

การตรวจสอบความตรงระดับความรู้สึกเหนื่อยของออมนิ สำหรับ การออกกำลังกายด้วยจักรยานในผู้หญิงวัยรุ่น : ฉบับภาษาไทย

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บทคัดย่อ

วัตถุประสงค์ การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อตรวจสอบความตรงระดับความรู้สึกเหนื่อยของออมนิ ฉบับภาษาไทยสำหรับผู้ใหญ่ ในการประเมินระดับความรู้สึกเหนื่อย ในกลุ่มอาสาสมัครที่มีสุขภาพดีเป็นหญิง จำนวน 17 คน อายุระหว่าง 18-25 ปี อาสาสมัครออกกำลังกายบนจักรยานวัดงานที่กำหนดให้มีระดับความหนักเพิ่มขึ้น

วิธีดำเนินการวิจัย อาสาสมัครเข้าร่วมการทดลอง 2 ครั้ง โดยแต่ละการทดลองห่างกันประมาณ 48-72 ชั่วโมง ทำการบันทึกอัตราการเต้นของหัวใจ, อัตราการใช้ออกซิเจน, อัตราการระบายอากาศ, อัตราการหายใจ และประเมินระดับความรู้สึกเหนื่อยของทั้งร่างกาย ขา และการหายใจในระหว่างการออกกำลังกายที่มีการเพิ่มความหนักของจักรยานวัดงานครั้งละ 25 วัตต์ ทุกๆ 3 นาที โดยใช้ระดับความรู้สึกเหนื่อยของออมนิฉบับภาษาไทยสำหรับผู้ใหญ่ในทุกๆ ช่วงของการออกกำลังกาย อาสาสมัครออกกำลังกายจนถึงความหนักของจักรยานวัดงานที่ 100 วัตต์

ผลการวิจัย ในขณะออกกำลังกายอาสาสมัครมีค่าเฉลี่ยของอัตราการเต้นของหัวใจ = 99.9-153.9 ครั้งต่อนาที อัตราการใช้ออกซิเจน = 559.18-1425.18 มิลลิลิตรต่อนาที, อัตราการระบายอากาศ

= 14.2-26.58 มิลลิลิตรต่อนาทีต่อน้ำหนักตัว, อัตราการหายใจ = 22.3-33.2 ครั้งต่อนาที และระดับความรู้สึกเหนื่อยของทั้งร่างกาย ขา และการหายใจ = 0.8-7.1 นอกจากนี้พบว่าระดับความรู้สึกเหนื่อยของอาสาสมัครมีความสัมพันธ์กับอัตราการเต้นของหัวใจ = (r: 0.74-0.79) อัตราการใช้ออกซิเจน (r: 0.79-0.80), อัตราการระบายอากาศ (r: 0.82-0.83) และอัตราการหายใจ (r: 0.47-0.49) อย่างมีนัยสำคัญทางสถิติ ($p < 0.01$) เมื่อเปรียบเทียบระดับความรู้สึกเหนื่อยในขณะออกกำลังกาย พบว่า ระดับความรู้สึกเหนื่อย เพิ่มขึ้นตามระดับความหนักของการออกกำลังกาย ($p < 0.01$) และระดับความรู้สึกเหนื่อยของขามีค่าสูงกว่าระดับความรู้สึกเหนื่อยของทั้งร่างกายและระดับความรู้สึกเหนื่อยจากการหายใจอย่างมีนัยสำคัญทางสถิติ

สรุปผลการวิจัย ระดับความรู้สึกเหนื่อยของออมนิ ฉบับภาษาไทยสำหรับผู้ใหญ่ มีความตรง สามารถนำไปใช้ได้กับผู้ใหญ่เพศหญิง ในการประเมินระดับความรู้สึกเหนื่อยขณะออกกำลังกาย

คำสำคัญ : ระดับความรู้สึกเหนื่อยของออมนิ ฉบับภาษาไทย / ความหนักของการออกกำลังกาย / อัตราการเต้นของหัวใจ / อัตราการใช้ออกซิเจน / อัตราการระบายอากาศ / อัตราการหายใจ

VALIDATION OF THE OMNI SCALE OF PERCEIVED EXERTION FOR CYCLE ERGOMETER EXERCISE IN YOUNG FEMALE: THAI VERSION

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Abstract

Purpose The purpose of this study was to validate of a Thai translated version of OMNI cycle ergometer exercise scale of perceived exertion among young healthy females (N = 17) (18-25 yrs).

