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Concordance Between Rating of Perceived Exertion and Function in Persons With Chronic, Disabling Back Pain

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Rating of perceived exertion (RPE), or the Borg scale, has been shown to be positively associated with physiologic effort in individuals undergoing cardiovascular assessment. This study examined the correlations between cardiovascular performance, psychosocial factors, and the RPE scale among 50 persons with chronic pain undergoing multidisciplinary assessment. The results indicated a significant negative association between fitness outcome measures (maximum VO_2 and endurance on bicycle), psychosocial measures, and age. With a mean maximum heart rate achieved on the exercise bicycle of 79.2% (SD = 8.3), there was no significant association between the highest rating of perceived exertion on the exercise bicycle test and percent of maximum heart rate. Percent of maximum heart rate was significantly related to self-reported pain and disability as well as age. These findings suggest that perceived exertion in this population is not highly correlated with physiologic effort, as other factors such as pain may influence effort ratings.

KEY WORDS: exertion; back pain; disability.

INTRODUCTION

Rating of perceived exertion (RPE), or the Borg scale, has been shown to be positively associated with physiologic effort in individuals undergoing cardiovascular assessment (1). Studies have demonstrated correlations between the rating of perceived exertion and maximum VO_2, lactate levels, and heart rate. However, this relationship has not been completely explored in patients experiencing pain. Given the high influence of psychosocial factors on the experience of pain, it is unknown whether this relationship can be generalized to individuals with chronic pain. This is important as functional assessment techniques are increasingly being employed in chronic pain populations (2).

This study examined the correlations between cardiovascular performance, psychosocial factors, and the RPE scale among 50 persons with chronic lower back pain undergoing functional assessment. We hypothesized that the RPE scale would be significantly correlated

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with cardiovascular performance in patients with chronic pain as they appear to be in the general population.

METHODS

This was a retrospective review of 50 consecutive subjects who participated in a multidisciplinary spine team assessment (STA) at a major university center from July 1, 1996, to May 1, 1998. Eighty-eight STA evaluations occurred during this period. Subjects were referred for a spine team assessment (STA) if they had chronic spine pain (>3 months), disability from work outside or in the home, and were cleared to participate in aggressive rehabilitation by attending physiatrists. Patients were excluded from participating in the STA if they had spinal instability and medical or psychiatric diagnoses that would interfere with participation in exercise.

Forty-four percent of participants were female, 56% male. The mean age was 42.5 years (SD 9.5) with an average pain duration of 52 months (maximum 384 months). The majority of patients had low back pain (84%), as defined by the International Association for the Study of Pain Primary Site of Pain Coding System (3). Pain in three or more bodily sites (8%), cervical pain (6%), and thoracic pain (2%) were the next three most common sites. Motor vehicle crashes and work-related injuries made up the majority of causes (54%). Twenty-seven percent of subjects were in litigation. Eighty-eight percent of participants completed high school, with an overall 10% of subjects having graduate school experience. The sample was predominantly Caucasian (92%); 8% were African American.

The STA is a multidisciplinary standardized evaluation used to triage patients with chronic spinal disability. It takes approximately 4 h to administer. Evaluators include a rehabilitation pain psychologist, physical therapist, occupation therapist, exercise physiologist, and vocational counselor. Under the leadership of a staff physician, results are discussed in a team meeting to guide further rehabilitation planning, including the need for a functional restoration program.

Measures

Demographic Pain Questionnaire

Subjects completed a questionnaire that obtains information regarding duration of pain, education, race, and other sociodemographic information such as litigation.

Psychosocial Measures

These included the CES—Depression Scale, McGill Pain Questionnaires (sensory, affective, evaluative, total pain rating), Quebec Back Pain Disability Scale, and Tampa Scale (including fear and avoidance).

CES-D Scale. The Center for Epidemiological Studies—Depression Scale is a 20-item scale wherein patients rate the frequency of depressive symptoms on a 0–3 scale in relation to how they felt during the past week (4). A total score is obtained by summing the

responses to all of the items. A study by Turk and Okifuji suggests that the CES-D has concurrent validity with *DSM-III-R* diagnoses of depression among patients with chronic pain (5).

