FINGER CIRCULATION IN YOUNGER AND OLDER MEN DURING PROLONGED EXERCISE IN DIFFERENT THERMAL CONDITIONS

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INTRODUCTION

During exercise in the heat, skin blood flow is increased for heat transfer from care to skin. In the hairy skin, cutaneous circulation increases through the withdrawal of sympathetic tone, and through the active vasodilatory reflex. In acral areas (fingers, hands, toes, face), the regulation is different: increase in skin blood flow occurs mainly through the withdrawal of sympathetic nervous activity.

It has been shown that in hairy skin older adults have lower skin blood flow than younger subjects (1). Whether this also applies to acral areas, is not known so well.

The purpose of the present study was to examine the effect of age on finger circulatory response to prolonged exercise in thermoneutrality and under heat stress.

METHOD

Eight younger men, and six older men walked on a treadmill at 30% of their maximum oxygen consumption up to 3.5 h in a thermoneutral (21°C/43%), a warm humid (30°C/80%), and a hot dry (40°C/20%) environment while wearing ordinary work clothing (Table 1). All subjects were unacclimated to heat.

Table 1. Age and physical characteristics of the subjects. Mean±SD.

Variable	Younger	Older	P
Age (years)	34±3	57±2	< 0.05
Height (cm)	178±6	175±7	n.s.
Weight (kg)	79±9	87±8	< 0.05
VO_2max (ml/min/kg)	41±3	36±4	< 0.05

Total finger blood flow and finger systolic blood pressure were measured at heart level every 30 min by strain-gauge plethysmography. Finger vascular resistance was estimated by dividing the systolic blood pressure by the total finger blood flow. Finger skin blood flow was measured by laser-Doppler flowmetry. A thermistor taped on the fingertip was used to measure skin temperature. For the analysis, the values were averaged over the entire test period for each subject. The results were analyzed with a two-way ANOVA (age, temperature).

RESULTS

In the end of exercise, the heart rate, rectal temperature, and mean skin temperature were not significantly different between the younger and older men in any of the three climates. These results have been published recently (2).

In the thermoneutral and warm humid environment, the older men had significantly ($p < 0.01$) lower finger skin temperatures as compared to younger men (30.5°C vs 33.8°C in thermoneutralily). Total fmger blood flow was similar in both groups in thermoneutralily but was at a higher level ($p < 0.05$) in older subjects especially in the hot dry environment (42 ml/100ml/min vs 61 ml/100ml/min in the younger and older subjects, respectively). Older subjects had lower ($p < 0.05$) laser-Doppler flow in thermoneutralily, but in both groups the flows were similar in dry and humid heat.

In the thermoneutral environment, linger systolic blood pressure and finger vascular resistance were significantly ($p < 0.01$) higher in older men in comparison to younger men. During exercise in the warm humid and the hot dry environment, older men had higher finger systolic blood pressure, but similar finger vascular resistance as younger men.

CONCLUSIONS

The results suggested that older men require a higher total linger blood flow in order to attain a similar level of superficial skin blood flow and skin temperature as younger men. This may indicate age-related changes in the cutaneous *vascular* bed in older men, such as reduced velocity of red blood cells and depressed vessel recruitment (3).

REFERENCES

1. Kenney W.L. and Havenith G. 1991, Aging, skin blood flow, and heat tolerance, in Proceedings of International Conference on Human-Environment System, Tokyo, 87-90.

2. Smolander J., Korhonen O. and Ilmarinen R. 1990, Responses of young and older men during prolonged exercise in dry and humid heat, European Journal of Applied Physiology 61, 413-418.

3. Richardson D. 1989, Effects of age on cutaneous circulatory response to direct heat on the forearm, Journal of Gerontology 44, M189-194.