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|  | **OMNI Scale** | **Borg Scale** |
| **What is it?** | Pictorial based RPE. Typically used for children and adjusted scales exist for adults. Adjusted scales also exist for resistance training, stepping exercises, biking, etc.  (see other doc for examples) | RPE scale based on numbers from 6-20 that roughly corresponds to HR/10.  <http://www.cdc.gov/physicalactivity/everyone/measuring/exertion.html>  (see other doc for examples) |
| **Who uses it?** | Children/Adolescents | Typically appears to be adults |
| **Benefits** | Picture-based  Easy to understand  Specifically adapted for kids | Easy to understand  Well-established  Extensively tested |
| **Drawbacks** | Variation across formats  Differing levels of success depending on children vs. adolescents | Not well tested on kids/younger population  Recent questioning of validity of scale for certain physiological variables |

**Overview:**

**References/What’s in the Literature:**

*On the Borg Scale: Overall, it appears the Borg Scale 6-20, or CR10, has the highest validity when it is tested on adults, not adolescents/children.*

1. **Criterion-related validity of the Borg ratings of perceived exertion scale in healthy individuals: a meta-analysis**

**Author(s):**[Michael J. Chen](http://go.galegroup.com/ps/advancedSearch.do?inputFieldName(0)=AU&prodId=AONE&userGroupName=lom_umichanna&method=doSearch&inputFieldValue(0)=%22Michael+J.+Chen%22&searchType=AdvancedSearchForm) , [Xitao Fan](http://go.galegroup.com/ps/advancedSearch.do?inputFieldName(0)=AU&prodId=AONE&userGroupName=lom_umichanna&method=doSearch&inputFieldValue(0)=%22Xitao+Fan%22&searchType=AdvancedSearchForm" \o ") and [Sondra T. Moe](http://go.galegroup.com/ps/advancedSearch.do?inputFieldName(0)=AU&prodId=AONE&userGroupName=lom_umichanna&method=doSearch&inputFieldValue(0)=%22Sondra+T.+Moe%22&searchType=AdvancedSearchForm)

**Source:*[Journal of Sports Sciences](http://go.galegroup.com/ps/aboutJournal.do?pubDate=120021101&actionString=DO_DISPLAY_ABOUT_PAGE&inPS=true&prodId=AONE&userGroupName=lom_umichanna&searchType=&docId=GALE%7C0CIJ" \o ").*** 20.11 (Nov. 2002): p873.

