

Experimental Applications of the use of Perceived Exertion Scales for Aerobic, Strength and Muscular Endurance

Pr. Ibrahim Mufleh Dabayeb

Jordan

INTRODUCTION:

Participation in fitness programs, physical activity and exercise is an important element of wellbeing and reduction of disease risk. Choosing the right exercise intensity and prescribing exercise activities in physical education classes and wellness program is essential for the success of the program. Millions of people all over the world use perceived exertion scales during exercise evaluation and to prescribe exercise intensity. Human perceptual response have been studied by William James of Harvard university and Wilhelm Wundt at the university of Leipzig. Both scientists are considered to be the founders of experimental Psychology (Noble and Robertson 1996). In the early 1960's, Borg of Sweden was the first to find the relation between the real physical effort and the subjective sensation of effort (Perceived Exertion). He developed an international recognized practical tool to measure perceptual effort (the Borg scale). Nowadays, thousands of researches have been focusing on the use of such scales similar to the Borg scale for the rating of perceived exertion for specific population. Since the development of this scale, a number of scales for the measurement of perceived effort or exertion have been developed and validated. These scales allow the user to choose a number (rating of perceived exertion) to describe their effort during exercise. More specific research has involved the exact intensity of perceived exertion as it relates to anatomical location as the origin or source of the feeling of exertion (i. g. legs, chest, and arms). In addition, more research involved the specific intensity of perceived exertion as it relates to the intensity and specificity of the effort (e. g. biking, running .etc) . Physical exertion subjective perception is the result of the feeling of effort, strain, discomfort and fatigue that a person experiences during exercise (Robertson and Noble 1997). The subjective responses involve three main effort continua: physiological, perceptual, and performance (Robertson 2004). As the exercise intensity or exercise performance increases, changes should occur on both the physiological and perceptual exertion. Moreover, this indicates that the perceptual response about the performance may provide as much information as the physiological response. This area of research has gained a great interest from exercise physiologist, sport experts, sport psychologist and clinicians. The following terms and definitions were proposed by Robertson (2004) to indicate the mostly commonly used terms in this area:

Category RPE scales: A perceived exertion rating scales which have numerical categories that represent equal intensity interval such Borg 6-20 and OMNI

Differentiated RPE: an RPE assigned specifically for some anatomical areas such as the Arms, legs, and/or chest.

Physiological mediators: physiological factors that influence the intensity of the RPE such as lactate, ventilation and heart rate.

OMNI scales have gained an international recognition in the fitness, clinical and educative setting and was translated and validated in different languages, backgrounds and cultures including African American, Caucasian American, French, Chinese, Malay, and Indian (Robertson 2000, Balasekaran 2008). Most of these scales are prepared originally in English language, and some of them are used immediately after literary translating them into different language without going through the validation stage of the translated version of the scale. The linguistic and cultural differences may also impose another limitation in the use of such translated scales in different cultures and different languages than the original (Mitsumasa 1986). Previous research has found that some English expressions of exercise intensity such as "light", "moderate" and "tired" may have several corresponding expression in another language (Mitsumasa 1986). The use of certain words with verbal expression only (i.e. without images or pictures) may not be the best way to interpret the feeling of exercise intensity particularly in children. Because of this limitation several researchers developed new and more adaptive scales to be use (i.e. Children specific scales OMNI, Robertson 2000, Children's Effort Rating Table (CERT), Williams, 1994). The OMNI scales have been developed to resolve certain limitations in the CERT particularly limitation related to the sensitivity of the scale at higher level of physiological responses (i.e. upper heart rate). The present group of studies have taken into consideration the limitation of translating OMNI Scales and were undertaken to examine the validity of the translated version of the OMNI scale in Arabic language. Similar to the original OMNI scales (figures: 1, 2, 3) the Arabic version of the OMNI Scales were developed in using pictorial, verbal description

and numerical response ranging from 1-10(figures 4, 5, 6). Each verbal description has been related to the pictorial as well as the numerical value.

