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Short Communication Open Access

Rating of Perceived Exertion for Quantification of the Intensity of Resistance Exercise

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Abstract

Rating of perceived exertion (RPE) is widely used in exercise tests using cycle ergometers (incremental aerobic exercise) for patients with cardiovascular and metabolic diseases such as hypertension and type 2 diabetes. On the other hand, RPE has also been used widely for determining the intensity of resistance exercise for healthy subjects. RPE anchoring is associated with percentage of 1 repetition maximum or the percentage of maximal voluntary contraction. This short communication explains a concrete method of RPE to quantify the intensity of resistance exercise. Physicians, physical therapists, and medical staff should use RPE for determining the intensity of resistance exercise in clinical practise.

Introduction

Rating of perceived exertion (RPE) has been widely used for determining the intensity of resistance exercise because it is related to physiological markers of the stress response to exercise [1-3]. The guidelines of the American Heart Association (AHA) and the American College of Sports Medicine (ACSM) recommended monitoring cardiovascular responses to resistance exercise, including the heart rate (HR), blood pressure (BP), and perceived exertion, and using the RPE to set the intensity of strength training in both young and older adults [4,5]. However, physicians, physical therapists, and medical staff engaged in rehabilitation are largely unfamiliar with the use of the RPE for adjusting the intensity of resistance exercise. This article reviews the use of several forms of RPE for resistance exercise, including the Borg Category Ratio (Borg CR-10), Borg 15-point RPE scale, and OMNI-Resistance Exercise Scale (OMNI-RES).

RPE can be used to track the progress of training in resistance exercise and may also be appropriate for quantifying the intensity of resistance exercise and prescribing an appropriate program [6,7]. A number of recent investigations have indicated that RPE is related to various indices of resistance exercise intensity [8,9]. Borg CR-10,0 Borg 15-point RPE scale, [10-12] and OMNI-RES [3] have been used as metrics of perceived exertion during resistance exercise.

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

Table 1: Borg Category Ratio (Borg CR-10).

jRating	Descriptor
6	No Exertion at all
7	Extremely Light
8	-
9	Very Light
10	-
11	Light
12	-
13	Somewhat Hard
14	-
15	Hard (Heavy)
16	-
17	Very Hard
18	-
19	Extremely Hard
20	Maximal Exertion

Table 2: Borg 15-point RPE scale.

Borg Category Ratio (Borg CR-10)

Borg CR-10 has been used to assess the RPE during resistance exercise via a modified 0-10 category ratio [6,13,14]. This scale is presented in Table 1. After completing each working set, the subjects were asked to rate their perceived exertion on the CR-10 scale by choosing any number on the scale to rate their overall effort during the resistance exercise. A rating of 0 was to be associated with no effort, i.e. rest, and a rating of 10 with maximal effort, i.e. the most stressful exercise performed. The Borg CR-10 scale has been used to quantify the perception of physical exertion [10]. Many studies have validated the CR-10 scale for measurement of the intensity of resistance exercise [7,9,13,15-21].

Borg 15-point RPE Scale

The Borg 15-point RPE scale is a modified 6-20-point RPE scale [22,23]. This scale is presented in Table 2. The Borg 15-point RPE scale has been used to measure the level of physical strain or perceived exertion [12]. The subjects were instructed to use any number on the scale to rate their overall effort during resistance exercise. A rating of 6 was to be associated with no exertion, i.e. rest, and a rating of 20 with

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maximal exertion, i.e. the most stressful exercise performed. Many studies have validated the Borg 15-point RPE for use in measuring the intensity of resistance exercise [22-29]. The rating on the Borg 15-point RPE scale increased as the intensity of resistance exercise increased.

OMNI-Resistance Exercise Scale (OMNI-RES)

The OMNI-RES was developed as a substitute for Borg's RPE scale [3]. This scale is presented in Figure 1. The subjects were instructed to report their RPEs at the end of resistance exercise as numbers on the OMNI-RES (0-10) scale. The subjects were instructed to use any number on the scale to rate their overall muscular effort, and the investigators used the same question, 'How hard do you feel your muscles are working?', each time. An anchoring procedure was included that required the subjects to assign the perceived level of exertion associated with lifting a very light weight as a scale rating of 'Extremely easy' and the feeling of exertion associated with lifting a very heavy weight as a scale rating of 'Extremely hard' [3]. Many studies have reported the OMNI-RES to be an accurate and reliable tool for selecting the appropriate intensity of resistance exercise for improving muscular fitness [3,30-37]. Another previous study reported that the OMNI-RES exhibits a high level of construct validity, indicating that it measures the same properties of exertion as the Borg RPE scale during resistance exercise and suggesting that the 2 scales can be used interchangeably in the quantification of resistance exercise [8].

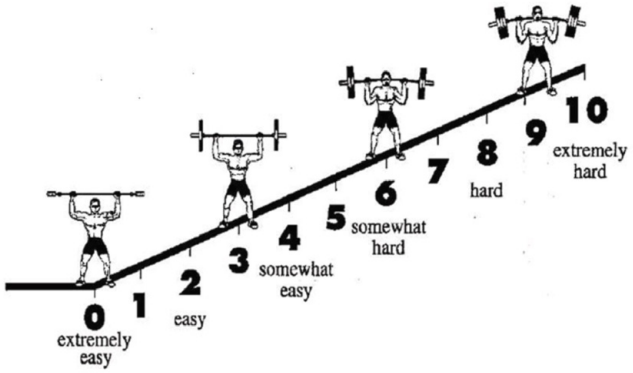

Figure 1: OMNI Perceived Exertion Scale for Resistance Exercise.

