Treatment of Borderline Hypertension

— Moderate Salt Restriction in the Treatment of Borderline Hypertension —

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Seventeen patients with borderline hypertension and 11 patients with sustained hypertension were instructed to reduce their salt intake to 5–8 g/day. We checked whether or not the patients were following instructions by estimating their 24-hour urinary sodium excretion (U_{NaV}). In borderline hypertension, the U_{NaV} was 5.6 ± 0.4 g/24-hour on a normal salt diet and 3.7 ± 0.3 ($p < 0.01$) on a salt-restricted diet, while in sustained hypertension it was 4.9 ± 0.3 g and 3.6 ± 0.4 g/24-hour ($p < 0.01$), respectively. After moderate salt restriction there was a significant fall in blood pressure in the supine, sitting and standing positions in both the borderline and the sustained hypertensives. There was a significant relationship between the fall of mean blood pressure in the supine position and the decrease in the 24-hour urinary sodium excretion, which was corrected for 24-hour creatinine excretion, in overall hypertensive patients ($r = 0.39$, $p < 0.05$). In the borderline hypertensive group, both the systolic and diastolic blood pressure in the sitting position were 8.7 mmHg or 6.3% ($p < 0.01$) and 6.2 mmHg or 6.6% lower ($p < 0.01$) on salt-restricted diets than those on normal salt diets, respectively. In 9 of 14 patients with borderline hypertension, the diastolic blood pressure moved into the normal range during the salt restriction. We suggest that moderate salt restriction is an effective management of borderline hypertension.

IT is estimated that the incidence of borderline hypertension is about 10% of the adults in the world.¹ The Ministry of Health and Welfare in Japan has reported that 25.4% of the adults in Japan over 30 years of age had diastolic blood pressure readings above 90 mmHg and 16% of them had readings between 90 and 100 mmHg in 1971 and 1972.

It is recognized that in borderline hypertension, the risk of developing future hypertension is higher than in the general population and the

mortality and cardiovascular morbidity significantly exceeds the rates in normotensive subjects based on an extensive review of the literature.¹

The absolute level of the risk of developing future hypertension is not extreme and the difference of the mortality and morbidity between borderline hypertensives and normotensive subjects is not dramatic. However, from the standpoint of public health, even a small risk and a small increase in mortality or morbidity presents a major problem.

Julius and Schork² have reported that the benefit of the antihypertensive treatment in patients with borderline hypertension would be so small that one could not recommend antihypertensive therapy for such patients. Since

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1977, the results of 4 important mild-hypertension trials have been reported: the U.S. Public Health Service Study (U.S.P.H.S.),³ the Australian National Blood Pressure Study (A.N.B.P.S.),⁴ the U.S. Hypertension Detection and Follow-up Program (H.D.F.P.)⁵ and the Oslo Study.⁶ The Medical Research Council (M.R.C.) trial in Britain⁷ is still in progress.

The W.H.O./I.S.H. Mild Hypertension Liaison Committee⁸ summarized as follows: the A.N.B.P.S. and the H.D.F.P. concluded that mortality of mild hypertensives was reduced by active treatment; the H.D.F.P. further demonstrated that for the subgroups with 90–94 mmHg, 95–99 mmHg, and 100–104 mmHg of diastolic blood pressure without target-organ damage and not on treatment, the reductions in mortality were 34%, 28% and 18%, respectively,⁵ whereas the U.S.P.H.S. and the Oslo Study were unable to demonstrate any overall reduction in mortality. Kaplan has stated with a careful scrutiny of the results of 3 trials, i.e., the H.D.F.P., the A.N.B.P.S. and the Oslo Study, that drug therapy for uncomplicated hypertension was indicated only for those whose diastolic blood pressure remain at or above 100 mmHg after 6 months of non-drug therapy.⁹

A minority of patients with borderline hypertension should be considered for antihypertensive drug treatment, i.e., those who are at a high risk either for the development of hypertension or for cardiovascular complications, while a majority of such patients should be considered for preventive non-pharmacologic management. Overweight and gain of weight are risk factors for development of hypertension,¹ and high sodium intake in the population of various countries is associated with a greater prevalence of hypertension.¹⁰

The purpose of this paper is to show the antihypertensive effect and hemodynamic change with a moderate salt restriction of 5–8 g/day in outpatients with borderline hypertension who continued their daily work in comparison with those in sustained hypertensives.

