

# EFFECTS OF THE CLOTHING PRESSURE APPLIED TO THE SKIN ON RESTING SALIVARY SECRETION

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## INTRODUCTION

It has been widely recognized that the skin pressure on specified areas of the body could cause depression of sweating rate (1). Ohtsuki *et al.* have observed that voluntary reaction time to light stimulation was longer with increased skin pressure brought on by compressive sportswear than without pressure and assumed that the pressure could cause depression of the central processing activity (2). Also, Tokura *et al.* have shown that skin pressure due to wearing a swimsuit had inhibitory effects on sweating (3), and the pressure from a bodysuit could cause reduction in the secretion of saliva from parotid gland (4). Thus, the skin pressure could have some inhibitory effects on several physiological parameters and the physiological permissible limiting value by an *obi* is known  $40 \text{ gf/cm}^2$  (5). This experiment aims to investigate whether the skin pressure has some effects not only on secretion of saliva, but also on digestive response.

## METHODS

**Experiment 1** Nine healthy females (aged 18 to 33 yrs) participated as subjects. They had standard physical characteristics; height  $158.0 \pm 7.1$  cm and weight  $51.2 \pm 9.2$  kg. The purpose of this study and the experimental procedures were explained to the subjects before voluntary consent was obtained. Individuals were asked to eat nothing for at least one hour this experiment.

In a bioclimatic chamber ( $28^\circ\text{C}$ ,  $50\%RH$ ), the subjects changed their ordinary clothing into experimental wears (one-piece with short sleeves and panties) having nearly no skin pressure to the body. Then, the subjects sat in a reclining seat calmly throughout the experimental period for 195 min; in a state having nearly no skin pressure for the first 90 min, in a state having skin pressure of 40 mmHg in abdomen and thighs and 60 mmHg in legs for the next 60 min by the use of cuffs inflated by air and in a state having nearly no skin pressure by releasing air out of the cuffs for last 45 min. The cuffs used in this experiment were 25 cm wide and 120 cm long for abdomen, 25 cm wide and 90 cm long for thighs and 15 cm wide and 50 cm long for legs.

Resting salivary secretion was collected every 15 min. The collection started at the time of 55 min after the beginning of experiment and was totally performed 10 times (Fig. 1). During 5 min the subjects were asked to prohibit swallowing saliva and to spit out saliva into a beaker whose weight was measured. The resting salivary secretion was obtained by subtracting the weight of the beaker from the weight of the beaker containing saliva.

We also investigated digestive time for starch by the saliva in term of iodine-starch reaction. After saliva weight was measured, the saliva (1 ml) was blended with 1% solution of starch (10 ml) in another beaker, which was kept at  $37^\circ\text{C}$

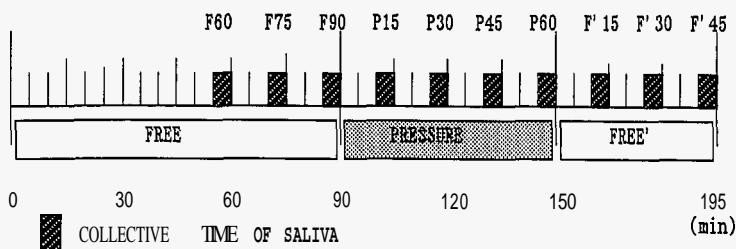


Fig. 1 Time schedule. First period consisted of 90 min with no skin pressure, designated control period, followed by 60 min period with the skin pressure by cuffs. Last period consisted of 45 min without pressure as recovery period. Black blocks represent the time of the resting saliva collection for 5 min.

in warm water controlled at 37°C. Then, the solution of saliva-starch (1 ml) was put on a slide glass every minute and 100 μl of the solution of the iodine was dropped on that. If the reaction color became blue, it means the starch was not yet digested by the saliva. If the reaction color remained yellow, it means the starch was already digested entirely by the saliva. We took photographs for each reaction and determined the digestive time from the pictures.

Experiment 2 The subjects were four healthy females (aged 18 to 22 yrs). Experiment 2 had the same schedule as experiment 1. The saliva obtained at 90 min of the control period, at 30, 60 min of the pressure period and at 15, 45 min of the recovery period were stored immediately in a freezer. The concentration of amylase of the saliva was determined by a substratemethod (5).

Experiment 3 The subjects were twenty healthy females (aged 21 to 23 yrs). The skin pressure was circumferentially applied in the areas around bust and waist with flat rubber threads fastened with pins. The lengths of the rubber threads were 15 cm shorter than those in circumference of bust and waist. After sitting calmly for 90 min without skin pressure by clothings, the skin pressure by the rubbers was applied for 30 min, and then the pressure was released for the next 30 min. The saliva obtained at 90 min (F60), at 30 min of skin pressure (P30) and at 30 min of recovery (F'30) were stored immediately in a freezer. The concentration of amylase in the saliva was analyzed.