MPQ. The McGill Pain Questionnaire measures subjective pain experience in a quantitative form, and consists of 20 groups of single-word pain descriptors with the words in each group increasing in rank order intensity. There are three major subscales of the MPQ, which assess the sensory, affective, and evaluative dimension of the pain experience. Repeat administration of the MPQ has revealed a 70.3% consistency rate in the Pain Rating Index score (6).

QBPDS. The Quebec Back Pain Disability Scale is a 20-item scale wherein patients are asked to rate the amount of difficulty they have performing various activities, such as getting out of bed, walking several miles, and making a bed. Patients are asked to rate their degree of difficulty on a 0 (*not difficult at all*) to 5 (*unable to do*) scale. Summing the responses to each item gives the total score for the scale. Test-retest reliability for the English version is 0.93, and internal consistency for the scale is 0.95. The scale has also been shown to be sensitive to changes in pain over time (7).

Tampa Scale. The Tampa Scale was used to assess fear of physical movement or activity. This measure is a 13-item scale where patients are asked to rate their level of agreement with each item on a 1 (*strongly disagree*) to 4 (*strongly agree*) scale. Sample items include "pain always means I have injured my body" and "It's really not safe for a person with a condition like mine to be physically active." A total score for the scale is obtained by summing the items. The overall reliability for the scale (Chronbach's alpha) was found to be 0.86 (8). Factor analysis of the scale suggests that items measure two constructs, labeled Activity Avoidance (eight items) and Pathological Somatic Focus (five items). Significant decreases on each of the subscales has also been observed among patients undergoing an inpatient chronic-pain management program.

Bike Test. A projected maximum metabolic equivalent (MET) level was calculated for each person based on an ergometer submaximal bicycle test (9). Subjects are asked to pedal a stationary bicycle at a constant rate (50 rpm). The initial workload and changes in resistance are based on the subject's heart rate, gender, and physical condition. Once the subject's heart rate begins to plateau, the resistance is increased. A heart rate between 110 and 155 beats/min at two or more workloads is needed to calculate a projected maximum MET level and maximum VO_2. A test is considered valid if a stable heart rate between 110 and 155 at two or more workloads is obtained, and the subject is able to pedal at a rate of 48–52 rpm. The test is terminated at the request of the subject, if he/she is unable to pedal at the specified speed, or he/she exceeds 85% of his/her maximum heart rate. An American College of Sports Medicine (ACSM) cardiovascular classification is calculated from the data (10). Subjects who could not complete a minimum of two workloads on the bicycle test were excluded from the study in order to have two data points to calculate maximum VO_2.

Rating of Perceived Exertion (RPE)

A physiological validated and reliable outcome measure in this study is the rating of perceived exertion scale, also known as the Borg scale (11,12). Borg scores range from 6 (*very, very light*) to 20 (*very, very heavy*).

Table I. Cardiovascular Performance

Measures	Mean (SD)
Height (in.)	67.6 (3.7)
Weight (lbs)	183.7 (34.4)
Achieved % of max heart rate	79.2 (8.3)
Projected maximum VO_2	25.2 (10.0)
Effort (min)	8.0 (2.6)
Rating of perceived exertion	16.3 (1.6)

Note. SD: standard deviation.

Statistical Analysis

Descriptive statistics were performed on demographic data. Simultaneous regression analysis was used to calculate the association among four independent variables (age, psychosocial measures, lifting capacity, litigation) using maximum VO_2 as a dependent variable.

RESULTS

This study examined the correlations between cardiovascular performance, psychosocial factors, and the RPE scale. Physical and functional measures are outlined in Table I. Average height was 67.7 in. (SD 3.7) and weight was 183.7 lbs (SD 34.4). Only 50 of 88 subjects were able to complete the bike test.

Psychosocial measures demonstrated the following mean scores and standard deviations (in parentheses): CES-D 20.2 (12.7), McGill Pain Questionnaires total 25.5 (10.8), Quebec Back Pain Disability Scale 53.4 (15.9), and total Tampa score 34.7 (7.2). Litigation was significantly positively correlated with the CES-D scale.

