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## A SYSTEMATIC REVIEW OF CROSS-CULTURAL ADAPTATION AND VALIDATION OF BORG'S RATING OF PERCEIVED EXERTION SCALE

### REVISÃO SISTEMÁTICA DA ADAPTAÇÃO TRANSCULTURAL E VALIDAÇÃO DA ESCALA DE PERCEPÇÃO DE ESFORÇO DE BORG

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#### RESUMO

O objetivo dessa revisão sistemática foi analisar os processos de adaptação transcultural e validação da Escala de Percepção Subjetiva de Esforço de Borg (6-20) e de suas instruções durante o exercício em adultos e idosos. A busca foi realizada nas bases de dados da área da saúde, esporte e psicologia (*Pubmed*, *ScienceDirect*, *Bireme (BVS)*, *PsycINFO*, *SportDiscus* e *Scopus*) e os descritores em inglês e português foram padronizados para todas as bases de dados (“exercise”/“exercício”; “validity”/“validade”; “borg scale”/“escala de borg”; “perceived exertion”/“percepção de esforço”; e “validation”/“validação”). Entre os 1488 artigos encontrados, foram selecionados 14 artigos para análise. Os principais resultados encontrados foram que a adaptação transcultural (Cantonês e Japonês) foi reportada em apenas quatro artigos. Os critérios mais baixos de qualidade metodológica foram aqueles relacionados a definição de percepção de esforço, a instrução e familiarização com a Escala. Os resultados indicam que a maioria dos estudos não realizou o processo de adaptação transcultural e além disso, só a validade concorrente foi utilizada como método de validação. Portanto, é necessário realizar adaptação transcultural da Escala de Borg (6-20) principalmente na língua portuguesa, além dos diferentes tipos de validação para se obter resultados mais precisos.

**Palavras-chave:** Exercício. Percepção. Validade dos testes. Tradução.

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#### ABSTRACT

The aim of this systematic review was to analyze the cross-cultural adaptation and validation processes of Borg's Rating of Perceived Exertion Scale (6-20) and its instructions during exercise in adults and the elderly. The study was conducted using databases that include the areas of health, sports and psychology (*Pubmed*, *ScienceDirect*, *Bireme (BVS)*, *PsycINFO*, *SportDiscus* and *Scopus*), and descriptors in the English and Portuguese languages were standardized for all databases (“exercise” / “exercício”, “validity” / “validade”, “borg scale” / “escala de borg”; “perceived exertion” / “percepção de esforço” and “validation” / “validação”). Among the 1,488 items found, 14 articles were selected for analysis. The main findings were that cross-cultural adaptation (Cantonese and Japanese) was reported in only four articles. The lowest-scored criteria for methodological quality were related to the concept of perceived exertion, and the instructions for use and familiarization with Borg's scale. The results indicate that the majority of the studies did not apply the cross-cultural adaptation process and additionally, that concurrent validity was the only validation method reported. Therefore, it is necessary to carry out the cross-cultural adaptation of Borg's Scale (6-20), mainly in the Portuguese language, in addition to other types of validation in order to ensure more accurate results.

**Keywords:** Exercise. Perception. Validity of tests. Translation.

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#### Introduction

Perceived exertion can be defined as the perception of how difficult and extenuating a physical activity is<sup>1</sup>. It is a psycho-physiological measure whose objective is quantifying the subjective perceived exertion originating throughout all the bodily systems<sup>1,2</sup>. Various studies have demonstrated interest in understanding how individuals perceive exertion during physical exercise (internal load) from a determined work load (external load)<sup>3</sup>. This concept was introduced to academia for the first time by Borg's scale<sup>4,5</sup>, which demonstrated a correlation with cardiac frequency<sup>4</sup> and intensity of exercise<sup>6</sup>. Borg's scale (6-20) is a categorical matrix of numbered intervals with equal distances between different perceptions of exertion<sup>5</sup>. The relation between the numerical categories and the verbal descriptors was

established with the use of quantitative semantics, which allow for the adequate judgment of perceived exertion by the individual with the numerical categories on the scale<sup>7</sup>. The scale also includes instructions related to its use, in addition to the concept related to the construct to be evaluated, with the purpose of facilitating the understanding of the individual and increasing the precision of reporting of perceived exertion. Due to the fact that this instrument is easy to understand and apply, and is of low cost<sup>1,8</sup>, various researchers have utilized this scale for diverse populations<sup>9</sup>. However, few studies took the time to carry out the cross-cultural adaptation and validation of this instrument (of the scale and its instructions for use) for different cultures, age groups, and socioeconomic levels.

