Environmental and Behavioral Conditions of Bathing among Elderly Japanese

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Abstract This study investigated the bathing conditions of elderly Japanese, and sought to find factors relating to regional differences in death rates from bathtub accidents. A questionnaire survey was carried out in 11 areas of Japan. Questionnaires including questions regarding the length of time since houses had been built, types of facilities, and subjects' indoor thermal sensations and behavior while bathing were distributed to detached houses in each area twice, once in summer and once in winter. Completed questionnaires were collected from approximately 160 elderly people over 65 years old. Information regarding thermal sensations of rooms in winter revealed that a prefabricated bath and insulating window glass eased the cold in the bathroom. Unexpectedly, more subjects in the southern region than in the northern region reported being cold or a little cold while bathing in winter. In the present study, thermal sensations and behaviors while bathing seemed to be more affected by facilities and the location of houses than by the sex and age of the subjects. *J Physiol Anthropol* 26(2): 235–240, 2007 <http://www.jstage.jst.go.jp/browse/jpa2>

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Introduction

Although most Japanese enjoy bathing, it is generally known that many accidents occur when people take baths. Extrapolating from the statistics in Tokyo, incidents of sudden death around the bathtub at home may amount to approximately 14000 per year in Japan (Takahashi, 2004). This means that the number of sudden deaths in the bathroom exceeds that by traffic accidents. Yasuhara (2000) examined cases of death while bathing in Tokyo, and showed that people

over 65 years old comprised 80 percent of the whole. There is a similar high rate of fatal bathtub accidents for elderly persons in the United States (Bundnick and Ross, 1985; O'Carroll et al., 1988; Quan and Cummings, 2005). It is possible that the rate of sudden death while bathing in Japan will increase because of the country's rapid demographic shift to an aging society.

The usual Japanese method of bathing is to immerse the body to the neck in hot water, even though many people take showers, especially in summer. Fatal bathtub accidents may be attributable to heat stress by water, which has high heat conductivity, to cold stress outside the bathtub in winter, to hydrostatic pressure, and so on. It is especially important to avoid a cold environment in the dressing room and bathroom. Tochiwara (1999) described how, in cold environments, the blood pressure of the elderly increases more rapidly than that of young people, and that there is a lower sensitivity to cold among the elderly.

Meanwhile, it is known that there are regional differences in the numbers of bathtub drowning deaths in Japan. Vital statistics show that there are some prefectures with consistently lower or higher death rates of such bathtub accidents. Thermal environment and behavior while bathing may influence these regional differences. The purpose of this study was to compare bathing conditions in each area of Japan in order to identify factors affecting the regional difference in the death rate from bathtub accidents.

Methods

Questionnaire surveys were carried out twice in summer and winter in 11 areas of Japan: Sapporo, Akita, Sendai, northern and southern Chiba, Shizuoka, Toyama, Osaka, Hiroshima, Fukuoka, and Kagoshima. Questionnaires were distributed to approximately 30 detached houses in each area. Subjects were asked about the number of years since their house was built,

Table 1 Relations of house structure and facilities with house age and region. Values are percentages of houses for each category.

Item	Category	House age			Region		
		New	Old [#]	Chi-square	North ^s	South ^{ss}	Chi-square
House structure	Made of wood	76.7	87.7	2.41	90.0	83.0	1.49
	Concrete or prefab	23.3	12.3		10.0	17.0	
Bath	Prefabricated bath	76.7	23.1	31.6**	46.7	25.0	7.95**
	Others	23.3	76.9		53.3	75.0	
Heater in bathroom	Set	26.7	20.3	0.50	21.7	22.0	0.00
	Not set	73.3	79.2		78.3	78.0	
Window glass in bathroom	Single	65.5	81.7	3.71	50.9	94.0	39.32**
	Double or layered	34.5	18.3		49.1	6.0	
Bathtub style	Japanese or half-Japanese	50.0	86.0	19.23**	81.7	77.8	0.34
	Western	50.0	14.0		18.3	22.2	

[#] houses built less than ten years ago; ^{##} houses built more than ten years ago; ^s areas where annual mean air temperatures are lower than 15°C; ^{ss} areas where annual mean air temperatures are higher than 15°C; ** $p < 0.01$

type of bathroom fixtures, thermal sensations in their house, behavior during bathing, and so on. In the present study, data was collected from houses where elderly persons over 65 years old were living. As a result, data was collected from 160 and 165 persons in summer and winter, respectively.