Methods Heart rate (HR, b/min), oxygen consumption (VO₂, L/min), minute ventilation (VE, L/min), respiratory rate (RR, b/min) and ratings of perceived exertion (OMNI cycle Scale; RPE) for the overall body (RPE-O), legs (RPE-L), and chest (RPE-C) were determined at the end of each of 3-min exercise stages in continuously administered exercise tests. Power output (PO) of cycling intensity started at 25 Watt (w) with 25 w incremented in every stage. Subjects performed the exercise test up to 100 w.

Results Exercise responses range was for HR: 99.9-153.9 b/min; VO₂: 14.20-26.58 ml/kg/min; VE: 15.1-41.7 L/min; RR: 22.3-33.2 b/min and OMNI RPE RPE-O, RPE-L, and RPE-C: 0.8-7.1. Linear regression analyses

showed that RPE-O, RPE-L and RPE-C distributed as a positive linear function for all criterion measures (HR, VO₂, VE, and RR) ($p < 0.01$). Correlation between RPE and HR ($r: 0.74-0.79$, $p < 0.01$), RPE and VO₂ ($r: 0.79-0.80$, $p < 0.01$), RPE and VE ($r: 0.82-0.83$, $p < 0.01$), and RPE and RR ($r: 0.47-0.49$, $p < 0.01$) were statistically significant. Two-way ANOVA with repeated measures showed that RPE increased at each exercise stage and RPE-L were higher ($p < 0.01$) than RPE-O and RPE-C. One-way ANOVA with repeated measures showed that HR, VO₂, VE, and RR significantly increased with the progression of workload ($p < 0.001$).

Conclusion The Thai translated version of the OMNI Scale of perceived exertion for cycle ergometer exercise concurrent validity is established for young adult female.

Key Words : RPE / Exercise intensity / OMNI Scale of perceived exertion / Heart rate / Oxygen consumption

INTRODUCTION

Exercise and physical activity are important in modern and sedentary lifestyle. Physically active life is associated with a reduction of incidence and risk of disease. Choosing the right exercise intensity for prescribing exercise activities in a wellness program is an essential for the success of the exercise program. Programming health related exercises depends on the exercise prescription knowledge. Precisely, improvements in health depend on the exercise volume (i.e. combination of frequency, duration, and intensity) of exercise (Vivian H. Heyward, 2006). The intensity of exercise is one of the important components of an individualized exercise program. The use of perceived exertion as a method to regulate exercise intensity is accepted by the American College of Sport Medicine (ACSM) as a reliable and a valid tool (ACSM, 2006). Perceived exertion is defined as the subjective intensity of effort, strain, discomfort, and /or fatigue that is experienced during physical exercise (Robertson and Noble 1997). Rating exercise perception depends on the physiological and psychological interpretation of exertion and effort sensation mediated by cardiopulmonary, metabolic and musculoskeletal signals.

The first rating scale of perceived exertion was developed in the early 1960s by psychologist Gunnar Borg at the University of Stockholm. This scale, called the “Borg Rating of perceived exertion scale” (Borg, 1998), consists of numbers

and descriptions to indicate the perception of effort intensity during exercise and physical activity. The first version of the OMNI scale was constructed and estimated the perception of exertion in children (Robertson et al, 2000). In addition, children often have difficulty interpreting verbal cues that are not part of their daily vocabulary. Following the development of the first OMNI scale for children, more versions of the scale for adults and for children were constructed using mode and gender specific format. The OMNI RPE scales have a category rating format that contain numbers (1-10), pictures, and description that depicts gradually increasing exercise intensity, such as going up to hill (Robertson, 2004). Each OMNI RPE scale includes pictures, illustrating several images for an individual participating in different types of exercise, such as running, stepping, weightlifting and cycling (Robertson et al, 2004; Robertson et al, 2005a, 2005b).

