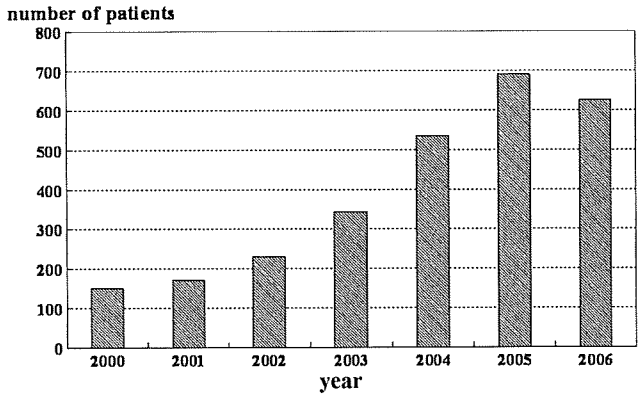

Fig. 1 Prevalence of TSP therapy in Japan. More than 600 IgA nephropathy patients per year received TSP therapy in 2005 and 2006. The total number of patients who have received TSP therapy since 2000 has now reached 2,746

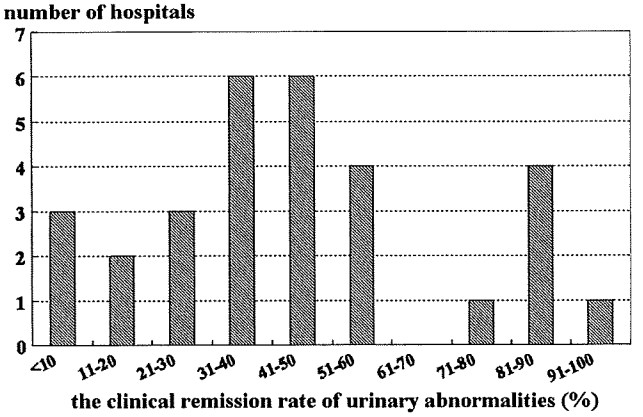

Fig. 2 The distribution of the CR rate at the 30 hospitals performing TSP therapy on more than ten patients. The *X*-axis defines the CR rate (%) and the *Y*-axis indicates the number of hospitals

Table 1 CR rate of tonsillectomy and steroid pulse therapy in patients with IgA nephropathy

Months after tonsillectomy	Patient number	Patients in clinical remission	Clinical remission rate (%)
6	1085	347	32.0
12	991	452	45.6

CR rate 1 year after TSP therapy

Of the 2,746 patients who received TSP therapy between 200 and 2006, 1,081 and 991 were evaluated for CR by urinary criteria at 6 and 12 months after TSP therapy, respectively. To eliminate any bias, this analysis excluded the 100 patients per year who received TSP therapy at Sendai Shakaihoken Hospital. The CR rates at 6 and 12 months were 32% (347/1,085) and 45.6% (452/991), respectively (Table 1).

Distribution of CR rate at the 30 hospitals performing TSP therapy on more than ten patients

Figure 2 demonstrates that the CR rate varied from less than 10% to greater than 90% at different hospitals. The high-CR-rate group (greater than 70% CR) consisted of six hospitals, the average-CR-rate group (31–60% CR rate) consisted of 16 hospitals, and the low-CR-rate group (below 30% CR) consisted of 8 hospitals.

Secondary survey

We collected patient data from ten hospitals at which the CR rate was over 70% or below 30%, although the CR rates in four out of the ten hospitals increased or decreased to between 50% and 70% after the addition of new patients. We divided the ten hospitals into three groups, those with a low CR rate (122 patients in four hospitals), a moderate CR rate (78 patients in four hospitals), and a high CR rate (103 patients in two hospitals).

Detailed information about tonsillectomy surgeons and intravenous steroid amount and administration times

There was no difference in surgeons between the low-CR-rate and high-CR-rate groups, because both groups included physicians whose experience levels varied from younger doctors in their third postgraduate year to oto-laryngology specialists who had performed over 200 tonsillectomies each. There was also no significant difference in the amount of intravenous methylprednisolone administered, as all hospitals used 500 mg/day for 3 days as described in Hotta's original report [6]. In the low-CR-rate group, one hospital administered one course of steroids and three hospitals dispensed three courses, while in the high-CR-rate group two hospitals administered three courses. Thus, we found no significant difference between groups in either the surgeons who performed the tonsillectomies nor in the steroid pulse therapy protocols.

Comparison of patient data between low- and high-CR-rate groups

A comparison of patient data between the low- and high-CR-rate groups showed a significant difference in age at onset (30.3 ± 11.1 versus 33.5 ± 13.7 years; $P = 0.05$), amount of proteinuria (1.3 ± 1.4 versus 0.9 ± 0.7 g/day; $P = 0.02$), total protein (6.7 ± 0.6 versus 6.5 ± 0.6 g/dl; $P = 0.02$), pathological grade ($P = 0.009$), and prognostic score as described by Wakai et al. [7] (34.5 ± 15.9 versus 28.8 ± 21.3; $P = 0.04$) (Table 2).

Table 2 Patient profile among the low-, middle-, and high-CR-rate groups and a comparison of patient data between the low- and high-CR-rate groups

	Low-CR-rate group CR rate 30.3%	Middle-CR-rate group CR rate 57.7%	High-CR-rate group CR rate 79.6%	*P*
Number of patients	122	78	103	
Male/female	52/70	41/37	37/66	n.s.
Age (years)	30.3 ± 11.1	40.6 ± 15.1	33.5 ± 13.7	0.05
Years until TSP therapy	7.2 ± 6.2	4.4 ± 5.2	5.9 ± 5.6	n.s.
Proteinuria (g/day)	1.3 ± 1.4	1.2 ± 1.6	0.9 ± 0.7	0.02
Hematuria (0: 1+: 2+: 3+)	7:12:30:73	4:10:25:39	4:25:20:54	n.s.
Systolic BP (mm Hg)	118 ± 16	123 ± 14	121 ± 15	n.s.
Diastolic BP (mm Hg)	73 ± 14	75 ± 11	72 ± 11	n.s.
Cr (mg/dl)	0.94 ± 0.36	0.91 ± 0.27	0.93 ± 0.44	n.s.
TP (g/dl)	6.7 ± 0.6	6.7 ± 0.5	6.5 ± 0.6	0.02
Pathological grade (I: II: III: IV)	6:14:47:55	2:15:40:21	4:32:41:26	0.009
Prognostic score by Wakai et al. [7]	34.5 ± 15.9	32.6 ± 14.1	28.8 ± 21.3	0.04

Table 3 Comparison of non-CR and CR subgroup patient data in all patients who received TSP therapy

	All patients		*P*
	CR rate 54.1%		
	Non-CR	CR	
Number of patients	139	164	
Male/female	61/78	69/95	n.s.
Age	33.1 ± 13.2	34.8 ± 14.1	n.s.
Years until TSP therapy	6.9 ± 6.8	5.3 ± 5.2	0.02
Proteinuria (g/day)	1.5 ± 1.6	0.8 ± 0.8	<0.0001
Hematuria (0: 1+: 2+: 3+)	11:19:33:76	4:28:42:90	n.s.
Systolic BP (mm Hg)	121 ± 15	119 ± 15	n.s.
Diastolic BP (mm Hg)	75 ± 15	72 ± 11	n.s.
Cr (mg/dl)	0.99 ± 0.40	0.87 ± 0.34	0.006
TP (g/dl)	6.6 ± 0.6	6.7 ± 0.6	n.s.
Pathological grade (I: II: III: IV)	5:14:64:56	7:47:64:46	0.0006
Prognostic score by Wakai et al. [7]	37.4 ± 17.8	28.1 ± 15.1	<0.0001

Analysis of factors predicting resistance to TSP therapy

The CR rate was 54.1% in all patients ($N = 303$). In comparing data from patients in the non-CR and CR subgroups, a significant difference was observed in duration from diagnosis until TSP therapy (6.9 ± 6.8 versus 5.3 ± 5.2 years; $P = 0.02$), amount of proteinuria (1.5 ± 1.6 versus 0.8 ± 0.8 g/day; $P < 0.0001$), serum creatinine (0.99 ± 0.40 versus 0.87 ± 0.34 mg/dl; $P = 0.006$), pathological grade ($P = 0.0006$), and prognostic score (37.4 ± 17.8 versus 28.1 ± 15.1; $P < 0.0001$) (Table 3).

