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QUANTITATION OF RESISTANCE TRAINING USING THE SESSION RATING OF PERCEIVED EXERTION METHOD

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ABSTRACT. Sweet, T. W., C. Foster, M. R. McGuigan, and G. Brice, Quantitation of resistance training using the session rating of perceived exertion method. *J. Strength Cond. Res. 18(4): 796–802. 2004.*—The purpose of this study was to apply the session rating of perceived exertion (RPE) method, which is known to work with aerobic training, to resistance training. Ten men (26.1 ± 10.2 years) and 10 women (22.2 ± 1.8 years), habituated to both aerobic and resistance training, performed 3 × 30 minutes aerobic training bouts on the cycle ergometer at intensities of 56%, 71%, and 83% $\dot{V}O_2$ peak and then rated the global intensity using the session RPE technique (e.g., 0–10) 30 minutes after the end of the session. They also performed 3 × 30 minutes resistance exercise bouts with 2 sets of 6 exercises at 50% (15 repetitions), 70% (10 repetitions), and 90% (4 repetitions) of 1 repetition maximum (1RM). After each set the exercisers rated the intensity of that exercise using the RPE scale. Thirty minutes after the end of the bout they rated the intensity of the whole session and of only the lifting components of the session, using the session RPE method. The rated intensity of exercise increased with the %$\dot{V}O_2$ peak and the %1RM. There was a general correspondence between the relative intensity (%$\dot{V}O_2$ peak and % 1RM) and the session RPE. Between different types of resistance exercise at the same relative intensity, the average RPE after each lift varied widely. The resistance training session RPE increased as the intensity increased despite a decrease in the total work performed ($p < 0.05$). Mean RPE and session RPE–lifting only also grew with increased intensity ($p < 0.05$). In many cases, the mean RPE, session RPE, and session RPE–lifting only measurements were different at given exercise intensities ($p < 0.05$). The session RPE appears to be a viable method for quantitating the intensity of resistance training, generally comparable to aerobic training. However, the session RPE may meaningfully underestimate the average intensity rated immediately after each set.

KEY WORDS. weight lifting, Borg CR-10 scale, training intensity

INTRODUCTION

Resistance training is well accepted as an effective exercise method for improving athletic performance and overall quality of life. Resistance training programs involving systematic heavier and lighter training periods (periodization) have been shown to decrease injury and to enhance strength and power output gains (7). Optimal periodization plans have not yet been created with resistance training programs because validated methods for quantifying the resistance training load have not been developed. Resistance training is a high-intensity exercise that cannot readily be quantified using objective measurements. Heart rate (HR) increases disproportionately during resistance training and cannot be used to quantify intensity. Oxygen consumption ($\dot{V}O_2$) does not represent the training load during resistance training because of the small amount of total work and the long recovery pauses necessary during high-intensity training. As a result, suboptimal performances attributable to training above or below optimal levels are prevalent.

Session rating of perceived exertion (RPE) is a modification of the classic RPE scale, which has been used to measure the intensity of an entire exercise session (6, 8–12). Session RPE can quantify exercise intensity across a wide range of aerobic exercises, including interval training, and it may be able to quantify resistance training (6, 8–12). A number of studies have shown RPE (including session RPE) to be a valid tool for quantifying the intensity of steady-state aerobic exercise (3, 4, 14). Noble et al. (14) compared RPE values obtained from subjects during steady-state progressive cycle ergometer tests versus objective measures including HR, blood, and muscle lactate during the tests. RPE increased linearly with HR and parallel with muscle and blood lactate during steady-state exercise (4, 14).