The verbal expressions in different linguistic and cultural backgrounds may indicate different meanings. Traditionally, all the exercise perception scales were developed in the english language. Some english language expressions may have several corresponding expressions and meanings in other languages. For this reason, the OMNI scale has been translated and validated in other languages and cultures, including Arabic, Italian, Spanish, Irish, African-American, and American (Dabayebeh, 2010; Guidetti et al, 2011; Suminski et al, 2008;

Finnegen et al, 2004; Robertson et al, 2000). In addition, the most previous studied was to validate the OMNI cycle scale in other languages for children and older subjects (Dabayeb, 2010, Guidetti et al, 2011). However, translation and physiological validation of the OMNI RPE cycle scale for the Thai language and for young adult has not been undertaken. OMNI scale in the Thai language may serve as a tool to facilitate the self-regulation and monitoring of exercise effort during exercise without using expensive instruments. Additionally, this scale may be used to assess perception of exertion, especially the differentiated RPE (RPE-chest, RPE-legs) and undifferentiated RPE (RPE-overall) during exercise.

OBJECTIVES

1. To validate adult OMNI scale of perceived exertion in the Thai language at various exercise intensity for a females group.
2. To evaluate the capacity of the Thai OMNI scale in the measurement differentiated RPEs and physiological variables for adult females.

RESEARCH METHODOLOGY

Subjects:

Seventeen healthy females, aged 18-25 yrs, clinically healthy, non-obese, non smokers and do not suffer from any neurological or meta-

bolic disorders, volunteered to participate in this study. Benefits and risks of participation were explained and each subject signed a consent form before completing a current health questionnaire. Experimental procedures and design were approved by the Mahidol University Institutional Review Board.

EXPERIMENTAL DESIGN

Each subject performed one orientation trial and one estimation trial during a load-incremented cycle ergometer exercise. Each subject performed one orientation trial and one estimation trial. The trials were separated by a minimum of 48 hours and maximum of 72 hours. The exercise trials were performed using cycle ergometer (Monark 828E, Sweden). Exercise performance consisted of 3-minute stages during the entire exercise test. Exercise intensity started with one minute pedaling at 50-revolution per minute (RPM) without resistance to establish the lower RPE anchoring during the orientation trial. The metronome was used for determining the pedaling rates during trial. Then, the exercise intensity started at 25 watt (0.5 kp) with 25 watt increments per stage until exhaustion. Except for pedaling rate, all exercise intensity indicators were masked from the participants throughout the trial. The Thai version of the OMNI- cycle adult (figure. 1) was in full view of the subject during the entire duration of the exercise test.

Anthropometric measurements:

Body weight (kg) and height (cm) were measured using a medical scale and attached stadiometer. Body fat percentage was estimated through standardized skin fold method taken three sites: triceps, suprailium, and thigh (Jackson, A. S., Pollock, M. L., & Ward, A, 1980). Waist to hip measurement (cm) was performed for the waist at the narrowest point below the rib cage and above the umbilicus; and for the hip circumference at the largest measurement around the posterior of the buttocks.

Heart rate monitoring and metabolic measurement:

Heart rate measurement was performed continuously during the length of the exercise trial and recorded during the last 10-15 seconds of every minute using the Polar monitoring system (Polar, Finland). Respiratory metabolic parameter was measured using the Oxycon mobile portable metabolic system (Oxycon mobile, Germany). Breath-by-breath data at the end of each incremental stage was recorded.

VO₂ peak and anchoring session:

Subjects were familiarized with the laboratory and scale procedures. A standardize set of RPE instruction (translated to Thai language) were used (Robertson 2004). Standardized anchoring procedures (translated to Thai language) were used for low and high exercise intensity as described by Robertson (2004). The Adult instruction included the definition of perceived exertion was given to the subjects (Robertson, 2004). During the entirety of the exercise trial, the OMNI scale was in full view of the subject.