Table 4 Stepwise logistic regression analysis of non-CR 1 year after TSP therapy

	Coefficients	OR	95% CI	*P* value
Age at onset	−0.0330	0.97	0.95–0.99	0.003
Amount of urinary protein (log) (g/day)	0.4772	1.61	1.23–2.12	<0.001
Hematuria	−0.2731	0.76	0.56–1.04	0.08
Pathological grade	0.7604	2.14	1.50–3.06	<0.001

Intercept −0.1894

Multivariate logistic analysis

The factors predicting resistance to TSP therapy were identified as age at onset, amount of proteinuria, hematuria grade, and pathological grade (Table 4). Resistance correlated positively with the score derived from the following formula: [(−0.0330) × (age) + (0.4772) × log (amount of urinary protein) − (0.0273) × (hematuria grade: 0, 1, 2, and 3) + (0.7604) × (pathological grade: 1, 2, 3, and 4) − 0.1894].

Efficacy [3] and limitation of the resistance score

An ROC curve analysis revealed that patients with a resistance score of greater than −0.02 in the current study more easily resisted TSP therapy (sensitivity 69%, specificity 75%; Fig. 3).

Discussion

The present study demonstrates five points. The first is that about 600 IgA nephropathy patients per year received TSP

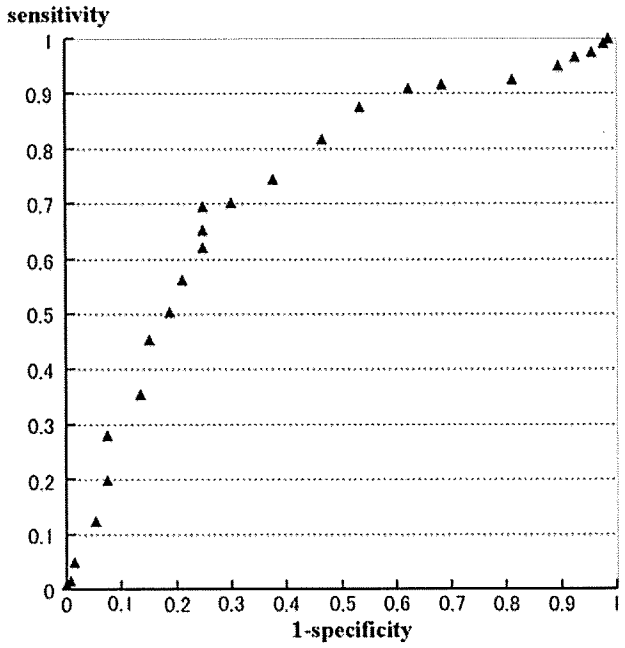

Fig. 3 Resistance correlated positively with the score derived from the following formula: [(−0.0330) × (age) + (0.4772) × log (amount of urinary protein) − (0.0273) × (hematuria grade: 0, 1, 2, and 3) + (0.7604) × (pathological grade: 1, 2, 3, and 4) − 0.1894]. The cutoff value is −0.02, with a sensitivity of 69%, specificity of 75%, and positive likelihood ratio of 2.76

therapy in Japan since 2001, at which time the efficacy of TSP therapy was reported in an international journal. The second is that the CR rate 1 year after TSP therapy was almost 50%, which confirms the data of original report. The third is that CR rates ranged from 10% to 100% in each hospital that performed TSP therapy on at least ten patients. The fourth is that low- and high-CR-rate groups differed considerably in age at onset, amount of proteinuria, total protein, pathological grade, and Wakai et al. prognostic score. This suggests that the indication criteria for TSP therapy in the high-CR-rate group may differ from that in the low-CR-rate group. The fifth point is that the factors that predicted resistance to TSP therapy are age at onset, amount of proteinuria, hematuria grade, and pathological grade.

The aim of the present study, namely the identification of the factors predicting resistance to TSP therapy, differed from that of Hotta's original report, which aimed to establish which factors led to clinical remission in all IgA nephropathy patients. The present study revealed that younger patients with massive proteinuria, mild hematuria, and a severe pathological grade easily resist TSP therapy. It should be noted that these factors were already included in the prognostic scoring system developed by Wakai et al. Our results suggest that patients with late-stage or severe IgA nephropathy are likely to resist TSP therapy, and conversely patients with early or mild to moderate disease easily achieve CR following TSP therapy. An ROC curve of the predictive score for resistance to TSP therapy shows that, when the score is more than −0.02, the sensitivity is almost 70%, the specificity is 75%, and the positive likelihood ratio is 2.76. It is still unclear whether responsiveness to TSP therapy depends on how early the treatment is given, or on other factors, for instance genetic characteristics, or on a combination of these. A retrospective analysis by Hotta's group suggested that TSP therapy may be more effective for patients in the early stages of the condition, based on data that patients with serum creatinine level of less than 2.0 mg/dl responded well to the treatment [8]. There are several medical decisions; one is whether TSP therapy should be performed for patients with early or mild to moderate grade nephropathy so as to induce clinical remission, and the other is whether TSP therapy should be used for patients with a progressive type of IgA nephropathy. Further study should clarify the indications for TSP therapy in patients with IgA nephropathy.

Regarding clinical remission of urinary abnormalities, TSP therapy is still the most promising treatment, with a maximum CR rate of almost 50%, compared with 10–20% seen in steroid pulse therapy as reported by Pozzi et al. [3]. According to Hotta's original report about TSP therapy, the renal survival rate following treatment is estimated as 90% at 10 years, 71% at 16 years, and 66% at 20 years, with 48% (157/329) of patients achieving complete remission of urinary abnormalities and 52% (172/329) resisting the therapy. The fact that almost half of enrolled patients showed a poor prognosis demonstrates that TSP therapy is not a curative treatment for all patients with IgA nephropathy. Regardless, we must evaluate various therapies based on the renal survival rate after longer periods, such as 20 years, not on the CR rate assessed shortly after treatment. Further prospective randomized controlled trials in which the primary end point is the renal survival rate at 20 years, or cohort studies having large number of patients, are needed to clarify the efficacy of TSP therapy.

Acknowledgments We thank the Fellows of the Japanese Society of Nephrology who responded to our questionnaire. This work was supported by a grant (to H.I.) from the Progressive Renal Diseases Research Project of the Ministry of Health, Labour and Welfare of Japan. Drs. Kikuchi K, Ito Y, Yamaji I, Fukazawa S, Kawada T, Sakurai T, Wada A, Nagane Y, Sato H, Taguma Y, Wakui H, Konta T, Degawa N, Masakane I, Yamagata K, Kobayashi M, Ebihara I, Nakamura S, Oda T, Tukamoto Y, Ishizuka A, Shiraga H, Imasawa T, Seki T, Takemoto F, Matsushita K, Shibata T, Murakami M, Takahashi T, Wakai S, Ando M, Mishio Y, Hayashi M, Sasaki S, Okada T, Nitta K, Higuchi C, Funahiki K, Tamura K, Yasuda H, Yoshimura A, Takizawa R, Suwabe T, Hayaasa J, Yokota S, Sato M, Jinguuji Y, Higuchi M, Nakao I, Yoshida H, Araki H, Yoshimura M, Wada T, Koni I, Yamamoto T, Kasai K, Tomita M, Fukuda M, Inaguma D, Naruse T, Yamashita H, Asada Y, Sugimoto T, Isono M, Mukoyama M, Mori Y, Komatsu H, Tsuji H, Ishimura E, Imai E, Inoue T,

Kajiwara N, Fukunaga M, Imanishi M, Muso E, Shin S, Yoshida T, Sakamoto I, Yamada Y, Otani H, Sugiyama H, Aya K, Fukushima M, Yorioka N, Okuno T, Munemura C, Hayashi A, Ito T, Imai T, Ooyabu Y, Takahashi T, Nishimura S, Fujieda M, Tsuchiyama Y, Morisada N, Masutani K, Saito T, Ito Y, Fukunari K, Ishida I, Narikiyo T, Yasunaga C, Kanai H, Tsuruta H, Takeda K, Furusu A, Horita Y, Kohda Y, Nawata T, Kaneda K, Fujimoto S, Ikeda N, Uehara H, Yoshi S.

Conflict of interest statement None declared.

