

Cardiorespiratory and Metabolic Responses to Sinusoidal Exercise of Moderate Intensity: Reliability of the Measurements and the Effects of Fatigue. The FASEB Journal, 34: 1-1. Esposito, F., Borrelli, M., Shokohyar, S., Doria, C., Limonta, E., Cè, E., Longo, S., Coratella, G., Bruseghini, P., Rampichini, S. and Ferretti, G. (2020), <https://doi.org/10.1096/fasebj.2020.34.s1.05343>

The cardiorespiratory and metabolic responses to sinusoidal exercise, in which work rate follows an oscillating pattern, have been proposed to assess the effectiveness of the cardiorespiratory adjustments. The repetition of successive sinusoidal periods permits to simultaneously reduce the influence of random fluctuations and accentuate the underlying physiological response. Data analysis has been often performed by overlapping and averaging successive cycles assuming no differences among them, thus excluding the possible presence of fatigue throughout successive cycles. After assessing the reliability of the measurements during sinusoidal exercise, this study sought to investigate the possible differences among subsequent cycles of sinusoidal work. Eleven active volunteers (age: 28 ± 6 yrs., body mass: 73 ± 7 kg; stature: 1.79 ± 0.06 m, maximum oxygen uptake ($\text{VO}_{2\text{max}}$): $52 \text{ ml} \cdot \text{kg}^{-1} \cdot \text{min}^{-1}$) participated to the study that was conducted in accordance with the Basic Principles of the Declaration of Helsinki. After determining individual $\text{VO}_{2\text{max}}$ and critical power (CP) on a cycle ergometer, they underwent sinusoidal work rates characterized by an amplitude (A), a midpoint (MP) and a period equal to $\pm 50\text{W}$, 50W below CP and 240s, respectively, up to exhaustion. On a different day, participants repeated the same experimental session for reliability purposes. Expiratory ventilation (VE), oxygen uptake (VO_2), carbon dioxide output (VCO_2), and heart rate (f_H) responses were fitted by the sinewave function that minimized the residuals. A, MP and the time-delay (t_D , the latency between mechanical work rate and physiological responses) of all parameters were determined for each cycle. Reliability assessment between day 1 and 2 was expressed as Cronbach's α and intraclass correlation coefficient (ICC). A one-way ANOVA for repeated measures tested the presence of differences among cycles. Regression analysis was also applied to explore possible relationship between each variables and time.

Reliability analysis revealed a very high to high ICC values for most of the parameters, with the exception of A for VO_2 and VCO_2 and t_D for f_H (moderate reliability). A of VE and f_H response increased and decreased with time, respectively ($p < 0.05$). MP of VE and f_H showed a positive regression that led to significantly higher values in the last compared to the first cycle; on the contrary, no changes were observed among cycles in all other MP data. t_D was similar in each cycle for all the investigated parameters despite a very slight negative regression found for VCO_2 .

In conclusion, most of the physiological responses to moderate sinusoidal exercise exhibited a high to very high reliability. Some of the cardiorespiratory parameters showed significant changes with time throughout the sinusoidal exercise possibly due to the onset of fatigue. Therefore, an approach that overlaps and averages all the cycles together should not be performed to avoid wrong estimation of physiological responses to sinusoidal exercise, unless the averaging approach involves only the first cycles.