Cross-cultural adaptation is a method utilized for the translation and adaptation of an instrument for a sample different from the original population where it was applied<sup>10,11</sup>. This process has been frequently utilized in studies due to being faster and more economical in comparison with the processes involved in creating a new instrument. In addition to translating the instrument, it is necessary to take into consideration the differences between the language of origin and the target language<sup>13</sup>, due to the cultural differences between the populations<sup>14</sup>. Therefore, cross-cultural adaptation allows samples of individuals with different ethnicities to present provide similar responses for the same test, due to a similar understanding of the instrument between samples.

In spite of the recurrent and continuous use of Borg's scale (6-20), it has been suggested that few studies have performed the cross-cultural adaptation of the instrument according to the guidelines found in the literature, with the use of methods such as the application of back translation<sup>14</sup>, the analysis of equivalences with the original version<sup>15</sup>, and the analysis of the target version by a committee of specialists<sup>16</sup>. This process becomes important, since, if the meaning of the terms on the instrument were altered during the translation to a target language, the instructions given could modify the construct that was originally proposed. In the same manner, if the meaning of the quantitative semantics is altered, the numerical categories related to these semantics will be interpreted incorrectly by the individual and, with this, the perceived exertion reported will be less accurate. In addition to this, when the instrument is not validated empirically (validation of content, construct, and criteria), its cross-cultural adaptation alone is not sufficient to ensure that the interpretations and conclusions of the phenomena related to a determined construct will be adequate<sup>17</sup>. For example, when the intensity of exercise increases, consequently, it is expected that the physiological responses will be higher and that perceived exertion will also increase, due to being an response to external load. However, it is necessary to develop processes for validation after cross-cultural adaptation in order to ensure that the translated Borg's scale (6-20) is truly measuring what it proposes, which is perceived exertion.

The growing number of publications about adults and the elderly utilizing Borg's scale (6-20)<sup>18</sup> is due to the expressive increase and incentive for the practice of physical exercise for this population, with the intuition of monitoring the intensity of the exercise through the perceived exertion<sup>19</sup>. As such, it has become more important to verify if Borg's scale (6-20) and its instructions have undergone the cross-cultural adaptation process for different languages, along with its respective validation for adults and the elderly. Therefore, the objective of this study was to analyze the cross-cultural adaptation and validation processes of Borg's Rating of Perceived Exertion Scale (6-20) and of its instructions during exercise, for adults and the elderly. The results of this systematic review will instruct future studies with regards to the necessity for applying the processes of cross-cultural adaptation of Borg's scale (6-20) for different languages or for applying validation processes in studies with different protocols, exercise modalities, or populations different from the original study.

## Methods

### *Research Strategies*

This systematic review followed methodological guidelines based on the peer-reviewed literature<sup>20</sup>. The study was completed using six electronic databases, which include the areas of health, sports, and psychology (*Pubmed*, *ScienceDirect*, *Bireme (BVS)*, *PsycINFO*, *SportDiscus* and *Scopus*). The searches were carried out between May and July of 2016, with no data restriction.

Borg's Rating of Perceived Exertion Scale (6-20) is a one-dimensional instrument that evaluates the perceived exertion during the performance of a physical exercise<sup>1</sup>. This scale presents the definition of the construct of perceived exertion and after that provides instruction for how the exertion should be perceived and how it needs to be reported using the numerical values on the scale. The numerical descriptors, with respective quantitative semantics, facilitate the understanding of the participants. The values on the scale go from 6 ("no exertion at all") to 20 ("maximum exertion"). There is also an explanation of the numerical descriptors which are important for increasing the accuracy of the result, such that 9 corresponds to "very light" exercise, 13 corresponds to "somewhat hard" exercise, 17 corresponds to "very hard" exercise, and 19 corresponds to "extremely hard" exercise. And finally, there are instructions explaining the importance of utilizing the scale for greater accuracy, independent of external opinions.

