Original Article

Relationship between the Awareness of Salt Restriction and the Actual Salt Intake in Hypertensive Patients

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A 24-h home urine collection was conducted to estimate accurate salt intake in hypertensive outpatients. Using 24-h urinary creatinine excretion as a criterion for success, urine samples were obtained from 534 hypertensive patients. The urinary salt excretion of hypertensive outpatients ranged widely from 1.5 to 23.4 g/day (mean value 9.7±3.9 g/day). Urinary salt excretion was higher in males than in females (10.6±4.0 *vs*. 9.2±3.7 g/day, *p*<0.01). Based on the questionnaires, the patients were divided into salt-conscious patients, or those who were careful to reduce their daily salt intake, and non-salt-conscious patients. It was found that urinary salt excretion was lower in the salt-conscious group than in the non-salt-conscious group (9.4±3.8 *vs*. 10.6±4.0 g/day, *p*<0.01), but that urinary salt excretion adjusted for body weight was not significantly different between the two groups (0.16±0.06 *vs*. 0.17±0.07 g/kg/day). Our results suggest that there was no obvious reduction in the actual salt intake in salt-conscious patients, suggesting the importance of monitoring salt intake by 24-h home urine collection and informing patients of their actual salt intake as a means of encouraging the achievement of salt restriction. (*Hypertens Res* 2004; 27: 243–246)

***Key Words*: salt restriction, 24-h home urine collection, urinary salt excretion, hypertension, salt intake**

Introduction

Extensive epidemiological literature has already documented the correlation between salt intake and blood pressure (BP) or the prevalence of hypertension (*1*, *2*). Salt restriction is now also widely promoted as an effective non-pharmacological approach to managing mild hypertension, as well as an important adjunct to pharmacological treatment in moderate and severe hypertension (*3*–*7*). The seventh report of the Joint National Committee (JNC 7) recommends sodium reduction to a level of no more than 100 mmol/day in hypertensive patients (*8*). Thus, it is recommended that physicians advise patients to reduce their salt intake, but the efficacy of this advice is questionable if patients' actual salt intake is not monitored. The aim of this study was to investigate urinary salt excretion and the relationship between the awareness of salt restriction and the actual salt intake in hypertensive outpatients.

Methods

We undertook 24-h home urine collection at first visit in 652 outpatients between January, 1998 and December, 1999. Twenty four-hour urine samples were collected using a partition cup (proportional sampling method (*9*)), which collects a 1/50 portion of the 24-h urine. If the 24-h creatinine excretion was within ±30% of the estimated values, the urine collection was considered successful. If the urine collection was judged to be unsuccessful, the patients were asked to try again. Patients who failed to complete the 24-h urine collection, in spite of possible repeated collection, were excluded from further analysis. BP was measured with a sphygmomanometer by the doctors while the patients were seated. Hypertension was considered to be present in patients with systolic blood pressure (SBP)≥140 mmHg and/or diastolic

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Table 1. Characteristics in Male and Female Patients

	All	Males	Females
Number of patients	534	211	323
Age (years)	58.3±11.6	58.0±12.9	58.5±10.6
BW (kg)	61.3±11.2	68.1±11.1**	56.9±8.9
BMI (kg/m^2)	24.3±3.5	24.6±3.3	24.1±3.6
SBP (mmHg)	144.0±12.5	144.3±13.0	143.9±12.2
DBP (mmHg)	87.4±7.7	87.9±7.8	87.0±7.7
Serum creatinine (mg/dl)	0.9±0.7	1.1±0.9**	0.7±0.4
Urinary salt excretion (g/day)	9.7±3.9	10.6±4.0**	9.2±3.7
Urinary salt excretion adjusted for BW (g/kg/day)	0.16±0.06	0.16±0.06	0.16±0.07
Antihypertensive drug (%)	49.6	52.1	48.0
Family history of hypertension (%)	47.6	51.7	44.9
Diabetes mellitus (%)	12.2	13.3	11.5

Values are means±SD. ** p<0.01 *vs*. females. BW, body weight; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure.

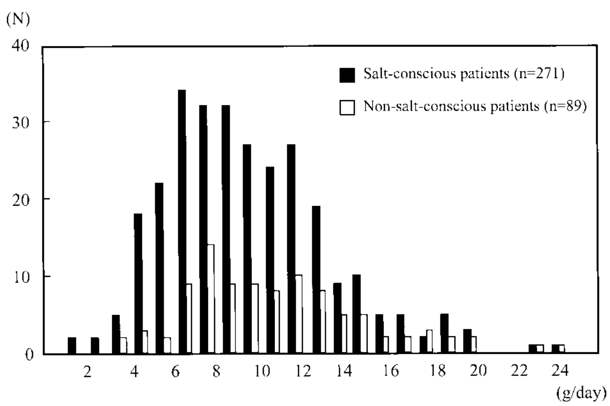

Fig. 1. *The distribution of 24-h urinary salt excretion in salt-conscious and non-salt-conscious patients.*

blood pressure (DBP)≥90 mmHg, or those patients on antihypertensive medication. The patients were asked, by questionnaire, about aspects of their lifestyle, such as habitual alcohol intake, smoking, and exercise, and were also asked whether they were conscious of salt, calorie and fat restrictions. The protocol was explained in detail, and informed consent was obtained from each patient.

Statistical Analysis

Values are presented as the means±SD. The differences in the variables were compared by one-way ANOVA. A χ^2 test was also utilized when appropriate. *P* values less than 0.05 were considered statistically significant.