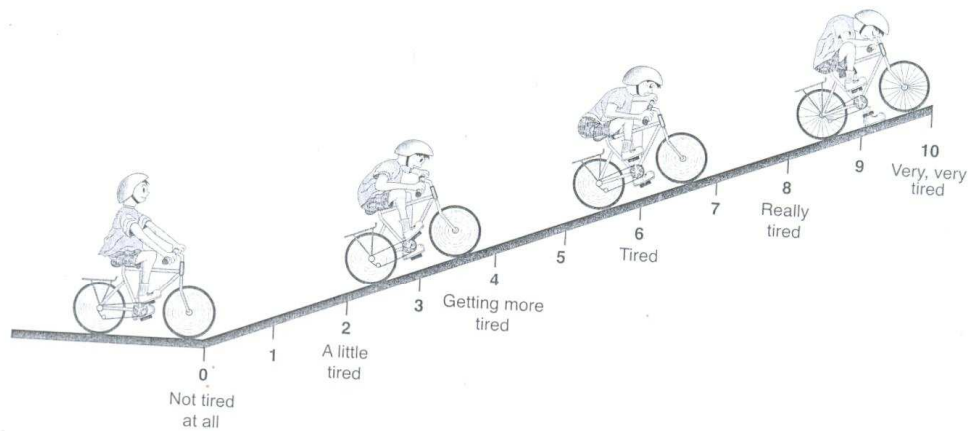


Figure1. The Original Children's OMNI Scale of Perceived Exertion (Robertson 2000)