SUBJECTS AND METHODS

Male and female patients, aged 31–55, with a diastolic blood pressure (DBP) above 90 mmHg on their visits to our outpatient clinic, were included in the study. These patients had not previously received any antihypertensive drugs.

The following protocol was designed: During

a control period of 2–4 weeks, each patient was observed on a normal salt diet. Physical examinations and clinical laboratory studies, including blood cell count, urinalysis, serum creatinine, endogenous creatinine clearance, blood sugar, serum lipids and serum sodium, potassium and chloride, were performed. No underlying cause for their high blood pressure was found. Patients with renal failure, ischemic heart disease or cerebrovascular disease were excluded from the study.

Following the control period with a normal salt diet, each patient underwent a period of 3–8 weeks on a low salt diet. The patients and their wives were instructed by a dietitian on how to reduce sodium intake to about 5–8 g/day. Clearly written instructions about the diet were also given to them. We checked whether or not the patients were following it by estimating their 24-hour urinary sodium excretion.

During each period blood pressure (BP) and heart rate (HR) were measured twice in the sitting, supine and standing position, respectively, on at least 3 different occasions, and 24-hour urinary sodium (U_{NaV}), potassium (U_{KV}) and creatinine excretions were measured on at least 2 occasions. The DBP was taken at the 5th phase of Korotkoff sounds. At the end of each period body weight and cardiac output were measured and the hemodynamic response to a treadmill exercise test was assessed by analyzing the HR, BP, double product (systolic BP $\times$ HR) and treadmill time. Cardiac output was determined by the dye-dilution method using an ear piece. The cardiac index (CI) was expressed as L/min/m². The total peripheral resistance index (TPRI) was calculated by the following formula:

$$TPRI = \frac{MBP \times 1332}{CI \times 60}$$

The multistage exercise test according to Bruce's protocol was performed until the HR increased to 75% of the predicted maximum HR.¹¹ The patients were then divided into 2 groups: sustained hypertension (SH) and borderline hypertension (BH). Patients whose blood pressure readings were all over 160/95 mmHg during the control period were designated SH. We applied the term "borderline hypertension" to patients whose average casual blood pressure during the control period was in the range of 140–159/90–94 mmHg or to patients whose blood pressure was found to be normal after 1-hour supine rest even if the average casual

TABLE I PATIENTS' COMPLIANCE TO SALT RESTRICTION

$U_{Na}V$ (g/day)	BH <i>n</i> = 17	SH <i>n</i> = 11
≤ 3.2	4 (23.5%)	3 (27.3%)
$3.2 < < 4.0$	7 (41.2%)	2 (18.2%)
$4.0 \leq < \text{Pre-}U_{Na}V$	3 (17.6%)	3 (27.3%)
$\text{Pre-}U_{Na}V <$	3 (17.6%)	3 (27.3%)

$U_{Na}V$ = 24-hour urinary sodium excretion;
 $\text{Pre-}U_{Na}V$ = $U_{Na}V$ during a regular diet;
 BH = borderline hypertension;
 SH = sustained hypertension;
n = number of patients

blood pressure was in the range of 140–159/95–100 mmHg.

Twenty-one patients with BH (18 males and 3 females) and 13 patients with SH (12 males and one female) were studied, and 7 normotensive males (NT) were used as controls. Seventeen

of the 21 borderline hypertensives and 11 of the 13 sustained hypertensives completed the protocol; 6 patients dropped out. Values are expressed as mean $\pm$ SEM. The differences among the groups and the differences between the control period and the salt restriction period were analyzed using Student's *t*-test, and a value less than 0.05 was considered significant.

RESULTS

Patients' Compliance to Salt Restriction

The $U_{Na}V$ of each patient during the salt restriction period varied from 2.3 to 6.1 g/day. According to urinary sodium excretion, 4 patients with BH and 3 with SH were considered to have followed the instructions of sodium intake restriction faithfully: the $U_{Na}V$ levels in these patients were equal to or below 3.2 g/day, which is equivalent to 8.0g of salt. Ten patients with BH and 5 with SH partially reduced their sodium intake: the $U_{Na}V$ levels were more than 3.2 g/day but less than that on a regular diet. The