Rating of perceived exertion during the estimation trials:

RPE readings were taken separately for chest, legs, and overall in a counterbalance order during the last 30 seconds of every stage using the OMNI-Cycle adult scale of perceived exertion in Thai versions (figure 1). The RPE-Overall was used to measure perceived exertion over all the body without differentiating the source of the exertion. The differentiated RPEs were used for the exertion in the chest (RPE-Chest) and for the exertion in the legs (RPE-Legs).

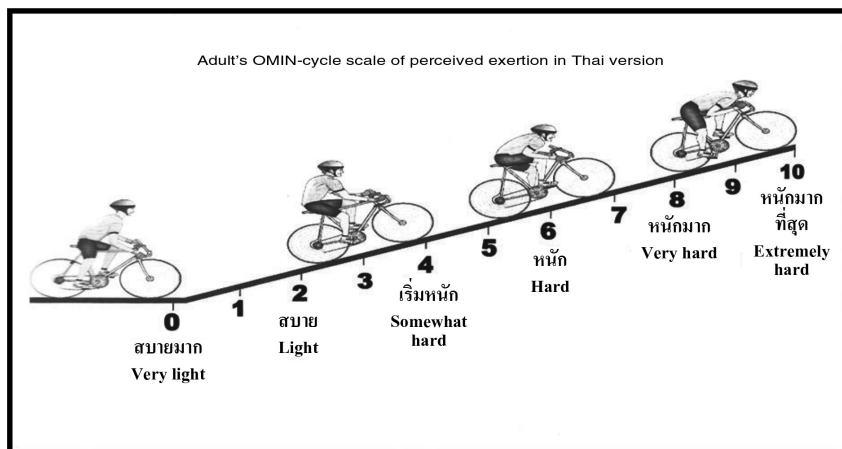


Figure 1. Adult OMNI-cycle scale in Thai version

Data analysis

Descriptive data for anthropometric, perceptual and physiological variables were calculated as mean \pm standard deviation (SD). Pearson correlation and linear regression analysis for HR, VO_2 , VE, and RR against OMNI Scale RPE-Overall, RPE-Legs, and RPE-Chest were used for the concurrent validation of the scale. One way ANOVA with repeated measures analysis was used to determine the differences of physiological responses among power output stages. Two ways (site \times intensity) ANOVA with repeated measures analysis was used to determine the main effects of sites (RPE-Legs, RPE-Chest, RPE-Overall) and intensity (PO stage) and interaction (sites \times intensity). Pair-wise comparison was performed using Bonferroni test. Mauchly test was used to analyze the assumption of sphericity. When the sphericity was not assumed, Greenhouse–Geisser correction was used.

RESULTS

Physical characteristics

Descriptive characteristics of subjects ($N = 17$) are the mean \pm standard deviation (SD): Age (yr) 21.24 ± 1.3 ; weight (kg) 56.03 ± 7.89 ; Height (cm) 162 ± 8.09 ; %Body fat 20.53 ± 4.52 ; Waist-hip ratio 0.77 ± 0.06 ; BMI 21.09 ± 2.5 ; VO_2 peak (L/min) 1.88 ± 0.27 ; VO_2 peak (ml/min/kg) 34.38 ± 5.83 .

Physiological variables responses

Physiological variable responses (HR, VO_2 , VE, and RR) at each power output were compared using one way ANOVA with repeated measures. HR, VO_2 , VE, and RR significantly increased with the progression of workload ($p < 0.001$). For HR [$F(1.54, 24.62) = 258.52$, $p < 0.001$], VO_2 [$F(2.40, 38.46) = 338.10$, $p < 0.001$], VE [$F(1.78, 28.51) = 221.84$, $p < 0.001$], and RR [$F(2.74, 43.87) = 46.67$, $p < 0.001$]. Results are presented in Table 1.