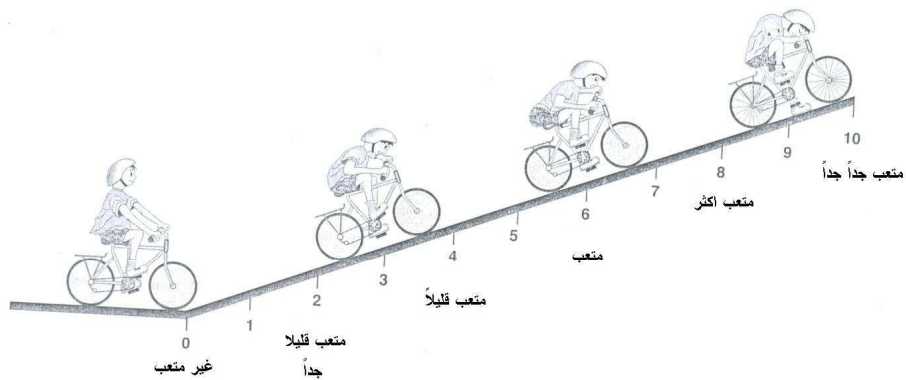


Figure.2 Arabic version of Children's OMNI Scale of Perceived Exertion

Arabic Translation of OMNI Scales of Perceived Exertion

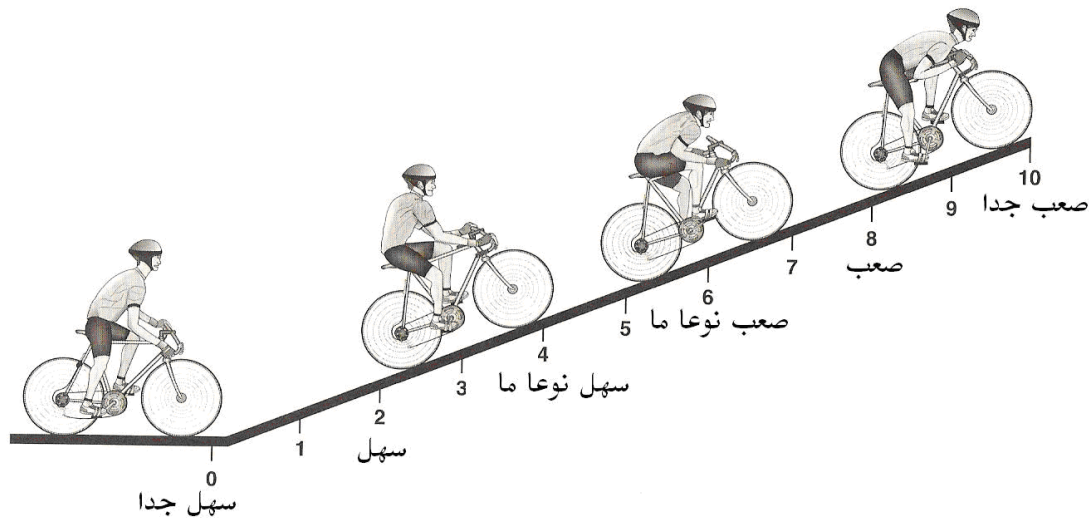


Figure 3. Arabic Translation of OMNI Scales of Perceived Exertion

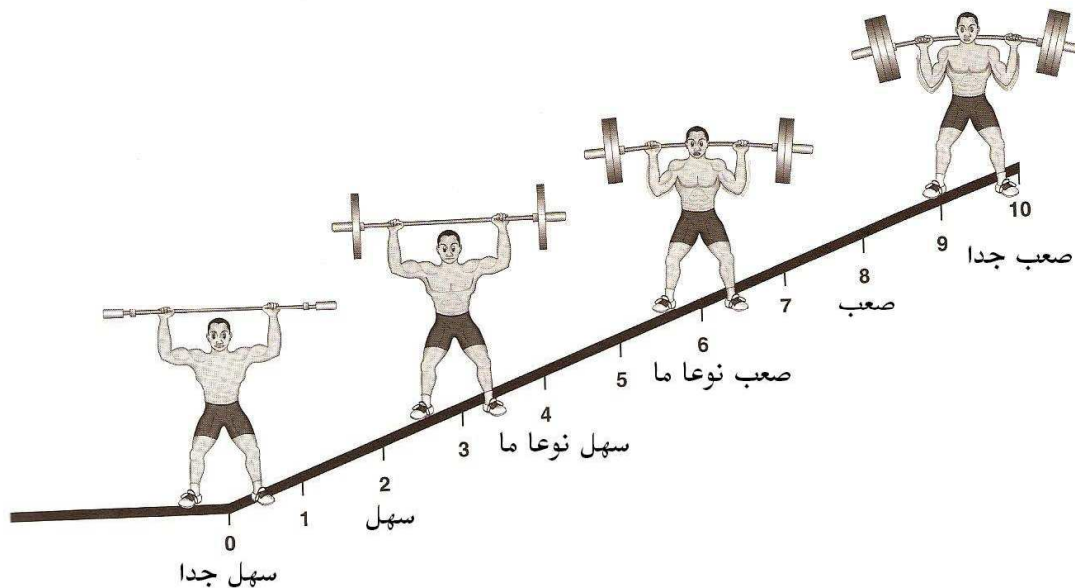


Figure.4 Arabic version of OMNI Resistance Exercise Scale of Perceived Exertion

The development of the original OMNI scale was the result of experimental and clinical need to estimate the perception of exertion in children (Robertson 1997). Previous research suggested that some vocabulary that is used by adult may not be used necessarily by children and therefore children may need to find their own words to express the intensity of exercise perception (Robertson 2000). Consideration the methodological limitation of applying literary translated version of OMNI scale and the limitation of using adult version of the Borg scale for children were taking into account. The present set of scales have been designed exactly similar to the original OMNI scale. Scales have pictorial and verbal expressions positioned on line of numerical responses ranging from 1 to 10. As it was proposed by the original OMNI scale, the meaning of each picture (image) in terms of exertion (feeling of effort) is presented below each picture. The numbers

below the picture (image) presents the corresponding intensity and therefore is related to both the picture and the verbal expression. The use of numbers, verbal expression, and image may increase accuracy of the expression and also widen the use of this scale by a large range of users from different backgrounds, social levels, and even different cultures. The application of this scales in exercise settings would be possible by a large number of participants without the need to use heart rate monitoring systems. Therefore, making exercise participation and exercise monitoring much easier for participants and exercise leaders in schools, clinical settings or recreational exercises. The use OMNI scale is relatively easy when it is compared to the use of bioelectrical instrumentation. In addition, the use of this scale doesn't require extensive experience by the exercise leader, subject, patient, athlete and physical education student. This group of researches examine the application of perceived exertion and explores this relatively new area particularly in Arabic language.

The purposes of this group experimental research were:

a) translate perceived exertion scales (i.e. OMNI, Robertson 2000); b) examine the validity of this newly translated version of the original internationally known and well accepted set of OMNI scales of perceived exertion and c) study the ability of the translated version of the scale to be applied for non- differentiated (RPE-overall) and differentiate (RPE-Legs and RPE-chest.)

