Subjective exertion perception.
Perceived exertion classification:
face scale utilization proposal

ABSTRACT: Subjective exertion perception (SEP) is an important strategy to control exercise intensity. Considering that Borg’s Ratings of Perceived Exertion (RPE) scale—a widely used instrument—is based on verbal communication. The aim of the present study was to investigate whether SEP using a scale based on non-verbal communication (i.e., the face scale) was able to provide reliable results. Therefore, our purpose (through a maximum progressive exertion) was to correlate the face scale and peak oxygen consumption (peak VO$_2$), Borg’s RPE scale and peak VO$_2$, and the face scale and Borg’s RPE scale. The sample (n = 10) included young non-athletes male adults, apparently healthy. During the test performed in a cycle ergometer, PSEs (Faces and Borg’s RPE) were recorded and respiratory gases were collected, sampled and recorded. With the purpose of determining the profile of the data set, localization (mean and median) and dispersion (standard error and standard deviation) measures were estimated. The correlation between the Face Scale and Borg’s RPE scale in terms of VO$_2$ peak was estimated using the Contingency Coefficient (C), since the variables were in nominal scale and arranged in 8x8 tables. To test the significance of the correlation estimation, a value of $\alpha = 5.000\%$ was defined and the classical $\chi^2$ test was applied, using H0 rejection when $-p < 0.05$. The results showed a high correlation level between the Face Scale and VO$_2$ (C$_{relative} = 0.824$; $r^2 = 67.936\%$; $p$ value $= 0.048$) and between Face Scale and Borg Scale (0.911; 82.960%; 0.010), indicating that the proposed Face Scale can be used instead of Borg’s RPE Scale, for the researched group.

Keywords: Subjective Exertion Perception (PSE), Borg’s RPE Scale, Face Scale Oxygen Consumption.
RESUMO

Percepção subjetiva do esforço. Classificação do esforço percebido: proposta de utilização da escala de faces (*)

A percepção subjetiva de esforço (PSE) apresenta-se como uma importante estratégia para o controle da intensidade de exercício. Considerando que a escala RPE de Borg (Ratings of Perceived Exertion), instrumento comumente utilizado, fundamenta-se na comunicação verbal, o presente estudo procurou verificar se a PSE, através de uma escala baseada na comunicação não verbal, quer seja, a escala de Faces, apresentava resultados confiáveis para sua utilização. Neste sentido, teve por objetivo verificar, através de um teste de esforço progressivo máximo, a correlação existente entre: a escala de Faces e o consumo de oxigênio de pico (VO2pico), a escala RPE de Borg e o consumo de oxigênio de pico (VO2pico) e entre a escala de Faces e a escala RPE de BORG. A “amostra” (n = 10) limitou-se a sujeitos aparentemente saudáveis, do gênero masculino, adultos jovens e não atletas. Durante o teste, realizado em cicloergômetro, as PSEs (Faces e RPE de Borg) foram registradas e os gases respiratórios coletados, amostrados e registrados. Objetivando definir o perfil do conjunto de dados, foram estimadas as medidas de localização (média e mediana) e dispersão (erro-padrão e desvio-padrão). A correlação entre as escalas (Faces e RPE de Borg) frente ao consumo de oxigênio de pico (VO2pico) e entre si foi estimada através do Coeficiente de Contingência (C), pois as variáveis encontravam-se em escala nominal e dispostas em tabelas 8 x 8. Para testar a significância da estimativa de correlação, definiu-se α = 0,00% e procedeu o teste χ2 clássico, tendo por regra de decisão a rejeição de H0 quando o valor-p < 0,05. Os resultados demonstraram uma alta correlação entre Faces e VO2pico = 0,824; χ2 = 67,936%; Valor-p = 0,048) e entre Faces e Borg (9,11; 82,960%; 0,010), indicando que a proposta escala de Faces pode ser utilizada em substituição à escala RPE de Borg, para o grupo investigado.

Palavras-chave: Percepção Subjetiva de Esforço (PSE), Escala RPE de Borg, Escala de Faces, Consumo de Oxigênio.

INTRODUCTION

Nowadays, it is widely known that the practice of physical exercises is one of the most important variables for the promotion of health and improvement of life quality (ACSM, 1998; 1995; Sharrat and Sharrat 1994). As a prerequisite for a safe practice, it is recommended that the users undergo clinical examinations and physical aptitude evaluation (ACSM, 2003; 1998). These procedures aim to investigate the individuals health state so that prescription and training control are performed safely, even being motivating (Aha, 2001; 2000; Dishinan, 1994; Saba, 2001; Toscano, 1998).