Regarding the environmental conditions of bathing, answers to the questionnaire were analyzed from the viewpoints of the age of the houses and regional differences. The houses were classified into two groups, “new” and “old,” i.e., less than or more than ten years since construction. Regional differences were analyzed by comparing questionnaire answers from the northern and southern areas of Japan, since air temperature seems to have an effect on indoor thermal conditions and behaviors during bathing. The boundary between the two areas was set to be 15 degrees centigrade as annual mean air temperature. The northern areas had annual mean temperatures lower than 15°C, and included the areas of Sapporo, Akita, Sendai, and Toyama. The southern areas had annual mean temperatures higher than 15°C, and included the areas of Chiba, Shizuoka, Osaka, Hiroshima, Fukuoka, and Kagoshima. Furthermore, behaviors during bathing were also investigated in the subjects over 65 years old from the viewpoints of the age of the houses, regional differences, the sex and age of the subjects, and seasons.

Frequency distributions between groups were compared statistically using the chi-square test, and the significance level was set at 5%. Additionally, in order to investigate the relationships of the death rate with climatic and demographic data, multiple regression analysis was employed.

Results and Discussion

Table 1 shows the percentages of different types of house

structure and facilities by house age, i.e., the length of time since house construction, and by region. As for the house structure, there was no difference between new and old houses or between the northern and southern areas. Most houses in Japan are still made of wood. In terms of facilities, the houses that were new and located in the northern areas had a larger percentage of prefabricated baths. This type of bath is heat-retaining and is called a “unit bath” in Japan. The northern areas also had a larger percentage of double or layered window glass in the bathroom. The bathtub style in most old houses was Japanese or half-Japanese, but half of the bathtubs in new houses were Western style.

Sex and age differences in thermal sensations and bathing behavior were investigated. The results are shown in Tables 2 and 3. Sex differences were found only in the order of bathing in the household. Seventy to eighty percent of male subjects were accustomed to bathing first. Old men had a tendency to take a bath prior to other members in the family. In addition, the conventional dominance of men over women may still remain in Japan. Subjects of both sexes were divided into two groups according to their age, that is, “young old,” from 65 to 74 years old, and “old old,” over 75 years. There was no age difference in thermal sensations or bathing behaviors between the two age groups in either summer or winter.

Thermal sensations of rooms in winter were investigated according to house facilities, inclusive of both sexes and the two age groups (Table 4). Although it was natural that having a heater in the bathroom made subjects feel less cold in winter, prefabricated baths and insulating window glass also eased cold sensations. It is thought that such facilities raise heat retention and insulation both in the anteroom where clothes are taken off and put on, and in the bathroom.

Table 5 shows thermal sensations and bathing behavior for

Table 2 Sex differences in thermal sensations and bathing behaviors for subjects over 65 years old. Values are percentages of persons for each category.

Item	Category	Summer			Winter		
		Males	Females	Chi-square	Males	Females	Chi-square
Thermal sensation (Anteroom)	Cold [#]	0.0	1.4	0.01	80.0	69.4	24.0
	Not cold ^{###}	100.0	98.6		20.0	30.6	
Thermal sensation (Bathroom)	Cold [#]	0.0	2.8	0.74	66.3	62.5	0.25
	Not cold ^{###}	100.0	97.2		33.7	37.5	
Frequency of bathing	Every day	84.1	83.3	0.02	68.9	58.3	1.94
	Others	15.9	16.7		31.1	41.7	
Duration of bathing (A) [§]	Less than 10 min	28.4	29.6	0.03	12.2	4.2	2.35
	More than 10 min	71.6	70.4		87.8	95.8	
Bathtub	In	72.4	73.6	0.03	95.6	97.2	0.01
	Not in	27.6	26.4		4.4	2.8	
Duration of bathing (B) ^{§§}	Less than 5 min	45.3	35.8	1.07	27.9	24.3	0.26
	More than 5 min	54.7	64.2		72.1	75.7	
Water temperature	Hot	22.2	11.5	2.26	26.2	24.3	0.07
	Moderate, Slightly warm	77.8	88.5		73.8	75.7	
Order of bathing	First	79.3	42.3	22.94**	71.3	42.9	12.9**
	Second or after that	20.7	57.7		28.7	57.1	