Table 1. Physiological variables responses at each power output (w)

Power output (w)	HR (b/min)	VO ₂ (ml/min/ kg)	VE (L/min)	RR (b/min)
	Mean (\pm SD)	Mean (\pm SD)	Mean (\pm SD)	Mean (\pm SD)
Resting	75.65 (\pm 7.67)	4.91 (\pm 0.59)	6.82 (\pm 1.59)	15.65 (\pm 3.60)
25	99.88 (\pm 9.41)**	14.20 (\pm 1.70)**	15.06 (\pm 2.86)**	22.29 (\pm 5.85)*
50	115.29 (\pm 12.96)**	19.44 (\pm 2.33)**	22.29 (\pm 2.73)**	26.06 (\pm 4.08)*
75	136.06 (\pm 15.94)**	24.58 (\pm 2.94)**	29.65 (\pm 4.83)**	29 (\pm 6.29)*
100	153.94 (\pm 18.11)**	26.58 (\pm 3.18)**	41.71 (\pm 7.66)**	33.18 (\pm 6.74)*

HR; heart rate (b/min), VO₂; oxygen consumption (ml/min/ kg), VE; minutes ventilation ((L/min), RR; respiratory rate (b/min)

* Significant effect of exercise intensity ($p < 0.01$)

** Significant effect of exercise intensity ($p < 0.001$)

Differentiated and undifferentiated RPE: effect of sites and intensity

Two ways ANOVA analyses showed significant main effect for sites and power output [$F(2,32) = 10.57$, $p < 0.001$; $F(3, 48) = 208.64$, $p < 0.001$]. Interestingly, post hoc test

revealed that the RPE-legs was significantly higher than those of the RPE-chest ($p < 0.01$) and the RPE-overall ($p < 0.01$). No interaction between PO and sites was observed. Results are presented in Figure 2.

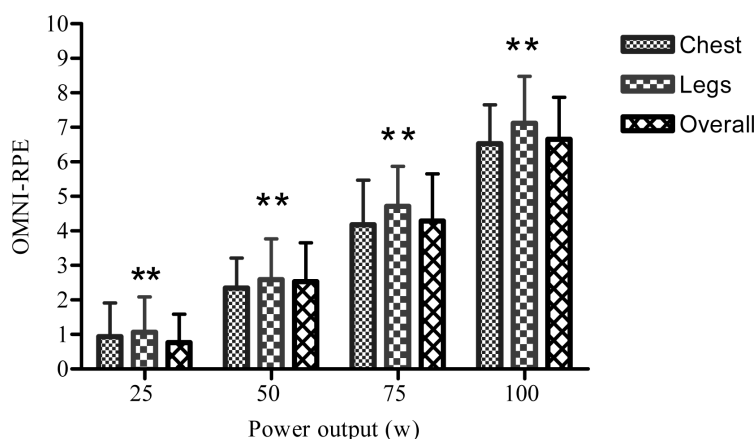


Figure. 2 OMNI-RPE for the RPE-chest, RPE-legs and RPE-overall during exercise with progression of work load (25-100 watts).

** Significant main effect for sites ($P < 0.01$).

Concurrent validity

The analysis demonstrated a relation between RPE-chest, legs and overall from the

Thai OMNI-RPE Scale with HR, VO₂, VE, RR.

All regression functions were significant ($P < 0.01$).

Results are presented in Table 2.

Table 2 Regression analysis of OMNI-RPE Scale expressed as a function of HR, VO₂, VE and RR

Variable		Slope	SEE	Intercept	SEE	R	R ²
Criterion	RPE Predictor						
HR	Chest	8.41	0.80	96.87	3.37	0.79*	0.63*
	Legs	7.21	0.80	98.43	3.72	0.74*	0.55*
	Overall	7.50	0.84	99.60	3.64	0.74*	0.55*
VO ₂	Chest	0.12	0.01	0.54	0.05	0.80*	0.64*
	Legs	0.11	0.01	0.54	0.05	0.79*	0.63*
	Overall	0.11	0.01	0.56	0.05	0.79*	0.63*
VE	Chest	3.91	0.32	13.50	1.34	0.83*	0.70*
	Legs	3.54	0.30	13.47	1.38	0.83*	0.68*
	Overall	3.66	0.32	14.16	1.37	0.82*	0.67*
RR	Chest	1.46	0.32	22.53	1.34	0.49*	0.24*
	Legs	1.33	0.29	22.50	1.35	0.49*	0.24*
	Overall	1.34	0.31	22.86	1.32	0.47*	0.22*

RPE; rating of perceived exertion, VO₂; oxygen consumption (L/min), HR; heart rate (b/min), VE; minutes ventilation (L/min), RR; respiratory rate (b/min), SEE; standard error of estimate, R; correlation coefficient, R²; regression coefficient.

