Comparison between continuous incremental ramp test and discontinuous square-wave test for vVO_{2max} assessment in long distance runners and soccer players

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Aim: In treadmill testing, the running velocity associated with maximum oxygen uptake (vVO_{2max}) 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 vVO_{2max} 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 vVO_{2max} 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 VO_{2max} and vVO_{2max} assessment. At rest and during exercise, cardiorespiratory and metabolic parameters were collected breath-by-breath. Blood lactate concentration [La^-] was measured at rest and at maximum exercise.

Results: No significant differences between groups and protocols were found in VO_{2max} (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, $[La^-]_{peak}$ and HR at maximum exercise. However, vVO_{2max} 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 VO_{2max} values, vVO_{2max} 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 VO_{2max}, the vVO_{2max} 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.