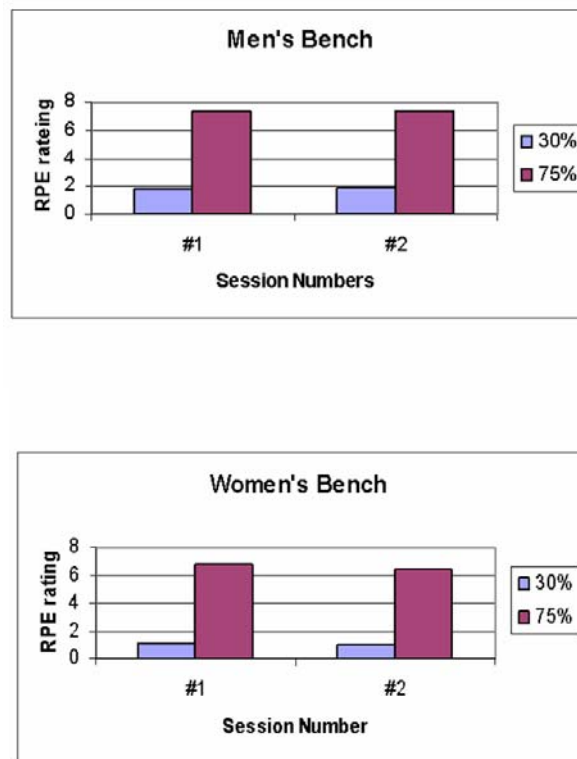


Figure 2. Bench RPEs

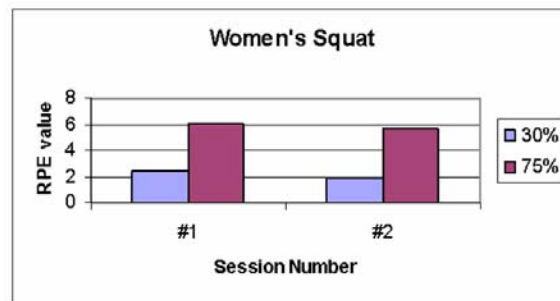
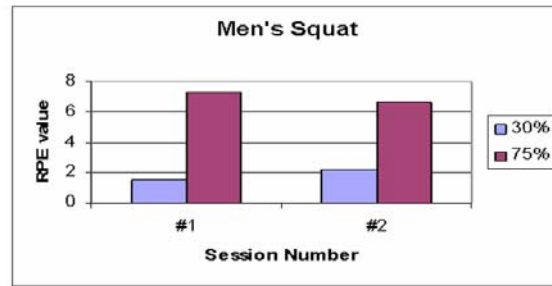


Figure 3. Squat RPEs



Figure 4. Session RPEs

A test for reliability of the session RPE to predict the same value across two different trials of the same intensity was performed. The ICC was 0.95 with the 95% confidence interval of 0.90-0.97. The CV was 17.0%.

DISCUSSION

The purpose of this study was to evaluate the reliability and effectiveness of the modified CR-10 category scale to rate an overall resistance training session. Through our research, we found a significant difference ($p < 0.05$) among mean RPE values of each intensity for the two exercises (bench press and squat). The average RPE value and session RPE value for the bench press exercise yielded $p < 0.05$. For the squat exercise however, no significant difference was found between average RPE value and session RPE value.

The findings of Gearhart et al (2001, 2002) gave evidence supporting our hypothesis and their experiments served as a model for our research. The RPE values for each set were taken in addition to the session rating. The purpose of taking the set RPE values was to further familiarize the subjects with rating their perceived effort on the modified CR-10 scale. This, we believed, would increase the accuracy of the session RPE value. A second purpose for taking the set RPE values was to have a basis to test the reliability of the session RPE. This study gave further evidence validating the findings of Gearhart et al. (2002) where fewer repetitions of a heavier resistance was perceived to be more difficult than performing more repetitions of a lighter resistance.

Since we found a significant difference ($p < 0.05$) among mean RPE values of each intensity for the bench press and squat, we have concluded our experiment was an accurate and reliable method of evaluating session RPE. Further evidence of this can be seen in Figure 4 where there was little difference shown in RPE values between the two trials.

To give further evidence of reliability a statistical test of session RPE to predict RPE values across two different trials of the same intensity was performed. The results revealed a 0.95 ICC with a 95% confidence interval of 0.90-0.97 (CV=17.0%). This reliability gives strong evidence that our hypothesis—that session RPE can be used to monitor the intensity level of a resistance training session—was correct. Also, this gives additional evidence supporting the findings of Gearhart et al. (2001, 2002).

The average RPE value and session RPE value for the bench press exercise yielded $p < 0.05$. Statistically this gives evidence that it may be possible to predict the session RPE value for the bench press based on the individual set RPE values of the workout. This would be beneficial to strength coaches, athletes, and researchers alike to know for example, if an overall session RPE of 6 was desired for the bench press, and a few individual set RPE values when averaged yielded the trainee was only working at an RPE of 4 the intensity level of the workout could be increased so to achieve the session RPE of 6. This is to say an individual could predict the session RPE value based on a few individual set RPE values and make adjustments as necessary before the conclusion of the workout and still achieve the session intensity they desired.

No significant difference was found between average RPE value and session RPE value for the squat exercise. Statistically, this indicates that further evidence is needed indicating that averaging individual set RPE values is an indication of overall session RPE values for the squat exercise. There was not enough evidence in our results to be able to claim average RPE for the individual set is an indication of session RPE.

The session RPE value was shown to consistently match the average RPE during the training session, further demonstrating the usefulness of this method when attempting to quantify resistance training bouts. A session RPE scale would be an easy and reliable method to prescribe work intensities for resistance training sessions as well as to provide for progressive increases in intensity that have been found necessary for continued increases in strength. Overall, the CR-10 scale was found to be an effective tool to quantify work of LIP and HIP workouts.

PRACTICAL APPLICATIONS

The results of this study have shown that session rating is a reliable and useful tool of measuring a resistance training session. This scale will be a beneficial tool for researchers, strength coaches, recreational weightlifters, and athletes as they strive to rate the work intensity of a resistance training session. Being able to rate a resistance training session would be beneficial since an athlete, strength coach etc. could choose an intensity prior to the start of the resistance training session (e.g., an RPE of 6), and be confident the work intensities will stay at the desired level. This would be much easier than using multiple measures of RPE throughout a resistance training workout since session RPE would be an easy and effective method to prescribe work intensities.

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