[#] includes cold and a little cold; ^{###} includes moderate, a little hot, and hot; [§] the length of time in the bathroom; ^{§§} the length of time in the bathtub; ** $p < 0.01$

Table 3 Age differences in thermal sensations and bathing behaviors for subjects over 65 years old. Values are percentages of persons for each category.

Item	Category	Summer			Winter		
		65–74 yrs	75 yrs–	Chi-square	65–74 yrs	75 yrs–	Chi-square
Thermal sensation (Anteroom)	Cold [#]	0.0	1.4	0.01	75.6	75.0	0.01
	Not cold ^{###}	100.0	98.6		24.4	25.0	
Thermal sensation (Bathroom)	Cold [#]	0.0	2.7	0.67	64.0	65.3	0.03
	Not cold ^{###}	100.0	97.3		36.0	34.7	
Frequency of bathing	Every day	84.9	83.1	0.09	68.6	59.2	1.55
	Others	15.1	16.9		31.4	40.8	
Duration of bathing (A) [§]	Less than 10 min	27.9	30.1	0.10	7.0	10.5	0.64
	More than 10 min	72.1	69.9		93.0	89.5	
Bathtub	In	68.2	78.4	2.06	96.5	96.1	0.08
	Not in	31.8	21.6		3.5	3.9	
Duration of bathing (B) ^{§§}	Less than 5 min	37.3	44.8	0.69	27.7	24.7	0.19
	More than 5 min	62.7	55.2		72.3	75.3	
Water temperature	Hot	15.8	19.0	0.20	21.0	30.1	1.70
	Moderate, Slightly warm	84.2	81.0		79.0	69.9	
Order of bathing	First	64.7	60.3	0.33	60.7	56.2	0.33
	Second or after that	35.3	39.7		39.3	43.8	

[#] includes cold and a little cold; ^{###} includes moderate, a little hot, and hot; [§] the length of time in the bathroom; ^{§§} the length of time in the bathtub.

Table 4 Thermal sensation of the anteroom and bathroom in winter according to facilities of the house. Values are percentages of persons for each category.

Item	Category	Sensation in the anteroom			Sensation in the bathroom		
		Cold [#]	Not cold ^{##}	Chi-square	Cold [#]	Not cold ^{##}	Chi-square
House structure	Made of wood	76.1	23.9	0.35	63.1	36.9	0.62
	Concrete or prefab	70.0	30.0		75.0	25.0	
Bath	Prefabricated bath	66.7	33.3	32.5	53.7	46.3	4.22*
	Others	79.6	20.4		70.1	29.9	
Heater in bathroom	Set	61.1	38.9	5.02*	33.3	66.7	19.82*
	Not set	79.4	20.6		73.6	26.4	
Window glass in bathroom	Single	79.8	20.2	7.01**	68.0	32.0	3.11
	Double or layered	57.6	42.4		51.5	48.5	

[#] includes cold and a little cold; ^{##} includes moderate, a little hot, and hot; ** $p<0.01$; * $p<0.05$

Table 5 Regional difference in thermal sensations and bathing behaviors for subjects over 65 years old. Values are percentages of persons for each category.

