

Comparison of the Gas Exchange Threshold Derived from Ramp and Step Graded Exercise Tests

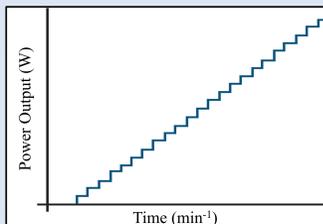
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PURPOSE:

This study compared the gas exchange threshold (GET) derived from a ramp (rGET) or step (sGET) cycle ergometry graded exercise test (GXT) and examined the metabolic responses during continuous rides at the rGET and sGET.

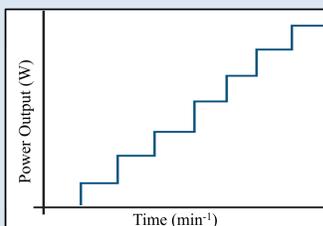
METHODS:

- Eight subjects (2 females, mean±SD, age=22±3 yr, weight=75.8±13.2 kg) completed ramp ($\dot{V}O_{2peak}=42.39\pm9.27$ mL·kg⁻¹·min⁻¹) and step ($\dot{V}O_{2peak}=40.96\pm9.14$ mL·kg⁻¹·min⁻¹) GXTs, in a randomized order, to determine the rGET and sGET.
- The ramp protocol consisted of 20W·min⁻¹ and 30W·min⁻¹ increases in power output (PO) for females and males, respectively. The step protocol included 30W increases in PO every 2 min for females and males.
- The GET was determined from visual inspection as the point of departure from linearity of the $\dot{V}CO_2$ versus $\dot{V}O_2$ relationship. The power outputs associated with the rGET and sGET were determined from the $\dot{V}O_2$ -PO relationship from the respective protocol.
- The mean response time (MRT) was calculated for the ramp protocol to account for the rightward shift in the $\dot{V}O_2$ -PO relationship. The rGET PO was adjusted based on the MRT.
- Continuous rides for 30 min or until exhaustion (T_{lim}), were performed at the rGET ($T_{lim}=29.3\pm2.0$ min) and sGET ($T_{lim}=29.7\pm1.0$ min) PO on separate days, in a randomized order.
- The initial $\dot{V}O_2$ (1-min average after the initial adjustment to exercise) and the final $\dot{V}O_2$ (average for the last 1 min of the ride) were used to examine the change in ($\dot{V}O_2$ across time ($\Delta\dot{V}O_2$, mL·min⁻¹)).
- Separate, paired samples t-tests were used to compare the PO and $\dot{V}O_2$ at the rGET and sGET. A repeated measures ANOVA (protocol x time) was used to compare the initial and final $\dot{V}O_2$ for the rGET and sGET rides (p<0.05).



Ramp GXT:

- 12-min warm-up
- Starting:
 - 50W (M); 30W (F)
- Increment:
 - 30W · min⁻¹ (M)
 - 20W · min⁻¹ (F)



Step GXT:

- 12-min warm-up
- Starting:
 - 50W (M); 30W (F)
- Increment:
 - 30 W · 2min⁻¹ (M and F)



Ramp GET Ride:

- 3-min warm-up
- 30-min ride @ PO associated with GET



Step GET Ride:

- 3-min warm-up
- 30-min ride @ PO associated with GET

Both ramp and step GXTs protocols produced gas exchange thresholds reflective of the moderate intensity domain.

Step GXTs may serve as a more accessible method of determining aerobic capacity and fatigue thresholds.

RESULTS:

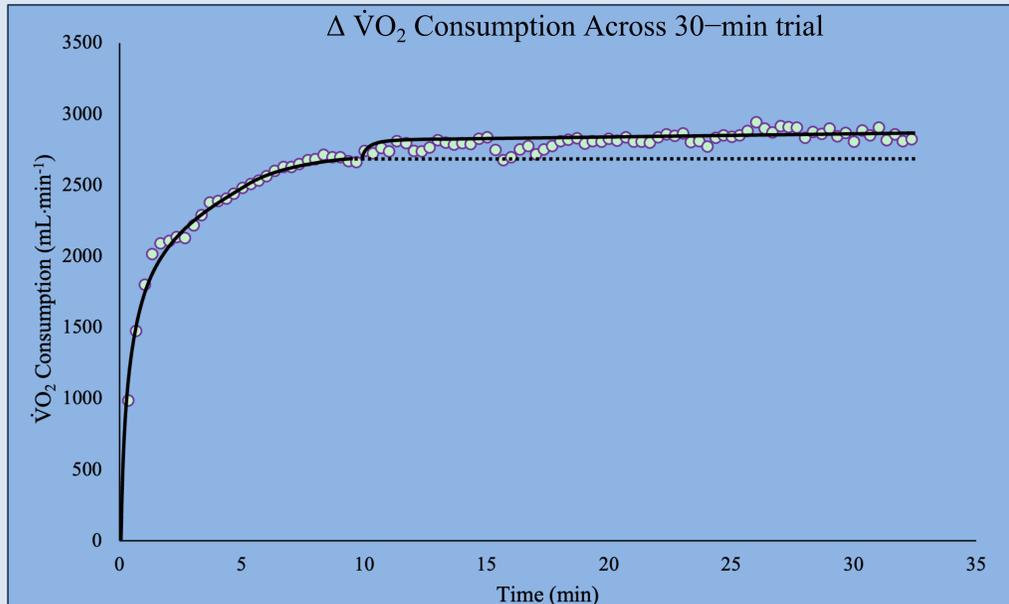
Table 1: Gas Exchange Threshold Results

	Power Output at GET	$\dot{V}O_2$ at the GET
sGET	154 ± 33W	24.98 ± 4.24mL · kg ⁻¹ · min ⁻¹
rGET	150 ± 49W	24.21 ± 5.65mL · kg ⁻¹ · min ⁻¹
p-value	0.731	0.579

Table 2: $\Delta \dot{V}O_2$ During 30-min Trial

	p-value	F-statistic	η_p^2
Protocol x Time	0.766	0.096	0.013
Protocol	0.796	0.72	0.010
Time	< 0.001*	29.65	0.809
	2,011 ± 25 mL · min ⁻¹ , 2,185 ± 95 mL · min ⁻¹ $\Delta 174 \pm 109$ mL · min ⁻¹		

* Indicates a significant increase in $\dot{V}O_2$ collapsed across time.



CONCLUSIONS:

- GXT protocol did not affect estimates of the GET. Although the $\dot{V}O_2$ significantly increased across time during the rGET and sGET PO rides ($\Delta\dot{V}O_2$ 174±109 mL·min⁻¹, collapsed across protocol), this change did not exceed the 200 mL·min⁻¹ value that defines the slow-component for exercise within the heavy intensity domain.
- Continuous rides at the rGET and sGET PO were consistent with responses within the moderate domain.

PRACTICAL APPLICATIONS:

Unlike the ramp protocol, the step protocol does not require the MRT adjustment for the rightward shift in the $\dot{V}O_2$ -PO relationship. Thus, a step GXT protocol may provide a more time efficient and less complex assessment of the GET than a ramp protocol.

ACKNOWLEDGMENTS:

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