References

1. Chauveau D, Droz D. Follow-up evaluation of the first patients with IgA nephropathy described at Necker Hospital. Contrib Nephrol. 1993;104:1–5.
2. Koyama A, Igarashi M, Kobayashi M. Natural history and risk factors for immunoglobulin A nephropathy in Japan. Am J Kidney Dis. 1997;29:526–32.
3. Pozzi C, Andrulli S, Del Vecchio L, Melis P, Fogazzi GB, Altieri P, et al. Corticosteroid effectiveness in IgA nephropathy: long-term results of a randomized, controlled trial. J Am Soc Nephrol. 2004;15:157–63.
4. Rasche FM, Schwart A, Keller F. Tonsillectomy does not prevent a progressive course in IgA nephropathy. Clin Nephrol. 1999;51:147–52.
5. Xie Y, Nishi S, Ueno M, Imai N, Sakatsume M, Narita I, et al. The efficacy of tonsillectomy on long-term renal survival in patients with IgA nephropathy. Kidney Int. 2003;63:1861–7.
6. Hotta O, Miyazaki M, Furuta T, Tomioka S, Chiba S, Horigome I, et al. Tonsillectomy and steroid pulse therapy significantly impact on clinical remission in patients with IgA nephropathy. Am J Kidney Dis. 2001;38:736–42.
7. Wakai K, Kawamura T, Endoh M, Kojima M, Tomino Y, Tamakoshi A, et al. A scoring system to predict renal outcome in IgA nephropathy: from a nationwide prospective study. Nephrol Dial Transplant. 2006;21:2800–8.
8. Sato M, Hotta O, Tomioka S, Chiba S, Miyazaki M, Noshiro H, et al. Cohort study of advanced IgA nephropathy: efficacy and limitations of corticosteroids with tonsillectomy. Nephron Clin Pract. 2003;93:c137–45.

Original Paper

Gaps Between Hypertension Treatment Guidelines and Clinical Practice in Japan: Baseline Survey Results From Fukushima Research of Hypertension (FRESH)

Hirohide Yokokawa, MD, PhD;[1] Aya Goto, MD, MPH, PhD;[1] Hironobu Sanada, MD, PhD;[2,3] Tsuyoshi Watanabe, MD, PhD;[3] Seiji Yasumura, MD, PhD[1]

This observational study assessed the achievement of treatment goals, as defined by the Japanese Society of Hypertension Guidelines for the Management of Hypertension (JSH 2004). These goals are: <140/80 mm Hg in elderly patients (65 years and older), <130/80 mm Hg in patients with diabetes or kidney disease, and <130/85 mm Hg in younger patients (younger than 65). From July 2006 to May 2007, 72 physician members of the Fukushima Hypertension Conference enrolled a total of 3320 patients from Fukushima Prefecture, Japan. The median age of the patients was 71 years and 46% were male. The success rate was 27% among patients with diabetes mellitus or renal disease, 30% among those younger than 65 years, and 66% among the elderly without the diseases. Factors significantly associated with an increased risk of failure to achieve goals were obesity, dyslipidemia, family histories of diabetes mellitus or hypertension, and number of antihypertensive drugs used. The presence of atherosclerotic complications decreased the risk. This study revealed low achievement rates, identified the importance of weight control and family histories, and indicated a need for better management to prevent complications. J Clin Hypertens (Greenwich). *2009;11:333–341.* ©*2009 Wiley Periodicals, Inc.*

From the Department of Public Health, Fukushima Medical University School of Medicine;[1] the Division of Health Science Research, Fukushima Welfare Federation of Agricultural Cooperatives;[2] and the Department of Internal Medicine, Fukushima Medical University School of Medicine,[3] Fukushima, Japan
Address for correspondence:
Hirohide Yokokawa, MD, PhD, Department of Public Health, Fukushima Medical University School of Medicine, Hikarigaoka, Fukushima City, Fukushima 960-1295, Japan
E-mail: yokokawa@fmu.ac.jp
Manuscript received June 30, 2008;
revised November 10, 2008; accepted March 26, 2009

doi: 10.1111/j.1751-7176.2009.00118.x

According to the World Health Organization (WHO),[1] reported cardiovascular disease (CVD) was the most common cause of death worldwide in 2005, accounting for approximately 30% of all deaths, with the main causes of death among individuals 60 years and older being ischemic heart disease followed by cerebrovascular disease.[2] Prevention of CVD is emphasized in both developed and developing countries.[1,2] Hypertension affects approximately 1 billion people worldwide[3] and is estimated to account for 6% of deaths worldwide.[4] It is among the most important modifiable risk factors for CVD, and also the most common reason for outpatient office visits to physicians.[5]

Hypertension management consists of several components, including the screening of elevated blood pressure (BP), lifestyle interventions and evaluation for pharmaceutical treatment, continued

medical follow-up, and adherence to treatment.[6,7] For several decades, many projects and studies have been conducted to clarify the factors associated with BP levels,[7–10] based on established treatment guidelines.[3,11,12] Major guidelines include the 2007 Guidelines for the Management of Arterial Hypertension: the Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and the European Society of Cardiology (ESC) (ESH/ESC 2007)[11] from Europe, the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7)[3] from the United States, and the 2003 WHO/International Society of Hypertension (ISH) Statement on Management of Hypertension (WHO/ISH).[12] These reports have produced concise, evidence-based manuals for the most effective and convenient therapy for hypertensive patients, although there are some differences between them regarding recommended first choice drugs and combinations of drugs. These guidelines provide clear and practical treatment algorithms, indicating goal BPs that take into consideration a patient's risk factors: <130/80 mm Hg for patients with diabetes mellitus or chronic kidney disease and 140/90 mm Hg for those without the diseases. Intensive and strict BP control among hypertensive patients with diabetes mellitus and/or chronic kidney disease is emphasized,[3,11,13] because hypertension is a known risk factor for these outcomes.[13] Furthermore, diabetes mellitus often leads to atherosclerotic disorders[14,15] and chronic kidney disease, which is defined as either renal damage or decreased kidney function for 3 months or longer,[16,17] and causes CVD.[18,19]

In Japan, the Japanese Society of Hypertension[20] first published the Japanese Society of Hypertension Guidelines for the Management of Hypertension (JSH 2000) in 2000, which was revised as JSH 2004 in 2004. The guidelines explain the measurement and clinical evaluation of BP as well as basic principals of treatment and lifestyle modification. It also indicates adequate BP goals according to individuals' risk factors, which is similar to previously published guidelines. The average BPs of the Japanese population have decreased between 1961 and 1990 among both men (from 143.2/83.0 mm Hg to 134.3/82.9 mm Hg) and women (from 143.3/82.2 mm Hg to 128.4/77.6 mm Hg) aged 30 to 69 years.[21] During the same period, the incidence of stroke has significantly decreased in response to health promotion activities and introduction of new antihypertensive drugs.[20–22] Nevertheless, there are more than 30 million hypertensive patients in Japan,[23] and it is the second most common disease among those categorized within the metabolic syndrome.[24]

Although a few studies reported robust achievement rates based on 140/90 mm Hg as a goal BP level,[25–27] there have been no reports from Japan assessing the rates toward individualized BP goals, and the present study was the first trial to evaluate these rates in a community. The aim of our study was to assess success rates in achieving treatment goals as defined by JSH 2004 in one prefecture in Japan. We will also explore the factors associated with these success rates, including patients' and physicians' characteristics.

RESEARCH DESIGN AND METHODS

The present study was a prospective cohort study carried out in Fukushima Prefecture, Japan, from July 2006 to May 2007. Fukushima Prefecture is located in the northern region of Japan, with a population of about 2 million. From March to April 2006, we called physician-members of the Fukushima Hypertension Conference to solicit participation in this study. The Fukushima Hypertension Conference was established in 1997 and there were 120 members as of April 2006.

Participants in our study had hypertension and had received antihypertensive medication for at least 3 months and visited a participating physician during the baseline survey period (July 2006). In the baseline survey, the physician enrolled the first 10 consecutive patients who were eligible and willing to participate in our study.[28] The enrollment continued until the total number of registered patients reached 50 for each physician. Even if the number of enrolled patients did not reach 50, the recruitment was stopped on the last day of July 2006. The research date was not announced to patients prior to the survey, and appointments for medical consultation were made according to their requests as usual. Enrolled patients were monitored for 1 year in 3-month intervals.