### *Criteria for inclusion and exclusion*

Articles in English or Portuguese were included, with searches for the keywords in syntactic form carried out in both languages. Two descriptors were standardized by the *Medical Subject Headings* (MeSH) ("*exercise*" and "*validity*") in English, and other terms were those frequently used in this area of study ("*borg scale*", "*perceived exertion*" and "*validation*"). The descriptors in Portuguese were "*exercício*" (*exercise*), "*validade*" (*validity*), "*escala de borg*" (*Borg's scale*), "*percepção de esforço*" (*perceived exertion*), and "*validação*" (*validation*), searched for in the same way as for the descriptors in English. The logical operators "AND" and "OR" were used for the combination of descriptors and the terms used in the search for articles.

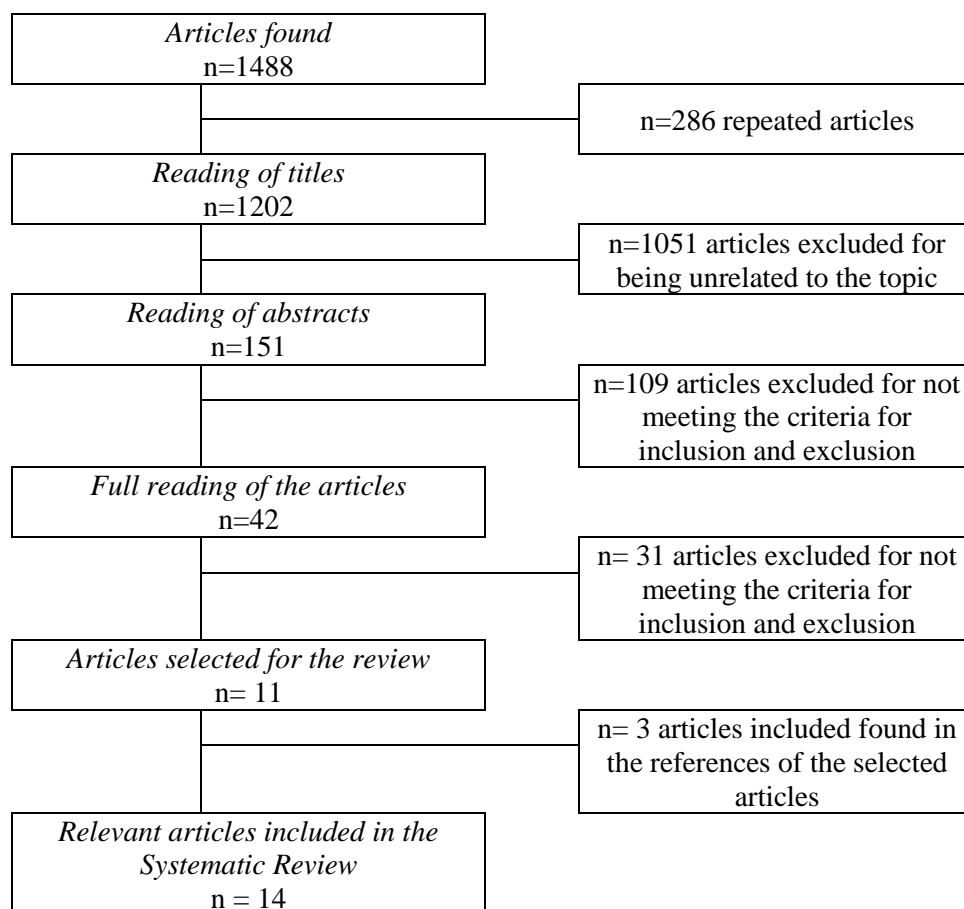
Studies conducted with adults (18 to 60 years) and the elderly (over 60 years of age) that applied Borg's scale (6-20) to exercise and that also presented some process of validation were included. Validation processes included the validation of content (an analysis of the scale's content by specialists in the area), the validation of concurrent criteria (the correlation between the perceived exertion and physiological variables), and the validation of predictive criteria (the correlation between the perceived effort and physiological variables at determined moments). Cross-cultural adaptation was considered when the study applied at least one protocol or used as a reference another study which applied the cross-cultural adaptation procedures accepted in the literature, which include: the translation, synthesis, and back translation<sup>14</sup>, the analysis of equivalences between the original version and the target version, the evaluation of the target version by a committee of specialists, and a pilot study of the target population<sup>13,16</sup>. After the completion of these phases, Borg's scale (6-20) should be adapted cross-culturally in order to ensure that the quantitative semantics of the scale have not been altered and that the instructions regarding the use of the scale have the same meaning as the original version.