* Significances for correlation and regression models ($P < 0.01$)

Discussion

The purpose of this investigation was to validate the adult OMNI scale of perceived exertion in the Thai language during cycle ergometer exercise for females. The results of validation demonstrated that 1) RPE and physiological variables (i.e. heart rate, oxygen

consumption, minute ventilation and respiratory rate) increased associately with power output and 2) a positive linear correlation between RPE derive from rating of perceived exertion and physiological variables during incremental cycling exercise ($r = 0.47-0.83$). These were consistent with the previous investigations that

used the OMNI-cycle scale for children and adult group (Robertson et al, 2000, Robertson et al, 2004 and Dabayeb, 2010), and that used the Italian version of OMNI-cycle scale in elderly (Guidetti et al, 2011). From linear regression analysis, the values of regression coefficient for most parameters were high except for respiratory rates (RR) which was lower than the other variables ($R^2 = 0.22-0.24$ for RPE-Legs, Chest, and Overall). However, it was consistent with what Guidetti et al (2011) reported regression for coefficient of respiratory rates ($R^2 = 0.30$ for RPE-Overall). The lower R^2 for the RR in the present study and previous study resulted from the higher variation of this parameter among subjects during exercise.

In addition, the positive relation between the differentiated and undifferentiated RPE from the OMNI scale of perceived exertion in the Thai language and exercise intensity in this investigation is consistent with previous investigations (Robertson et al, 2004). During cycle exercise at low intensity, the RPE response range is from 0.76-1.06. However the cycling exercise at high intensity the RPE response ranged from 6.53-7.12. The findings of this investigation are in agreement with Borg's Range Model (Robertson, 2004). Borg's Range Model makes two important measurement assumptions: that for a given exercise range between rest and maximum and that there is a corresponding and equal RPE range. Borg's range model arises from exercise stimulus after the intensity

of exercise changes (from low to high intensity) and after the RPE response linearity follows the intensity of exercise.

The OMNI-cycle scale in the Thai language in this study was capable of assessing the undifferentiated RPE (overall) and the differentiated RPE (chest and legs). It is clearly shown that the differentiated RPE deriving from the leg was more intense than both the differentiated RPE from chest or breathing and the undifferentiated RPE from feeling the overall body during cycle ergometer exercise in consistent with the results of previous studies (Robertson, 2000, Robertson et al, 2004, Bolgar, 2010, Dabayeb, 2010). During aerobic exercise, depending on the most active muscles, often one of differentiated perceptual rating is more intense. The most intense RPE is called the dominant RPE. It has been shown that the dominant RPE depend upon the exercise type, anatomical origin of the differentiated feelings, and the performance environment (Bolgar, 2010, Robertson, 2004), while the undifferentiated RPE involves integration of many differentiated signals and takes place in the sensory cortex (Cafarelli 1982, Robertson and Noble 1997). The present investigation was load-incremented cycle ergometer exercise, thus the dominant RPE for this exercise session was RPE-Legs and this was confirmed by the higher RPE for legs than the RPE for chest and overall. This research study is the first study about adult OMNI scale in Thai version corresponding

to Thai culture, female age 18-25 yrs specific format. This scale also demonstrated concurrent validity and capability estimate dominant from active muscle Vs. non dominant RPE, and undifferentiated Vs. differentiated RPE during cycling exercise.

Conclusion

The present findings of validation adult OMNI-cycle scale in the Thai language demonstrate concurrent validity and present new evidence supporting the use of the OMNI-Cycle to estimate undifferentiated and differentiated RPE during cycle ergometer exercise for Thai adult female. Therefore, the new version of OMNI- Cycle scale of perceived exertion in the Thai language can serve as a tool to facilitate the self regulation and monitoring effort during cycle ergometer exercise without the use of expensive monitoring instruments. Further validation is necessary for different types of exercise (e.g. walking/running, stepping, and resistance exercise) and other people (e.g. children, elderly) using other exercise modalities.

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