

Updating Pediatric Norms for Peak VO₂ in a Clinical Setting

Nederend M.(1,2), Ten Harkel A. D. J. (2), Allison T. G.(1)

Mayo Clinic, Rochester, USA (1); Leiden University Medical Center, Leiden, the Netherlands (2)

Introduction: Predicting peak VO₂ in a pediatric population presents with multiple challenges, including evolving sociocultural norms. Currently recommended norms for predicted peak VO₂ based on sex and weight in children and adolescents date from 1984 (Cooper et al.). Our aim was to determine the applicability of those norms in current practice.

Methods: We reviewed the Mayo Rochester Integrated Stress Center database for the most recent cardiopulmonary exercise test performed by patients ≤ 18 years from January 2011 to July 2016. Patients with significant structural heart disease, use of negative chronotropic drugs, AICD implantation, sympathetic denervation, or obesity (CDC guidelines) were excluded. T-tests were used to determine differences in anthropometric variables, peak VO₂, and percent predicted peak VO₂ (PPVO₂) between boys and girls. Sensitivity analysis was performed by excluding patients with submaximal effort (n=135, peak respiratory exchange ratio (RER) < 1.05) on the test to determine if differences in PPVO₂ could be due to differential test effort.

Results: 360 children (163 girls) with a mean age of 13, range 6-18, for both boys and girls were analyzed. Mean height was 162 ± 18.2 for boys and 158.3 ± 13.9 cm for girls (p=0.033). BMI was comparable for boys and girls, 19.7 ± 3.3 and 19.9 ± 3.1 kg/m², respectively (p=0.69). Average peak VO₂ was 43.2 ± 9.4 mL/kg/min in boys compared to 35.6 ± 7.9 in girls (p<0.0001). PPVO₂ was higher in girls (103.7 per cent [95% CI: 99.9-107.5] compared to 93.5 per cent [95% CI: 90.8-96.1]; p<0.0001). Sensitivity corrected PPVO₂ increased for both boys (96.8 per cent [95% CI: 93.6-100.0]; p=0.063) and girls (109 per cent [95% CI: 104.8-113.8]; p<0.0001). Boy-girl differences remained statistically significant (p<0.0001).

Conclusion: Based on sensitivity analysis, girls achieved higher peak VO₂ than predicted by the Cooper equations. These results may reflect different trends in physical activity in the United States in boys compared to girls over the 32 years since these prediction equations were published. For more accurate exercise test interpretation, we suggest adjusting predicted peak VO₂ upwards by 10% for girls in current practice.