Review articles, theses, dissertations, book chapters, articles about groups with special health conditions (ex.: diabetes, multiple sclerosis, or coronary heart disease), articles unrelated to the proposed theme, articles that used scales other than Borg's scale (6-20) for

measuring perceived exertion, articles that did not apply validation processes, and articles that used the perceived exertion of a session as a measurement were excluded from the review. The use of perceived exertion of a session is distinct method for analyzing perceived exertion, in which the calculation is carried out after a complete exercise session; thus, the result cannot be compared with the results of perceived exertion during exercise.

The systematic review was carried out by two independent reviewers who completed the following stages: (1) the search for articles using the descriptors in the databases and the extraction of the titles; (2) the exclusion of repeated titles; (3) the reading of the titles and selection of abstracts; (4) the reading of the abstracts and selection of the articles for full reading; (5) the full reading of the articles; and (6) the inclusion of the articles for the systematic review analysis. The stages of the inclusion or exclusion of articles followed the pre-established criteria described above. At the end of each stage, a consensus meeting was held in order to determine the articles to be included in the next stage of the analysis. In the case of divergence, a third reviewer was contacted in order to break the tie of the stage.

The association of the descriptors generated 1,488 articles (228 articles in *PubMed*, 847 articles in *ScienceDirect*, 81 articles in *BVS*, 33 articles in *PsycINFO*, 217 articles in *SportDiscus*, and 82 articles in *Scopus*), totaling 1,202 after the exclusion of repeated articles. Of these, 1,051 were excluded for being unrelated to the topic. Finally, 42 articles were selected for a full reading. Figure 1 presents the criteria for the search, selection, and exclusion of articles for this review. After the inclusion of articles found by the systematic review, three studies found in the references of the selected studies were also included.



**Figura 1.** Flowchart of the search, selection, and exclusion of the articles for review

Source: The authors

### Methodological Quality

The studies included in this review were analyzed with respect to their methodological quality (Table 1). The criteria utilized included the following items: 1) the proposal of the study corresponds to the results found; 2) the inclusion of the statistics utilized; 3) the inclusion of the experimental design; 4) the inclusion of the general characteristics of the sample; 5) the inclusion of the nationality of the sample; 6) the inclusion of the definition of perceived exertion; 7) the inclusion of instructions for the use of Borg's scale (6-20); 8) a description of how familiarization with the scale was carried out; and 9) a conclusion responding to the objective of the study. In the case of doubts regarding the quality of the studies, a third reviewer was contacted. The maximum rating was 9 points, such that a higher rating represented a higher level of quality of the articles.

### Results

1,488 articles in total were found, and after the process the inclusion and exclusion of studies, 14 articles were included (Table 2). The total sample of participants (the summation of all the studies) was a group of 426 individuals, consisting of the following: 333 adults (average (DP): 31.3 (5.81 years), 128 men and 205 women; and 93 elderly individuals without special health conditions (70.1 (4.05) years), 16 men and 77 women. Of the 14 articles analyzed, only three studied an elderly population<sup>21-23</sup>. The 14 articles included in the revision spanned a time period from 1976 to 2015.

**Table 1.** Table of the methodological quality of the articles included in the review.

<i>Author/Year</i>	1	2	3	4	5	6	7	8	9	<i>Total (max.=9)</i>
Baildon et al., 1994	x		x	x		x			x	5
Chen et al., 2013	x	x		x	x	x			x	6
Chung et al., 2015	x	x		x	x					4
Edwards et al., 1976	x			x				x	x	4
Karavatas & Travakol, 2005	x	x		x	x		x			5
Leung et al., 2004	x	x		x	x	x	x		x	7
Lollgen et al., 1977	x								x	2
López-Miñarro & Muyor, 2010	x	x		x				x	x	5
Muyor, 2013	x	x		x				x	x	5
Myuor & López-miñarro, 2012	x	x		x				x	x	5
Pollock et al., 2013	x	x	x						x	3
Robertson et al., 1996	x	x	x	x					x	5
Shigematsu et al., 2004	x	x		x	x	x	x	x	x	8
Wenos et al., 1996	x	x	x	x					x	5