## RESULTS

Experiment 1 Fig. 2 shows distinctly that resting salivary secretion was clearly inhibited by skin pressure due to the cuffs. Fig. 3 shows the average digestive time. As seen clearly, it tended to be longer during the skin pressure period.

Experiment 2 Decrease of the concentration of amylase was observed in three out of four subjects during the pressure period.

**Experiment 3** Fig. 4 shows the average concentration of amylase. It was significantly lower at 30 min of skin pressure than at 90 min of control, and did not recover at 30 min of recovery.

### CONCLUSIONS

Resting salivary secretion and concentration of amylase was inhibited by skin pressure due to the cuffs. The digestive time tended to be longer during the period of increased skin pressure period. These results might suggest that the autonomic nervous system is depressed by the skin pressure. Therefore, these results are of significance for the improvement of the relationship between clothing and health maintenance in terms of digestive physiology.

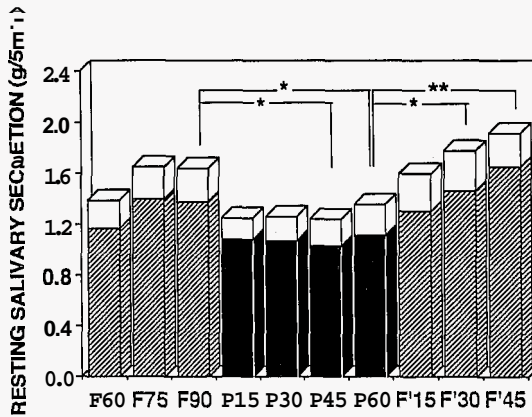
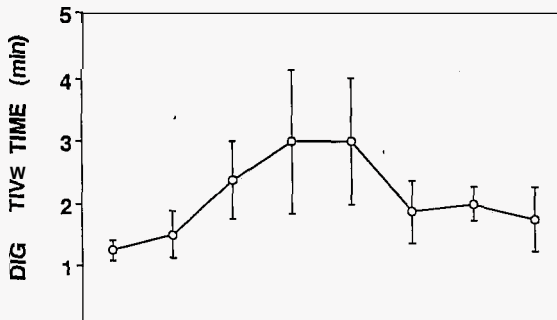


Fig. 2 Resting salivary secretion per 5 min. Mean  $\pm$  S.E. N=9



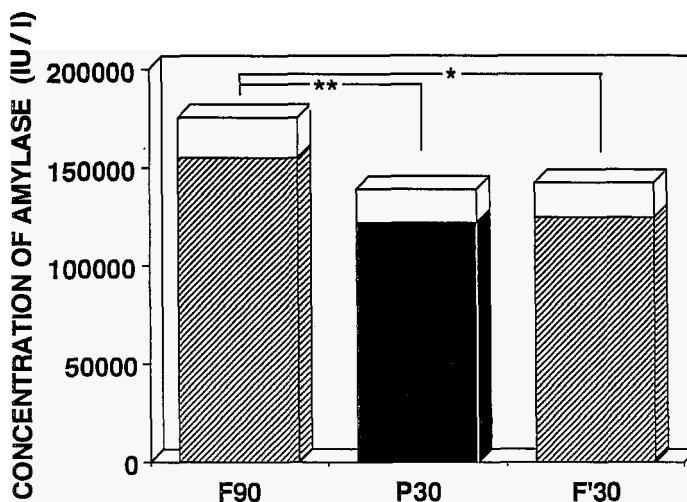


Fig. 4 The average concentration of resting saliva amylase.

## REFERENCES

1. Takagi, K. 1972, Functional Control of Living Systems. (Chuoukouronsya, Tokyo), 2-33, in Japanese.
2. Ohtsuki, T., Kim, H.E., and Tokura, H. 1993, Effects of pressure applied to the body by sportswear upon voluntary reaction time. *Desent Sports Science*, **16**, 93-99.
3. Maruta, N. and Tokura, H. 1988, Effects of skin pressure by swimsuit on local sweat rate, respiratory frequency, heart rate and clothing feeling in sedentary women at an ambient temperature of 35 °C. *Journal of Home Economics of Japan*, 39, 607-611.
4. Tokura, H., 1989, Physiological significance of clothing and human health, in Tokura, H. (eds.), *Proceeding of International Symposium of Clothing Comfort Studies in Mt. Fuji* (The Japan Reseach Association for Textile End-Uses Publishing, Osaka), 203-222.
5. Ohno, S., Yoshida, K., Iizuka, S., Kuji, R., Taya, T. 1989, Clothing Hygiene and Mechanism. (Asakurasyoten, Tokyo), 125, in Japanese.
6. Henkel, E., Morich, S. and Henkel, R. 1984, 2-Chloro-4-nitrophenyl-β D -maltoheptaoside; A new substrate for the determination of α -Amylase in serum and urine. *Journal of Clinical Chemistry Clinical Biochemistry*, **22**, 489-495.