Actual Versus Predicted VO_2max: A Comparison of 4 Different Methods

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ABSTRACT

Measuring expired gases (EGs) while performing a maximal (max) effort exercise test is considered the most accurate evaluation of VO_2 max. This methodology is not applicable for all populations. Submaximal (sub-max) protocols not measuring expired gases are more applicable, however their ability to accurately predict VO_2max is not clear. **PURPOSE:** To compare VO_2max results from 1) University of Houston Non-Exercise Test (UHNET), 2) McArdle Step Test (MST), 3) Bruce Protocol measuring EGs to max (Bruce-EGs), and 4) Bruce Protocol using time to max (Bruce-TM). **METHODS:** Recreationally active men and women {n= 24 (16M/8W); age = 25±7.7 years; body mass = 74.5±10.9kg; BMI = 24.3±2.9} completed 4 tests (on the same day) in the following order: 1) UHNET, 2) MST, 3) Bruce-EGs, and 4) Bruce-TM. For the UHNET, participants rated his/her physical activity (PAR). This was followed with a specified equation to estimate the participants VO_2 max based on their PAR, age, BMI, and gender. Upon completion of the UHNET, participants performed the MST. The MST required participants to step on a 16.25inch bench at a specific cadence (different for men and women) for 3 minutes. Five seconds following the MST, radial pulse (RP) was assessed for 15 seconds. The radial pulse was converted to HR (beats/min) using the formula (RP*4). To estimate VO_2max from the MST, the HR value was applied to a specific equation (different for men and women). Ten minutes after completing the MST, participants performed the Bruce protocol to max. For the Bruce Protocol, VO_2max was calculated via 1) measurement of EGs and 2) the time it took to achieve max (TM). Expired gases were measured using a metabolic cart (Parvo Medics TrueOne 2400). To estimate VO_2max using TM, the Bruce Protocol Time Formula (different for men and women) was applied. In addition to EGs and TM, HR_{max}, and Respiratory Exchange Ratio (RER) were assessed. Significant differences ($p<.05$) between the actual VO_2 (Bruce-EGs) and estimated VO_2 (UHNET, MST, and Bruce-TM) were determined using a one-way repeated measures ANOVA. Pearson correlations and liner regression were performed to determine the relationship between the estimated and actual VO_2, as well as, determine how well the estimated VO_2 predicted the actual VO_2. **RESULTS:** For the Bruce protocol, HR_{max}=192±10.1bpm; RER=1.2±0.1, and TM=11.29±1.5 min. For the MST, the average HR was 144±23.3bpm. The actual VO_2 (46.3±9.4 ml•kg^{-1}•min^{-1}) was similar to the estimated VO_2 from UHNET (45.7±5.6 ml•kg^{-1}•min^{-1}) (p=.67) and MST (47.7±10.1 ml•kg^{-1}•min^{-1}) (p=.32). However, the VO_2 obtained from the Bruce-TM (42.3±6.7 ml•kg^{-1}•min^{-1}) was significantly lower ($p<.01$) than the actual VO_2. Significant correlations ($p<.01$) were found between the actual VO_2 and all predicted VO_2 values. Liner regression equations expressed an R^2 of .38, .61, and .65 for UHNET, MST, and Bruce-TM, respectively. **CONCLUSION:** Bruce-TM provided the most accurate estimation of the actual VO_2max. The MST was slightly less predictive of VO_2max though still a valid predictor. The results of this study suggest that to accurately predict VO_2max, individuals will need to achieve max effort but might not need to have EGs analyzed. The MST results suggest that estimating VO_2max on individuals who do not achieve max effort is still a valid option though might not be as accurate as when achieving max effort. These results should be taken with caution. This study was limited by 1) a small sample size, 2) evaluated only 2 modes of exercise, 3) a potential bias due to non-randomized trials, and 4) evaluated only healthy, active individuals. Increasing the sample size, comparing more methodologies, and randomizing the trials could strengthen the validity of any future investigations.