Several studies have evaluated training load and prescribing exercise periodization using session RPE (8, 9, 12). Foster et al. (9) reported that self-directed increases in training load, using the session RPE scale, improved athletic performance during cycling time trials. However, another study by Foster (8) revealed that a sudden increase in training load above normal training limits caused a decrease in performance and led to injury or illness. Periodization or variation of training intensity should be used within a weekly training plan and can be monitored using session RPE values obtained by the individual after each exercise session. In an attempt to explain the incidence of overtraining syndrome in athletes, Foster et al. (12) found that athletes did not follow training sessions prescribed by coaches. Session RPE values compared between coaches and athletes demonstrated that athletes trained too hard on coach-designed easy days and too easy on coach-designed hard days (12). Session RPE should allow greater training synchronicity between a coach-designed training regimen and the actual intensity at which athletes train. Session RPE could also lead to optimal athletic performance with a reduced injury/illness cost resulting from overtraining.

Many studies have attempted to quantify the intensity of non–steady-state exercise bouts using various forms of the RPE scale. Skinner et al. (16) compared the standard RPE scale and HR with steady-state and non–steady-state exercise on a cycle ergometer. RPE and HR were well correlated in both the steady-state and non–steady-state exercise protocols. Subjects using the standard RPE scale could accurately perceive small changes in workload. Foster et al. (10) compared session RPE with HR during an interval exercise with varied interval durations and magnitudes during cycle ergometer tests. Session RPE and HR were also compared during non–steady-state high-intensity basketball practice. Regression analysis of basketball practice and interval cycle ergometer tests revealed a significant correlation between HR and session RPE. It was concluded that session RPE may be able to quantify other high-intensity anaerobic activities such as resistance training (10).

A recent study was performed using RPE during judo competition. Serrano et al. (15) measured the intensity of judo competition using RPE. The standard RPE and CR-10 scale values were collected 10 and 30 minutes after fighting. Each participant completed 2 to 3 fights during the competition. The 10-minute RPE value was used to describe the intensity of the last fight, whereas the 30-minute RPE value was used to describe the intensity of the entire competition, which is conceptually similar to the approach taken by Foster et al. (8–12). The 30-minute RPE values for the entire competition correlated to maximal blood lactate levels 1 and 3 minutes after fighting (15). Judo is very high intensity exercise, as is resistance training. The correlation between RPE 30 minutes postfighting and maximal blood lactate levels supports the concept that session RPE represents global exercise intensity, and that it may accurately reflect the demands of very high intensity exercises.

Studies have shown that the CR-10 RPE scale can be used to quantify resistance training exercises (6, 13). We have recently shown session RPE to be reliable at quantifying resistance training at different intensities (6). Session RPE was measured 30 minutes postexercise, and significant differences in session RPE values were found depending on the intensity of the resistance training sessions. Higher-intensity protocols produced higher session RPE measurements despite a decrease in the number of repetitions performed. Repetition of each training session supported session RPE as a reliable method for quantifying resistance training intensity (6).

Session RPE can measure intensity across a wide range of exercises, and it may provide an easy way to quantify resistance training. Therefore, the purpose of this study was to test the hypothesis that session RPE can be used to quantify the intensity of resistance training exercise sessions in a way that is comparable to similar intensity levels during aerobic exercise.

METHODS

Experimental Approach to the Problem

Each subject participated in 2 separate parts of the study. One part of the study required the participants to perform 3 bouts of steady-state aerobic exercise on a cycle ergometer. The other part of the study required the participants to perform 3 high-intensity resistance training bouts. Both the resistance training and the cycle ergometer portions of this study contained exercise sessions that were intended to be easy, moderate, and hard in perceived intensity. The exercise regiments took place after performing 1RM and $\dot{V}O_2$ max sessions. The order and intensity of the resistance training and cycling sessions were randomized. Resistance training sessions were at least 48 hours apart for each subject. Proper use of 6 different resistance training exercises was demonstrated for each subject. Subjects were familiarized with a modified CR-10 RPE scale (Table 1) and its verbal anchors before beginning either part of the study (6, 8–12).

TABLE 1. Modification of the category ratio rating of perceived exertion (RPE) scale for this study (10).

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

* The verbal anchors have been changed slightly to reflect American English (e.g., light becomes easy; strong or severe becomes hard). Briefly, the subject is shown the scale approximately 30 minutes following the conclusion of the training bout and asked, "How was your workout?"