After the diagnostic step, during the development of training/conditioning programs, some procedures were used for the prescription and training control, which it is relevant as regards the control of exercise intensity (ACSM, 2003). However, with the strategies used for this control, some present a certain degree of difficulty in its applicability and/or gauge, for example, the control of heart frequency (HF) and blood pressure (PA) (AHA, 2001; 2000).

Therefore, Subjective Perception of Exertion is important for its agile and easy applicability in the prescription (Borg, 1982; Brandao et al., 1989), mainly for the modalities of aerobic exercise (NOBLE, 1982). These play an important role in prevention, control and rehabilitation of diseases and reduction of morbidity (ACSM, 1998; 1995). Such a fact is underpinned the excellent results obtained by means of the correlation with oxygen consumption (QO2), oxygen uptake (VO2) and HF (BORG, 1998; 1982).

A great number of studies give support mainly to the scale of subjective perception of exertion (SPE) which is widely used, Borg’s RPE scale (Borg, 2000) (cf. Figure 1), confirming its applicability in adults. These studies cover athletes (Franchini et al., 1998; Lajoie, Laurencelle and Trudeau, 2000), non-athletes (Gearhart et al., 2001; GREEN, Michael and Solomon, 1999; Lagally et al., 2002; Moyna et al., 2001; Willson and Kernozek, 1999) and bearers of diseases (Guimaraes et al., 2002; Kuwahira et al., 2000; Loughedd et al., 2002; O’donnell, Chau and Webb, 1998; Meyer et al., 1997; Pires Di Lorenzo et al., 2003; Pfister, Berrol and Caplan, 1998; Ye et al., 2002; Whaley et al., 1997). It is also observed the initiative of studies aims at children (Lamb and Eston, 1997; Robertson et al., 2000).

Similarly, the afore-said scale, others also base their making, adopting as referential standard the verbal communication. Some exceptions are found in the studies of Burnetto, Paulin and Yamaguti (2002) and Robertson et al. (2000), with hybrid instruments, i.e., verbal communication, but supported by some criterion of non-verbal communication (color and pattern, respectively).

RESUMEN

Percepción Subjetiva del Esfuerzo. Clasificación del esfuerzo Percebido: propuesta de utilización de la escala facial(*)

A percepción subjetiva de esfuerzo (PSE) presenta-se como una importante estrategia para el control de la intensidad de ejercicio. Considerando que la escala RPE de Borg (Ratings of Perceived Exertion), instrumento comumente utilizado, fundamenta-se en la comunicación verbal, el presente estudio procuró verificar si la PSE, a través de una escala baseada en la comunicación no verbal, quer sea, la escala de Faces, presentaba resultados confiables para su utilización. En este sentido, tuvo por objetivo verificar, a través de un test de esfuerzo progresivo máximo, la correlación existente entre: la escala de Faces y el consumo de oxígeno de pico (VO2pico), la escala RPE de Borg y el consumo de oxígeno de pico (VO2pico) y entre la escala de Faces y la escala RPE de BORG. La “muestra” (n = 10) limitó-se a sujetos aparentemente sanos, el género masculino, adultos jóvenes y no atletas. Durante el test, realizado en un ergómetro, las PSEs (Faces y RPE de Borg) fueron registradas y los gases respiratorios colectados, amosados y registrados. Objetivando definir el perfil del conjunto de datos, fueron estimadas las medidas de localización (media y mediana) y dispersión (error-padrón y desviopadrón). La correlación entre las escalas (Faces y RPE de Borg) frente al consumo de oxígeno de pico (VO2pico) y entre sí fue estimada a través del Coeficiente de Contingencia (C), pues las variables encontraban-se en escala nominal y dispuestas en tablas 8 x 8. Para probar la significancia de la estimación de correlación, se definió α = 0,00% y se realizó el test χ2 clásico, teniendo por regla de decisión la rechazo de H0 cuando el valor-p < 0,05. Los resultados demostraron una alta correlación entre Faces y VO2pico = 0,824; χ2 = 67,936%; Valor-p = 0,048) y entre Faces y Borg (9,11; 82,960%; 0,010), indicando que la propuesta escala de Faces puede ser utilizada en sustitución de la escala RPE de Borg, para el grupo investigado.

