Thermal Effect on Uniform Increase in Pulmonary Diffusing Capacity during Exercise

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It has been reported in the previous study (Yasukouchi, 1985) that pulmonary diffusing capacity for carbon monoxide during exercise increased with energy expenditure in a linear fashion and that the slope of diffusing capacity on oxygen intake was constant among subjects. In this study, it was examined whether the uniform increase in diffusing capacity was affected by ambient temperature and by subject groups who lived in different districts in Japan.

METHODS

The subjects were five healthy young male adults (19–22yr old) with no significant history of cardiopulmonary complaints. All subjects lived in Kyushu island or Western district of Honshu island. Thermal conditions were ambient temperatures of 16, 20, 24 and 28°C, each with a respective relative humidity of about 50%, maintained in a climatic chamber. Each of the subjects, wearing a thin running shirt and shorts, was exposed to each temperature condition for about 2 hrs and 30min. Diffusing capacity and oxygen intake were measured at the 120th min of exposure at rest in the sitting position on a bed and also measured during exercise after a resting period. Exercise was performed successively at loads of 50 and 100 watts with a bicycle ergometer for each about 8 min.

Diffusing capacity was measured by the breath-holding method based on the technique of Ogilvie et al. (1957) and oxygen intake was obtained by Douglas bag method.

RESULTS AND DISCUSSION

Table 1 shows that the individual regression

coefficients of diffusing capacity on oxygen intake calculated by data on rest and exercise at loads of 50 and 100 watts in each thermal condition. Range of regression coefficients, from 0.007 to 0.014 in all conditions, was small and it seemed that there were no individual differences in this study. Table 2 shows regression equation of diffusing capacity on oxygen intake and two confidence limits of the regression coefficient for the 5% point of the distribution of *t* in each thermal condition. As a result of analysis of variance, the slopes among four equations were almost constant ($F=0.115$, d.f.=3, 52). Although *y* intercepts seemed to be higher in a

Table 1. Individual regression coefficients of pulmonary diffusing capacity on oxygen intake during rest and exercise in each thermal condition.

Subject	Ambient temperature (°C)			
	16	20	24	28
HG	.010	.007	.010	.009
OK	.008	.008	.010	.009
AM	.011	.007	.014	.010
IK	.008	.012	.012	.011
TR	.010	.013	.010	.013

Table 2. Regression equation of pulmonary diffusing capacity (D_L , ml/min/Torr) on oxygen intake ($\dot{V}O_2$, ml/min) and two confidence limits of the regression coefficient for the 5% point of the distribution of *t* in each thermal condition.

Ambient temperature(°C)	Regression equation	Confidence limits of the slope	<i>r</i>	<i>N</i>
16	$D_L = 35.1 + 0.009\dot{V}O_2$	0.005–0.013	.778	15
20	$D_L = 34.1 + 0.009\dot{V}O_2$	0.005–0.013	.815	15
24	$D_L = 33.6 + 0.010\dot{V}O_2$	0.005–0.015	.760	15
28	$D_L = 32.2 + 0.010\dot{V}O_2$	0.006–0.014	.822	15

cool environment than in 28°C, there were no statistical differences ($F=0.583$, d.f.=3, 55). Regression equation obtained in all conditions was as follows:

$D_L = 33.6 + 0.010 \dot{V}O_2$ $r = .793$ $N = 60$,
and confidence limits of the regression coefficient were estimated at 0.008 and 0.012.

In the previous study (Yasukouchi, 1985), the regression coefficients of diffusing capacity on oxygen intake were obtained by data on rest and exercise at five loads in range from 50 to 130 watts at 25°C and it was indicated that there were no individual differences. The group of the subjects, who lived in Kanto district, was different from the group in this study. In a comparison between the two groups, the slopes were shown to be identical by analysis of covariance ($F=1.737$, d.f.=1, 96).

It was concluded that increase in diffusing capacity per unit increase in oxygen intake during exercise was almost constant among subjects and subject groups and that the uniform increase in diffusing capacity was not affected by change in ambient temperature in this study.

REFERENCES

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