*Description of the criteria for methodological quality: 1) proposal of the study corresponds to the results found; 2) inclusion of the statistics utilized; 3) inclusion of experimental design; 4) inclusion of the general characteristics of the sample; 5) inclusion of the nationality of the sample; 6) inclusion of the definition of perceived exertion; 7) inclusion of instructions for the use of Borg's scale (6-20); 8) description of how familiarization with the scale was carried out; and 9) inclusion of a conclusion responding to the objective of the study.*

Source: The authors

For the analysis of the affiliated country of the authors of the articles included in this review, it was verified that 28.6% of the studies originated in the United States, 21.5% in Spain, 14.3% in Germany, 7.1% in Switzerland, and 28.6% in Asian countries (China, Taiwan and Japan). Among these articles, only 35.7% (n=5) of the studies reported the nationality of

the sample<sup>21,23-26</sup> and only one of these articles did not use the scale adapted to the culture of the study<sup>26</sup>.

The exercise modalities utilized in the studies were *cycle ergometer* (38%)<sup>21,23,25,27-29</sup>, *treadmill* (19%)<sup>22,24,26</sup>, *resistance exercises* (13%)<sup>24</sup>, *indoor cycling* (19%)<sup>30,31,32</sup>, *Nintendo Wii games* (6%)<sup>33</sup>, and *cycle ergometer adapted for the pool* (6%)<sup>24</sup>. Among the protocols utilized in the articles, four studies applied test protocols with an incremental load (25%), one study applied a decreasing load (6%), four studies applied a continuous load (25%), and seven studies applied an interval load (44%).

After the analysis of the methodological quality of the studies, a divergence in the manner of application of Borg's scale was found, as the majority of the studies lost points for the criteria referring to the definition of perceived exertion and the instructions for the use and familiarization of the scale, and only one article achieved points for all three criteria<sup>23</sup>. The average rating of the articles was five points for the criteria for methodological quality (57.1%). The article that achieved the highest rating (8 points) was Shigematsu et. al. (2004)<sup>23</sup> and the article which achieved the lowest rating (2 points) was Lollgen et al. (1977)<sup>29</sup>.

Cross-cultural adaptation was developed in only one study<sup>25</sup> and three other studies (21%)<sup>21,23,24</sup> utilized Borg's scale with the cross-cultural adaptation developed by previous studies<sup>25,35</sup>. The article by Edwards et. al. (1976)<sup>28</sup> did not follow the guidelines for cross-cultural adaptation proposed by the literature<sup>15,16</sup>, when translating Borg's scale from English to the Swedish language.

Among the different methods used to determine the validity of the scale, the articles in the review only applied concurrent validity as a part of the study. The subjective perceived exertion was correlated with cardiac frequency (CF), potency, rate of ventilation, oxygen consumption, gross metabolic efficiency, and blood lactate concentration. Perceived exertion and cardiac frequency (CF) were correlated in ten articles, such that one study presented a very strong correlation ( $r = 0.90 - 1.00$ )<sup>23</sup>, five studies presented strong correlation ( $r = 0.70 - 0.90$ )<sup>21,22,25,27,28</sup>, two studies presented moderate correlation ( $r = 0.50 - 0.70$ )<sup>26,29</sup>, one study presented weak correlation ( $r = 0.30 - 0.50$ )<sup>33</sup>, and one study presented very weak correlation ( $r = 0.00 - 0.30$ )<sup>32</sup>. Furthermore, one study presented a high regression coefficient for the treadmill test (70%,  $R^2=0.70$ ) and a relatively weak coefficient for resistance exercises (27%,  $R^2=0.27$ )<sup>24</sup>. There was also elevated correlation between perceived exertion and maximum consumption of oxygen ( $r = 0.774$  to  $0.998$ )<sup>23</sup>. Potency was correlated in four studies, such that these studies presented correlations from moderate to very strong ( $r = 0.50 - \geq 0.90$ ). In addition to this, weak values of correlation were found between perceived exertion and percentage of reserve cardiac frequency ( $r = 0.41$ ;  $r = 0.18$ ;  $r = 0.37$ ) in different studies<sup>30-32</sup>.