Subjects

Twenty volunteer subjects (10 men, 10 women) participated in the study and successfully completed all aspects of the study. The subjects were healthy, moderately active college age students who exercised using both aerobic and resistance exercises at least 30 minutes a day on most days of the week. Each subject provided informed consent before participation. The protocol was approved by the Institutional Review Board for the Protection of Human Subjects at the University of Wisconsin–La Crosse.

Exercise Protocol

A preliminary cycle ergometer test was performed by each of the subjects. RPE values were taken every 2 minutes using the modified CR-10 RPE scale. The subjects pedaled at a freely chosen rate within the range of 60–80 revolutions per minute (rpm). The test began with a 3-minute warm up at 25 W for men and 20 W for women. The power output then increased by 25 W for men or 20 W for women every minute until the subjects could no longer continue. Peak $\dot{V}O_2$ was taken as the highest 30-second value reached by the subject during the test.

Each subject subsequently performed 3 exercise sessions of steady-state exercise on the cycle ergometer. Using data from the $\dot{V}O_2$ peak test, subjects exercised on the cycle ergometer for 30 minutes at 70%, 90%, and 110% of their ventilatory thresholds (VT-1). The resistance increased every minute during the first 5 minutes until the desired power output was reached. The subject continued to pedal at the steady-state workload for 25 minutes. Thirty minutes following exercise, subjects were asked, "How was your workout?" (10). The question was answered by giving a global intensity rating (session RPE) to describe the intensity of the entire exercise bout (see Table 1).

A preliminary 1RM was determined for each subject on each of 6 resistance exercises, using previously described methods (6). The 1RM was defined as the maximal amount of weight that the individual could lift 1 time without help. The participants then performed 3 sessions of high-intensity resistance training. The results of individual 1RM for 6 different resistance exercises were used to create exercise intensity bouts for each subject. The 6 different resistance exercises performed during each session included the lateral pulldown, biceps curl, triceps extension, leg press, chest press, and shoulder press. The first session required the subjects to perform 15 repetitions per set, 2 sets per machine, at 50% of 1RM. The second session consisted of 10 repetitions per set, 2 sets per machine, at 70% of 1RM. The last session required 4 repetitions per set, 2 sets per machine, at 90% of 1RM. The workload for each exercise was within 0.5 kg of the actual percentage that the subject was required to lift during any given resistance training session. A warm-up set on each resistance exercise of <30% of the subject's 1RM was performed before lifting the required workloads for the session. The subjects were given 30 minutes to complete each resistance training session, which allowed 60–90 seconds of rest between each set, depending on the number of repetitions required during the session.

RPE was used to determine the intensity of each resistance training session. After each set of each exercise, subjects were asked to give an RPE for the difficulty of that set. The subjects were only required to perform the desired number of repetitions per set. However, during the 90% session, subjects were asked to complete 5 repetitions if they had not reached exhaustion on completion of the fourth repetition. An RPE value of 10 was given automatically if the set could not be completed. The average of the RPE values given after each set of each exercise during the resistance training sessions were used to develop a mean RPE (MRPE). This was done to provide average rating of RPE, which is how RPE has been typically measured in previous studies (13). Thirty minutes following the bout, subjects were asked, "How was your workout?" (10). The question was answered by giving a session RPE value to describe the intensity of the entire exercise session. RPE was taken 30 minutes postexercise to prevent particularly difficult or easy elements near the end of the exercise session from skewing the overall rating of the session (10). The rest periods, repetitions, and actual weight lifted could all be taken into account when providing a session RPE measurement. Because long rest periods between sets could bias the results, subjects were also asked to give an RPE for the lifting only. The lifting-only value asked the subjects to provide an RPE that described the difficulty of the actual weight that they had to lift during the session (session RPE–lifting only [or session RPE-LO]). Session RPE-LO was provided at the same time that session RPE was measured. The goal of the session RPE was to encourage the subject to view the training session globally and to simplify the myriad of exercise intensity cues during the exercise bout. We have previously determined the reliability of the session RPE method, and it has been shown to be high (ICC = 0.88) (6).