Palabras clave: Percepción Subjetiva del Esfuerzo (PSE), Escala RPE de Borg, Escala Facial, Consumo de Oxígeno.
The instrument now proposed, the Faces Scale (changed . Costa, 1998) (cf. Figure 2) is based on the existing intrinsically relation between the psychophysiological phenomena, which is special to these types of scales. However, the theoretical principle, which gives support to the relevance of the present study, concentrates on the possibility of a better comprehension. In addition, therefore it can provide the best reading through the figures (MYERS, 1999) of this psychophysical scale of exertion and, consequently, in the opportunity of the range which will result. A positive result may suggest the application of this instrument in population with special characteristics, for instance, illiterate individuals (BORG, 2000; 1998) and children (Robertson et al., 2000).

As Myers (1999) highlights, the human beings remember more precisely about words that are associated to images than abstract, isolated words, disconnected from images. According to this author, usually one has to make an effort to memorize mathematical formulae, dates and concepts; conversely one is able to easily project where s/he was yesterday, for instance which clothes wore and what ate. The older recollections, almost with certain, involve visual images, or mental frames.

Considering that Borg’s RPE Scale (2000) anchors its numerical points in verbal expressions, the validation of Faces Scale might offer greater possibility of its universalization, avoiding errors deriving from comprehension, and even, the translation of these verbal expressions. (Borg, 1998).

The underpinning for this principle is found in the language studies. According to Mesquita (1997):

Non-verbal communication is a non-discursive way, which may be transmitted by means of three underpinnings: body, the object associated to the body and the products of human ability. Scientific Investigations have evidenced that the importance of words in the interaction among between is only indirect. Results of several studies demonstrate that interpersonal relations are more influence by non-verbal communications channels rather that verbal ones. That is an indicative that the non-verbal discourse ensures the relevance in the processes of human communications. It is, then, evident that in certain professions non-verbal signs are of paramount importance, mainly for those professionals whose action is more directly related to body and movement, as they contribute relevantly for better perception of other people . the clients (Mesquita, 1997:155 . our italics).

About this specific characteristic of the proposed instrument, in the caricature of facial expressions, which give rise to the name of the referred, it is significant referential. Since Darwin’s unheard-of study (Galvao, 2001), a great number of researchers have related some category which contemplate the facial expressions in studies on non-verbal communication.

While Corraze (1982), for instance, places the own body, in its physical, physiological qualities and its movements, as one of the three underpinnings through which non-verbal communication is processed, Argyle (1978) distinguishes a facial expression as one of the channels. Conversely, Knapp (1982) divides it in seven areas, within which it is stood out body movement or kinesics (badges, illustrators, expressions of affection, regulators and adaptators). Whereas Davis (1979), journalist, upon synthetically approaching non-verbal communication, he postulates, within others, the following subheading: the human face (our italics).

According to Rector and Trinta (1985 apud MESQUITA, 1997), Mehrabian studies and, more recently, Appebaum et al., have demonstrated the percent of non-verbal communication in the transmission of any message is very high in an interaction among individuals. Mehrabian demonstrated that 55% of face-to-face communication takes place using the body, gestures and facial expression; 38% is related to intensity, tonality and other voice characteristics; and which only 7% of this communication is carried out through words. That is there is a great predisposition for instrument of SPE of non-verbal characteristic, mainly, herein by figures (Robertson et al., 2000).

Therefore, the present study adopted as Gold Standard the oxygen uptake (VO2), more precisely, oxygen consumption peak (VO2peak), i.e., the greatest value achieved of oxygen uptake during the test of maximum progressive exertion.

Adopting this referential (VO2peak) is based upon the evidence that some studies use as a reference are predominant, specially, in the non-athlete population (AHA, 2000). For instance, in the following studies: Carter et al. (2001) who checked the mus-
culoskeletal adaptations for men and women, form resistance training; Drinkard et al. (2001) who correlated cardiorespiratory aptitude and overweight adolescents; Dunn et al. (1999) who correlated life style and cardiorespiratory aptitude; and Roy, Green and Burnett (2000) who related hydration and its consequent collateral damage in the therapeutical and cardiovascular stress.