* Meta-analysis of 437 studies: overall, it questions validity of Borg Scale
* Looked at 6 physiological variables to test validity: heart rate, blood lactate concentration, percent maximal oxygen uptake (%V[O.sub.2max]), oxygen uptake (V[O.sub.2]), ventilation and respiration rate.
* Strongest correlation when male participants (whose V[O.sub.2] or ventilation was measured) were required to maximally exert themselves (measuring %V[O.sub.2max] or ventilation); when the exercise task was unusual [e.g. when participants were swimming, which is less common than walking or running (when heart rate, %V[O.sub.2max] and V[O.sub.2] are measured)]; or when the 15-point RPE scale (measuring blood lactate concentration) was used.
* From a developmental perspective, children and adolescents deserve special consideration. As can be seen in Table 8, only three studies used participants whose ages were less than or equal to 12 years, culminating in only 10 validity coefficients (9 for heart rate and one for %V[O.sub.2max]). Of the nine validity coefficients for ratings of perceived exertion and heart rate, eight were from two studies by the same author (Lamb, 1995, 1996), who used cycle ergometry, a progressive intermittent protocol and a 15-point RPE scale with 12-23 healthy but inactive children. For two of these eight coefficients, Lamb (1995) reported two trials for boys, two for girls and two for all children combined, resulting in six coefficients being reported in his table 5 (Lamb's table 4 is composed of `ecological correlations' based on means rather than on individual scores and, therefore, they were not used in this meta-analysis). In Lamb's (1995) table 1, there are 34 children altogether, but this figure is not broken down into boys and girls. Therefore, we only used the two coefficients (two trials) for the combined boys and girls reported in his table 5; as indicated above (see `Methods'), a sample size must accompany each reported coefficient, as the former is critical for the calculation of weighted coefficients.
* In light of the small number of validity coefficients for children and adolescents, moderator analysis was not warranted. In addition, the mean unweighted mean coefficient for ratings of perceived exertion and heart rate of children was not significantly different from that of adults (age > 20 years) (children 0.66 [+ or -] 0.048; adults 0.64 [+ or -] 0.016; [F.sub.1,265] = 0.028, P > 0.05, [[eta].sub.2] = 0.0001).
* Nine studies used adolescents aged 12-20 years. However, because six of these studies reported mean ages, which were at the high end of the 12-20 year range [for example, Hardy and Rejeski (1989) reported a mean age of 19.5 years], rather than age ranges, adults were mixed with adolescents in these studies. The results of these studies, therefore, could not be inferred from adolescents alone, although the other three studies reported age ranges within the 12-20 year range (Borg, 1973; Butts, 1982; Eston and Williams, 1986). For ratings of perceived exertion and heart rate, Borg reported six coefficients (r = 0.593 [+ or -] 0.072), Butts reported six coefficients (r = 0.526 [+ or -] 0.173) and Eston and Williams reported one (r = 0.74). Butts also reported one coefficient each for ratings of perceived exertion and %V[O.sub.2max] (r = -0.21), V[O.sub.2] (r = -0.40) and ventilation (r = 0.12). Despite the different study features between Borg (healthy but inactive males, cycle ergometry, progressive continuous and submaximal protocols, 15-, 21- and 9-point RPE scales) and Butts (healthy and active females, treadmill running, progressive continuous protocol, 15-point RPE scale), because of the small number of validity coefficients, moderator analysis, again, was not warranted. When the adults were partitioned into adolescents (taking the three aforementioned studies separately) and adults ([greater than or equal to] 21 years), the mean coefficients for ratings of perceived exertion and heart rate of adolescents were significantly different from those of adults (children 0.66 [+ or -] 0.048; adolescents 0.53 [+ or -] 0.041; adults 0.66 [+ or -] 0.017; [F.sub.2,264] = 4.74, P > 0.05, [[eta].sub.2] = 0.0347); however, this difference is not great (0.53 vs 0.66; note the small [[eta].sub.2]).