TABLE II CHARACTERISTICS OF SUBJECTS

	Borderline H. (<i>n</i> = 14)	Sustained H. (<i>n</i> = 8)	Normotensives (<i>n</i> = 7)
Age	41.9 $\pm$ 5.7	44.5 $\pm$ 6.2	40.3 $\pm$ 6.0
Body Weight (kg)	63.5 $\pm$ 2.3	65.3 $\pm$ 2.4	67.0 $\pm$ 3.8
BW/IBW (%)	105.9 $\pm$ 2.2	113.5 $\pm$ 5.7	108.5 $\pm$ 13.2
Severity score	1.6 $\pm$ 0.2	2.9 $\pm$ 0.4**	0

Values are given as mean $\pm$ SEM. BW/IBW = body weight/ideal body weight, ** = *p* < 0.01

TABLE III BLOOD PRESSURE AND HEART RATE IN THE SITTING POSITION, URINARY Na AND K EXCRETIONS AND ENDOGENOUS CREATININE CLEARANCE IN SUBJECTS ON NORMAL DIETS

		BH (<i>n</i> = 14)	SH (<i>n</i> = 8)	NT (<i>n</i> = 7)
SBP	mmHg	138.9 $\pm$ 2.0** †	160.1 $\pm$ 3.3 †	115.6 $\pm$ 4.9
DBP	mmHg	93.9 $\pm$ 0.8** †	106.6 $\pm$ 1.2 †	77.6 $\pm$ 3.3
HR	/min	80.5 $\pm$ 2.8* †	72.1 $\pm$ 2.5	72.0 $\pm$ 2.4
$U_{Na}V$	g/day	5.6 $\pm$ 0.4	4.9 $\pm$ 0.3	5.6 $\pm$ 0.4
U_KV	g/day	2.3 $\pm$ 0.1** †	1.7 $\pm$ 0.2	1.7 $\pm$ 0.2
$CU_{Na}V$	g/g·Cr	4.1 $\pm$ 0.3	3.9 $\pm$ 0.1	3.8 $\pm$ 0.3
Ccr	L/day	121.1 $\pm$ 4.7	126.0 $\pm$ 8.3	128.2 $\pm$ 10.4

Values are given as mean $\pm$ SEM. * = *p* < 0.05 and ** = *p* < 0.01 (BH vs SH). † = *p* < 0.05 and ‡ = *p* < 0.01 (NT vs BH, NT vs SH).

BH = borderline hypertension; SH = sustained hypertension; NT = normotension; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; $U_{Na}V$ = 24-hour urinary sodium excretion; U_KV = 24-hour urinary potassium excretion; $CU_{Na}V$ = 24-hour urinary sodium excretion corrected for creatinine excretion; Ccr = creatinine clearance

TABLE IV EFFECTS OF SALT RESTRICTION IN THE BH AND THE SH GROUPS

		BH (n = 14)		SH (n = 8)	
		normal diet	low salt diet	normal diet	low salt diet
Supine	SBP	140.1 ± 2.4	130.1 ± 2.2**	159.9 ± 2.2	153.5 ± 3.0*
	DBP	90.5 ± 1.1	84.1 ± 1.0**	102.5 ± 1.3	96.4 ± 2.0**
Sitting	SBP	138.9 ± 2.0	130.1 ± 2.9**	160.1 ± 3.3	151.8 ± 3.3**
	DBP	93.9 ± 0.8	87.7 ± 0.9**	106.6 ± 1.2	102.6 ± 2.0**
Standing	SBP	137.0 ± 2.4	126.9 ± 2.8**	155.5 ± 3.8	149.8 ± 3.4*
	DBP	95.9 ± 0.9	88.7 ± 1.0**	106.5 ± 1.8	102.0 ± 2.7**
Supine	HR	77.0 ± 2.3	76.2 ± 2.1	69.3 ± 1.7	71.1 ± 3.9
Sitting	HR	80.5 ± 2.8	81.4 ± 1.8	72.1 ± 2.5	75.0 ± 4.3
Standing	HR	84.0 ± 2.5	86.3 ± 2.4	77.0 ± 2.9	79.4 ± 4.3
U _{Na} V	g/24h	5.6 ± 0.4	3.7 ± 0.3**	4.9 ± 0.3	3.6 ± 0.4**
CU _{Na} V	g/g·Cr	4.1 ± 0.3	2.9 ± 0.2**	3.9 ± 0.1	2.8 ± 0.3**
U _K V	g/24h	2.3 ± 0.1	1.9 ± 0.1**	1.7 ± 0.2	1.6 ± 0.1
CU _K V	g/g·Cr	1.6 ± 0.1	1.5 ± 0.1*	1.3 ± 0.1	1.3 ± 0.2
BW	kg	63.5 ± 2.3	61.6 ± 2.0**	64.6 ± 2.6	63.9 ± 2.6

Values are given as mean ± SEM. * = $p < 0.05$ and ** = $p < 0.01$.