The analysis of the 35 correlations for different exercise protocols presented the following results. In the four studies that applied incremental tests, 17% of the correlations were between strong and very strong, and 9% of the correlations were moderate. For the seven articles that applied interval tests, 20% of the correlations were weak to very weak, 11% of the correlations were moderate, and 14% of the correlations were strong to very strong. For the analyses in the four studies that applied continuous tests, 9% of the correlations were moderate and 20% of the correlations were strong to very strong.

**Table 3.** Results of the studies included in the review

References	Affiliated country of the authors	Sample	Protocol/Exercise modality	Type of Validation	Results	Cross-cultural adaptation
Baildon et al., 1994	Germany	10 men 22.6 (1.9) years	Incremental/decreasing tests on cycle ergometer (maximum and minimum exertion)	Concurrent Validity	Correlation between RPE and potency after 1.5 min ( $r=0.83$ ) RPE and CF after 1.5 min ( $r=0.78$ )	Not cited
Chen et al., 2013	Taiwan	12 men 22.9 (1.3) years	Continuous tests at different intensities on treadmill (dynamic exercise) and with partially dynamic and isometric resistance exercises	Concurrent Validity	Coefficient of determination between RPE and CF for dynamic ( $R^2=0.70$ ) partially dynamic ( $R^2=0.27$ ) and static ( $R^2=0.10$ ) exercise	Utilized the version from Cantonese de Leung et al (2004) <sup>25</sup> for Chinese participants
Chung et al., 2015	China	40 elderly individuals (16 men and 24 women) 69.8 (4.5) years	Interval tests on cycle ergometer	Concurrent Validity	Correlation between RPE and CF ( $r=0.70$ ) between PSE and $VO_2$ ( $r=0.51$ )	Utilized the version from Cantonese de Leung et al (2004) <sup>25</sup> for Chinese participants
Edwards et al., 1976	Switzerland	3 men 28.3 (3.8) years	Continuous and interval tests on cycle ergometer	Concurrent Validity	Correlation between RPE and potency (C: $r=0.96$ ; I: $r=0.94$ ) RPE and $O_2$ consumption (C: $r=0.97$ ; I: $r=0.91$ ) RPE and CF (C: $r=0.87$ ; I: $r=0.85$ ) RPE and respiratory rate (C: $r=0.66$ ; I: $r=-0.39$ ) RPE and rate of ventilation (C: $r=0.93$ ; I: $r=0.89$ ) RPE and lactate (C: $r=0.77$ ; I: $r=0.63$ )	Translated without including the protocol for execution

Karavatas & Travakol, 2005	United States	12 adults (6 men and 6 women) 26.8 (7.4) years	Incremental tests on treadmill	Concurrent Validity	Correlation between RPE and CF (r= 0.58)	Not cited
Leung et al., 2004	China	54 adults (25 men and 29 women) 22.2 (4.7) years	Incremental tests on cycle ergometer	Concurrent Validity	Correlation between RPE and CF (r ≥ 0.73) Correlation between RPE and potency (r ≥ 0.69) Correlation between RPE and VO <sub>2max</sub> (r ≥ 0.68)	Adaptation based on Brisilin (1970) <sup>14</sup>
Lollgen et al., 1977	Germany	4 men 29 (8.5) years	Interval tests on cycle ergometer	Concurrent Validity	Correlation between RPE and WL (r=0.71) Correlation between RPE and PR (r=0.20) Correlation between RPE and CF (r=0.63)	Not cited
López-Miñarro & Muyor, 2010	Spain	59 adults (13 men and 46 women) 32.1 (10.2) years	Interval tests during indoor cycling (Spinning <sup>R</sup> )	Concurrent Validity	Correlation between RPE and reserve %CF (r=0.41)	Not cited
Muyor & López-Miñarro, 2012	Spain	80 adults (19 men and 61 women) 32.3 (9.5) years	Interval tests during indoor cycling (Spinning <sup>R</sup> )	Concurrent Validity	Correlation between RPE and reserve %CF (r=0.18)	Not cited
Muyor, 2013	Spain	53 adults (25 men and 28 women) 28.8 (6) years	Interval tests during indoor cycling (Spinning <sup>R</sup> )	Concurrent Validity	Correlation between RPE and CF (r=0.29) Correlation between RPE and reserve %CF (r=0.37)	Not cited