*On the OMNI Scale:*

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|  | 1. **Med Sci Sports Exerc. 2002 Jan;34(1):139-44. Children's OMNI Scale of Perceived Exertion: walking/running evaluation.** [**Utter AC**](http://www.ncbi.nlm.nih.gov/pubmed?term=Utter%20AC%5BAuthor%5D&cauthor=true&cauthor_uid=11782659)**,**[**Robertson RJ**](http://www.ncbi.nlm.nih.gov/pubmed?term=Robertson%20RJ%5BAuthor%5D&cauthor=true&cauthor_uid=11782659)**, [Nieman DC](http://www.ncbi.nlm.nih.gov/pubmed?term=Nieman%20DC%5BAuthor%5D&cauthor=true&cauthor_uid=11782659" \t "_blank),**[**Kang J**](http://www.ncbi.nlm.nih.gov/pubmed?term=Kang%20J%5BAuthor%5D&cauthor=true&cauthor_uid=11782659).  PURPOSE:The Children's OMNI-walk/run Scale of Perceived Exertion (category range, 0-10) was evaluated using male and female children (6-13 yr of age) during a treadmill graded exercise test. METHODS:A cross-sectional, perceptual estimation paradigm using a walking/running test protocol was administered. Oxygen uptake (VO(2), mL x min(-1)), %VO(2max), ventilation (VE, L x min(-1)), respiratory rate (RR, breaths x min(-1)), respiratory exchange ratio (RER), heart rate (HR, beats x min(-1)), V(E)/VO(2) ratio, and ratings of perceived exertion (RPE) measurements were made every minute throughout the test. RESULTS: Significant correlations were found between OMNI-walk/run Scale RPE responses and VO(2), %VO(2max), HR, V(E)/VO(2) ratio, and RR throughout the maximal treadmill exercise test. The strongest correlations were found between RPE and %VO(2max) (r = 0.41-0.60, P < 0.001) and HR (r = 0.26-0.52, P < 0.01). CONCLUSION: The psychophysiological responses provide validity evidence for use of the Children's OMNI-walk/run Scale over a wide range of exercise intensities during both walking and running.  |  | | --- | | 2. **Med Sci Sports Exerc. 2000 Feb;32(2):452-8. Children's OMNI scale of perceived exertion: mixed gender and race validation.**  [**Robertson RJ**](http://www.ncbi.nlm.nih.gov/pubmed?term=Robertson%20RJ%5BAuthor%5D&cauthor=true&cauthor_uid=10694131)**,**[**Goss FL**](http://www.ncbi.nlm.nih.gov/pubmed?term=Goss%20FL%5BAuthor%5D&cauthor=true&cauthor_uid=10694131)**,**[**Boer NF**](http://www.ncbi.nlm.nih.gov/pubmed?term=Boer%20NF%5BAuthor%5D&cauthor=true&cauthor_uid=10694131)**,**[**Peoples JA**](http://www.ncbi.nlm.nih.gov/pubmed?term=Peoples%20JA%5BAuthor%5D&cauthor=true&cauthor_uid=10694131)**,**[**Foreman AJ**](http://www.ncbi.nlm.nih.gov/pubmed?term=Foreman%20AJ%5BAuthor%5D&cauthor=true&cauthor_uid=10694131)**, [Dabayebeh IM](http://www.ncbi.nlm.nih.gov/pubmed?term=Dabayebeh%20IM%5BAuthor%5D&cauthor=true&cauthor_uid=10694131" \t "_blank), [Millich NB](http://www.ncbi.nlm.nih.gov/pubmed?term=Millich%20NB%5BAuthor%5D&cauthor=true&cauthor_uid=10694131" \t "_blank), [Balasekaran G](http://www.ncbi.nlm.nih.gov/pubmed?term=Balasekaran%20G%5BAuthor%5D&cauthor=true&cauthor_uid=10694131" \t "_blank), [Riechman SE](http://www.ncbi.nlm.nih.gov/pubmed?term=Riechman%20SE%5BAuthor%5D&cauthor=true&cauthor_uid=10694131" \t "_blank),**[**Gallagher JD**](http://www.ncbi.nlm.nih.gov/pubmed?term=Gallagher%20JD%5BAuthor%5D&cauthor=true&cauthor_uid=10694131)**, [Thompkins T](http://www.ncbi.nlm.nih.gov/pubmed?term=Thompkins%20T%5BAuthor%5D&cauthor=true&cauthor_uid=10694131" \t "_blank).** PURPOSE: The newly developed Children's OMNI Scale of Perceived Exertion (category range: 0 to 10) was validated using separate cohorts of female and male, African American and white subjects. Each of the four cohorts contained 20 clinically normal, nonobese children, 8-12 yr of age. METHODS: A cross-sectional, perceptual estimation paradigm using a single multi-stage cycle ergometer test protocol was used. Oxygen uptake (VO2; mL x min(-1)), heart rate (HR; beats x min(-1)) and ratings of perceived exertion for the overall body (RPE-Overall), legs (RPE-Legs), and chest (RPE-Chest) were determined at the end of each continuously administered 3-min power output (PO) (i.e., 25, 50, 75, and 100 W) test stage. RESULTS: The range of responses over the four POs for all cohorts was VO2: 290.8 to 1204.0 mL x min(-1); HR: 89.2 to 164.4 beats x min(-1); and RPE-Overall, RPE-Legs, and RPE-Chest: 0.85 to 9.1. First-order correlation and linear regression analyses were performed for each cohort separately and the total sample using a repeated measures paradigm over the four POs. For all correlation/regression paradigms RPE-Overall, RPE-Legs, and RPE-Chest distributed as a positive linear function of both VO2 and HR; r = 0.85 to 0.94; P < 0.01. Differences between RPE-Overall, RPE-Legs, and RPE-Chest were examined with ANOVA for the repeated measures paradigm. RPE-Legs was higher (P < 0.01) than RPE-Chest and RPE-Overall at 25, 50, 75, and 100 W. RPE-Chest did not differ from RPE-Overall at 25 and 50 W but was lower (P < 0.01) than RPE-Overall at 75 and 100 W. CONCLUSION: The psycho-physiological responses provide validity evidence for use of the Children's OMNI Scale over a wide range of dynamic exercise intensities. | |

