

寒冷下運動負荷時の体温調節反応と寒冷血管反応に 及ぼす体力水準の差異

長崎大学 管原正志
(共同研究者) 同 田井村明博
同 大渡伸
同 上平憲

Effect of Aerobic Power on Thermoregulation and Cold-induced Vasodilation during Exercise in a Cold Environment

by

Masashi Sugawara

Department of Exercise Physiology, Faculty of Education, Nagasaki University

Akihiro Taimura

Natural Environmental Conservation, Faculty of Environmental Studies, Nagasaki University

Nobu Ohwatari

Institute of Tropical Medicine, Nagasaki University

Shimeru Kamihira

Department of Laboratory Medicine, School of Medicine, Nagasaki University

ABSTRACT

Twenty male athletes were grouped into high (H-G) and low (L-G), based on their maximal oxygen intake, were examined for cold-induced vasodilation (CIVD) and autonomic thermoregulatory response during exercise in cold environment. The subjects sit for 30 minutes and exercised using the ergometer at 70% of maximum oxygen uptake for 30 minutes in a climatic chamber (mean room temperature; 10°C, mean relative humidity; 60%, mean air stream 0.5m/sec). Their rectal temperature (T_{re}) skin temperature (forehead,

chest, abdomen, back, upper arm, forearm, thigh, dosum of manus), metabolic rate and CIVD were measured.

On the H-G group, there was a small decrease in rectal temperature, whereas in L-G, an increase was noted before exercise in a cold. Mean skin temperature (\bar{T}_{sk}) decreased in both groups immediately after cold exposure. L-G showed a lower \bar{T}_{sk} during exercise. In both groups, metabolic heat production (M ; W/m^2) increased after cold exposure, and the increase was much larger during exercise. The value of M was always highest in H-G. CIVD indicators, which were: mean skin temperature (MST), temperature first rise (TFR) and resistance index (RI), were significantly higher in H-G than in L-G. Time of temperature rise (TTR) in H-G was also faster. The body fat (BF%) was significantly negatively correlate with $\dot{V}O_{2max}$, T_{re} , \bar{T}_{sk} and M ; thus, it may be inferred that high physical fitness for endurance is less affected by body fat. High tolerance to cold can be explained by increases M and skin vessel constriction.

Endurance training may improves thermal sensibilities and metabolic heat production. The relationship between the peripheral vessel vasomotor reaction and the autonomic thermoregulatory response during exercise in the cold environment become clearer.

要 旨

成人男子運動鍛錬者20名について、平均環境温度10℃、平均相対湿度60%そして平均気流0.5m/secの測定室に、長袖シャツにランニングパンツで自転車エルゴメータ上にて30分間安静の後、運動強度70% $\dot{V}O_{2max}$ で30分間運動負荷した。そして運動鍛錬者の $\dot{V}O_{2max}$ (ml/kg/min) が60ml/kg/min以上を高値群(H-G, n=10)、59ml/kg/min以下を低値群(L-G, n=10)の2群に分け、寒冷に対する末梢血管調節反応(CIVD)と自律性体温調節反応について持久性体力水準別に観察し検討した。

直腸温(T_{re})は、安静中H-Gが緩やかに低下しているのに対し、L-Gでは低下が大きく、運動開始とともにH-Gの上昇は大きかった。平均皮膚温(\bar{T}_{sk})は、寒冷暴露とともに両群低下し、運動開始後H-GよりL-Gは低かった。代謝量 M (W/m^2)は、寒冷暴露後両群ともに亢進し、さら

に運動により急上昇したが、終始H-Gの M が大きかった。運動開始より30分間のCIVDテストは、H-Gが平均指皮温(MST)、反応発現温度(TFR)は高く、反応発現時間(TTR)は早く、抗凍傷指数(RI)は高かった。体脂肪%(BF%)と $\dot{V}O_{2max}$ 、 T_{re} 、 \bar{T}_{sk} 、 M とは、負の相関関係にあり、持久性体力の優れた者は、寒冷暴露下での体脂肪による断熱性は低下するものの、産熱量の増加と皮膚血管収縮の増大が耐寒性を獲得していた。

持久的運動トレーニングは、寒冷下運動に対して体温調節の感受性や熱産生反応の改善が見られ、末梢血管調節反応と自律性体温調節反応との間の関連性がより明らかになった。