In the baseline survey, the registered patient's clinical data was copied from medical files to survey sheets. The data included the patient's age, sex, height, weight, waist circumference, family histories (hypertension, diabetes mellitus, dyslipidemia, heart disease, stroke, renal disease, and premature CVD), alcohol consumption, current smoking habits, systolic and diastolic BPs, whether home BP measurement was instructed, duration of hypertension treatment, usage of antihypertensive drugs, and presence of metabolic disorders (diabetes mellitus,

dyslipidemia), end-organ damage, and CVDs (brain, heart, kidney, blood vessel, hypertensive, and diabetic retinopathy). The status of renal disease and diabetes mellitus was obtained from physician reports. In Japan, diabetes mellitus is defined based on the Japan Diabetes Society, Diabetes Treatment Guideline 2008–2009.[29] Renal disease is defined based on the Japanese Clinical Practice Guidebook for Diagnostic and Treatment of Chronic Kidney Disease.[16] As for methods to measure BP, we asked physicians to maintain their usual practices and report BP measurements on each day the patients were surveyed. Follow-up surveys (October 2006, January 2007, and April 2007) collected hypertension-related information. As for physicians' characteristics, the following information was collected in the baseline survey: age, sex, place of employment, main specialty, number of hypertensive patients (per month), and measurer, timing, place, and method of BP measurement. The present report used data from the baseline survey and conducted analyses on achievement toward treatment goals and its associated factors.

All data were entered into a computer and analyzed using SPSS version 14 (SPSS Inc, Chicago, IL). We classified participants into 3 groups according to the JSH 2004: elderly patients 65 years and older without diabetes mellitus or renal disease, young or middle-aged patients without diabetes mellitus or renal disease, and patients with diabetes mellitus or renal disease. The success rates were calculated following treatment goals for each group indicated in JSH 2004: <140/90 mm Hg for elderly patients without diabetes mellitus or renal disease, <130/80 mm Hg for patients with the diseases, and <130/85 mm Hg for young or middle-aged patients without the diseases. For the analysis of factors associated with failure to achieve the treatment goals, we computed odds ratios (ORs) and 95% confidence intervals (CIs) for each item using univariate logistic regression. Significant factors in the univariate analysis ($P<.05$) were then entered into a multivariate logistic regression analysis.

With regard to the analysis of physicians' characteristics and the success rates of their patients, we divided participating physicians into 2 groups using a median split of overall patient success rates (<45% vs ≥45%). The 2 groups were compared using the chi-square test and Fisher exact test for categoric items and Mann–Whitney test for continuous items.

This survey was conducted according to the Ethical Guideline for Epidemiological Studies established by the Japanese government,[30] and work was performed in accordance with the Declaration of Helsinki of 1975 (revised in 2000).[31]

RESULTS

Seventy-two of 120 members of the Fukushima Hypertension Conference enrolled patients into the study. In the baseline survey, 3358 hypertensive patients were initially registered. Of those registered, 38 patients were excluded due to missing data on BPs and nonmedication, and thus 3320 patients were entered into the present analysis. Median age of patients was 71 years (24–99 years) and the percentage of males was 46.1% (Table I). As for anthropometric measurements, median body mass index (BMI) was 24.3 (13.2–45.4), and median waist circumference was 87.6 cm (59.0–126.0 cm) for males and 85.0 cm (53.0–134.0 cm) for females. Among family histories, the prevalence of hypertension was most frequent (55.2%), followed by stroke (27.6%), diabetes mellitus (18.0%), and heart disease (15.3%). The prevalence of alcohol use (daily consumption) was 21.7%, and that of current smoking was 12.1%. The median systolic and diastolic BPs were 134 mm Hg (82–212 mm Hg) and 76 mm Hg (36–124 mm Hg), respectively. Sixty percent of patients were instructed to measure BPs at home, 43.6% of patients were treated by 1 antihypertensive drug, and the median duration of hypertension treatment was 8.0 years (0.5–60.0 years). The proportion of those with diabetes mellitus was 31.7% and that of dyslipidemia was 44.8%. Cardiovascular complications were reported in 21.5% of patients, neurological complications in 13.4%, and renal complications in 11.1%.

Table II shows various characteristics of the physicians assisting in this study. Seventy of 72 physicians completed the questionnaire. The proportion of males was 93.0% and median years after graduation from medical school was 24 years. The most frequent specialty among participating physicians was general internal medicine (n=35), followed by cardiology (n=17), gastroenterology (n=7), and endocrinology (n=7). The proportion of those working at hospitals was 52.9%, and 60.0% were located in urban areas (defined as cities with >100,000 residents). Median number of hypertensive patients per physician per month was 300. Eighty percent of physicians measured BPs by themselves, 82.9% during medical consultation, 82.9% in a consultation room, and 72.9% using mercury sphygmomanometer.

The median systolic and diastolic BPs were 134 mm Hg (84–190 mm Hg) and 75 mm Hg (36–120

Table I. Characteristics of Hypertensive Patients at Baseline

Variables	Median (Range) or No. (%)
Age, y	71 (24–99)
Male sex	1524 (46.1)
Anthropometric measurements	
Body mass index	24.3 (13.2–45.4)
Waist circumference, cm	
Male	87.6 (59.0–126.0)
Female	85.0 (53.0–134.0)
Family histories	
Hypertension	1805 (55.2)
Stroke	902 (27.6)
Diabetes mellitus	589 (18.0)
Heart disease	499 (15.3)
Dyslipidemia	132 (4.0)
Renal disease	123 (3.8)
Premature cardiovascular disease	47 (1.4)
Alcohol consumption (daily)	705 (21.7)
Current smoking	392 (12.1)
Hypertension-related factors	
Systolic blood pressure, mm Hg	134 (82–212)
Diastolic blood pressure, mm Hg	76 (36–124)
Instruction of home blood pressure measurement (yes)	1969 (59.6)
Duration of hypertension treatment, y	8.0 (0.5–60.0)
No. of antihypertensive drug used	
1	1449 (43.6)
2	1318 (39.7)
≥3	553 (16.7)
Metabolic disorders	
Diabetes mellitus	1050 (31.7)
Dyslipidemia	1484 (44.8)
Organ damage/cardiovascular disease	
Heart	713 (21.5)
Brain	445 (13.4)
Kidney	368 (11.1)
Peripheral vascular disease	249 (7.5)
Hypertensive retinopathy	150 (4.5)
Diabetic retinopathy	176 (5.3)

Table II. Characteristics of Physicians Participating in the Survey

Variables	Median (Range) or No. (%)
Male sex	65 (93.0)
Years after graduation from medical university, y	24 (8–44)
Main specialty	
General internal medicine	34 (48.6)
Cardiology	16 (22.9)
Gastroenterology	7 (10.0)
Endocrinology	7 (10.0)
Others	6 (8.5)
Medical office	
Hospital	37 (52.9)
Clinic	33 (47.1)
Location of medical office (urban[a])	
Urban[a]	42 (60.0)
Rural	28 (40.0)
Number of attending hypertension patients (No. per month)	300 (15–1500)
Measurer of BP	
Physician	56 (80.0)
Nurse	8 (11.4)
Patient	6 (8.6)
Timing of BP measurement	
During medical consultation	58 (82.9)
Waiting time	11 (15.7)
Others	1 (1.4)
Place of BP measurement	
Consultation room	58 (82.9)
Treatment room or waiting space	11 (15.7)
Others	1 (1.4)
Method of BP measure	51 (72.9)
Mercury sphygmomanometer	51 (72.9)
Automated sphygmomanometer	19 (27.1)
No. of registered patients	49.5 (14–51)
Achievement rate toward treatment goals	43.9 (14.3–82.0)

Abbreviation: BP, blood pressure. [a]Urban is defined as a city with a population of ≥100,000.

mm Hg) for elderly without diabetes mellitus or renal disease, 132 mm Hg (100–180 mm Hg) and 80 mm Hg (43–106 mm Hg) for those younger than 65 years without the diseases, and 134 mm Hg (82–212 mm Hg) and 76 mm Hg (39–124 mm Hg) for those with the diseases. Success rates toward treatment goals (defined by JSH 2004) were 66.0% for the elderly without diabetes mellitus or renal disease, 30.4% for those younger than 65 years without the diseases, and 26.7% for those with the diseases (Table III). We conducted an additional analysis among those younger than 65 years without the diseases according to JNC 7[3] (<140/90 mm Hg), whose target BP level differs from JSH 2004, and found the success rate to be 65.9%.