*On Both:*

1. **Perceived exertion: influence of age and cognitive development**

**Author(s):**[Alain Groslambert](http://go.galegroup.com/ps/advancedSearch.do?inputFieldName(0)=AU&prodId=AONE&userGroupName=lom_umichanna&method=doSearch&inputFieldValue(0)=%22Alain+Groslambert%22&searchType=AdvancedSearchForm" \o ") and [Anthony D. Mahon](http://go.galegroup.com/ps/advancedSearch.do?inputFieldName(0)=AU&prodId=AONE&userGroupName=lom_umichanna&method=doSearch&inputFieldValue(0)=%22Anthony+D.+Mahon%22&searchType=AdvancedSearchForm)

**Source:*[Sports Medicine](http://go.galegroup.com/ps/aboutJournal.do?pubDate=120061101&actionString=DO_DISPLAY_ABOUT_PAGE&inPS=true&prodId=AONE&userGroupName=lom_umichanna&searchType=&docId=GALE%7C0MLR" \o ").*** 36.11 (Nov. 2006): p911.

**Overall, Borg is validated in adults, but not children. OMNI was developed specifically for children, but there are varying degrees of success in determining RPE. REALLY GOOD ARTICLE!**

* The results of the review show that the cognitive developmental level of children aged 0-3 years does not allow them to rate their perceived exertion during a handgrip task. From 4 to 7 years of age, there is a critical period where children are able to progressively rate at first their peripheral sensory cues during handgrip tests, and then their cardiorespiratory cues during outdoor running in an accurate manner. Between 8 and 12 years of age, children are able to estimate and produce 2--1 cycling intensities guided by their effort sense and distinguish sensory cues from different parts of their body. However, most of the studies report that the exercise mode and the rating scale used could influence their perceptual responsiveness.
* During adolescence, it seems that the RPE-heart rate (HR) relationship is less pronounced than in adults. Similar to observations made in younger children, RPE values are influenced by the exercise mode, test protocol and rating scale. Limited research has examined the ability of adolescents to produce a given exercise intensity based on perceived exertion. Little else is known about RPE in this age group.
* From this relationship, different rating scales have been validated in adults, such as Borg 6-20 rating of perceived exertion (RPE) scale, [3] which was constructed to provide perceptual data that are linear with HR and power output. Borg [2] also developed a category-ratio scale (CR-10) that is appropriate for assessing sensations that may arise from physiological variables that grow exponentially, such as blood lactate or pulmonary ventilation. However, these rating scales have been validated only in adults not in children. For this reason, there are linear rating scales for children created on the basis of common expressions and familiarity with a limited number range (e.g. 1-10) such as the Children's Effort Rating Table (CERT), [4] and pictures and expressions such as the OMNI, [5-7] Cart and Load Effort Rating (CALER), [8] Pictorial CERT (PCERT), [9] Bug and Bag Effort (BABE) [10] and Rating of Perceived Exertion in Children (RPE-C) Scales. [11] A pictorial curvilinear scale also has been proposed recently by Eston and Parfitt. [12] All of these rating scales have been used with varying degrees of success as a means of assessing exercise effort.
* The Period of Concrete Operations: 8-12 Years: It is generally recognised that at a given relative exercise intensity, measures of perceived exertion using the Borg 6-20 scale are typically lower in children versus adults either through direct comparison [30] or indirectly by comparing perceptual responses in children and adults at similar exercise intensities, but across different studies (table II). [31,32] In contrast, others have reported that perceived exertion responses using the Borg 6-20 scale are similar in children and adults when referenced to the ventilatory threshold. [33,34] In both of these studies, ventilatory threshold occurred at the same percentage of [??][O.sub.2max] in boys and men. Differences in the perceptual responsiveness between children and adults may be due to the validity of the rating scale used, particularly the Borg 6-20 RPE scale and the exercise intensity at which the comparison is being made. Indeed, the original notion that exercise HR could be determined by multiplying Borg 6-20 RPE value by 10 may be valid only for middle-aged and older individuals. The ratio does not appear to be accurate for children, adolescents or young adults. [30] In support of this, it has been reported that the RPE-HR correlation for the Borg 6-20 scale is low in children aged 9-11 years (r = 0.45-0.79, [29,35] increases during adolescence (r = 0.74-0.87) [36-38] and is still higher (r = 0.89-0.95) in adults. [39,40] However, when perceived exertion is measured by a rating scale adapted for children (e.g. OMNI scale), [5] the perceived exertion-HR correlation values across increasing exercise intensity are quite similar between children aged 8-12 years (r = 0.87-0.94) [5] and adults (r = 0.81-0.90). [41] Likewise, Lamb [35,42] and Lamb and Eston [43] have highlighted the importance of using a rating scale adapted and validated for children. Their studies have shown the perceived exertion-HR relationship is more pronounced when the children used the CERT (r = 0.69-0.79) [35,44] compared with the Borg 6-20 scale (r = 0.45-0.79). [35] In contrast to these results are the findings of Utter et al. [6] who reported correlations between OMNI perceived exertion and various physiological measures of effort that were considerably lower than the correlations reported by Robertson et al. [5] Explanations for this discrepancy are not fully apparent but may be due to differences in exercise modality (treadmill [6] vs cycle ergometer [5]) and age range (6-13 years [6] vs 8-12 years [5]).