Instrumentation

A preliminary $\dot{V}O_2$ peak test was performed by each subject, using an electronically braked cycle ergometer (Quinton, Seattle, WA). Oxygen uptake ($\dot{V}O_2$) was measured using open-circuit spirometry (Quinton Q-Plex, Seattle, WA). VT-1 was identified using the v-slope technique (2). The 1RM for 6 different resistance exercises was found by using continued increases in weight with decreases in repetitions over multiple sets (13). The RPE scale was used to measure the intensity of resistance training and steady-state cycling sessions (4). Subjects were asked to use any number on the scale to rate their overall effort. A rating of 0 was to be associated with no effort (rest), and a rating of 10 was considered to be maximal effort and to be associated with the most stressful exercise ever performed.

Table 2. Mean (±*SD*) characteristics of the subjects.

	Men	Women
Age (years)	26.1 ± 10.2	22.2 ± 1.8
Height (cm)	178.6 ± 9.9	165.5 ± 4.2
Mass (kg)	81.3 ± 15.0	58.7 ± 5.0
BMI (%)	25.4 ± 6.1	21.6 ± 1.8
Peak $\dot{V}O_2$ ($L \cdot min^{-1}$)	3.60 ± 0.58	2.26 ± 0.31
Peak heart rate ($b \cdot min^{-1}pm$)	187 ± 15	183 ± 5.0
Ventilatory threshold ($L \cdot min^{-1}$)	2.36 ± 0.42	1.79 ± 0.23
Bench press 1RM (kg)	85.5 ± 18.3	41.8 ± 11.5
Lateralis pulldown 1RM (kg)	73.0 ± 10.3	46.7 ± 5.3
Shoulder press 1RM (kg)	64.2 ± 13.6	30.8 ± 8.3
Leg press 1RM (kg)	262.6 ± 44.0	182.8 ± 40.2
Biceps curl 1RM (kg)	37.2 ± 6.9	22.3 ± 5.3
Triceps extension 1RM (kg)	74.4 ± 10.7	42.8 ± 7.5

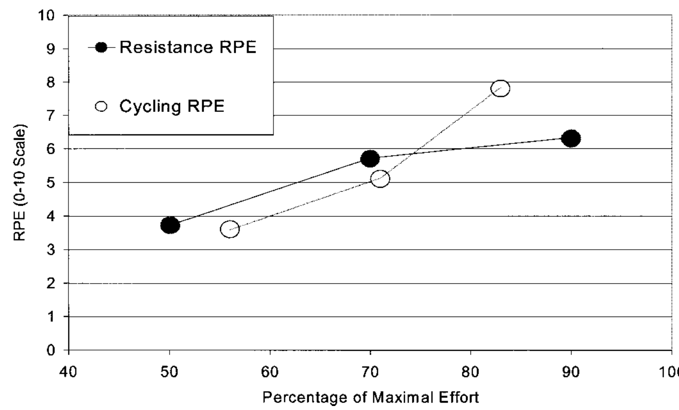

Figure 1. Relationship of session RPE during resistance training and steady state cycling at percentages of maximal ability.

Statistical Analyses

Session RPE values for the resistance training bouts were compared to session RPE values in the cycle ergometer protocol. Repeated measures ANOVA was used to test for differences in session RPE, session RPE-LO, and MRPE. A 2-way within-subjects repeated measures ANOVA was used to detect significant differences. Pair-wise comparisons were made, when justified by ANOVA, using the Tukey test.