The study herein sought to verify whether the SPE, through a scale based on non-verbal communication, be it Faces Scale presented reliable results for the use. In this sense, we aim to verify through a test of maximum progressive exertion, the existing correlation between: a Faces Scale and a oxygen consumption de peak (VO\textsubscript{2peak}), a scale RPE de Borg and a oxygen consumption de peak (VO\textsubscript{2peak}) and between a Faces Scale and a scale RPE and BORG.

**METHODODOLOGY**

**Study Model**

As we sought to describe the intensity of physical exertion through the individual perception, the study herein is characterized as a research of descriptive nature, transversal, transversal and correlacional (Thomas and Nelson, 2002).

**Sample Selection**

The sample group was composed of students from the first term, morning shift, Physical Education of the Estacio de Sa University, Reboucas Campos, located in Rua do Bispo, n.83, Rio Comprido, Rio de Janeiro, seeing that ten male apparently healthy (n = 10) and young adults aged 18-30, and were non-athletes.

**Exclusion Criteria**

Individuals who had been making use of medicine and/or nutritional ergogenic resources were excluded.

**PROCEDURE FOR DATA COLLECTION**

**Preliminary procedures**

All volunteers were informed about some specific guidance necessary for carrying out the tests. They were also informed that they could talk to the instructor at any time or stop the test. At this moment, they signed a term of consent

**Collection of variables**

The experimental test of maximum progressive exertion, based on the recommendations of ACC/AHA (2000), ACSM (2003), AHA (2001; 2000) and the Brazilian Society of Cardiology (SBC, 2002), was followed by medical history or anamnesis approaching to life habits, family factor and the practice of physical exercises aiming to classify the risks through Physical Activity Readiness Questionnaire, PAR-Q. Subsequently, it was carried out the body mass, stature and skinfolds measures. Afterwards, it was estimated the BMI and body fat percentage. For this, it was used Jackson & Pollock model of three skinfolds for men (1978) with Siri equation (1961) (Fernandes Filho, 2003; Neves and Santos, 2003).

**Estimate of Peak Oxygen Consumption (VO\textsubscript{2peak})**

During all tests, it was taken the measures from cycle to cycle of end-tidal fraction of oxygen (ET\textsubscript{FO}2) and end-tidal fraction of carbon dioxide (ET\textsubscript{FCO}2), that is, at the of expiration and ventilation (VE), from which it was calculated the oxygen uptake (O\textsubscript{2} – VO\textsubscript{2}) and a elimination de carbon dioxide (CO\textsubscript{2} . V\textsubscript{CO2}). Lastly, VO\textsubscript{2} (VO\textsubscript{2peak}) was reckoned. All volunteers breathed in a tube of low resistance, connected to pneumotachometer, linked to a gas analyzer VO2000 (Inbrasport, BRA). The expiratory fractions of O\textsubscript{2} (EFo2) and CO\textsubscript{2} (EFCO2), and as well as the ventilation (VE) were measured every respiratory cycle and, from them, it was possible to reckon the oxygen uptake (V\textsubscript{O2}) and the elimination of CO\textsubscript{2} (V\textsubscript{CO2}). Lastly, VO\textsubscript{2} was reckoned as the mean value every 1 minute, and V\textsubscript{O2peak} was attributed to the mean Vo2 at the last minute of the test.

**Test protocol**

Before the test, it was herein the scales faces (changed . COSTA, 1998) and Borg’s RPE (2000). Specific instructions on the test were also developed before it. It was explained the interpretations of scales faces and Borg’s RPE. Before beginning the test, every subject was again informed that they could at any time stop the test and/or interact with the instructor.

**Pre-exercise phase of Repose**

During this phase, the individuals remained seated for four minutes, and it was measured PA and HF of repose, being collected during the thirty final second and registered in the Form of Register of all Measures for the Maximum Progressive Exertion Test. The individuals, after the presentation about the instructions related to the scales, were informed about the SPE in this stage. This stage was related to the first image and/or verbal anchor of each one of the scales Faces (changed . COSTA, 1998) and Borg’s RPE (2000), respectively.

**Pre-exercise phase of Warm-up**

This phase aimed to adapt the individuals to the experimental test which was applied. They pedaled for 4 continuous minutes at 50-60 rpm (rpm) (ACSM, 2003; AHA, 2000; 2001), with no load in the cycleergometer (load 0W), adapting to the motor act which would be carried out in the test. In it, PA and HF and respiratory gases were, respectively, collected and sampled, registered in the last thirty minutes. They were informed about the SPE was related to the second image and/or verbal anchor of each one of the scales Face (changed . COSTA, 1998) and Borg’s RPE (2000).