CU_KV = 24-hour urinary potassium excretion corrected for creatinine excretion; BW = body weight.

Other abbreviations are the same as in Table III.

U_{Na}V did not decrease at all in 6 patients, 3 from each group. These results are summarized in Table I.

Characteristics of the Subjects

In 14 patients with BH who could restrict their sodium intake to some extent, the mean age, body weight and the ratio to ideal body weight [(height - 100) × 0.9] were 41.9 ± 5.7 years, 63.5 ± 2.3 kg and 105.9 ± 2.2%, respectively. They were not significantly different from those of the SH and the NT groups. The severity scores of both the BH and the SH groups were mild, but they were significantly less in the former than in the latter (Table II).

BP, HR, U_{Na}V, U_KV and endogenous creatinine clearance on a normal salt diet are shown in Table III. The casual blood pressure of the BH group was 138.9 ± 2.0/93.9 ± 0.8 mmHg, which was significantly higher than that of the NT group but significantly lower than that of the SH group. HR of the BH group was 80.5 ± 2.8/min, which showed a significant increase as compared with those of the other 2 groups. The U_{Na}V of the BH group was 5.6 ± 0.4 g/day, which is equivalent to 14.3g of salt. The U_{Na}V was corrected for 24-hour creatinine excretion (CU_{Na}V). There were no significant differences of U_{Na}V and

CU_{Na}V among the BH, SH and NT groups. The mean U_KV of the BH group increased significantly as compared to those of the other 2 groups. There were no significant differences of endogenous creatinine clearance among the 3 groups.

Blood Pressure, Urinary Sodium and Body Weight

After 3–8 weeks of moderate salt restriction there was a significant fall in both systolic and diastolic pressure (Table IV). In the BH group the mean value of several blood pressure measurements in the sitting position fell significantly from 138.9 ± 2.0/93.9 ± 0.8 to 130.1 ± 2.9/87.7 ± 0.9 mmHg. Both the systolic and diastolic sitting blood pressures on a salt-restricted diet were 8.7 mmHg or 6.3% and 6.2 mmHg or 6.6% lower than those on a normal salt diet, respectively. In 9 of 14 patients, DBP fell into the normal range. The significant fall in blood pressure was observed in the supine and the standing position, too. In the SH group there was also a significant fall in blood pressure in each position after salt restriction: the systolic sitting blood pressure was 8.4 mmHg or 5.2% and the diastolic sitting blood pressure was 4.0 mmHg or 3.7% lower than those on a normal diet.

Fig.1. Changes of BP and CUNaV in subjects who failed in salt restriction. CUNaV = 24-hour urinary sodium excretion corrected for creatinine excretion; BH = borderline hypertension; SH = sustained hypertension; pre = before salt restriction; post = after salt restriction

The mean U_{NaV} during salt restriction in the BH group fell significantly to 3.7 ± 0.3 g/day, which is equivalent to 9.6g of salt. In the SH group, the U_{NaV} also decreased significantly during salt restriction.

Body weight significantly declined during salt restriction in the BH group, but not significantly in the SH group.

Blood pressure and urinary sodium excretion remained unchanged in both the BH and the SH groups who failed to restrict their salt intake (Fig. 1).

There was a significant relationship between the fall in MBP (ΔMBP) and that in CUNaV (ΔCUNaV) in the supine position in borderline and sustained hypertensive patients (Fig. 2). In the BH group standing ΔMBP related closely to ΔCUNaV , and in the SH group supine ΔMBP related closely to ΔCUNaV . There was also a

Fig.2. Relationship between the fall in mean blood pressure (ΔMBP) and that in CUNaV (ΔCUNaV) in the supine position during salt restriction in patients with BH and SH. Abbreviations are the same as in Fig. 1.

relationship between ΔCUNaV and ΔBW in hypertensive patients ($r = 0.36$).