Item	Category	Summer			Winter		
		North	South	Chi-square	North	South	Chi-square
Thermal sensation (Anteroom)	Cold [#]	1.7	0.0	0.07	66.1	80.6	42.3*
	Not cold ^{##}	98.3	100.0		33.9	19.4	
Thermal sensation (Bathroom)	Cold [#]	0.0	2.0	0.14	55.2	69.9	3.52
	Not cold ^{##}	100.0	98.0		44.8	30.1	
Frequency of bathing	Every day	71.7	91.0	10.3**	48.5	74.8	13.72**
	Others	28.3	9.0		54.2	25.2	
Duration of bathing (A) [§]	Less than 10 min	25.5	31.3	0.72	3.4	11.7	2.28
	More than 10 min	75.5	68.7		96.6	88.3	
Bathtub	In	79.7	69.0	2.14	98.3	95.1	0.36
	Not in	20.2	31.0		1.7	4.9	
Duration of bathing (B) ^{§§}	Less than 5 min	27.1	50.7	6.54**	19.0	30.6	2.55
	More than 5 min	72.9	49.3		81.0	69.4	
Water temperature	Hot	27.1	10.4	5.39*	27.6	24.0	0.25
	Moderate, Slightly warm	72.9	89.6		72.4	76.0	
Order of bathing	First	63.3	62.2	0.02	55.2	60.6	0.45
	Second or after that	36.7	37.8		44.8	39.4	

[#] includes cold and a little cold; ^{##} includes moderate, a little hot, and hot; [§] the length of time in the bathroom; ^{§§} the length of time in the bathtub; ** $p<0.01$; * $p<0.05$

subjects in each region. Thermal sensation was significantly different between the regions in winter. Unexpectedly, more subjects in the southern group than in the northern group reported being cold or a little cold in the anteroom in winter. This result may be partly because of cold acclimatization in northern subjects and partly because their house structures and facilities are adapted to a more severe climate. Frequency of bathing was lower for the northern group; notably, in winter,

fewer than half of the northern subjects took a bath every day. Although answers to the questionnaire were subjective and dependent on their feelings, the length of time in the bathtub was shorter for the southern group in summer, and water temperature in the bathtub seemed to be hotter for the northern group in summer. As indicated in Tables 2 to 5, it seems that the differences in thermal sensations and behaviors while bathing are more affected by house facilities and region than

Table 6 Seasonal differences in thermal sensation and bathing behavior for subjects over 65 years old. Values are percentages of persons for each category.

Item	Category	Summer	Winter	Chi-square
Thermal sensation (Anteroom)	Cold [#]	0.6	75.3	187.04**
	Not cold ^{##}	99.4	24.7	
Thermal sensation (Bathroom)	Cold [#]	1.3	64.6	142.75**
	Not cold ^{##}	98.8	35.4	
Frequency of bathing	Every day	83.8	64.2	15.96**
	Others	16.3	35.8	
Duration of bathing (A) [§]	Less than 10 min	28.9	8.6	21.73**
	More than 10 min	71.1	91.4	
Bathtub	In	73.0	96.3	33.54**
	Not in	27.0	3.7	
Duration of bathing (B) ^{§§}	Less than 5 min	41.0	26.3	6.61**
	More than 5 min	59.0	73.7	
Water temperature	Hot	17.4	25.3	2.42
	Moderate, Slightly warm	82.6	74.7	
Order of bathing	First	62.7	58.6	0.54
	Second or after that	37.3	41.4	

[#] includes cold and a little cold; ^{##} includes moderate, a little hot, and hot; [§] the length of time in the bathroom; ^{§§} the length of time in the bathtub; ** $p < 0.01$; * $p < 0.05$

Table 7 Multiple regression of bathtub accident death rate with latitude, annual mean air temperature, and the rate of elderly population[#]. Data were collected from 47 prefectures using secondary materials in 2003.

Independent variable	Partial regression coeff.	Standard partial regression coeff.	Contribution rate (%)
Latitude	0.2016	0.4207	49.6
Annual mean air temperature	0.1013	0.1979	23.3
Rate of elderly population	0.1019	0.2304	27.1
(Intersection)	−8.3419	—	—

[#] persons over 65 years of age.

by physical characteristics of the subjects such as sex and age.