**Phase of Exercise**

This consisted of a test of maximum progressive exertion in cycle-ergometer at 50-60 rpm (ACSM, 2003; AHA, 2000, 2001), from the power 25W, increasing at 25W every three minutes (AHA, 2001; SBC, 2002), until the test was interrupted, in general, for physical-function impairment, safety limit, signal or limiting-exertion symptom and/or the individuals volition to stop it (ACSM, 2003; AHA, 2001). In the last 30 seconds of each phase of three minutes, it was registered the HF, PA and SPE.

The register of SPE was determined through two scales, however, at random in relation to the order of presentations. In this sense,
either the Faces Scale (changed . COSTA, 1998) was initially hereind and, later, Borg’s RPE Scale (2000), or Borg’s RPE (2000) was initially hereind, immediately after, to be hereind the Faces Scale.

**Post-Exercise Phase**

Its interruption, for any of the reasons herebefore, determined the post-exercise phase, or physical post-exertion. In it, the individuals maintained active repose (25W, 30rpm) for four minutes (ACSM, 2003; AHA, 2001). The PA, HF and SPE were registered in the last thirty seconds, from the 4 continuous minutes, obeying the standards sets in the previous phase.

**PROCEDURE OF DATA ANALYSIS**

**Descriptive statistics**

Aiming to define the profile of the data set, it was estimated the measurements of localization and dispersion. Relevant to the first, it was calculated the mean and median (Md). For the second, it was estimated the standard error (and), coefficient of variation (CV) and standard deviation (s) (COSTA NETO, 1995).

The correlation between scales of Faces and Borg’s RPE (2000) against the other variables, and among themselves was estimated by the Coefficient of Contingency (C), for the variables were in the nominal scale, and squared matrix of order eight (Bunchaft and Kellner, 1999). It is important to highlight that the coefficient of correlation presents a maximum value different from the unity, even in the presence of perfect correlation. The maximum estimate can only be calculated when the number of lines (L) is equal to the number of columns, that is, the existence of squared matrix. In terms of this limitation and aiming to favor the interpretation of the estimate, it was defined the relative coefficient provided by the percent ration between C and Cmax, that is, Crelative = C / Cmax. To express in percent points how much the knowledge of the variable explains the variability according to the second variable, it was estimated the coefficient of explanation by the square Crelative (r2).

Considering that the scales of SPE may only present, for the exertion test, eight answers referring to it, for this first image and/or verbal anchor of each one characterized by repose, it carried out the making of the tables of contingence 8 x 8.

From this value, it was estimated the Crelative representative of each one of the target correlations, through the division of the value of correlation (C), normally estimated for 1.000, by the valor o Cmax. About these data, it was estimated the coefficient of explanation (r2), result of Crelative 2.

According to Bunchaft and Kellner (1999), the quoted estimate is suitable for the data, which respect a certain hierarchy, having continuous or discreet rating, and independently of the distribution of probability obeyed.

From these, it was estimated the maximum correlation (Cmax), which achieved the value Cmax = 0,935. For practical purposes, it is necessary to have a Crelative equal or superior to a 0.850, with respective value of R2 of 72.25%, reflecting an error in the explanation of a variable for another one of 27.75%.

A great number of studies on SPE, which admit correlations of 0.80 as significant (Dishman, Farquiar and Cureton, 1994; Lamb and Eston, 1997; Odonnell, Chau and Webb, 1998; Rittweger, Beller and Felsenberg, 2000), supports these values. Some studies have suggested some superior correlations, about 0.90. However, most of these are related to the individual results, and not the selected groups (Lamb and Eston, 1997) and/or clinical studies, which may point out some higher correlations with SPE (Birk and Birk, 1987; Eston and Thompson, 1997; Meyer et al., 1997).

**Inferential statistics**

The inferential analysis was developed aiming to test the significance of correlation estimate. For this, it was defined = 5.000% and the classic text 2 was carried out, having “rejection decision rule of H0, when the value-p < 0.05, considering the following hypotheses:

H0: Coefficient of correlation = 0, considering:

H01 = the faces scale will not present significant correlation with the VO2peak;

H02 = the faces scale will not present significant correlation with Borg’s Scale RPE (1998);

H1: Coefficient of correlation , 0.