The results indicated a significant negative association between fitness outcome measures (maximum VO_2 and endurance on bicycle), psychosocial measures, and age (Table II). Maximum VO_2 negatively correlated with endurance ($r = -.422$, $p < .01$), CES-D ($r = -.388$, $p < .05$), McGill Affective score ($r = -.358$, $p < .05$), McGill Evaluative score

Table II. Correlations Between Cardiovascular Performance and Psychosocial Factors

	Max VO_2	Effort (min)	RPE	Max HR (%)	CES-D	McGill Affective	McGill Evaluative	Quebec	Age
Max VO_2	1.000								
Effort (min)	.422**	1.000							
RPE	−.110	−.072	1.000						
Max HR (%)	−.016	.182	−.103	1.000					
CES-D	−.388*	−.163	.115	−.039	1.000				
McGill Affective	−.358*	−.323	.129	.223	.293	1.000			
McGill Evaluative	−.421*	−.171	.000	.344*	.220	.197	1.000		
Quebec	−.351*	−.491**	.205	−.284	.452**	.362*	−.067	1.000	
Age	−.322*	−.314*	−.007	.209	.071	.225	.227	.166	1.000

* $p < 0.05$ level (two-tailed); ** $p < 0.01$ level (two-tailed).

($r = -.421$, $p < .05$), Quebec ($r = -.351$, $p < .05$), and age ($r = -.322$, $p < .05$). Effort on the bicycle test in minutes negatively correlated with the Quebec scores ($r = -.491$, $p < .01$) and age ($r = -.314$, $p < .05$). Maximum heart rate achieved on the bicycle test significantly correlated with McGill Evaluative scores ($r = .344$, $p < .05$).

With a mean maximum heart rate achieved on the exercise bicycle of 79.2% (SD = 8.3), there was no significant association between the highest rating of perceived exertion ($X = 16$) on the exercise bicycle test and maximum heart rate. There was also no significant association between the rating of perceived exertion with any of the psychosocial factors examined.

DISCUSSION

The findings from this small, retrospective study suggest that the rating of perceived exertion (Borg) scale is not highly correlated with physiologic effort in a chronic pain population. While objective measurements of heart rate, calculated maximum VO_2, and endurance on the bicycle in minutes correlated significantly, subjective measurement of perceived exertion did not correlate. While the past literature has shown physiological correlation with the rating of perceived exertion (Borg) scale, this may not be an applicable scale within the context of evaluating patients for chronic pain for a variety of reasons. As seen in the general population, fatigue can be an expected reason for stopping a bike test for endurance. However, in the chronic pain population, it may be a combination of fatigue in addition to other factors such as pain and fear of movement. While projected maximum VO_2, physiological effort, and perceived effort have been correlated in the general population, this study demonstrates a dissociation with perceived effort and maximum VO_2 in a chronic pain population.

This study has implications for the use of effort-based tests in the chronic pain population. While deconditioning has been proposed to be an important contributor to disability and an important focus of treatment in chronic pain populations (13), this study suggests that the dissociation between perceived exertion and cardiovascular performance may jeopardize the validity of this type of assessment in this population. Chemical stress tests may be more valid in this population, but are more costly, invasive, and not easily administered in the pain clinic.

The loss of self-monitoring may be an integral part of the chronic pain experience and may help characterize this subject population. Fear of movement, for example, has been shown in the literature to correlate with function in persons with chronic back pain (14). Our results also continue to confirm the importance of the role that psychosocial factors play in the functional performance of patients with chronic back pain disability. In addition, within the context of evaluating a patient with chronic pain, the Borg scale may not be applicable because of an expectancy effect on part of the patient and examiner. The patient may put out an increased effort on the bicycle test with an increase in heart rate as demonstrated in this study beyond what the individual perceives as "usual."

There may also be a selection bias in this small study as only patients who were able to complete the bicycle test were included. The decreased heterogeneity of this study population may decrease any effect. The significant correlation between maximum VO_2 and effort on the bike (in min) may also be a spurious finding, as the longer time spent on the bike provides a more valid plot for calculating maximum VO_2.

Further research is needed to examine the factors that contribute to perceived exertion in this population. Aerobic conditioning and strength training exercises as part of a rehabilitation program for chronic pain patients require increases in resistance and aerobic capacity in order to progress. If a patient feels that he/she has put maximum effort and not achieved the corresponding increase, there will potentially be fewer perceived benefits to the exercise program, which may lead to decreased compliance. Barriers to physiologic effort need to be further explored.

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