The Figure shows the number of antihypertensive drugs used. Monotherapy was most frequent among the elderly without diabetes mellitus or renal disease (47.7%), while bitherapy was most frequent among the patients with the diseases (40.9%). Median systolic and diastolic BPs were 132 mm Hg (82–190 mm Hg) and 77 mm Hg (36–120 mm Hg) among patients treated with monotherapy, 134 mm Hg (92–190 mm Hg) and

Table III. Median of Blood Pressure (BP) and Success Rates Toward Target BP Levels

	JSH 2004 Target BP Level, mm Hg	Median (Range) of Systolic and Diastolic BP, mm Hg	Success Rates, No. (%)
Elderly patients without diabetes mellitus or renal disease (n=1518)	<140/90	134 (84–190)/75 (36–120)	1002 (66.0)
Young or middle-aged patients without diabetes mellitus or renal disease (n=583)	<130/85	132 (100–180)/80 (43–106)	177 (30.4)
Patients with diabetes mellitus or renal disease (n=1212)	<130/80	134 (82–212)/76 (39–124)	324 (26.7)

Abbreviation: JSH 2004, Japanese Society of Hypertension Guidelines for the Management of Hypertension.

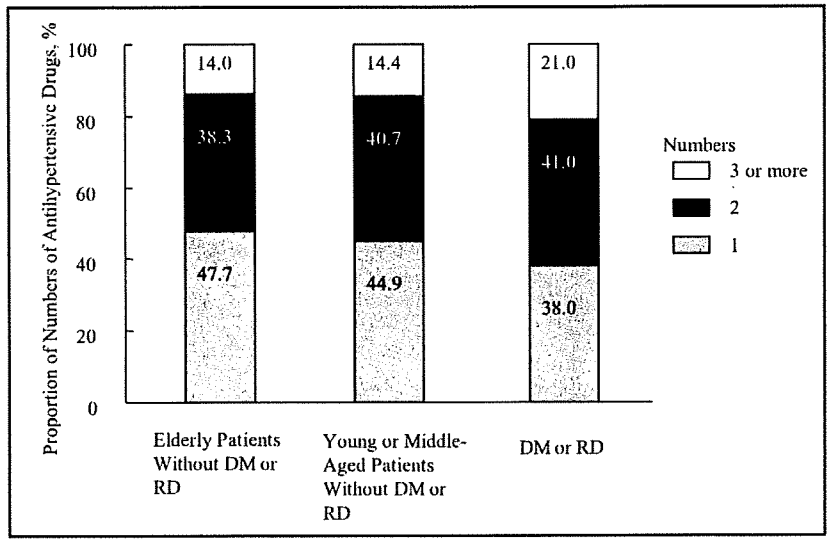

Figure. Numbers of antihypertensive drugs. DM indicates diabetes mellitus; RD, renal disease.

76 mm Hg (39–111 mm Hg) among those treated with bitherapy, and 135 mm Hg (96–212 mm Hg) and 76 mm Hg (41–124 mm Hg) among those treated with ≥3 drugs.

The multivariate analysis showed that the factors significantly associated with failure to achieve treatment goals were waist circumference of ≥85 cm for men and ≥90 cm for women (OR, 1.26; 95% CI, 1.01–1.57) and usage of ≥3 antihypertensive drugs (OR, 1.96; 95% CI, 1.42–2.71) for the elderly group without diabetes mellitus or renal disease (Table IVa). For young and middle-aged patients without diabetes mellitus or renal disease, the significant factors were BMI ≥25 (OR, 1.74; 95% CI, 1.19–2.56), family history of hypertension (OR, 1.67; 95% CI, 1.14–2.45), cerebrovascular complication (OR, 0.33; 95% CI, 0.16–0.68), and hypertensive retinopathy (OR, 0.33; 95% CI, 0.12–0.91) (Table IVb). For patients with diabetes mellitus or renal disease, BMI ≥25 (OR, 1.34; 95% CI, 1.03–1.75), family history of diabetes mellitus (OR, 1.40; 95% CI, 1.04–1.87), dyslipidemia (OR, 1.41; 95% CI, 1.08–1.84), and cerebrovascular (OR, 0.62; 95% CI, 0.44–0.87) and vascular complications (OR, 0.48; 95% CI, 0.33–0.70) were significantly associated (Table IVc).

Table V shows the differences in characteristics between 2 groups of physicians categorized by overall success rates of their patients. The proportion of elderly patients without diabetes mellitus or renal disease was higher among physicians with higher success rates.

DISCUSSION

This community-based assessment of hypertension control among our patients in one prefecture in Japan showed excellent results with a median BP <140/90 mm Hg. Now given new target BP levels redefined by recent hypertension management guidelines,[3,11,20] we used the JSH 2004 to calculate the success rates among our patient population. Achievement rates were relatively pessimistic, especially among patients with diabetes mellitus or renal disease and those younger than 65 years without

Table IV. Association of Blood Pressure Achievement-Failure

Variables	No. (%)	Odds Ratio	95% Confidence Interval	*P* Value
(a) In elderly patients without diabetes mellitus or renal disease (multivariate logistic regression analyses)				
Waist circumference ≥85 cm for men, ≥90 for women	620 (42.1)	1.26	1.01–1.57	<0.05
No. of antihypertensive drugs used				
1	461 (38.0)	1.00 (Reference)		
2	496 (40.9)	1.15	0.91–1.46	
≥3	255 (21.0)	1.96	1.42–2.71	<0.05
(b) In young and middle-aged patients without diabetes mellitus or renal disease (multivariate logistic regression analyses)				
Body mass index ≥25	241 (42.8)	1.74	1.19–2.56	<0.05
Family history of hypertension (yes)	378 (66.4)	1.67	1.14–2.45	<0.05
Organ damage/cardiovascular disease				
Brain (yes)	33 (5.7)	0.33	0.16–0.68	<0.05
Hypertensive retinopathy (yes)	17 (2.9)	0.33	0.12–0.91	<0.05
(c) In patients with diabetes mellitus or renal disease (multivariate logistic regression analyses)				
Body mass index ≥25	582 (48.5)	1.34	1.03–1.75	<0.05
Family history of diabetes mellitus (yes)	379 (31.5)	1.40	1.04–1.87	<0.05
Dyslipidemia (yes)	656 (54.3)	1.41	1.08–1.84	<0.05
Organ damage/cardiovascular disease				
Brain (yes)	191 (15.8)	0.62	0.44–0.87	<0.05
Blood vessel (yes)	144 (11.9)	0.48	0.33–0.70	<0.05

Table V. Physician Characteristics of Blood Pressure Achievement Rates Toward Treatment Goals

	Achievement Rate Median (Range) or No. (%)[a]		*P* Value
Variables	<45% (n=38)	≤45% (n=32)	
Male sex	35 (92.1)	30 (93.8)	
Years after graduation from medical university	24 (8–40)	25 (11–44)	
Main specialty (internal medicine)	37 (97.4))	29 (90.6)	
Medical office (hospital)	23 (60.5)	14 (43.8)	
Location of medical office (urban[b])	25 (65.8)	17 (53.1)	
Number of attending hypertension patients (for one month)	300 (15–1500)	300 (32–1200)	
Measurer of BP (physician)	31 (81.6)	25 (78.1)	
Timing of BP measurement (during medical consultation)	32 (84.2)	26 (81.3)	
Place of BP measurement (consultation room)	32 (84.2)	26 (81.3)	
Method of BP measure (mercury sphygmomanometer)	28 (73.7)	23 (71.9)	
Proportion of registered patients, %			
Elderly patients without diabetes mellitus or renal disease	42.8 (0.0–74.0)	55.0 (0.0–84.0)	<0.01
Young and middle-aged patients without diabetes	18.6 (0.0–60.0)	13.3 (0.0–61.3)	
Patients with diabetes mellitus or renal disease	29.2 (4.0–100)	27.9 (2.0–100)	

Abbreviation: BP, blood pressure. [a]The chi-square test and Fisher exact test for categoric items and Mann–Whitney test for continuous items were used to assess the significance. [b]Urban is defined as a city with a population of ≥100,000.

diseases based on JSH 2004, although median BPs showed excellent results of <140/90 mm Hg.