Results

Descriptive statistics of the subjects are represented in Table 2. A general correspondence was observed between comparable intensities of non–steady-state resistance training and steady-state aerobic cycling using the session RPE method (Figure 1). Session RPE for resistance training increased from 3.8 ± 1.6 to 5.7 ± 1.7 to 6.3 ± 1.4 as the percentage of 1RM increased from 50% to 70% to 90%, respectively. At the same time, session RPE for cycling increased from 3.6 ± 1.1 to 5.1 ± 1.3 to 7.8 ± 1.3 as the intensity increased from 56% to 71% to 83% $\dot{V}O_2$

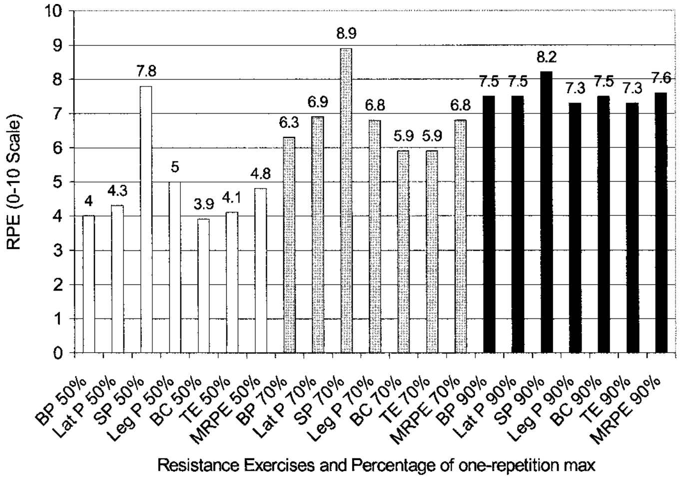

FIGURE 2. RPE with different resistance exercises at 50%, 70%, and 90% of 1 repetition maximum (1RM). BP = bench press, Lat P = lat pulldown, SP = shoulder press, Leg P = leg press, BC = bicep curl, TE = triceps extension, MRPE = mean RPE.

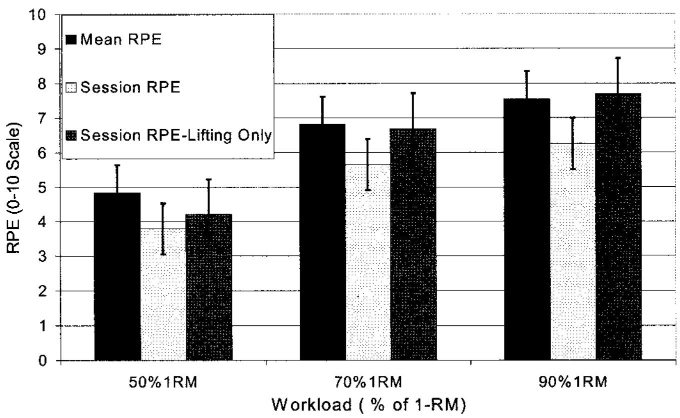

FIGURE 3. Session RPE, MRPE, and session RPE-LO values during resistance training at different intensity levels.

peak, respectively (70%, 90%, and 110% of VT-1 was converted to percentages of $\dot{V}O_2$ peak).

The RPE with various resistance training exercises increased as the intensity approached 1RM. RPE for bench press, lateral pulldown, leg press, biceps curl, and triceps extension increased as the percentage of 1RM increased from 50% to 70% to 90%, despite a decrease in number of repetitions, from 15 to 10 to 4. The average values for each resistance exercise are found in Figure 2. Shoulder press was the only exercise to contradict this finding by decreasing between 70% and 90% of 1RM. Although the RPE after each of the different resistance training exercises increased with increased percentage of 1RM, the RPE at a given percentage of 1RM varied widely among the 6 resistance training exercises. The RPE values given after each set on the shoulder press were consistently higher than those following any other resistance exercise at all percentages of 1RM.