Seasonal differences in subjects' thermal sensations and bathing behaviors were also examined, inclusive of both regions (Table 6). Large seasonal differences were found in thermal sensations in the anteroom and the bathroom. Many subjects felt cold or a little cold while bathing in winter. Concerning the frequency of bathing, the percentage of subjects taking a bath every day decreased from 84 to 64 in winter. Duration of bathing in winter was prolonged, and most of the subjects preferred immersing themselves in the bathtub. Thus, thermal environments and behavior while bathing differ according to season, and more severe conditions are introduced by the winter cold. In particular, the naked body is exposed to acute cold stress, which may occasionally be responsible for cardiovascular dysfunction or fatal bathtub accidents.

On the other hand, the relationships of the death rate from

bathtub accidents with latitude, annual mean air temperature, and the rate of elderly population (persons 65 years old and over) for each area were analyzed using secondary materials in 2003 (Health and Welfare Statistics Association, 2004; National Astronomical Observatory of Japan, 2004). The results of multiple regression analysis are shown in Table 7. Latitude has a relatively close relationship with the death rate from bathtub accidents. Annual mean air temperature and the rate of elderly population have relationships with the death rate to the same extent. These relationships suggest that the death rate is high in the northern areas where people are exposed to severely cold environments. However, as shown in responses to the questionnaire in this study, facilities such as a prefabricated bath and thermal insulating window glass that maintain a mild environment in the bathroom are fairly common in the northern areas. Furthermore, subjects in the northern group

felt less cold while bathing than those in the southern group. These results complicate the factors affecting the death rate from bathtub accidents. It is possible that behavioral factors such as frequency of bathing, the length of time in the bathtub, and water temperature are also associated with the difference in the death rate between the northern and the southern areas.

Areas observed in the present study were classified roughly into northern and southern groups, but there were several large differences in bathtub accident death rates between adjacent prefectures even in the same regional group. This made it difficult to clarify the cause of the regional differences in the death rate from the viewpoint of thermal environmental factors only. In this context, the obscurity of the diagnostic criteria for fatal bathtub accidents has been pointed out by several investigators. Kurosaki et al. (2002) suggested that sudden deaths in the bathroom were variously diagnosed as internal or external causes and that the diagnoses depended on individual physicians. Statistics of fatal bathtub accidents include death from an external cause like drowning, but exclude sudden death from internal causes diagnosed as cardiovascular attacks. Yoshioka et al. (1998) also investigated the samples that were regarded as sudden death in the bathroom, and showed that there were large differences in the cause of death among prefectures. Consequently, in order to draw more solid conclusions about regional differences in bathtub accident death rates, it is necessary to establish criteria for the diagnosis of sudden death in the bathroom and to accumulate data based on objective evidence.

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References

- Bundnick LD, Ross DA (1985) Bathtub-related drownings in the United States. *Am J Public Health* 75: 630–633
- Health and Welfare Statistics Association (2004) Trends of Public Health in Japan. *J Health and Welfare Assoc Supplement* 51: 38 [*In Japanese*]
- Kurosaki K, Kuriwa F, Hara S, Kano S, Misawa S, Endo T (2002) Questionable diagnoses on the cases of sudden death while bathing. *Res Pract Forens Med* 45: 175–180 [*In Japanese*]
- National Astronomical Observatory of Japan (2004) Chronological scientific tables. Maruzen, Tokyo, 168–173 [*In Japanese*]
- O'Carroll PW, Alkon E, Weiss B (1988) Drowning mortality in Los Angeles county, 1976 to 1984. *JAMA* 260: 380–383
- Quan U, Cummings P (2005) Characteristics of drowning by different age groups. *Injury Prevention* 9: 163–168
- Takahashi R (2004) Why do bathing accidents happen for the elderly? *Community Health* 35: 53–57 [*In Japanese*]
- Tochihara Y (1999) Bathing in Japan: A review. *J Human-Environment System* 3: 27–34
- Yasuhara M (2000) Accidents for middle and old aged persons while bathing in the cold season: From the viewpoint of forensic medicine. *Nihon Iji Shinpo* 3996: 21–25 [*In Japanese*]
- Yoshioka N, Nibe H, Enzan K, Shigeomi S (1998) Sudden death in the bathroom and its medico-legal issues. *Res Pract Forens Med* 41: 353–359 [*In Japanese*]

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