Other factors associated with failure to achieve treatment goals included BMI, waist circumference, family histories, dyslipidemia, and usage of ≥3 antihypertensive drugs increased the risk of achievement failure, while presence of complications was paradoxically associated with success rates.

The success rate of elderly patients without diabetes mellitus or renal disease in our study was substantially higher compared with those of young and middle-aged patients. Likewise, a Japanese cross-sectional study reported that achievement rate toward goal BP (defined as <140/90 mm Hg) was 17.0% in patients younger than 60 years while it was 40.6% for patients 60 to 69 years, 54.4% for

patients 70 to 79 years, and 65% for patients 80 years and older.[32] In contrast, previous studies have reported advancing age as an independent predictor of inadequate BP control in the United States.[33,34] The discrepancies in achievement rates between the elderly and nonelderly in Japan and between the elderly in Japan and the United States could be explained in part by differences in health behaviors among the older generations. JNC 7 emphasizes the importance of the following 5 healthy lifestyles: weight reduction, improvement in dietary habits, dietary sodium restriction, increased physical activity, and appropriate alcohol consumption.[3] The proportions of those who exercise regularly, keep healthy weight, and do not smoke were higher in the elderly compared with the nonelderly according to a Japanese national survey.[35] In the United States, on the other hand, these proportions in the elderly are lower compared with the nonelderly.[36,37] Furthermore, BP level is correlated with cardiovascular mortality in the nonelderly,[10] which could result in a survivor effect causing a relatively elevated success rate among the Japanese elderly.

The study indicated that 2 markers of obesity, high BMI and waist circumference, were significantly associated with achievement failure among hypertensive patients with diabetes mellitus or renal disease, and young and middle-aged patients without the diseases. Several studies have reported a high prevalence of hypertension among obese individuals compared with nonobese individuals.[38–40] The sympathetic nervous system, sodium retention/salt sensitivity, and insulin resistance are thought to be involved in the etiology of hypertension accompanied by obesity.[20] As previous research emphasized,[41,42] body weight control is thus considered one of the most important therapeutic strategies in JSH 2004,[20] JNC 7,[3] and ESH/ESC 2007.[12] In other words, obesity is an important risk factor of failure to achieve treatment goals[33] as indicated in our results.

It is well-known that family histories of hypertension,[43] diabetes mellitus,[44] and dyslipidemia[45] are risk factors for hypertension. The number of these risk factors, as well as nonfavorable health behaviors, is associated with an increased incidence of hypertension and overall CVD severity. In Japan, family histories are usually recorded in standard medical files with other basic information and are checked in general clinical practice and routine health check-ups.

Interestingly, we found a positive association between history of organ and vascular complications and achieving treatment goals. It may be possible that both patient and physician become more aware of the need to maintain goal BP levels, once organ and vascular complications present. Previous studies have reported a similar association between history of CVD and improved BP control, explained by increased patient compliance and/or more aggressive treatment.[46,47] Supporting this hypothesis, Street and colleagues[48] also reported that physicians seeing patients with a critical disease paid more attention to their clients than physicians seeing patients with less severe conditions. Furthermore, a lack of disease awareness has been pointed out as a patient-related factor related to poor BP control.[49] Had patients been treated appropriately in the past, such a paradoxical result may not have been found, and presence of complications may have instead become a risk factor of inadequate BP control. Our results suggest the necessity of better management of hypertension prior to the onset of complications.

Using $\geq$2 drugs was a risk factor of achievement failure among our elderly patients without diabetes mellitus or renal disease. A previous report from the United States also showed that a multi-drug regimen was an independent risk factor of poor BP control,[46] and patients whose BP is difficult to control are more likely to be treated with multiple drugs. Additional analyses of our study showed that a multiple antihypertensive drug therapy correlates with higher number of vascular and/or organ damage, longer duration of hypertension treatment, and a family history of hypertension. These findings suggest that resistance to treatment persists among the elderly without diabetes mellitus or renal disease, despite physician adherence to treatment guidelines. Further analysis of follow-up data on change in antihypertensive drugs may provide additional insight on the relationship between different medications and BP control.

LIMITATIONS

Our study has some major limitations. First is a selection bias; the physicians who participated in our study were limited to members of the Fukushima Hypertension Conference, and participants were limited to hypertensive patients who visited these physicians. In addition, some important information on their characteristics and medical practices were not investigated, and the patient characteristics appeared as the only factor that differed significantly between 2 groups of physicians classified by their achievement levels. It is possible that participating members might be more aware about hypertension management compared with nonmembers.

Success rates might become lower showing significant associations with physician's characteristics once nonmembers are included. Secondly, this was a cross-sectional analysis using baseline data, and causal relationships between success rates and the associated factors cannot be fully elucidated. Further analyses of follow-up survey data are needed. Thirdly, other important factors, such as patient's health behaviors, physicians' treatment strategies, and their disease awareness were not obtained in our survey. The inclusion of additional factors in the multivariate analysis model might have modified our results.

CONCLUSIONS

The present study, which was conducted in one prefecture in Japan, revealed low achievement rates toward treatment goals among hypertensive patients regardless of physician characteristics, especially in groups with diabetes mellitus or renal disease and those younger than 65 years without the diseases. Analysis of associated factors indicated the importance of weight control, assessment of family history, and a need for better management before atherosclerotic complications appear.

Acknowledgments and disclosures: We thank physician members of the Fukushima Hypertension Conference for their excellent help in data collection, and the staff of the Department of Public Health, Fukushima Medical University School of Medicine, for data management. This study was funded by a Fukushima-ken Igaku Shinkoukai (Fukushima Medical Foundation) grant (2006).

REFERENCES

1 World Health Organization. *Ten Statistical Highlights in Global Public Health. World Health Statistics 2006.* http://www.who.int/whosis/whostat2006_10highlights.pdf. Accessed June 1, 2008. 2006.
2 World Health Organization. *Global Health: Today's Challenges. The World Health Report 2003.* 2003. http://www.who.int/whr/2003/en/Chapter1-en.pdf. Accessed June 1, 2008.
3 Chobanian AV, Bakris GL, Black HR, et al. National Heart, Lung, and Blood Institute Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure; National High Blood Pressure Education Program Coordinating Committee. The Seventh Report of the Joint National Committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. *JAMA.* 2003;289:2560–2572.
4 Murray CJ, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. *Lancet.* 1997;349:1436–1442.
5 Cherry DK, Woodwell DA, Rechtsteiner EA. National Ambulatory Medical Care Survey: 2005 summary. *Adv Data.* 2007;387:1–39.
6 Whelton PK, He J, Appel LJ, et al. National High Blood Pressure Education Program Coordinating Committee. Primary prevention of hypertension: clinical and public health advisory from The National High Blood Pressure Education Program. *JAMA.* 2002;288:1882–1888.
7 Mechanic D, McAlpine DD, Rosenthal M. Are patients' office visits with physicians getting shorter? *N Engl J Med.* 2001;344:198–204.
8 Kikuya M, Hozawa A, Ohokubo T, et al. Prognostic significance of blood pressure and heart rate variabilities: the Ohasama study. *Hypertension.* 2000;36:901–906.
9 Stamler J, Stamler R, Neaton JD. Blood pressure, systolic and diastolic, and cardiovascular risks. US population data. *Arch Intern Med.* 1993;153:598–615.
10 Flack JM, Neaton J, Grimm R Jr, et al. Blood pressure and mortality among men with prior myocardial infarction. Multiple Risk Factor Intervention Trial Research Group. *Circulation.* 1995;92:2437–2445.
11 Mancia G, De Backer G, Dominiczak A, et al; Management of Arterial Hypertension of the European Society of Hypertension; European Society of Cardiology. 2007 Guidelines for the management of arterial hypertension: the task force for the management of arterial hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *J Hypertens.* 2007;25:1105–1187.
12 Whitworth JA; World Health Organization, International Society of Hypertension Writing Group. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. *J Hypertens.* 2003;21:1983–1992.
13 National Kidney Foundation Kidney Disease Outcome and Quality Initiative (NKF/KDOQI). K/DOQI clinical practice guidelines on hypertension and antihypertensive agents in chronic kidney disease. *Am J Kidney Dis.* 2004;43(5 suppl 1):S1–S290.
14 Almdal T, Scharling H, Jensen JS, et al. The independent effect of type 2 diabetes mellitus on ischemic heart disease, stroke, and death: a population-based study of 13,000 men and women with 20 years of follow-up. *Arch Intern Med.* 2004;164:1422–1426.
15 Adler AI, Stratton IM, Neil HA, et al. Association of systolic blood pressure with macrovascular and microvascular complications of type 2 diabetes (UKPDS 36): prospective observational study. *BMJ.* 2000;321:412–419.
16 The Japanese Society of Nephrology. *Clinical Practice Guidebook for Diagnostic and Treatment of Chronic Kidney Disease.* Tokyo: Tokyo Igakusya; 2007 (In Japanese).
17 Levey AS, Coresh J, Balk E, et al.; National Kidney Foundation. National Kidney Foundation practice guidelines for chronic kidney disease: evaluation, classification, and stratification. *Ann Intern Med.* 2003;139:137–147.
18 Go AS, Chertow GM, Fan D, et al. Chronic kidney disease and the risks of death, cardiovascular events, and hospitalization. *N Engl J Med.* 2004;351:1296–1305.
19 Deo R, Fyr CL, Fried LF, et al.; Health ABC study. Kidney dysfunction and fatal cardiovascular disease – an association independent of atherosclerotic events: results from the Health, Aging, and Body Composition (Health ABC) study. *Am Heart J.* 2008; 155:62–68.
20 Japanese Society of Hypertension. Japanese Society of Hypertension guidelines for the management of hypertension (JSH 2004). *Hypertens Res.* 2006;29(suppl):S1–S105.
21 Kitamura A, Iso H, Iida M, et al. Trends in the incidence of coronary heart disease and stroke and the prevalence of cardiovascular risk factors among Japanese men from 1963 to 1994. *Am J Med.* 2002;112:104–109.
22 Kubo M, Kiyohara Y, Kato I, et al. Trends in the incidence, mortality, and survival rate of cardiovascular disease in a Japanese community: the Hisayama study. *Stroke.* 2003;34:2349–2354.
23 Ministry of Health and Welfare. *5th National Basic Survey for Circulatory Disease.* http://www.mhlw.go.jp/toukei/saikin/hw/kenkou/jyunkan/jyunkan00/gaiyo.html. Accessed June 1, 2008. 2001 (In Japanese).