**PRESENTATION AND DISCUSSION OF RESULTS**

**Sample selection**

Such an option was based on the easiness in obtaining the sample, however, this was based on four basic on aspects:

1. Students of the first term of Physical Education, for they did not have any first hand experience about the procedure of verification of physical exertion intensity. This fact was confirmed when the application of the procedures;

2. Morning shift. for greater schedule availability for the tests;

3. Male gender. for the absence of significant hormonal variations, which may influence directly in the response to exertion, as for example, the menstrual cycle (Borg, 1998);

4. Young adults. aged 18-30. This age group comprises the biological cycle which tends to present greater values in the curve of functional capacity for non-athlete males (AHA, 2001; 2000).

**Uniformity of the Sample**

It is observed in the table 1 the existence of high dispersion (CV > 20.000%) in the set of e variables of skin folds and, as a consequence, body fat percentage (%F). For these, the central tendency is estimated by the media. For the others, it is the mean in which lies the best estimate of central tendency. It is important to emphasize that Standard error (є) observed in all variables is low, but for body mass. And thus, it is not expected, a priori, that there is a relevant difference from this group for the other group of volunteers. This fact is important when it is investigates de possibility of covering a certain instrument, as the study herein.
Presentation and Discussion of the collected Data

According to the Table 2, it is observed that the found $C_{relative}$ between the Faces Scale and VO$_2$peak was 0.824, quite above the values considered accepted by the literature, between 0.60 and 0.80 (Dishman, Farquhar and Cureton, 1994; Lamb and Eston, 1997; Odonnell, Chau and Webb, 1998), despite being considerably below the minimum value of 0.850 considered in this study. However, this Crelative indicates an $r^2$ of 67.36%, that is, insufficient to explaining the VO$_2$peak from the proposal of Faces Scale, considering its minimum value ($r^2 = 72.25\%$) from the minimum required of 0.850. It is noteworthy that the difference between the limit of application (72.25%) and the found result (67.936%) is small. We can infer that, with the increase of the number of individuals, this result tends to improve, especially for the possible variability existing in this type of instrument, SPE scale (Borg, 1998).

Maybe such a result can be explained through the error estimated of the equipment ($\pm 5.000\%$), specially, if we bear in mind that the correlation between the RPE Scale RPE and VO$_2$peak reached of the equipment (±5.000%), specially, if we bear in mind that the correlation between the Faces Scale and VO$_2$peak was 0.824, quite above the correlation between the RPE Scale RPE and VO$_2$peak reached of the equipment (±5.000%), specially, if we bear in mind that the correlation between the RPE Scale RPE and VO$_2$peak reached of the equipment (±5.000%), specially, if we bear in mind that the correlation between the SPE scale (Borg, 1998).

However, from the observation of the relation of mean values of this parameter (VO$_2$peak) with answer obtained by SPE (cf. Tables 3 and 4), it is identified a result quite curious. While for the Faces Scales the results presented a progressive profile of this mean value (cf. Table 3), that is, growing what is common comparatively to the maximum progressive exertion test, for Borg's Scale RPE, it was observed some decrease in the mean value of VO$_2$peak in the continuity of the test (cf. Table 4) (ACSM, 2003; AHA, 2000, 2001; SBC, 2002).

Such disparity maybe it derives from the group size ($n = 10$), in this case, a small group. Upon the analysis by category, this $n$ was reduced may provide an error propagation negatively or positively. This error, however, when it is analyzed all the exertion evolution represented by the mean (cf. Tables 3 and 4), it is diluted during the gauges, and likewise, this may occur positively or negatively, as observed through the comparisons of mean values attained for both.

However, for its progressive characteristic, it is noticed a tendency of error smaller, or constant error, in the evolution of mean values in the Faces Scales in relation the Borg's RPE Scale, considering VO$_2$peak.

In the comparative analysis between the two scales, it was determined a $C_{relative} = 0.911$ (Value-p = 0.010, $r^2 = 82.960\%$) between the two scales (cf. Table 2). These results, quite impressively, translate the high correlation and explanation between them, respectively. Borg's RPE scale indicates that the results of a scale may replace the other one.

If, on the other hand, the Faces Scale is not presented as significant as the Borg's RPE Scale in correlation with VO$_2$peak. The fact that there is a way of explaining (replacing) the other one minimizes this aspect, despite a small error margin, which it can be explained by an intrinsic error in relation to the equipment, $n$ sample space reduced and/or, even the test protocol (ACSM, 2003; AHA, 2001, 2000).