Results

Among the 652 patients enrolled in this study, 534 patients successfully collected 24-h urine samples.

Characteristics in male and female patients are shown in Table 1. The patients had a mean age of 58.3±11.6 (26–90) years, and a mean BP of 144.0±12.5/87.4±7.7 mmHg. There were no differences in age, body mass index (BMI), BP, or prevalence of patients receiving antihypertensive drugs between males and females. Body weight and urinary salt excretion were significantly higher in males than in females. However, urinary salt excretion adjusted for body weight was similar between the two groups.

The questionnaire on the awareness of salt restriction was obtained from 360 patients. As shown in Fig. 1, the values of the 24-h urinary salt excretion were distributed widely, ranging from 1.5 to 23.4 g/day. Comparisons of the characteristics between the patients who were careful to reduce their daily salt intake (salt-conscious group, n=271) and the non-salt-conscious group (n=89) are presented in Table 2. There were no differences in BMI and frequency of family history of hypertension between the two groups. The salt-conscious group was older than the non-salt-conscious group, and there was a higher prevalence of females. This group also showed a lower BP and a higher prevalence of being on antihypertensive medication. Urinary salt excretion was significantly lower in the salt-conscious group than in the non-salt-conscious group (9.4±3.8 *vs*. 10.6±4.0 g/day, p<0.01), but urinary salt excretion adjusted for body weight was not significantly different between the groups.

Table 2. Characteristics in the Salt-Conscious and Non-Salt-Conscious Groups

	Salt-conscious group	Non-salt-conscious group
Number of patients	271	89
Men (%)	36.9 ††	55.0
Age (years)	59.7±11.3*	54.6±11.9
BW (kg)	60.5±11.6	63.8±12.2
BMI (kg/m^2)	24.2±3.6	24.5±3.7
SBP (mmHg)	141.0±10.4**	144.6±11.9
DBP (mmHg)	85.5±6.9**	87.9±7.1
Serum creatinine (mg/dl)	0.9±0.7	0.9±0.9
Urinary salt excretion (g/day)	9.4±3.8**	10.6±4.0
Urinary salt excretion adjusted for BW (g/kg/day)	0.16±0.06	0.17±0.07
Antihypertensive drug (%)	77.9**	60.7
Family history of hypertension (%)	73.1	62.9
Diabetes mellitus (%)	11.1	13.5

Values are means±SD. * $p<0.05$, ** $p<0.01$ *vs*. non-salt-conscious by ANOVA, †† $p<0.01$ *vs*. non-salt-conscious by χ^2 test. BW, body weight; BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure.

Discussion

The present study demonstrated that in hypertensive outpatients, there was no relationship between the awareness of salt restriction and the actual salt intake evaluated by 24-h urinary collection, which has been widely used to estimate dietary salt intake in epidemiological studies (*10*−*13*).

In the present study, urinary salt excretion was higher in males than in females, which may be attributable to the greater energy intake in males than females (*14*). In fact, males showed a higher body weight, and when urinary salt excretion was adjusted for body weight, urinary salt excretion was comparable between males and females.

It seems reasonable that BP and urinary salt excretion were significantly lower in the salt-conscious group than in the non-salt-conscious group. The characteristics of the two groups differ in sex and age. Thus, we may speculate that elderly and female individuals could be more aware than others of the importance of lifestyle modifications, such as salt restriction. However, no significant difference was found in urinary salt excretion adjusted for body weight between the salt-conscious and non-salt-conscious groups. This observation indicates that awareness of the necessity of salt restriction may not lead to an actual reduction of salt intake. Salt intake by the Japanese population has traditionally been high, although it has been decreasing in recent years. The National Nutrition Survey in Japan showed that the salt intake was 11.5 g in 2001 (*15*). The difficulty in achieving long-term dietary salt restriction might be attributable to the difficulty in changing the dietary habits of the Japanese. It has also been pointed out that although there has been an increase in variety in the Japanese diet, there is now a greater reliance on dining out, and the consumption of fast foods is increasing (*12*, *16*). These trends in the dietary habits of Japanese may also make it difficult to reduce salt intake.

With regard to seasonal variation, urinary salt excretion tended to decrease in summer (*17*). In the present study, 24-h urine collection was performed throughout the year in both groups. Thus, it seems unlikely that the seasonal variation of urinary salt excretion influenced the principal results of this study.

Doctors advise all hypertensive patients to reduce their salt intake, but it is important to evaluate whether patients follow this advice. Some methods have been proposed to improve compliance with dietary salt restriction. One study indicated that group management, in which feedback is provided to patients on their urinary salt excretion, was more effective in decreasing dietary salt intake than advice given without this support, or through an intensive educational effort by doctors and clinics (*18*). Another study showed that self-monitoring of urinary salt excretion at home, using chloride titrator strips, could, in conjunction with dietary counseling, facilitate compliance with a reduced salt intake (*19*). However, another report indicated that short counseling sessions with advice on salt restriction were not successful in producing dietary changes (*5*). Taken together, these results suggest that repeated monitoring of urinary salt excretion, along with providing feedback to patients, is the most important and practical way to achieve the reduction of salt intake in individual hypertensives.

In conclusion, there was no obvious reduction in actual salt intake in salt-conscious patients in the present study, suggesting the importance of monitoring salt intake and informing patients of their actual salt intake as a means of encouraging the achievement of salt restriction.

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