

WEARABLE HEART RATE MONITORS INTRODUCE TIME RELATED ERRORS WHEN PREDICTING VO_{2MAX} FROM STEP TESTS

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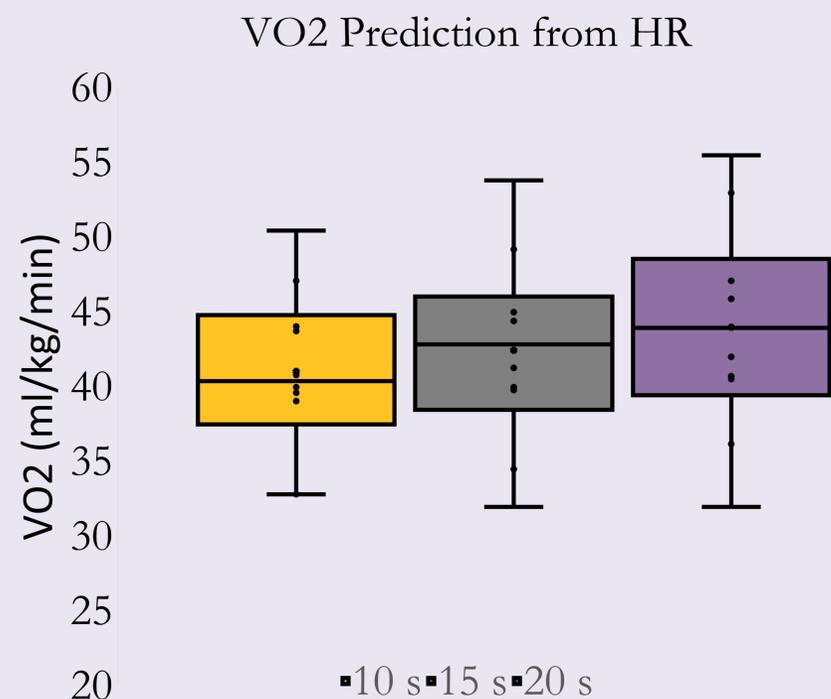
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INTRODUCTION

- Sub-maximal tests are used to predict fitness, monitor intensity, and track readiness
- Heart rate recovery (HRR) is particularly useful in aerobic fitness prediction due to HRR's relationship with parasympathetic modulation of the heart
- Many sub-maximal tests were developed using palpation of radial or carotid pulse numbers
- Advancements in technology have made heart rate monitors ubiquitous
- The purpose of this study was to use a heart rate monitor to compare VO_{2max} predictions from HRR at 10 s, 15 s, & 20 s after a 3-minute step test

METHODS

- Participants (n = 10; female = 4)
- Age = 24 ± 3 y
- Completed 3-minute step test (Queens College/McArdle Step Test) wearing a chest strap, Polar H10 heart rate monitor with data collected via the Polar Beat iOS app
- HR was captured at 10 s, 15 s, & 20 s after the step test
- VO_{2max} Prediction Equation
 - Male $VO_2 = 111.33 - (0.42 \cdot HR)$
 - Female $VO_2 = 65.81 - (0.1847 \cdot HR)$
- Repeated-measures ANOVA & LSD post-hoc to compare means



HR MONITORS INTRODUCE ERROR
COMPARED TO PALPATION
DURING SUBMAXIMAL AEROBIC
ASSESSMENTS

RESULTS

- ANOVA indicated a difference [$F(1.127,10.146) = 16.027, p = 0.002$]
- LSD post-hoc analysis revealed a difference between VO_{2max} at all time points (all pairwise $p \leq .01$)
- 10 s (HR = 155 ± 22 bpm; $VO_{2max} = 41.0 \pm 5.6$ mL·kg·min⁻¹)
- 15 s (HR = 150 ± 22 bpm; $VO_{2max} = 42.5 \pm 6.5$ mL·kg·min⁻¹)
- 20 s (HR = 146 ± 24 bpm; $VO_{2max} = 44.0 \pm 7.2$ mL·kg·min⁻¹)

CONCLUSION

- VO_{2max} predictions increased by $\approx 5\%$ after each five-second interval reported in this study.
- Additional research is needed to update submaximal aerobic prediction equations to use modern-day heart rate monitors
- Wearables HR monitors provide immediate feedback compared to manual palpation, resulting in a potential underestimation of VO_{2max} .

PRACTICAL APPLICATIONS

- Practitioners should be cautious when performing common submaximal aerobic fitness assessments that were validated using manual, palpated heart rate if the athlete/client is using a wearable heart rate monitor.
- Mean differences and error can be introduced ($\approx 10\%$ over 10 s window) when using wearables in the place of previously-validated manual palpations.
- Estimate errors impact prescribed training loads or can cause a misclassification of an individual's aerobic fitness.