Pollock et al., 2013	United States	13 adults (2 men and 11 women) 53.5 (5.4) years	Interval tests with a variation of virtual games for the Nintendo Wii	Concurrent Validity	Correlation between RPE and CF (r=0.32)	Not cited
Robertson et al., 1996	United States	9 men 28.2 (4) years	Continuous tests at different intensities on cycle ergometer adapted for arms and legs in the pool	Concurrent Validity	Correlation between RPE and potency (r= 0.56 to 0.79) Correlation between RPE and GME (r=0.55 to 0.68)	Not cited
Shigematsu et al., 2004	Japan	24 women 46.9 (7) years and 29 elderly women 75.5 (3.8) years	Incremental tests on cycle ergometer	Concurrent Validity	Correlation between RPE and VO <sub>2</sub> (r= 0.77-0.99) RPE and CF (r= 0.96 youth) (r= 0.95 elderly women)	Utilized the Japanese version from Onodera and Miyashita (1976) <sup>35</sup>
Wenos et al., 1996	United States	24 elderly women 65 (3.8) years	Continuous tests at different intensities on treadmill	Concurrent Validity	Correlation between RPE and CF (r=0.85)	Not cited

*RPE = rating of perceived exertion; CF= cardiac frequency; VO<sub>2</sub> = maximum volume of oxygen; %MR = percentage of maximum repetitions; WL: workload; PR: pedaling rate; O<sub>2</sub>= oxygen; GME = gross metabolic efficiency; C = continuous; I = intermittent.*

*Source: The authors*

## Discussion

The objective of the present study was to analyze the validation and cross-cultural adaptation processes of Borg's Rating of Perceived Exertion Scale (6-20) and of its instructions during exercise in adults and the elderly. The main results of this systematic review were that cross-cultural adaptation was reported in only four studies (for only the Cantonese and Japanese languages), and concurrent validity was the only validation method used, such that the majority of the studies used adults in the sample. In addition to this, the criteria for methodological quality that were less frequently achieved were those related to the application of Borg's Rating of Perceived Exertion Scale (6-20).

Cross-cultural adaptation is a necessary method for the translation and adaptation of an instrument for different cultures<sup>15</sup>. However, few adaptations for Borg's scale (6-20) were found in this systematic review. Failing to complete the adaptation process can also influence the use of the scale. Furthermore, few articles reported the nationality of the sample. Evidence in the literature has indicated that there are cultural differences between different countries, as well as between different regions of the same country<sup>12,15,16</sup>. Situations were also found in which the instrument was originally developed for young adults and applied to the elderly<sup>21</sup>. In addition to a demand for caution during the entire process of adaptation of the linguistic terms, the validation process should determine if the translated scale accurately measures the construct to which it refers, for different age groups. Thus, the need for adaptation and validation of the instrument in accordance with the particularities and specificities of each sample (ex.: age group, language, and culture) is fundamental so that the results are understandable in relation to the new culture, without losing the original meaning<sup>16</sup>.

No studies carrying out the cross-cultural adaptation of Borg's scale (6-20) and its instructions were found for the Portuguese language, even though there is widespread use of the scale in this language. The translation of the scale and its instructions into Portuguese were only found in Borg's book (2000)<sup>36</sup>, without a description of the cross-cultural adaptation process for this language. It should be noted that this scale has been frequently referenced in studies carried out in Brazil<sup>37</sup>. Changes to the qualitative semantics in the original scale can occur when cross-cultural adaptation is not applied, and this can directly influence the values reported when the translated scale is used. Thus, there is a gap in the development of the cross-cultural adaptation process for Borg's scale (6-20) for various languages, including Portuguese. One aspect to be taken into consideration is that the searches for the articles were only conducted in English and Portuguese, which could limit the results found, such that there is a chance that other studies which carried out the cross-cultural adaptation and validation processes for Borg's scale (6-20) in different languages are not represented in this systematic review.

