

# THERMAL CONDITIONS IN THE BATHROOMS OF THE ELDERLY IN SUMMER, AUTUMN AND WINTER IN JAPAN

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## INTRODUCTION

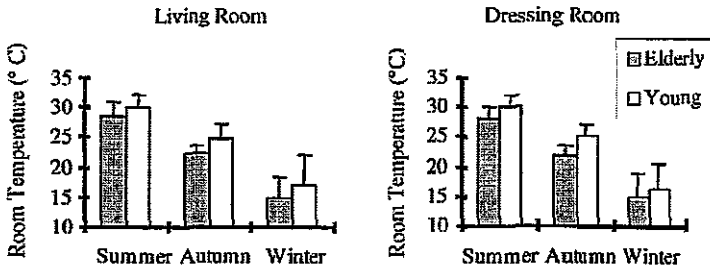
A large number of deaths from accidents at home have still been observed in Japan, and about two-thirds of the victims are elderly people (1). Among the causes of accidents, death by drowning is the greatest in number, and those are found in bathrooms in the winter seasons (2). It might be due to insufficient heating in the bathrooms; however, the survey of the thermal conditions in the bathrooms of the house of the elderly from a viewpoint of preventing accidents is limited in number. Hence, this survey was conducted to measure the thermal conditions in the houses of the elderly including those in the bathrooms.

## MATERIALS AND METHODS

The subjects were 30 elderly (mean age 75.6 years) and 30 young (21.7 years) females in Fukuoka Prefecture, Japan. All of the elderly lived in detached houses and 17 young persons lived in apartment houses. Room temperatures in the living room and dressing room were measured every 2 min for 7 continuous days in summer (August), autumn (October) and winter (January) using an automatic thermorecorder (RT10, Tabai Espec Co. Japan). Water temperature of the bath was measured by the subjects using a thermometer while taking a bath. The clothes worn just before taking a bath were recorded in the living room, and the clo values of their clothes were estimated (3). Thermal sensations were voted in the living room just before taking a bath and in the dressing room after taking off the clothes. The bathing habits, such as times of bathing per week, time of day and duration of taking a bath, and so on, were asked by a questionnaire.

## RESULTS

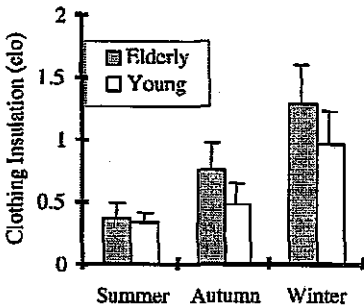
Figure 1 shows the air temperatures in the living rooms and dressing rooms in the three seasons. The living room temperature represented the temperature when subjects were resting there just before taking a bath. The dressing room temperature is given when the subjects undress. In summer and autumn, significantly higher room temperatures in both rooms were found in the young persons' houses. On the other hand, there were no significant differences in rooms between the groups in winter. The mean temperatures (SD) in the dressing rooms in winter were 15.1 (3.8)°C in the elderly and 16.1 (4.5)°C in the young, respectively. Some cases with air temperatures at 10°C or below were observed in the elderly persons' houses. However, one-third of the elderly did not perceive it as "cold" when air temperature was at 15°C or below in the dressing room after taking off their clothes.



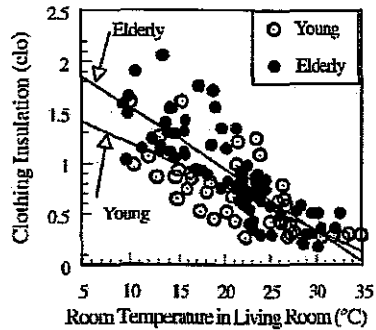
**Figure 1.** Room temperatures in living room (left) and dressing room (right) in the three seasons. Values are means  $\pm$  SD.

Figure 2 shows the insulation of clothing worn in the living room just before taking a bath. Clothing insulation was significantly higher for the elderly in winter compared with the young. In autumn and summer, there were no significant differences between the groups.

Figure 3 shows the relationships between living room temperature and clothing insulation. Significant linear relations were found for both the elderly ( $r = -0.82$ ,  $P < 0.01$ ) and the young ( $r = -0.79$ ,  $P < 0.01$ ).