* It is interesting to note that the children in this age group also can discriminate levels of exertion in different parts of their body (leg, chest and overall body) during both a graded exercise test [7,34,45] and steady-state submaximal exercise. [48] The studies by Robertson et al. [7,45] used the OMNI scale and the studies by Mahon et al. [34,48] utilised the Borg 6-20 scale. In these studies, the sensations arising from the legs, appears to have provided the dominant sensory signal in children of this age with the cardiorespiratory factors serving as a secondary cue. This suggestion also was made by Mahon et al., [46] although they only assessed overall perceived exertion. According to Piaget, [20] this period corresponds to the developmental level where the children are progressively able to accurately distinguish feelings in the different parts of their body. However, it appears that exercise intensity must be high because it has been reported that at slow-to-moderate walking speeds neither the respiratory-metabolic nor peripheral ratings of perceived exertion appeared to dominate the whole-body sensory-integration process in children of this age. [54]
* In this age group, it has been reported that [??][O.sub.2] and HR did not differ significantly between estimation and production trials at two different levels (2 and 6) on the OMNI scale; [16] however, as should be expected, [??][O.sub.2] and HR differed between the two perceived exertion levels. Williams et al. [49] reported that HR differed across three different Borg 6-20 RPE levels (9, 13 and 17) but not within each level in 11-year-old boys and girls; however, comparisons were restricted to a production trial only. Likewise, Eston et al. [44] using CERT levels of 5, 7 and 9 noted that the HR and power output measured during an estimation trial were significantly correlated to HR and power output during a production trial. However, HR and power output during the production trial were significantly lower than the corresponding measurements obtained in the estimation trial.
* Based on this information, it appears that children of this age can discriminate up to four intensities during cycle exercise. [16,42,49,50] This finding is in line with Piaget [20] who observed that most 8-year-old children are able to accurately rate together more than three objects of different sizes. The author also reported that at the end of the concrete operations period, the level of psychological development allows the children to understand the constancy of the sizes. Indeed, the children of this age group are able to determine a 'standard perception' (e.g. item 'tired' in the OMNI-scale of Robertson et al. [5]) that allows from this standard perception to compare and to rate different perceptions (e.g. not tired at all, a little tired or very, very tired). Thus, the type of rating scales and the verbal and pictorial descriptors influence the perceptual responsiveness.
* 4. The Formal Intelligence Period: 13-18 Years: The adolescent period corresponds to the beginning of the logical-mathematic meaning. Adolescents are progressively able to make hypotheses or to understand different mathematical concepts (table III). [20] Thus, children in this age range should have the cognitive ability to understand and accurately rate perceived exertion using the Borg 6-20 RPE scale. [3] However, the RPE-HR relationship found in this age group during a maximal incremental cycling exercise tends to be slightly lower (r = 0.74-0.87) [36-38] than the relationship observed in adults (r = 0.89-0.95). [39,40] This result may be due, such as in children, to the RPE-HR ratio that is not adapted for adolescents. In addition, Pfeiffer et al. [55] reported in adolescent girls very significant OMNI%-H [R.sub.max] (r = 0.86) and OMNI-% [??] [O.sub.2max] (r = 0.89) correlations, compared with the Borg 6-20 RPE%H [R.sub.max] (r = 0.66) and Borg 6-20 RPE-% [??] [O.sub.2max] (r = 0.70) correlations. The intraclass and single-trial reliability estimates were higher for the OMNI (r = 0.95 and 0.91, respectively) compared with the Borg scale (r = 0.78 and 0.64). The authors concluded that the OMNI scale is more valid and reliable than the Borg 6-20 RPE scale for use in adolescent girls during treadmill exercise. The comparison of the correlations assessed in the study by Pfeiffer et al. [55] in adolescents girls (r = 0.89 and 0.86) and by Utter et al. [6] in 10-year-old children (r = 0.41-0.60 for RPE-% [??] [O.sub.2max]), suggest that cardiorespiratory factors involved in perceived exertion may increase in relation to aging. This finding has been recently reported by Yelling et al. [9] who observed that during estimation stepping trials using the PCERT, at each intensity level the RPE-HR relationships were higher in adolescents aged 15.3 years (r = 0.26-0.87) compared with children aged 12.4 years (r = 0.21-0.66).
* From these few observations, it seems that the cardiorespiratory factors involved in perceived exertion may increase in relation to aging. In addition, it appears that the Borg 6-20 RPE-HR relationship in adolescents is less pronounced than adults and RPE values may be influenced by the mode of protocol used. Alternatively, the OMNI scale seems to be more tightly coupled to physiological measures of strain than the Borg 6-20 scale in this age group.