MRPE, session RPE, and session RPE-LO all increased as the percentage of 1RM (intensity) increased (Figure 3). Tests of within-subjects repeated measures ANOVA revealed a significant intensity effect ($p < 0.05$). For each method, the 90% 1RM values were significantly greater ($p < 0.05$) than the 70% 1RM, and the 70% 1RM values were significantly greater ($p < 0.05$) than the 50% 1RM values. The Tukey post hoc comparison for MRPE, session RPE, and session RPE-LO shows that the mean difference between the 50%, 70%, and 90% 1RM sessions were significantly different ($p < 0.05$) with the exception of the mean difference between 70% and 90% 1RM session RPE.

Post hoc analysis showed that significant differences ($p < 0.05$) occurred between session RPE, MRPE, and session RPE-LO at any given percentage of 1RM, in most cases. There were some cases in which session RPE, MRPE, and session RPE-LO were similar at given exercise intensities. Post hoc comparisons show that the mean difference between 50% session RPE and 50% session RPE-LO, 70% MRPE and 70% session RPE-LO, and 90% MRPE and 90% session RPE-LO were not significantly different ($p > 0.05$). All other RPE results were significantly different at any given exercise intensity ($p < 0.05$).

DISCUSSION

The purpose of this study was to determine whether session RPE could quantify intensity during resistance training, as it has been shown to do with aerobic exercise and other forms of high-intensity exercise. Session RPE during easy, moderate, and high-intensity resistance training was compared to session RPE during comparable intensities of steady-state aerobic exercise on a cycle ergometer. The session RPE appears to be a valid method for quantitating the intensity of resistance training and is generally comparable to aerobic training. As with previous studies, the ratings were consistent in the pattern that RPE values were given, showing their ability to perceive slight changes in intensity (6, 10). Session RPE, MRPE, and session RPE-LO all increased as the percentage of 1RM increased, despite a decrease in repetitions and total workload. This study supports other studies that have shown RPE to be a valid method to quantify the intensity of resistance training (6, 13). Furthermore, a wide range of actual RPE measurements were provided by the subjects at any given resistance training intensity, depending on the type of resistance training exercise being used.

The results of this study are consistent with those of previous studies on the relationship between session RPE and differing intensities of steady-state exercise. As the intensity of each session increased on the cycle ergometer, the session RPE increased comparably to heart rate (9, 10, 16). A correspondence between steady-state and high-intensity exercise was found and is supportive of previous findings (10, 15). Foster et al. (10) found a significant correlation between high-intensity non–steady-state basketball practice and steady-state cycling. This supports the concept that high-intensity resistance training may be quantified using session RPE (10).

The RPE measurements taken after each set varied widely depending on the type of resistance exercise being performed. Many of the resistance exercises were consistently perceived to be more or less difficult than the MRPE across all subjects at low-, moderate-, and high-intensity sessions. Actual RPE measurements for the shoulder press immediately after completing a set were consistently higher in all subjects at all intensities. Lower ratings were found in biceps curl and triceps extension at lower intensities, but they appeared to increase at a greater rate than the MRPE as the intensity approached the individual's 1RM.

Many factors could have influenced variations in actual RPE measurements. Resistance training exercises that use larger muscle groups require a large number of motor units to be recruited (1). The metabolic needs of larger muscle groups can also make the perception of maximal effort more noticeable because a greater percentage of total skeletal muscle is taking part in work. Exercises that require a range of motion using multiple joints such as leg press, bench press, shoulder press, and lateral pulldown may increase RPE. Single-joint smaller-muscle exercises, like biceps curl and triceps extension, require less energy expenditure (1). It appears logical that the triceps extension and biceps curl would have lower RPE measurements. The order in which the exercises are performed could also influence RPE. If the bench press is usually performed at the beginning of resistance exercise, and then on another day the bench press is performed last, the RPE is going to be higher than usual. Therefore, every effort was made to keep the resistance training exercises in the same order. Muscle fatigue increases closer to the end of a resistance training session than to the beginning. The fiber type of the working skeletal muscle also influences RPE at given intensities. Fast-twitch muscle fibers can produce strong, quick contractions, making use of the anaerobic system (1). Muscles that are largely made up of fast-twitch fibers are better able to perform quick high-intensity movements (1). Muscle or muscle groups that are largely made up of fast-twitch fibers may allow individuals to lift a large percentage of their 1RM at low repetitions without perceiving it to be very difficult. This may result in lower RPE values in fast-twitch muscles compared with those of slow-twitch fibers during the high-intensity low-repetition protocol. At the same time, trying to perform a lower percentage of the 1RM with a large increase in repetitions may be difficult because the fast-twitch fibers do not make good use of the aerobic system. The fast-twitch fibers fatigue quickly and are unable to perform submaximal intensities repetitively or over a considerable amount of time. Muscles that make greater use of the slow-twitch fibers may be made apparent by lower-than-normal RPE measurements when using low-intensity, high-repetition protocols. The percentage of slow- and fast-twitch fibers that an individual has is genetically determined, but the fibers can take on certain traits or make better use of different systems depending on whether the individual is aerobically or anaerobically trained (1).

