Metabolic Gas Sampling Methods Significantly Affect Data Reporting During Brief Anaerobic Exercise

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Purpose

- To compare four different gas sampling methods in their ability to accurately measure metabolic and ventilatory variables during short-duration, high-intensity exercise and the immediate recovery period.
- This study aims to identify which methods best capture rapid physiological changes such as oxygen consumption (VO_2), carbon dioxide production (VCO_2), and ventilation rate (VE), particularly during the peak effort and early recovery phases.
- The findings may inform future protocols in sport science and clinical exercise testing, where capturing transient metabolic events is essential.

Methods

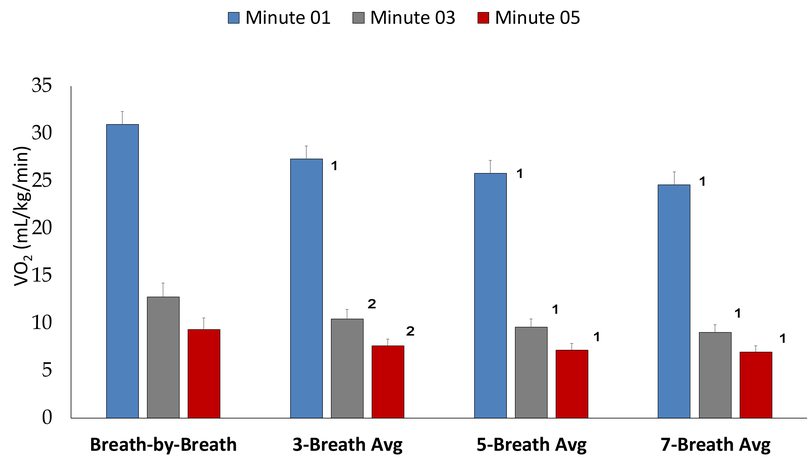
- Four recreationally active and strength trained women (30.8±3yrs, 64.7±7.5kg, 167.4±4cm) and four men (29.8±7.1yrs, 86.3±13.5kg, 177.1±3.9cm), volunteered.
- During each session, subjects completed a standardized warmup consisting of 5min on a cycle ergometer followed by a dynamic stretching routine.
- Testing consisted of a single bout of 30s of maximal effort squats on a flywheel device. Subjects completed three sessions across one week with three inertial loads (0.01kg•m², 0.025kg•m², 0.05kg•m²) in random order.
- Metabolic data were collected continuously during the exercise bout and for five minutes post-exercise.
- Metabolic data were exported as breath-by-breath and then filtered using one of three techniques: 3-breath running average (3B), 5 breath running average (5B), and 7 breath running average (7B).
- Using the three filtering techniques and raw data, the Volume of Carbon Dioxide Production (VCO_2), Volume of Oxygen Consumption (VO_2) and Ventilation (VE) were compared over the entire trial.

Results

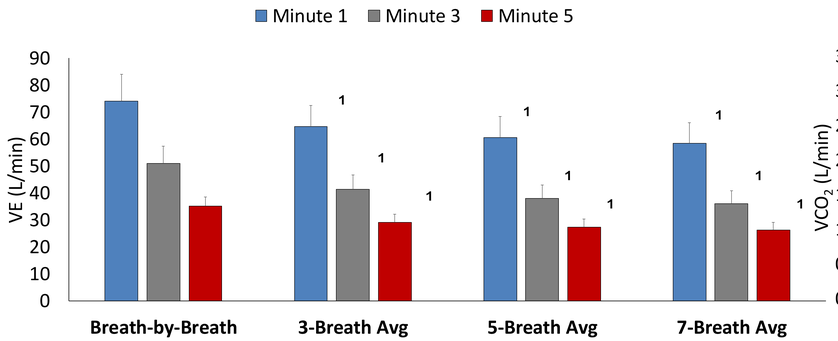
- When compared to breath-by breath data, there was a significant difference in VCO2 and VE using 3B, 5B, and 7B.
- When compared to the breath-by-breath data during minute one, three, and five VO2 was significantly different than to 3B, 5B, and 7B.

Example of subject using Flywheel training device with metabolic breath by breath sampling method

Results



Comparisons to breath by breath. ¹ p<0.001 ² p=0.001



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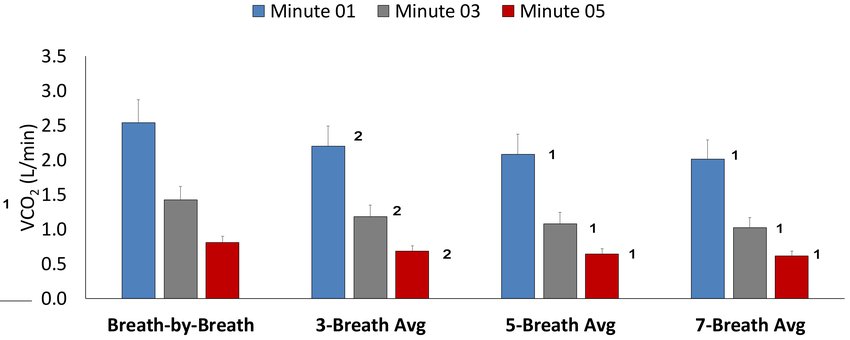

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Practical Applications

Techniques for filtering metabolic data have traditionally been developed using steady-state or graded exercise tests, where metabolic and ventilatory demands increase gradually. Fewer studies have examined filtering techniques during high-intensity anaerobic testing, where rapid shifts in metabolic state occur. Evidence suggests that the choice of metabolic sampling method can significantly affect the reported outcomes, highlighting the need for practitioners to critically evaluate and transparently report the averaging techniques they use. Scientists and clinicians should clearly document their sampling methods when conducting anaerobic testing, as using smaller sampling intervals that can capture rapid changes. More frequent measurements enhance the accuracy of peak effort and recovery assessments, leading to more effective evaluations of training or performance.

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