METHODS:

The most appropriate words which were used by subjects were chosen to describe effort perception at each one of the exercise intensities. After reviewing the pictures, the subjects were asked to describe the intensity of physical exertion. Then, the most suitable and repeated word were chosen.

The development steps of the Arabic OMNI scale were similar to the development steps of the original scale which consist of the following: The same four images were used (similar to the original scale). Subjects were asked to assign Arabic words to describe the intensity of the exercise in each of the four images. Six words were chosen and assigned in relation to the original English word, the image and the number in similar manner to the original work of the OMNI scale. These words consisted of "not tired at all, a little tired, getting more tired, tired, really tired, very very tired.

Experiments and exercise trials:

Aerobic trials: The design of the different experiments used perceptual estimation or production trials performed during a single, 20, 25 minutes test session. The exercise trials were performed using electrical braked bike (Technogym, Italy). Exercise performance consisted of 3-minutes stages with a total of four stages during the entire exercise test. The exercise intensities were applied according to the following: 25, 50, 75, and 100 Watt. A pedaling rate of 50 RPM in all stages was used. The RPM was signaled electronically by the computerized exercise testing bike. The exercise intensity at each stage was not known by the subject and was determined by a trained technician. The OMNI scale was in full view of the subject during the entire duration of the exercise test. Heart rate measurement (beat per minute) was performed continuously during the length of the exercise trial and was recorded during the last 10 seconds of every minute using Polar monitoring system (Polar, Finland). Separate RPE readings were taken for chest, legs, and overall in random order during the last 30 seconds of every stage using the Arabic OMNI scale. The subjects instructions included the definition of perceived exertion which was specifically prepared for children. Using the definition and the instruction, we established an anchoring system for the child by explaining the lowest intensity (zero, lower anchor) and the highest intensity (ten, higher anchor). During all the length of the exercise trial, the OMNI scale was in full view of the subject.

Analysis of the data:

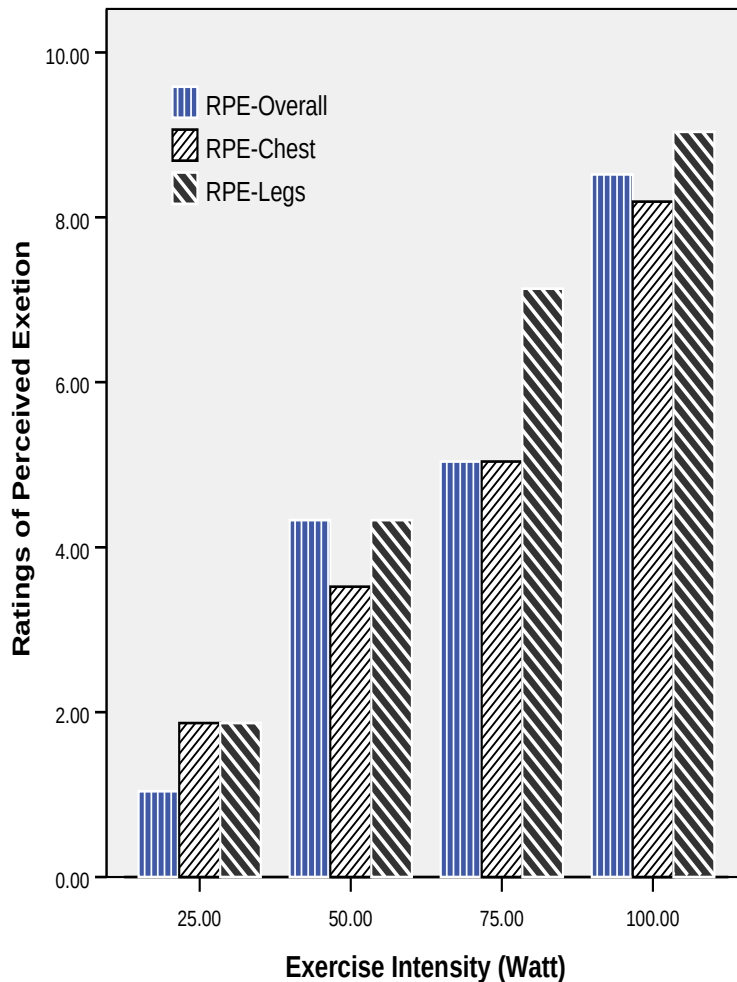
Rating of perceived exertion (i.e. RPE-Overall, and Differentiated RPE Legs, RPE-Chest); heart rate of each exercise intensity (i.e. exercise stages: 25, 50, 75, 100 Watt). The following data will be presented for some of the studies:

- 1- Means and Standard Deviations (Std. D.) of Rating of Perceived Exertion for each exercise test stage for all subjects (combine samples) and then for males and females.

