Comparison between continuous incremental ramp test and discontinuous square-wave test for \( vV\text{O}_{2\text{max}} \) assessment in long distance runners and soccer players

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Aim: In treadmill testing, the running velocity associated with maximum oxygen uptake (\( vV\text{O}_{2\text{max}} \)) 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 \( vV\text{O}_{2\text{max}} \) 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 \( vV\text{O}_{2\text{max}} \) 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 \( V\text{O}_{2\text{max}} \) and \( vV\text{O}_{2\text{max}} \) 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 \( V\text{O}_{2\text{max}} \) (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\(_2\), [La\(^-\)]\(_{\text{peak}}\) and HR at maximum exercise. However, \( vV\text{O}_{2\text{max}} \) 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 \( V\text{O}_{2\text{max}} \) values, \( vV\text{O}_{2\text{max}} \) 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 \( V\text{O}_{2\text{max}} \), the \( vV\text{O}_{2\text{max}} \) differences between protocols must be acknowledged to prescribe correctly high intensity training, especially for soccer players.