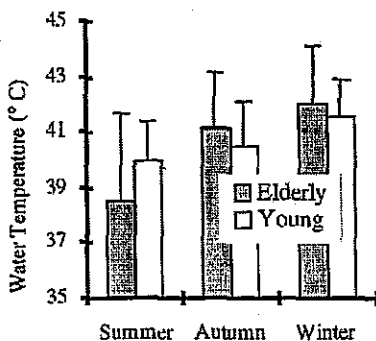
**Figure 2.** Clothing insulation in the three seasons.



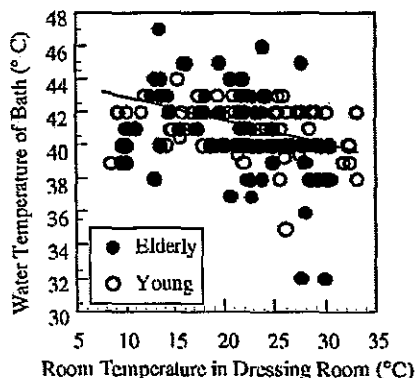
**Figure 3.** Relationships between living room temperatures and clothing insulation.

Figure 4 presents the temperature of bath in the three seasons. The mean (SD) of water temperature were 39.0 (3.2)°C for the elderly and 40.0 (1.4)°C for the young in summer, 41.1 (2.1)°C for the elderly and 40.5 (1.6)°C for the young in autumn, 42.2 (2.2)°C for the elderly and 41.5 (1.4)°C for the young in winter, respectively. A significant difference in water temperature was found among the seasons but not between the groups.

Figure 5 shows the relationship between the water temperature of bath and the air temperature in the dressing room. Although, there were significant linear relationships between them in both groups, no significant difference was found in the regression lines between the groups. A regression equation for the pooled



**Figure 4.** Water temperature of bath in the three seasons.



**Figure 5.** Relationships between dressing room temperature and temperature of bath.

data was calculated as  $Y = -0.12X + 43.5$  ( $r = -0.33$ ,  $P < 0.01$ ), where Y is water temperature of bath in °C; X is room temperature in dressing room in °C.

## DISCUSSION

The room temperatures were around 30°C in summer and 15°C in winter (Figure 1), which is quite different from the standards or recommendations for thermal environmental conditions for occupancy (4). In this survey, all houses were equipped with air conditioner and/or heater in the living room. However, they were used for very short duration, i.e., mealtimes. As a result, the indoor temperature did not reach the standards. Tochiyama and Ohnaka (5) surveyed the thermal conditions in Tokyo and reported that the average (SD) room temperatures at 7:00 PM of the houses of the elderly and the young were 15.6 (4.8)°C and 18.1 (3.9)°C, respectively. They were similar to those in this study and lower by 4 to 5°C than those in USA (6).

The elderly dressed warmer than the young in winter (Figure 2), and there was a significant difference in the relationship between living room temperature and clothing insulation (Figure 3). The lower room temperature in the houses of the elderly and use of warmer clothing under cool conditions were also reported by Tochiyama and Ohnaka (5). Elderly Japanese prefer to wear warmer clothes rather than warming their rooms.

In this survey, there were no air conditioners or heaters in the dressing rooms. The room temperatures in the dressing rooms were lower than those in the living rooms (Figure 1). Some elderly did not feel cold at 15°C and below after taking off their clothes in the dressing room. The reason heaters are not installed in the bathrooms might be not only economic but the result of a diminished sensitivity to cold found in elderly persons (7).

It is well known that Japanese prefer hotter baths than Americans or Europeans. In this study, the temperature of baths varied from about 39°C in summer to 42°C in winter (Figure 4). Significant relationships were found

between water temperature of bath and air temperature in the dressing room (Figure 5). Higher water temperature during showering was preferred when body temperature was low (8). Higher water temperature in winter might be due to Japanese habits but more likely due to insufficient bathroom heating in winter. The lower room temperature and the warmer bath water in winter create a steep temperature gradient that requires instant cardiovascular adjustments. This may increase the risk of adverse health effects and accidents among the elderly.

## REFERENCES

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