

Comparison between continuous incremental ramp test and discontinuous square-wave test for $v\text{VO}_{2\text{max}}$ assessment in long distance runners and soccer players

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Aim: In treadmill testing, the running velocity associated with maximum oxygen uptake ($v\text{VO}_{2\text{max}}$) is largely utilized for both laboratory testing and training on the field. Differences between a continuous incremental ramp test (R1) and a discontinuous square wave tests (SW) in $v\text{VO}_{2\text{max}}$ assessment have been already described. Long distance runners and soccer players are both athletes involved with running. However, the physiological demands are different: in runners are continuous while in soccer players are discontinuous, with an alternation of aerobic and anaerobic tasks. Therefore, the aim of the study was to compare the $v\text{VO}_{2\text{max}}$ difference between R1 and SW in both these athletes. Hypothesis is that, this difference should be higher in soccer players than in runners, due to a different capacity to adjust the oxygen transport system at each workload.

Method: Eight runners (RUN) and nine soccer players (SOC) reported to the laboratory twice to perform two maximum incremental tests: R1 (1 km/h per min) and SW (workloads of 4 min each, with 5 min of rest in between), in random order, on a motorised treadmill for $\text{VO}_{2\text{max}}$ and $v\text{VO}_{2\text{max}}$ assessment. At rest and during exercise, cardiorespiratory and metabolic parameters were collected breath-by-breath. Blood lactate concentration $[\text{La}^-]$ was measured at rest and at maximum exercise.

Results: No significant differences between groups and protocols were found in $\text{VO}_{2\text{max}}$ (SOC: 3892 ± 104 vs 3922 ± 423 ml/min; RUN: 4159 ± 115 vs 4170 ± 116 , for SW and R1, respectively), as well as in VE, VCO_2 , $[\text{La}^-]_{\text{peak}}$ and HR at maximum exercise. However, $v\text{VO}_{2\text{max}}$ was significantly higher in R1 compared to SW in both groups (SOC: 16.1 ± 0.3 vs 19.4 ± 0.4 km/h, RUN: 19.5 ± 0.3 vs 22.1 ± 0.3 km/h, for SW and R1, respectively; $P < 0.05$), with a higher difference between R1 vs SW in SOC than RUN (+21% vs +13%, respectively; $P < 0.05$).

Conclusion: Despite similar $\text{VO}_{2\text{max}}$ values, $v\text{VO}_{2\text{max}}$ was higher in R1 than in SW in both groups. However, the difference was significantly higher in SOC than RUN, possibly due to a slower capacity to adjust the oxygen transport system to a given workload in SOC. Even though the two protocols can be used to assess $\text{VO}_{2\text{max}}$, the $v\text{VO}_{2\text{max}}$ differences between protocols must be acknowledged to prescribe correctly high intensity training, especially for soccer players.

Reference: Buchheit M, Laursen PB (2013) High-intensity interval training, solutions to the programming puzzle: Part I: cardiopulmonary emphasis. *Sports medicine* 43 (5):313-338.