Hemodynamics

The effects of moderate salt restriction on hemodynamics were studied in 9 patients with BH and 5 with SH. The cardiac index (CI) in the BH group was 3.2 ± 0.1 L/min/m² on a normal salt diet (Table V). It was not different from those in the NT and the SH groups. The total peripheral resistance index (TPRI) in the BH group on a normal salt diet was 2643 ± 166 dyne·sec·cm⁻⁵·m², being higher than that in the NT group but significantly lower than that in the SH group. In the SH group, the CI increased and the TPRI decreased during salt restriction. However, the CI and the TPRI remained unchanged in the BH group in spite of a significant lowering of the blood pressure during salt restriction. In order to examine the mechanism in blood pressure lowering during salt restriction, we divided the patients with BH into 2 subgroups, i.e., "output group", where the CI was more than one SE above the mean value of the NT group, and the "resistance group", where the TPRI was more than one SE above the mean value of the

TABLE V HEMODYNAMIC CHANGES DURING SALT RESTRICTION IN THE BH AND THE SH GROUPS

			BH (n = 9)	SH (n = 5)	NT (n = 6)
CI	L/min/m ²	Normal	3.24 ± 0.13	2.76 ± 0.16	3.37 ± 0.33
		Low Salt	3.25 ± 0.16	3.18 ± 0.17	
TPRI	dyne·sec·cm ⁻⁵ ·m ²	Normal	2642.5 ± 166.3*	3608.3 ± 323.0†	2166.7 ± 255.4
		Low Salt	2460.0 ± 196.6	3076.5 ± 310.3	

* = $p < 0.05$ (BH vs SH); † = $p < 0.01$ (NT vs BH, NT vs SH).

Values are given as mean ± SEM.

CI = cardiac index; TPRI = total peripheral resistance index.

Other abbreviations are the same as in Table I.

TABLE VI HEMODYNAMIC CHANGES DURING SALT RESTRICTION IN SUBGROUPS OF BORDERLINE HYPERTENSION

		output-group (n = 2/9)		resistance-group (n = 6/9)	
		Normal	Low Salt	Normal	Low Salt
SBP	mmHg	152 ± 8	136 ± 14	138 ± 2	130 ± 2*
DBP	mmHg	89 ± 1	79 ± 1	88 ± 2	82 ± 2**
CI	L/min/m ²	3.9 ± 0.1	3.6 ± 0.1	2.9 ± 0.1	3.4 ± 0.2
TPRI	dyne·sec·cm ⁻⁵ ·m ²	2068 ± 265	2211 ± 243	2885 ± 92	2400 ± 216*

Values are given as mean ± SEM. * = $p < 0.05$ and ** = $p < 0.01$.

Abbreviations are the same as in Table I and V.

TABLE VII EFFECT OF SALT RESTRICTION ON TREADMILL TEST IN HYPERTENSIVES

			BH, (n = 11)		SH, (n = 5)	
			Pre-TM	Post-TM	Pre-TM	Post-TM
SBP	mmHg	N	140 ± 4	165 ± 5	162 ± 7	201 ± 7
		L-S	128 ± 6	169 ± 8	152 ± 7	187 ± 4
HR	/min	N	86 ± 3	125 ± 1	70 ± 4	124 ± 2
		L-S	82 ± 4	126 ± 1	73 ± 3	123 ± 3
DP		N	20677 ± 591		24909 ± 979	
		L-S	21334 ± 1040		23171 ± 702	
TMT	min	N	5.6 ± 0.6		7.2 ± 0.7	
		L-S	6.8 ± 0.5		7.0 ± 0.8	

Values are given as mean ± SEM.

* = $p < 0.05$; BH = borderline hypertension; SH = sustained hypertension; SBP = systolic blood pressure; HR = heart rate; TM = treadmill; N = normal diet; DP = double product; L-S = low salt; TMT = treadmill time

NT group on a normal salt diet (Table VI). Only 2 of 9 patients belonged to the output group, 6 belonged to the resistance group and one was within normal range. The number of patients in the output group was too small for statistical

analysis. The resistance group showed significant decreases both in SBP and DBP, which were accompanied with a significant decrease of the TPRI, during salt restriction similar to the SH group. In the BH group, the treadmill time to

reach 75% of the predicted maximum HR was longer on a low salt diet than that on a normal salt diet. However, the SBP and the double product at peak exercise did not change with salt restriction. In the SH group the treadmill time did not change, but the SBP and the double product at peak exercise were lower on a low salt diet than on a normal salt diet. In both groups, salt restriction improved the physical capacity during the treadmill test.