1. **Reliability and validity of the Borg and OMNI rating of perceived exertion  
   scales in adolescent girls. Med. Sci. Sports Exerc., Vol. 34, No. 12, pp.  
   2057-2061, 2002.  
   PFEIFFER, K. A., J. M. PIVARNIK, C. J. WOMACK, M. J. REEVES, and R. M. MALINA**.  
     
   Purpose: To examine the reliability and validity of the Borg and OMNI rating of  
   perceived exertion (RPE) scales in adolescent girls during treadmill exercise.  
   Adolescent girls (N = 57, age = 15.3 +/- 1.5 yr) were randomly assigned to use  
   an RPE scale (Borg or OMNI) during one of three treadmill submaximal exercise  
   conditions (walking, walking uphill, or jogging). After RPE assessment, exercise  
   intensity was increased until participants achieved volitional exhaustion  
   ([latin capital V with dot above]O2max). Expired respiratory gases and heart  
   rate (HR) were measured continuously during exercise. Reliability of the RPE  
   scales was assessed using ANOVA (intraclass) and Spearman-Brown prophecy formula  
   (single trial) measures. Validity estimates were calculated using Pearson  
   Product Moment correlations, with % HRmax and % [latin capital V with dot  
   above]O2max as criterion measures.  
   Intraclass and single-trial reliability estimates were higher for the OMNI  
   (rxx = 0.95 and rkk = 0.91, respectively) compared with the Borg (rxx = 0.78 and  
   rkk = 0.64, respectively) RPE scale. Validity estimates were also higher for the  
   OMNI scale compared with the Borg scale. Validity coefficients (rxy) for %HRmax  
   and %[latin capital V with dot above]O2max comparisons were 0.86 and 0.89,  
   respectively, for the OMNI, compared with 0.66 and 0.70, respectively, for the  
   Borg.  
   Conclusion: The OMNI cycle pictorial scale was found to be reliable and valid  
   for use with adolescent girls. It also appears to be more reliable and valid  
   than the Borg scale for use in this population during treadmill exercise.
2. **Use of Session Rating of Perceived Exertion for Monitoring Resistance Exercise in Children who are Overweight or Obese**