- 2- Simple linear regression analysis and correlation for RPE (OMNI, perceptual variable) expressed as a function of heart rate (physiological variable)
- 3- Two ways ANOVA with repeated measures (RPE X PO) to test the differentiated responses (i.e. Overall, Chest, and Legs) and the validity of the RPE response was performed also.

Examples of the results:

1-



4-

Figure 3. Differentiated ratings of perceived exertion using OMNI scale for overall (RPE-overall), chest (RPE-chest) and legs (RPE-legs) at four exercise intensities for the combine sample. At 25 WT, RPE-Legs and RPE-chest were higher ($P < .01$) than RPE-Overall, at 50 WT, RPE-L and RPE-O were higher ($P < .01$) than RPE-C. At 75, 100 WT, RPE-L was higher ($P < .01$) than both RPE-O and RPE-C.

DISCUSSION:

The results of the different investigations indicate the validation of the translated OMNI scale for each group and for the undifferentiated (overall) and the differentiated ratings (chest, legs) of perceived exertion. The validation results indicate the linearity of ratings perceived exertion as a function of exercise intensities. It is also indicated that the translated OMNI scales can be used to show the RPE ratings for overall, chest and legs. The results of linearity in this investigation are similar to the results of previous studies that used OMNI scale (Balasekaran 2008, Balasekaran 2005, Robertson 2004, and Robertson 2002). The positive linearity is accepted by previous studies as a validation criterion for non-obese and obese children (Robertson 2004). This group of studies is the first to validate RPE scales in Arabic language and on Jordanian subjects. The use of pictorial and verbal scales is new even in the English language. OMNI RPE scales are considered among the first scale to use pictures, numbers and verbal expressions to indicate the perceived exercise intensity (Robertson 2002). The results suggested that the positive linearity between physiological variable

(i.e. heart rate) and the perceptual variable (RPE) was not influenced by gender differences. This indicates the ability of both genders to use the OMNI scale in similar manner.

The present study uses a sub-maximal paradigm to validate OMNI Scale similar to previous investigations (Robertson 2002). The highest mean for RPE and heart rate do not indicate maximal effort (100%) because of the sub-maximal nature of exercise trials. Therefore, the linearity of response was not evaluated through 100% heart rate (maximal effort). However, it seems that the heart rate and the effort was close enough of the maximal exercise intensity.

It is clearly indicated in the results of this investigation the increase of both physiological and perceptual response following the increase in exercise intensity (i.e. power output). The validation of the present translated scale indicates its ability to be used in exercise, sport, pedagogical settings and clinical applications. The validation for both genders is indicated by the positive linearity of perceptual responses with the physiological responses. Therefore, the practical application of the present scale seems also to be accepted for both genders regardless of ethnical background. The results of this study confirmed the results of previous investigations regarding the use of the scale by both genders (Robertson 2004, and Robertson 2002). The present scales showed ability to be used for differentiated responses for RPE- chest and RPE- legs. This finding indicates the application possibility of the present scale by subjects of both genders to differentiate the intensity of exercise perception for legs and chest.

Conclusions:

- 1- the newly translated versions of OMNI/ RPE scales may be applied to measure both undifferentiated RPE (RPE-Overall) and differentiated RPE (RPE-Chest and RPE-Legs) for different ages subjects.
- 2- the use of OMNI scale is validated for cycle exercise and resistance exercises and for healthy non-obese children and adult subjects in Jordan.

Recommendations: Further validations for other forms of exercise and exercise modalities for healthy and non-healthy children are needed. In addition, because of possible subtle expression differences among Arabic countries, further validation may be need in other parts of the Arabic world.

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