24 Eckel RH, Grundy SM, Zimmet PZ. The metabolic syndrome. *Lancet.* 2005;365:1415–1428.
25 Spranger CB, Ries AJ, Berge CA, et al. Identifying gaps between guidelines and clinical practice in the evaluation and treatment of patients with hypertension. *Am J Med.* 2004;117:14–18.
26 Singer GM, Izhar M, Black HR. Goal-oriented hypertension management: translating clinical trials to practice. *Hypertension.* 2002;40:464–469.
27 Osuga E, Tamachi H, Hayakawa H. Blood pressure control in outpatients with hypertension after the publication of the JSH 2000 guidelines. *Jpn J Clin Pharmacol Ther.* 2003;34:283–288 (In Japanese).
28 Phan TL, Elias C, Nguyen TL, et al. The prevalence of reproductive tract infections in Hue, Vietnam. *Stud Fam Plann.* 2002;33:217–226.
29 Japan Diabetes Society. *Diabetes Treatment Guideline 2008-2009*, Tokyo: Bunkodo; 2008 (In Japanese).
30 Ministry of Health, Labor and Welfare & Ministry of Education, Culture, Sports, Science and Technology. *Ethical Guideline for Epidemiological Studies.* http://www-bm.mhlw.go.jp/general/seido/kousei/i-kenkyu/ekigaku/0504sisin.html. Accessed June 1, 2008. 2007 (In Japanese).
31 Anonymous. World Medical Association Declaration of Helsinki. *JAMA.* 2000;284:3043–3045.
32 Yamamoto Y, Sonoyama K, Matsubara K, et al. The status of hypertension management in Japan in 2000. *Hypertens Res.* 2002;25:717–725.
33 Lloyd-Jones DM, Evans JC, Larson MG, et al. Differential control of systolic and diastolic blood pressure: factors associated with lack of blood pressure control in the community. *Hypertension.* 2000;36:594–599.
34 Hyman DJ, Pavlik VN. Characteristics of patients with uncontrolled hypertension in the United States. *N Engl J Med.* 2001;345:479–486.
35 Public Health Division, Ministry of Health, Labor and Welfare. *National Survey of Health and Nutrition.* http://www.mhlw.go.jp/houdou/2007/05/h0516-3a.html. Accessed June 1, 2008. 2007 (In Japanese).
36 Reeves MJ, Rafferty AP. Healthy lifestyle characteristics among adults in the United States, 2000. *Arch Intern Med.* 2005;165:854–857.
37 *Summary Health Statistics for U.S. Adults: National Health Interview Survey.* 2006. http://www.cdc.gov/nchs/data/series/sr_10/sr10_235.pdf. Accessed June 1, 2008.
38 Brown CD, Higgins M, Donato KA, et al. Body mass index and the prevalence of hypertension and dyslipidemia. *Obes Res.* 2000;8:605–619.
39 Wilsgaard T, Schirmer H, Arnesen E. Impact of body weight on blood pressure with a focus on sex differences: the Tromso Study, 1986-1995. *Arch Intern Med.* 2000;160:2847–2853.
40 Rosenbaum M, Leibel RL, Hirsch J. Obesity. *N Engl J Med.* 1997;337:396–407.
41 Anonymous. Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. *Arch Intern Med.* 1998;158:1855–1867.
42 Kiernan M, Winkleby MA. Identifying patients for weight-loss treatment: an empirical evaluation of the NHLBI obesity education initiative expert panel treatment recommendations. *Arch Intern Med.* 2000;160:2169–2176.
43 Tozawa M, Oshiro S, Iseki C, et al. Multiple risk factor clustering of hypertension in a screened cohort. *J Hypertens.* 2000;18:1379–1385.
44 Kannel WB, Wilson PW, Zhang TJ. The epidemiology of impaired glucose tolerance and hypertension. *Am Heart J.* 1991;121:1268–1273.
45 Bønaa KH, Thelle DS. Association between blood pressure and serum lipids in a population. The Tromsø Study. *Circulation.* 1991;83:1305–1314.
46 Knight EL, Bohn RL, Wang PS, et al. Predictors of uncontrolled hypertension in ambulatory patients. *Hypertension.* 2001;38:809–814.
47 Di Bari M, Salti F, Nardi M, et al. Undertreatment of hypertension in community-dwelling older adults: a drug-utilization study in Dicomano, Italy. *J Hypertens.* 1999;17:1633–1640.
48 Street RL Jr, Gordon HS, Ward MM, et al. Patient participation in medical consultations: why some patients are more involved than others. *Med Care.* 2005;43:960–969.
49 Düsing R. Overcoming barriers to effective blood pressure control in patients with hypertension. *Curr Med Res Opin.* 2006;22:1545–1553.

Original Paper

Longitudinal Community-Based Assessment of Blood Pressure Control Among Japanese Hypertensive Patients: Fukushima Research of Hypertension (FRESH)

Hirohide Yokokawa, MD, PhD;[1] Aya Goto, MD, MPH, PhD;[1]
Hironobu Sanada, MD, PhD;[2,3] Tsuyoshi Watanabe, MD, PhD;[3]
Seiji Yasumura, MD, PhD[1]

In this observational cohort study, the authors assessed the achievement of treatment goals as defined in the Japanese Society of Hypertension's Guidelines for the Management of Hypertension (JSH 2004) among 2743 Japanese hypertensive patients who were followed for 1 year (follow-up rate of 82.6%). Median age was 72 years, and 45% were men. Achievement of treatment goals across all 4 seasons was very low, at 4.1% among patients with diabetes mellitus or renal disease, 3.9% among nonelderly patients (<65 years of age) without these diseases, and 30.8% among elderly patients (≥65 years of age) without these diseases. These findings highlight the importance of maintaining appropriate blood pressure control. In addition, an analysis of factors associated with achievement rates identified the importance of weight control, lifestyle modification, and family history, and indicated a need for better blood pressure management before complications arise. J Clin Hypertens (Greenwich). *2010;12:166–173.* ©*2010 Wiley Periodicals, Inc.*