**Michael R. McGuigan, Abdulaziz Al Dayel, David Tod, Carl Foster, Robert U. Newton, and Simone Pettigrew: Pediatric Exercise Science, 2008, 20, 333-341© 2008 Human Kinetics, Inc.**

***Not sure if this is what you are looking for or not too, but it’s interesting…***

Previous research has demonstrated the effectiveness of the session RPE method for monitoring training intensity in adults (7) and specifically for resistance exercise (2,18). There is no previous research investigating the efficacy of session RPE in other populations such as children, however. The findings of the current study indicate that the RPE values are higher when OMNI-RES measures are obtained following the whole training session than when expressed as an average for all exercise sets. This difference suggests that in overweight children the session RPE provides different information than the average RPE across the entire session. However, there was a very high correlation between the session and average RPE and the session RPE method was highly reliable.

**Other Sources:**

**Observation of perceived exertion in children using the OMNI pictorial scale.**[Robertson RJ](http://www.ncbi.nlm.nih.gov/pubmed?term=Robertson%20RJ%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Goss FL](http://www.ncbi.nlm.nih.gov/pubmed?term=Goss%20FL%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Aaron DJ](http://www.ncbi.nlm.nih.gov/pubmed?term=Aaron%20DJ%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Tessmer KA](http://www.ncbi.nlm.nih.gov/pubmed?term=Tessmer%20KA%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Gairola A](http://www.ncbi.nlm.nih.gov/pubmed?term=Gairola%20A%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Ghigiarelli JJ](http://www.ncbi.nlm.nih.gov/pubmed?term=Ghigiarelli%20JJ%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Kowallis RA](http://www.ncbi.nlm.nih.gov/pubmed?term=Kowallis%20RA%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Thekkada S](http://www.ncbi.nlm.nih.gov/pubmed?term=Thekkada%20S%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Liu Y](http://www.ncbi.nlm.nih.gov/pubmed?term=Liu%20Y%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Randall CR](http://www.ncbi.nlm.nih.gov/pubmed?term=Randall%20CR%5BAuthor%5D&cauthor=true&cauthor_uid=16394969), [Weary KA](http://www.ncbi.nlm.nih.gov/pubmed?term=Weary%20KA%5BAuthor%5D&cauthor=true&cauthor_uid=16394969). [Med Sci Sports Exerc.](http://www.ncbi.nlm.nih.gov/pubmed/16394969) 2006 Jan;38(1):158-66.

[Validation of the Children's OMNI-Resistance Exercise Scale of perceived exertion.](http://www.ncbi.nlm.nih.gov/pubmed/15870636)

Robertson RJ, Goss FL, Andreacci JL, Dubé JJ, Rutkowski JJ, Frazee KM, Aaron DJ, Metz KF, Kowallis RA, Snee BM.

Med Sci Sports Exerc. 2005 May;37(5):819-26.



[Validation of the children's OMNI RPE scale for stepping exercise.](http://www.ncbi.nlm.nih.gov/pubmed/15692326)

Robertson RJ, Goss FL, Andreacci JL, Dubé JJ, Rutkowski JJ, Snee BM, Kowallis RA, Crawford K, Aaron DJ, Metz KF.

Med Sci Sports Exerc. 2005 Feb;37(2):290-8.

[Self-regulated cycling using the Children's OMNI Scale of Perceived Exertion.](http://www.ncbi.nlm.nih.gov/pubmed/12131258)

Robertson RJ, Goss FL, Bell JA, Dixon CB, Gallagher KI, Lagally KM, Timmer JM, Abt KL, Gallagher JD, Thompkins T.

Med Sci Sports Exerc. 2002 Jul;34(7):1168-75.

[OMNI scale perceived exertion at ventilatory breakpoint in children: response normalized.](http://www.ncbi.nlm.nih.gov/pubmed/11689748)

Robertson RJ, Goss FL, Boer N, Gallagher JD, Thompkins T, Bufalino K, Balasekaran G, Meckes C, Pintar J, Williams A.

Med Sci Sports Exerc. 2001 Nov;33(11):1946-52.