Furthermore, the presented values for the Faces Scale are showed close to the ones estimated for Borg's RPE scale, indicating the existence of some proximity between them. This showed that the correlation between the scales was high, despite the group size may strongly impact on the results negatively.

The fore-mentioned results points out for the use of Faces Scale instead, when necessary for the studied population.

Considering, then the studies also make use of measurement instrument of SPE based on non-verbal communication (Burnetto, Paulin and Yamaguti, 2002; Robertson et al., 2000), the results are promising. The Faces Scale showed a correlation of 0.824 between the SPE and o VO$_2$peak, compared to the value between 0.850 and 0.940 referring to the important instrument found in Robertson et al.study (2000). This is the Scale OMN, developed for children. Alternatively the Value-p of Faces Scale was of 0.048 between SPE and VO$_2$peak, comparing to the result of 0.32 referring to the instrument of Burnetto, Paulin and Yamaguti (2002),

Table 1 - Descriptive results for the characterization of the Group of Volunteers.

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Mean</th>
<th>Md</th>
<th>CV</th>
<th>s</th>
<th>Value-p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>23.667</td>
<td>23.000</td>
<td>13.362%</td>
<td>3.162</td>
<td>2.431</td>
</tr>
<tr>
<td>Body mass (kg)</td>
<td>80.722</td>
<td>75.200</td>
<td>12.871%</td>
<td>10.390</td>
<td>7.986</td>
</tr>
<tr>
<td>Stature (m)</td>
<td>1.779</td>
<td>1.770</td>
<td>3.765%</td>
<td>0.067</td>
<td>0.051</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>25.418</td>
<td>26.050</td>
<td>7.399%</td>
<td>1.881</td>
<td>1.446</td>
</tr>
<tr>
<td>Pectoral (mm)</td>
<td>8.433</td>
<td>8.700</td>
<td>35.111%</td>
<td>7.180</td>
<td>5.519</td>
</tr>
<tr>
<td>Abdomen (mm)</td>
<td>21.100</td>
<td>22.300</td>
<td>34.028%</td>
<td>7.180</td>
<td>5.519</td>
</tr>
<tr>
<td>Thigh (mm)</td>
<td>14.311</td>
<td>13.300</td>
<td>45.171%</td>
<td>6.464</td>
<td>4.969</td>
</tr>
</tbody>
</table>

F = body fat percentage; _ = standard error; Md = median CV = coefficient of variation; s = standard deviation; Value-p ( ) = significance level.

Table 2 - Results of Correlation and Inference

<table>
<thead>
<tr>
<th>Variables</th>
<th>C</th>
<th>$C_{relative}$</th>
<th>$r^2$</th>
<th>Value-p</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borg x VO$_2$peak</td>
<td>0.801</td>
<td>0.856</td>
<td>73.326%</td>
<td>0.031</td>
<td>It is reject the H0</td>
</tr>
<tr>
<td>Faces x VO$_2$peak</td>
<td>0.771</td>
<td>0.824</td>
<td>67.936%</td>
<td>0.048</td>
<td>It is reject the H0</td>
</tr>
<tr>
<td>Borg x Faces</td>
<td>0.852</td>
<td>0.911</td>
<td>82.960%</td>
<td>0.010</td>
<td>It is reject the H0</td>
</tr>
</tbody>
</table>

Borg = Borg’s RPE scale; Faces = Faces scale; VO2peak = peak oxygen consumption de.
the Scale of Borg Changed Visual Analogy (EBMAV), developed for the evaluation of dyspnoea in clinical environment.

**Presentation and Discussion of Tests of Statistical Hypotheses**

Considering that the substantive hypothesis in the study herein (HS) anticipated that the Faces Scale may present a significant correlation to VO$_2$peak and to Borg’s RPE Scale (2000), its statistical hypotheses were presented in two null hypotheses. In this way, the rejection of these null hypotheses confirms its HS. Confirming it indicates the use of Faces Scale as an instrument of verification of intensity during the accomplishment of a physical exertion, especially progressive for the studied group.

However, the use of predicted value should be more investigated, in terms of results not very satisfactory in relation to SPE until this moment for his analysis (Noble, 1982). Lagally et al. (2002), Gearhart et al. (in press) have been investigating this predicted phenomenon. According to Gearhart et al., these correlations have assumed some values between 0.73 and 1.00, however, they cannot be generalized yet, in term of the sample size (n = 5).

