# COMPARISON OF CORE TEMPERATURE THRESHOLDS FOR VENTILATION TO VENTILATION THRESHOLDS 1 AND 2 DURING INCREMENTAL EXERCISE IN HUMANS

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Human ventilation during a progressive exercise to maximal attainable levels, expressed as a function of oxygen consumption ($VO_2$), shows two successive inflection points or ventilation thresholds (VT). Employing the terminology of Skinner-McLellan-Kinderman, the lower ventilation threshold ($VT_1$) is suggested to coincide with the onset of blood lactate accumulation and the upper ventilation threshold ($VT_2$) is possibly of a neurogenic origin. At close to 70-80% of the maximal attainable work-rate, core temperature thresholds for ventilation were also demonstrated (White and Cabanac 1996). However, it is not known if the work rates at these core temperature thresholds for ventilation are the same or different than the work rates at $VT_1$ and $VT_2$. The purpose of the present study was to compare the $VO_2$ at the core temperature thresholds for ventilation to both $VT_1$ and $VT_2$. The goal was to address if these three separate ventilation thresholds are similar or different physiological or metabolic responses. Six fit male, college-aged subjects pedaled a cycle ergometer on 2 occasions in progressive exercise tests until the point of exhaustion. In one exercise session work rate was increased by 20W/2 min (slow ramp) and in the other by 40W/2 min (fast ramp). Subjects were instrumented for esophageal temperature ($T_{es}$), skin temperatures and their expired gases were collected to assess oxygen consumption ($VO_2$), carbon dioxide production ($VCO_2$) and minute ventilation ($V_E$). In both exercise sessions, ventilatory equivalents for oxygen consumption ($V_E/VO_2$) and carbon dioxide production ($V_E/VCO_2$) were plotted as a function of both $T_{es}$ and $VO_2$. These plots allowed the determination of $VO_2$ at each of the $T_{es}$ threshold for ventilation, $VT_1$ and $VT_2$. In the slow ramp session the $VO_2$ of 2.85± 0.23 l/min at the $T_{es}$ threshold for $V_E/VO_2$ ($p< 0.01$) and the $VO_2$ of 2.44± 0.19 l/min at the $T_{es}$ threshold for $V_E/VCO_2$ ($p< 0.01$) were significantly greater than the $VO_2$ of 1.81± 0.11 l/min at $VT_1$. In the fast ramp session the $VO_2$ of 2.87±0.16 l/min at the $T_{es}$ threshold for $V_E/VO_2$ ($p< 0.001$) and the $VO_2$ of 2.68±0.15 l/min at the $T_{es}$ threshold for $V_E/VCO_2$ ($p< 0.01$) were both significantly greater than the $VO_2$ of 1.15±0.23 l/min at $VT_1$. Comparisons of $VO_2$ at the $T_{es}$ threshold for ventilation to $VO_2$ at $VT_2$ gave different results. In the slow ramp session the $VO_2$ at the $T_{es}$ threshold for $V_E/VO_2$ was not significantly different than the $VO_2$ of 3.01 ± 0.17 l/min at $VT_2$. The $VO_2$ at the $T_{es}$ threshold for $V_E/VCO_2$ in the same slow ramp session was significantly lower ($p <0.01$) than $VT_2$. In the fast ramp session the $VO_2$ at the $T_{es}$ thresholds for $V_E/VO_2$ and $V_E/VCO_2$ were both not significantly different than the $VO_2$ of 2.71 ± 0.18 /min at $VT_2$. In conclusion, the $VO_2$ at the $T_{es}$ thresholds for ventilation is significantly greater than the oxygen consumption at $VT_1$ and appears not to be different than oxygen consumption at $VT_2$. The results appear to support that $VT_1$ is a ventilatory response occurring at significantly lower $VO_2$ than either $VT_2$ or the $T_{es}$ threshold for ventilation.

White, M.D. & Cabanac, M. (1996) Exercise Hyperpnea and hyperthermia in human. *J. Appl. Physiol.* 81, 1249-1254.

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