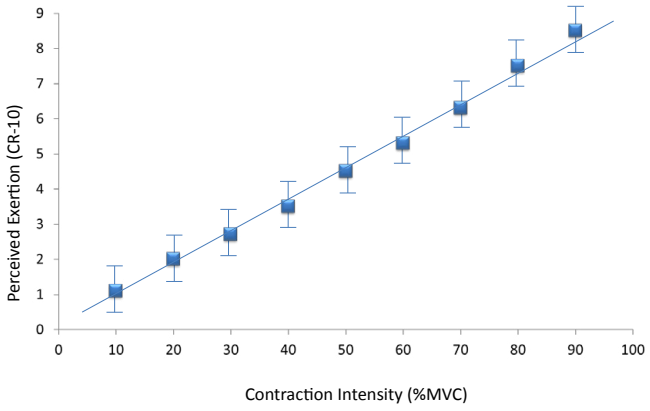

Figure 2: Ratings of perceived exertion versus contraction intensity (10-90% MVC) during isometric contraction.

Different Methods of Anchoring the RPE

Anchoring RPE on percentage of 1 repetition maximum (%1RM) or the percentage of maximal voluntary contraction (%MVC).

Most studies of RPE anchoring have investigated the relationship between the RPE and the %1RM or %MVC [9,17,19,20,22,26,28,35,37-39]. This relationship shows in Figure 2. Many such reports used similar study designs in which the subjects were asked about their perceived exertion after voluntary contraction at different target intensities, and all found that the RPE increased as the %1 RM or %MVC increased. In addition, the perceived exertion was significantly lesser than the equivalent value on the CR-10 scale for each intensity [9,39]. This means that a value of '1' on the CR-10 scale represents <10%MVC.

Anchoring RPE on the Number of Repetitions

Other studies have investigated the relationship between the RPE and the number of repetitions of resistance exercise [3,40,41]. These studies used similar study designs in which the subjects were asked about their perceived exertion following different numbers of repetitions of resistance exercise at a target voluntary contraction intensity and found that the RPE increased with the number of repetitions at the target voluntary contraction intensity [3,40,41].

Anchoring RPE on the Duration of Voluntary Isometric Contraction

Other studies have investigated the relationship between the RPE and the duration of voluntary isometric muscle contraction [42,43]. The RPE increased with the duration of contraction at a constant %MVC [42,43].

Several Factors Affect the RPE

Effect of age on the RPE

Several studies have investigated the differences in RPE during resistance exercise between older and younger people [44,45]. These studies found that the perceived exertion level during the same resistance exercise was significantly greater in older than in younger adults [44,45].

Sex differences in RPE

Many studies have investigated the differences in the perceived level of exertion during resistance exercise between women and men with conflicting results [18-20,39,40,46,47]. Women rated exercise performed at the same intensity as requiring less effort than reported by men [40]. Similarly, women displayed significantly higher power function exponents for the same perceived exertion rating than did men [18]. In contrast, in another study the increase in the RPE during resistance exercise was significantly greater in women than in men, although only during single-joint endurance exercise [47]. However, other reports have shown no difference in perceived exertion during resistance exercise between men and women. [19,20,39,46].

Effect of Concentric vs. Eccentric Muscle Contraction on the RPE

Several studies have investigated the differences in the effects of concentric and eccentric muscle contraction on the RPE [48,49]. These studies have shown that concentric exercise elicits a greater perceptual (higher RPE) response than does eccentric exercise at the same absolute workload [48,49].

The RPE of Active Muscle vs. the Overall RPE

Several studies have investigated the differences between the RPE

values of the active muscle and the overall perception of exertion and found the RPE of the active muscle to be greater than the overall RPE during resistance exercise [30,38].

Effect of the %1 Repetition Maximum (RM) on RPE during Equal Total Work

Several authors have examined the effect of the %1RM muscle activity on the RPE during resistance exercises requiring equal total work [13,23,25,38,50]. The intensity and number of repetitions of a resistance exercise were varied to produce programs requiring equal amounts of total work, e.g. 4 repetitions were performed at 90%1RM, 6 repetitions at 60%1RM, or 12 repetitions at 30%1RM [38]. Performing fewer repetitions at a higher intensity was perceived to be more difficult than performing more repetitions at a lower intensity, i.e. a high %1RM produced higher RPE scores than did a low %1RM [13,23,25]. However, another report showed no difference in the mean RPE between exercise at 50%1RM and 75%1RM [50].

Effect of the Interval Length on the RPE

The effect of the length of the rest interval on the RPE during a resistance exercise session has been examined [31,51,52]. The RPE during a resistance exercise session is greater for shorter rest intervals than for longer rest intervals [31,51,52].

Use of RPE in Children

A few studies have used RPE in 10-14-year-old boys and girls to examine the validity of perceived exertion in children and found that RPE was a valid measure of the intensity of resistance exercise in children [53-55].

Application of the RPE in Patients with Various Conditions

The RPE has recently been used in studies of resistance exercise in patients with various diseases, including peripheral artery disease [56] and multiple sclerosis, [57] as well as in postmenopausal women [58].

Conclusion

RPE has often been used for determining the intensity of resistance exercise in healthy subjects. Many reports have shown the validity of RPE for quantification of the effort required during resistance exercise. The RPE during resistance exercise is an inexpensive and convenient measure that can be used anywhere and could thus be available in the hospital, nursing home, and home settings for patients with medical conditions. Physicians, physical therapists, and medical staff engaged in rehabilitation should be aware of the usefulness of the RPE during resistance exercise.

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