During our study, the session RPE, MRPE, and session RPE-LO all increased as the percentage of 1RM increased, even though the number of repetitions decreased. Gearhart et al. (13) and Day et al. (6) also found that RPE increases as the percentage of 1RM approaches 100%, even with decreases in repetitions. RPE seems to be more sensitive to increases in the actual weight lifted (intensity) than to the number of repetitions (volume) completed (6, 13). During this study, the lowest session RPE, MRPE, and session RPE-LO were given by the subjects during the low-intensity–high-repetition sessions. The highest session RPE, MRPE, and session RPE-LO measurements were given by the subjects during high-intensity–low-repetition sessions. The results of this study support the findings of Day et al. (6), that session RPE is the lowest during the lowest-intensity resistance training session even though the low-intensity session actually requires the highest total work of all because of the increase in repetitions. The results of this study are supportive of evidence that RPE is influenced primarily by intensity rather than repetitions or total work performed (6). Gearhart et al. (13) have indicated that some factor other than energy consumption has a large influence on RPE. Increases in motor unit recruitment and frequency of firing during heavy lifting may have a large influence on RPE (13).

The findings of this study differed from similar studies in certain aspects. During this study significant differences between session RPE and MRPE were found at comparable exercise intensities. Day et al. (6) showed that the session RPE and MRPE were not significantly different at any given exercise intensity. It was concluded that session RPE is a valid and reliable method for quantifying resistance training intensity. Day et al. (6) concluded that the session RPE measurements, provided 30 minutes postexercise, were as accurate at measuring intensity as the sum of actual RPE measurements taken after each set of each exercise. During our study, the session RPE-LO measurements were comparable to MRPE values at 70% and 90% 1RM, but session RPE did not give comparable measurements to MRPE. Session RPE values were consistently lower than the MRPE and session RPE-LO values during 50%, 70%, and 90% 1RM sessions. Why comparable session RPE and MRPE data were not observed, as in the study of Day et al. (6), is not entirely clear.

In this study, RPE values were taken after each of 2 sets (per exercise) versus after 1 set in Day et al. (6). The second set of exercise was often perceived to be more difficult than the first set. Statistical analysis showed that there was a significant increase in the RPE measurements given between the first and second set of each exercise ($p < 0.05$). Measuring a second set did increase the MRPE for any given resistance training intensity. The type of subject may have altered the results. The study by Day et al. (6) seemed to contain pure strength-training individuals. The subjects in the current study were cross-training individuals (i.e., moderately active and using both aerobic and resistance exercises at least 30 minutes a day on most days of the week), who may not be able to perceive the intensity of resistance exercise the same as pure strength-training individuals. Foster et al. (10) noted that pure strength-training individuals are better at measuring intensity on muscular tension. Including session RPE-LO in this study may have altered the way that subjects used session RPE, or session RPE may meaningfully underestimate the average intensity rated immediately after each set (MRPE). When the subjects had to lift heavier loads but the repetitions were low, the session RPE-LO measurements were high and comparable to MRPE. Subjects may have rated session RPE the same as MRPE if session RPE-LO was not an option. Another factor could also have been the number of repetitions performed during each set. The subjects were only required to perform the desired number of repetitions per set. In the majority of cases, this represented the limit of the number of repetitions that could have been performed (i.e., failure). However, it is possible that not all of the sets were performed to failure.