The results of the investigation herein, considering a value-<0.05 (cf. Table 3). It is then established:

- **Faces Scale x VO$_2$ = value-p = 0.048** = It is reject the H01.
- **Faces Scale x Borg’s RPE Scale = value-p = 0.010** = It is reject the H02.

Such considerations are ratified by the operating characteristic curve observed in the Figure 3, based on which can be affirmed that for the Error type II ($\beta$) suitable, it may be necessary a sample of approximately thirty-five participants. This was not possible in the investigation herein. However, the results are part of a strong evidence of the application of Faces Scale.

**CONCLUSIONS AND RECOMMENDATIONS**

As it is known, SPE is an important strategy in order to verify the quantity of applied during physical exercises, especially, upon the lack of equipments for its verification and/or lack of technical expertise. From the found correlations in the investigation herein, with direct (VO$_2$) and indirect (Borg’ RPE Scale) physiological parameters, we can conclude that there are some valid hints for the application of this new instrument of SPE, the Faces Scale.

In this sense, considering that the Faces Scale is an instrument based on non-verbal communication, its application is more wide-ringing. Such a fact is based upon the need for literacy for the understanding and comprehension of most part of the existing scales, base don verbal communication, for instance, Borg’ RPE Scale, which we used in the study as the parameter for the verification of the employment of the Faces Scale. This evidence is unique, if we consider that verbal communication brings some difficulties for specific groups, for example, illiterate individuals. Furthermore, from these results, we can recommend the use of Faces Scale, especially for the studied individuals: young male adults, non-athletes, apparently healthy.

From these results, for further studies, it is recommended a greater sample space, aiming to provide more consistency for the generalized application of results using this specific population. It is also recommended that from the increase of the number of participants in the sample, it is important to verify the correlation of each answer of SPE using percentages of VO$_2$ and HF, considering also different protocols referring to the HD. Studies of test and re-test are also recommended in order to verify whether the obtained SPE in a test of maximum progressive exertion, it is repeated a certain specific intensity in a test of continuous exertion.

It is advised that further studies are carried out using other types of population, such as women, athletes, elderly and clinical cases. This aims to verify the behavior of Faces Scale before the different groups. We strongly recommend the development of studies with children, illiterate and semi-literate individual of different nationalities in order to observe the impact of non-verbal communication, intrinsically to this instrument in the SPE of these groups. This fact may be of grant relevance for practical intervention in special situations like these ones.

**Table 3 - Ratings for the Faces Scale related to the mean consumption of oxygen (VO$_2$peak mean).**

<table>
<thead>
<tr>
<th>Rating</th>
<th>VO$_2$peak mean (l/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G</td>
<td>1.207 ± 0.270</td>
</tr>
<tr>
<td>S</td>
<td>1.619 ± 0.415</td>
</tr>
<tr>
<td>T</td>
<td>1.489 ± 0.934</td>
</tr>
<tr>
<td>N</td>
<td>1.724 ± 0.724</td>
</tr>
<tr>
<td>A</td>
<td>1.850 ± 0.825</td>
</tr>
<tr>
<td>C</td>
<td>1.775 ± 0.974</td>
</tr>
<tr>
<td>E</td>
<td>2.275 ± 0.877</td>
</tr>
<tr>
<td>M</td>
<td>2.306 ± 1.396</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rating</th>
<th>VO$_2$peak mean (l/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely light</td>
<td>2.047 ± 1.097</td>
</tr>
<tr>
<td>Very light</td>
<td>1.904 ± 0.490</td>
</tr>
<tr>
<td>Light</td>
<td>1.519 ± 0.810</td>
</tr>
<tr>
<td>Little intense</td>
<td>1.510 ± 0.767</td>
</tr>
<tr>
<td>Intense</td>
<td>1.747 ± 0.443</td>
</tr>
<tr>
<td>Very intense</td>
<td>1.770 ± 0.973</td>
</tr>
<tr>
<td>Extremely intense</td>
<td>2.064 ± 0.604</td>
</tr>
<tr>
<td>Maximum</td>
<td>1.235 ± 0.090</td>
</tr>
</tbody>
</table>

$\text{l/min = liters per minute.}$
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REFERENCES


**Figure 1** - Borg’s RPE Scale (Borg, 2000).