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RAPID COMMUNICATION

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Time-series variations of blood pressure due to contact with wood

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Introduction

It is known that contact with wood produces a gentle feeling, so wood has been used for floors and furniture, such as tables and chairs, that we touch directly. Many researchers have evaluated the sense of contact with wood subjectively. Harada et al.[1] and others reported the relations between the thermal properties and sensory warmth of wood surfaces. Okajima et al.[2–7] and others have reported the relations between the sense of contact and the physical properties of some materials. However, the sense of contact with wood has not been evaluated by physiological response. This study clarifies the effect of contact with wood on the human body by measuring blood pressure and pulse continuously.

Methods

The subjects were 19 healthy female students 20–29 years old. Included in the tests were sugi wood (*Cryptomeria japonica* D. Don) with a planed surface, sugi wood with a sawn surface, hinoki wood (*Chamaecyparis obtusa* Endl.) with a sawn surface, silk, denim, stainless steel board of 4 mm thickness, and a vinyl bag of 0.08 mm thickness filled with cold water (about 6°C). These materials were randomly used as materials to be touched.

Each subject sat on a chair, and blood pressure and pulse were measured on the left middle finger by Finapres[8] (Ohmeda model 2300, analysis software: NEC San-ei Instruments) in a room that was controlled at 25°C, 60% relative humidity, and 10 lux. During the first 30 s the blood pressure and pulse of the subjects were measured in a quiet condition. During the next 3–5 seconds an instruction was given by the experimenter, and the subject touched the material. The measurement was continued for 60 s. For the control test, the subject was instructed not to move the arm, and the measurement was continued for 60 seconds. Contact was made by bringing the right hand onto the material centering around the elbow without rubbing the material. The right arm and the material were hidden from the subject by a curtain. Before the experiment the subjects were assured that the materials were not dangerous to touch. Each datum of blood pressure and pulse was taken as a percentage of the average over the 10 s before contact at 2-s intervals. The difference between each datum and the average over the 10 s before contact was analyzed by *t*-test paired comparison.

Results and discussion

Figure 1 shows the time-series variations of systolic blood pressures. As shown, the systolic blood pressure varied from 98.1% to 103.2% for hinoki wood with a sawn surface, and the difference between the maximum and minimum pressures was 5.1%. The variation of systolic blood pressure for sugi wood with a sawn surface was small, and the difference between the maximum and minimum values was 4.3%. The difference between maximum and minimum values for silk was 3.5%, which was the smallest difference of all materials. For the vinyl bag filled with cold water, the systolic

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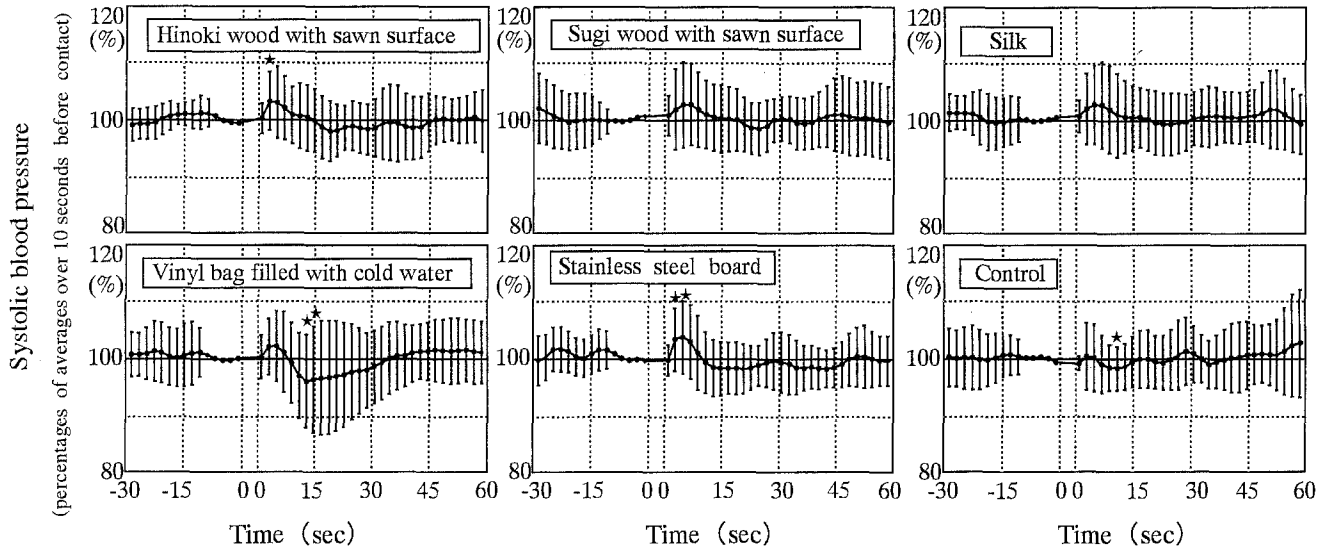

Fig. 1. Influence of contact with each material on systolic blood pressure. *Error bars*, standard deviations; *stars*, $P < 0.05$ from averages over 10 seconds before contact (*t*-test of paired comparison)

Table 1. Differences between maximum and minimum pulses and systolic blood pressures for each material

Specimen	Maximum – minimum difference (%)	
	Pulse	Systolic blood pressure
Hinoki wood with sawn surface	2.2	5.1
Sugi wood with planed surface	4.5	5.8
Sugi wood with sawn surface	4.6	4.3
Silk	3.8	3.5
Denim	5.8	5.1
Stainless steel board	4.9	5.7
Vinyl bag filled with cold water	5.8	6.0
Control	3.1	4.5

blood pressure rose, rapidly dropped, then rose again and never recovered to the value before the contact even 60 s later. The difference between the maximum and minimum values was 6.0%. The same tendency was observed for the stainless steel board, where the difference between maximum and minimum values was 5.7%. For the control test, the difference between maximum and minimum values was 4.5%.

Table 1 shows the differences between maximum and minimum values for the pulse and systolic blood pressure for all materials. Variations for hinoki wood with a sawn surface, sugi wood with a sawn surface, and silk were small; the differences between maximum and minimum pulses were 2.2%, 4.6%, and 3.8%, respectively; and their differences between maximum and minimum systolic blood pressures were 5.1%, 4.3%, and 3.5%, respectively. For sugi wood with a planed surface, the difference between maximum and minimum systolic blood pressures was 5.8%, which was large; however, the difference between maximum and minimum pulses was 4.5%, which was small. Variations for the vinyl bag filled with cold water and the stainless steel board were large, their differences between maximum and minimum pulses were 5.8% and 4.9%, and their differences between maximum and minimum of systolic blood pressure were 6.0% and 5.7%, respectively. As these results show, both pulse and systolic blood pressure varied greatly for the vinyl bag filled with cold water and the stainless steel board. This means that these materials place a lot of stress on the living body.

The results indicate that contact with hinoki wood with a sawn surface, sugi wood with a sawn surface, and silk had little effect on the pulse and systolic blood pressure, but contact with the vinyl bag filled with cold water and stainless steel board had a major effect on pulse and systolic blood pressure. The small variation caused by contact with hinoki wood with a sawn surface, sugi wood with a sawn surface, and silk suggests that these materials place less stress on the living body.

The results were confirmed by showing the physiological responses to contact with wood as time-series variations measured at 2-s intervals. This continuous measurement of the automatic nervous system can be used to evaluate emotional states.

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