During high-intensity sessions, subjects may have thought that they needed to give a higher session RPE-LO measurement that was true to the MRPE. Subjects may have put more thought into the increased amount of rest periods and decreased need for muscular endurance during the high-intensity–low-repetition sessions to justify making session RPE lower than session RPE-LO. When subjects were asked to give a session RPE-LO for the actual weight they had to lift during the session, it seems to be most comparable to MRPE as the 1RM is approached. If session RPE-LO was not an option and session RPE was the only method to describe the difficulty of the high-intensity–low-repetition sessions, then the method may have been comparable to MRPE during high-intensity resistance training sessions, as seen in other studies (6). The correlation between session RPE-LO and MRPE may indicate that session RPE-LO is better at perceiving the intensity of resistance training than session RPE.

The correlation between session RPE during resistance training and aerobic training decreased as intensity approached 100%. During the high-intensity cycling session, individuals were exercising above their ventilatory threshold. Brooks et al. (5) explains that prolonged exercise above the ventilatory threshold becomes uncomfortable and the mechanisms allowing high levels of activity start to be inhibited by the large accumulation of hydrogen ions (5). During the high-intensity resistance training session, rest periods prevented any large buildup of hydrogen ions. Resistance training represents a complex milieu of perceptual signals, including muscle mass recruited in an exercise, type of exercise used, metabolic acidosis, and loading, that is entirely dependent on the type of resistance exercise protocol that is employed. These factors may have made a difference in how difficult the high-intensity cycling session felt compared with the high-intensity resistance training session. Despite the complex nature of resistance exercise that involves a range of physiological cues depending on the type of training undertaken, there does appear to be a fundamental similarity to the use of session RPE with monitoring aerobic exercise.

Research by Foster et al. (10) has shown that muscularly strong individuals were comparatively poor at perceiving their own exertion level during aerobic training. Aerobically trained individuals tend to perceive intensity based on the sensation of dyspnea, whereas muscularly strong individuals base intensity on the amount of muscular tension (10). A cross-sectional study of pure resistance-trained and pure aerobically trained athletes should be used to compare variations in how intensity is perceived using session RPE if each type of athlete performs both resistance training and aerobic training. More studies on RPE and neurological function are needed to understand the exact mechanisms that influence RPE. Furthermore, tests of reliability during resistance training versus steady-state exercise may be helpful in showing that session RPE can compare the relationship between resistance training and aerobic exercise consistently.

This study and studies by Day et al. (6) and Gearhart et al. (13) have shown that RPE is most influenced by exercise intensity and not by the volume of exercise being performed. Multiplying session RPE (during resistance training) by the number of repetitions and dividing it by the amount of time that the exercise took may be a better way to determine both the intensity and volume of work performed in a given amount of time.

PRACTICAL APPLICATIONS

Session RPE appears to be a reasonable method for quantifying the intensity of resistance training. Session RPE shows a general correspondence to steady-state aerobic exercise during resistance training. The goal of the session RPE is to encourage the athlete to view the training session globally and to simplify the myriad of exercise intensity cues during the exercise bout. Periodization of resistance training might be prescribed with greater adherence to desired intensities with the use of the session RPE method. Current periodizations of lighter and heavier training days do reduce the risk of overtraining. However, many nonathletes do not use periodization in their resistance training program, or they do not follow periodization with good adherence. A session RPE value provided after each resistance training session would allow coaches to see increases or decreases in the perception of intensity when compared to previous session RPE values at a given workload and work volume. Increases in session RPE at any given workload can be an early indicator of overtraining, and modification of the periodization plan can be implemented to optimize the specific needs of an individual athlete. Coaches and athletes can use the session RPE method to quantify resistance and aerobic training.

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