DISCUSSION

The major problem of salt restriction is whether or not the patient can follow the diet restrictions. All of our subjects were outpatients and most of them continued their daily work and social life and ate out at least once a day. We, therefore, instructed them to reduce salt intake to 5–8 g/day instead of a rigid 2 or one g/day salt restriction, which was considered incompatible with their everyday routine. Nevertheless, the patients' compliance to salt restriction was not good. In the patients with BH, the moderate salt restriction reduced the urinary sodium excretion significantly from 5.6 to 3.7 g/day, but the extent of the reduction did not reach the desired level. The blood pressure fell significantly as a whole, averaging 8.7/6.2 mmHg after salt restriction. However, the blood pressure fell into the normal range in 9 of 14 patients. If we could reduce the salt intake in all patients to less than 8 g/day, the blood pressure would probably be controlled better.

Previous studies have also shown that not only a rigid salt restriction of below 2 g/day, but also a moderate salt restriction, reduces blood pressure in essential hypertension.^{12,13} Parijs et al.¹² have shown that a moderate sodium restriction reduced 24-hour urinary sodium excretion from 191 to 93 mEq and a significant decrease of home blood pressure of 7.7/4.4 mmHg on the average was detected in mild to moderate hypertension. Morgan et al.¹³ have found that although salt restriction reduced urinary sodium excretion only from 191 to 159 mmol/24-hour, being similar to our level, it reduced blood pressure down to the normal range in many borderline hypertensive patients. Further, MacGregor et al.¹⁴ have clearly shown that moderate sodium restriction from 191 to 83 mmol/24-hour significantly lowers the mean blood pressure by 7.6 mmHg on the average in mild to moderate hypertensive patients in their

double-blind randomized crossover study. However, both Swales¹⁵ and Simpson¹⁶ remained skeptical about the value of moderate sodium restriction.

Although the mechanism of blood pressure reduction during sodium restriction is not clear, the fall in the mean blood pressure was related to the change in urinary sodium excretion in the present study.

In regard to hemodynamics, most studies have indicated that a substantial portion of the subjects with borderline hypertension have an elevated cardiac output, and the difference of the cardiac output between the BH and the NT groups was significant.^{1,17–22} However, Johanson²³ has reported that although a nearly significant elevation in the cardiac output was found in the younger-aged group, there was no difference in the older subjects. Levy et al.²⁴ did not find any difference in cardiac output. In our middle-aged borderline hypertensives, the CI was not different from that in the NT group, whereas the TPRI was noticeably higher than that in the NT group. Recently Frohlich et al.²⁵ have reported that in borderline hypertension a higher cardiac index and a normal total peripheral resistance were found in the patients younger than 30 years of age as compared to normotensive subjects, whereas, in those over 40 years of age no difference of cardiac index was observed and their total peripheral resistance increased significantly.

There is little information about the hemodynamic response to dietary sodium changes in hypertensive humans. Sullivan et al.²⁶ have reported that in borderline hypertensive patients with an average age of 27, a 10 mEq sodium diet (a very rigid restriction) for 4 days resulted in a significant fall in the MBP and the CI and a significant increase in the TPR. In our present study, 6 of 9 borderline hypertensive patients, who belonged to the resistance subgroup, responded to a moderate salt restriction by a significant fall in both blood pressure and the TPRI.

The Framingham study has demonstrated that the prevalence of adiposity increased with a development of hypertension.²⁷ Reisin et al.²⁸ have reported that weight loss without salt restriction related significantly to the reduction of blood pressure in overweight hypertensive patients. Shikata and Ueda²⁹ have also found a significant relationship between a decrease of the Quetelet index per year and that in SBP or DBP

per year in a prospective study on hypertension in Hisayama, Japan.

In our study, a moderate salt restriction also induced a significant decrease in body weight in the BH group. It is probable that these patients did not consume as much food daily due to the salt restriction. Thus, the fall in blood pressure may be due to the weight loss during salt restriction in the BH group.

In the present study a moderate salt restriction reduced blood pressure in patients with both borderline and sustained hypertension, and in a majority of the patients with borderline hypertension, diastolic blood pressure fell into the normal range.

In conclusion, we suggest that a moderate salt restriction is an effective management of borderline hypertension and that it should be tried before any drug therapy.

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