The stage following cross-cultural adaptation is that of validation. The articles found in this systematic review only utilized concurrent validity as a method of validation for Borg's scale (6-20). This type of validity is the one most frequently found in correlations with ratings of perceived exertion, probably due to the ease of relating the scale with physiological measures (ex.: cardiac frequency, maximum volume of oxygen, rate of ventilation, among others) that have already been validated for evaluating the intensity of exercise<sup>6</sup>. Another possible motive for the use of this type of validity is the fact that Borg's scale (6-20) was developed to correspond to the linear increase of psycho-physical functions with physiological response and intensity of exercise<sup>1</sup>. However, it can be observed that the relationship between the physiological variables and the exercise protocol used must be taken

into consideration. This is observed, for example, in the CF analyses of the incremental and interval tests. For interval exercises, to the extent to which the intensity changes (decreasing or increasing), CF accompanies this variation, but perceived exertion continues to increase over time, even though the relationship of exertion/pause is maintained through the session<sup>35</sup>. For incremental tests, CF and perceived exertion increase in a linear manner with the elevation of the intensity of exercise. The motive for this discrepancy between exercise protocols and perceived exertion responses and physiological variations might be the origin of perceived exertion, sensory afferent pathways, or in the brain<sup>3,39</sup>. However, this discussion is outside the scope of this article. Thus, it is important to verify if the exercise protocol for which the scale is validated is similar to that which the researcher will develop in their study, in addition to the exercise modality.

The methodological quality of the application of Borg's scale was lacking in the studies reviewed due to the absence of the definition of the construct of perceived exertion and instructions for the use and familiarization of the instrument. The concept of perceived exertion is the first aspect to be considered when Borg's scale (6-20) is applied to a population, and only five studies clarified this concept. Studies have related that there are variations in the definition of perceived exertion<sup>42</sup>, as the perception of general body fatigue or the perception of discomfort observed during the exercise<sup>1,41</sup>. Shigematsu et al (2004)<sup>23</sup> reports the definition as "how difficult the individual feels the exercise is." It is also possible to distinguish perceived exertion by way of other sensations not mentioned in the definitions above, such as, for example, thermal pain and discomfort<sup>41</sup>. With this, the discrepancy that studies have presented regarding the definition of ratings of perceived exertion can be observed. Thus, when studies use Borg's scale (6-20) and its instructions, there should be a standard for the definition proposed by Borg (1998)<sup>1</sup> ("perception of how hard and extenuating a physical task is"), so that the construct is not altered, and as a result, incorrect interpretations are not made which make the comparison of results between studies impossible<sup>40</sup>.

The instructions for Borg's scale (6-20) were provided in only five of the articles in this systematic review. Borg (1998)<sup>1</sup> explains that the instructions for application of the scale should be clear and easy to understand, making necessary a standardized format among individuals to be tested, in order to obtain a more accurate result. The way in which instructions are given and questions are asked during the use of the scale of perceived exertion can influence the results and hinder the individual's understanding of the scale<sup>42</sup>. Another problem is the difficulty of comparison between studies, when the instructions and analyses of perceived exertion are given in different ways for different studies. Therefore, it is important to consider the definition and the instructions given to the individuals in the sample, so that perceived exertion can be obtained accurately<sup>41</sup>.

A session for familiarization with the scale ensures that individuals will be able to differentiate perceived exertion from other sensations and avoid underestimating or overestimating the indicated score<sup>41</sup>. In addition to this, familiarization with the scale is indispensable for the valid collection of data, since the utilization of pre-tests for perceived exertion involves memory recall and verbal associations<sup>43</sup>. However, only five studies reported familiarization with the scale. Therefore, familiarization with Borg's scale (6-20) should be carried out so that the individual understands perceived exertion, reports accurate scores, and also allows for the comparison between evaluations from different instances.

## Conclusions

Future studies that apply Borg's Rating of Perceived Exertion Scale (6-20) for individuals that speak Portuguese as their native language need to develop cross-cultural adaptation and validation procedures for the scale (concurrent criteria, predictive criteria and content) for this language. Thus, after the development of a version of Borg's scale (6-20) adapted to this language, and in cases in which the population evaluated or the exercise protocols or modalities are different from the original study, processes of validation should be applied in order to ensure that the scale evaluates perceived exertion adequately.

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