Reference Values and Predictive Equation for Cardiopulmonary Exercise Testing in Thai Healthy Adults

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Background: To identify abnormal exercise responses in patients with exercise intolerance, comparison of the reference values of normal responses from healthy individuals of Thai ethnicity is essential. The exercise response determined by cardiopulmonary exercise testing (CPET) in Thai healthy adults in order to construct a set predictive equations for normal maximal exercise response is lacking.

Objective: To acquire the CPET responses of Thai healthy adults corresponding to age, sex, body weight, height, and physical activity in healthy Thai adult aged between 20-80 years and to build up a set of predictive equations of CPET parameters.

Methods: A cross-sectional study of 578 Thai healthy adults, aged 20-80 years, was screened by health and physical activity questionnaires and spirometry. Subjects with a history of heart and pulmonary diseases, smoking ≥ 10 pack-years, and having abnormal spirometry were excluded. All subjects were asked to perform CPET on a cycle ergometry by an incremental exercise protocol to a symptom-limited maximum. CPET parameters (maximum oxygen consumption, oxygen consumption at anaerobic threshold (AT), oxygen consumption per heart beat (O2 pulse), maximum minute ventilation (VEmax), and ventilatory efficiency (ventilatory equivalents for VO2 and VCO2 at AT) were recorded. Statistical analysis was done separately for male and female sex. Prediction equations for CPET parameters were established by multiple stepwise linear regression including age, height, weight, and physical activity level.

Results: The data from a total of 511 subjects (214 males, 297 females) were analysed. The highest VO2 max among men (2.09±0.56 L/min), and women (1.40±0.27 L/min) was observed in the youngest age group (21-30 years, sex differences p<0.001) with a reduction per decade of age. AT was observed at approximately 60% and 64% of VO2max among men and women. The best ventilator efficiency was observed in the youngest age group (25±2.6) in both men and women (28±3.5) (sex difference, p<0.001) with a deterioration per decade of age. The highest VE max among men (80.6±19.6 L/min), and women (56.3±11.3 L/min) was observed in the youngest age group (21-30 years, sex differences p<0.001) with a reduction per decade of age.

Conclusion: This is the first largest Thai reference values of CPET parameters in healthy adults aged 20-80 years. This will be useful in evaluating cardiopulmonary heath for Thai population.

Keywords: Cardiopulmonary exercise testing, Reference values, Maximum oxygen consumption