From the Department of Public Health, Fukushima Medical University School of Medicine;[1] the Fukushima Welfare Federation of Agricultural Cooperatives, Division of Health Science Research;[2] and the Division of Nephrology, Hypertension, Endocrinology, and Diabetology/Metabolism, Fukushima Medical University School of Medicine,[3] Fukushima, Japan
Address for correspondence: Hirohide Yokokawa, MD, PhD, Department of Public Health, Fukushima Medical University School of Medicine 1, Hikarigaoka, Fukushima City, Fukushima 960 1295, Japan
E-mail: yokokawa@fmu.ac.jp
Manuscript received May 26, 2009; revised October 20, 2009; accepted October 30, 2009

doi: 10.1111/j.1751-7176.2009.00242.x

Cardiovascular diseases (CVDs) are some of the most prevalent causes of death globally and are projected to remain the leading cause of death for the foreseeable future.[1–3] The World Health Organization has reported that 17.5 million persons worldwide are estimated to have died from CVDs in 2005, and an estimated 20 million persons will die from them every year by 2015, mainly from heart attacks and strokes, if corrective action is not taken.[4] Hypertension is well-known to be one of the most common risk factors for CVDs, which include coronary artery disease, cerebrovascular disease, heart failure, and peripheral artery disease.[5,6] Up to 30% of adults have high blood pressure (BP) in much of the world, and 50% to 60% of these cases could be prevented by increasing physical activity, maintaining an ideal body weight, and eating a balanced diet.[7]

In the past several decades, many studies have revealed risk factors for hypertension and many

trials have been conducted in attempts to prevent hypertension and improve BP levels.[8–11] From these studies and trials, several hypertension management guidelines have been established as part of evidence-based manuals, advising health care providers on the most effective and practical therapies for hypertensive patients.[12–15] Despite these guidelines, however, the prevalence of hypertension is increasing. In the United States, the National Health and Nutrition Examination Survey (NHANES), which was conducted in 1999–2000, reported that the prevalence of hypertension was 28.7% in that period, an increase of 3.7% from 1988 to 1991.[16] Furthermore, the proportion of hypertensive patients whose BP was >140/90 mm Hg remained constant during that time, at 31.0%, although awareness and treatment improved compared with the previous survey. In Japan, the average BP decreased from 1961 to 1990 in men (from 143.2/83.0 mm Hg to 134.3/82.9 mm Hg) and women (from 143.3/82.2 mm Hg to 128.4/77.6 mm Hg) aged 30 to 69 years, likely as a result of public health efforts and newly developed medications.[15] There are still more than 30 million hypertensive patients in Japan,[17] however, and hypertension is the third most common reason for Japanese outpatient clinical visits.[18]

Researchers have reported seasonal effects on BP and the incidence and mortality of cerebrovascular disease.[19,20] A survey of the general Japanese population revealed a significant seasonal pattern in the incidence of intracerebral hemorrhage among patients with hypertension and negative correlations between mean ambient temperature and incidence of both intracerebral hemorrhage and infarction.[20] The temperature in Japan varies seasonally, with the average temperature in August reaching approximately 30°C, while in January, the average temperature in Tokyo is approximately 8°C. Based on these previous reports, the importance of controlling BP consistently across all seasons is emphasized in the Japanese Society of Hypertension's Guidelines for the Management of Hypertension (JSH 2004), as well as in other guidelines for hypertension management.[12–15] A few epidemiologic studies outside Japan have reported success in achieving target BP goals across all seasons,[21–23] but there is little evidence of this in Japan.

We conducted a prospective study among Japanese hypertensive patients for 1 year. Results from the baseline survey have been previously reported.[24] In short, we found a low success rate in achieving treatment goals defined by JSH 2004, and found that obesity, family history, organ damage, and CVDs were factors that affected this success rate.[24] The aim of this report was to assess seasonal changes in the achievement of treatment goals as defined by JSH 2004 and to explore factors associated with success in maintaining BP levels consistently across all seasons.

RESEARCH DESIGN AND METHODS

The present study was a prospective cohort study carried out in Fukushima Prefecture, Japan, from July 2006 to May 2007, and a detailed description is provided in our previous report.[24] Participants in our study were hypertensive patients who had been treated with antihypertensive medication for at least 3 months and who visited a participating physician during the baseline survey period (July 2006). Enrolled patients were monitored for 1 year at 3-month intervals (July 2006, October 2006, January 2007, and April 2007).

For the baseline survey, we copied registered patients' clinical data from medical files to survey sheets. Data included age, sex, height, weight, waist circumference, family history (hypertension, diabetes mellitus, dyslipidemia, heart disease, stroke, renal disease, and premature CVD), alcohol consumption, current smoking status, systolic and diastolic BPs, whether the patient had been instructed in home BP measurement, duration of hypertension treatment, usage of antihypertensive drugs, presence of metabolic disorders (diabetes mellitus, dyslipidemia), presence of organ damage, and/or CVD status (brain, heart, kidney, blood vessels, hypertensive, or diabetic retinopathy). We asked physicians to employ their standard methods to measure BP. In general, measurements are taken according to JSH 2004 recommendations in Japan. According to our survey, 80.0% of physicians personally take patient BP measurements, 82.9% do so during medical consultation, 82.9% do so in a consultation room, and 72.9% use a mercury sphygmomanometer. Follow-up surveys collected hypertension-related information, which included whether appointments were kept during the preceding 3-month period, systolic and diastolic BP measurements, and changes in medication.

All data were entered into a computer and analyzed using SPSS version 16 (SPSS Inc, Chicago, IL). We classified patients into 3 groups according to JSH 2004: elderly patients 65 years and older without diabetes mellitus or renal disease, nonelderly patients younger than 65 years without diabetes mellitus or renal disease, and patients with diabetes mellitus or renal disease. We calculated success rates according to the following treatment goals for

Table I. Characteristics of Hypertensive Patients at Baseline

Variables	Median (Min–Max) or No. (%)
Age, y	72 (24–99)
Sex, male	1229 (44.8)
Anthropometric measurements	
Body mass index, kg/m^2	24.3 (13.2–45.4)
Waist circumference, cm	
Male	85.0 (53.0–134.0)
Female	87.5 (59.0–126.0)
Family history	
Hypertension	1567 (57.1)
Stroke	796 (29.0)
Diabetes mellitus	476 (17.4)
Heart disease	418 (15.2)
Dyslipidemia	115 (4.2)
Renal disease	99 (3.6)
Premature cardiovascular disease	35 (1.3)
Alcohol consumption (daily)	594 (21.7)
Current smoking status	317 (11.6)
Hypertension-related factors	
Systolic blood pressure, mm Hg	134 (84–212)
Diastolic blood pressure, mm Hg	76 (36–124)
Instruction in home blood pressure measurement (yes)	1581 (57.7)
Duration of hypertension treatment (yes)	9.0 (0.5–60)
Number of antihypertensive drugs used	
1	1219 (44.4)
2	1103 (40.3)
≥3	421 (15.3)
Metabolic disorders	
Diabetes mellitus	834 (30.4)
Dyslipidemia	1211 (44.2)
Organ damage/cardiovascular disease	
Heart	538 (19.6)
Brain	368 (13.4)
Kidney	248 (9.0)
Peripheral vascular disease	197 (7.2)
Hypertensive retinopathy	119 (4.3)
Diabetic retinopathy	141 (5.1)

each group as indicated in JSH 2004: ≤140/90 mm Hg for elderly patients without diabetes mellitus or renal disease, ≤130/80 mm Hg for patients with these diseases, and ≤130/85 mm Hg for nonelderly patients without these diseases. We compared seasonal changes in success rates with baseline data using the McNemar test for each group. For groups in which seasonal change in BP was observed, we displayed the change distribution from the second baseline to the follow-up survey in figures.

To analyze factors associated with failure to achieve treatment goals across all seasons, we first conducted univariate logistic regression analysis. The following independent variables were entered into the analyses: sex, body mass index (BMI), waist circumference, family history, alcohol consumption, current smoking status, instruction in home BP measurement, number of antihypertensive drugs used (1, 2, or ≥3), dyslipidemia, and presence of organ damage or CVD. We excluded family history of dyslipidemia, renal disease, and premature cardiovascular death, which were included in JSH 2004, because the incidence of these was very low in our study population. Significant factors from the univariate analysis ($P<.05$) were then entered into a multivariate logistic regression analysis, and odds ratios (ORs) and 95% confidence intervals (95% CIs) were calculated.

This survey was conducted in accordance with Ethical Guidelines for Epidemiological Studies established by the Japanese government,[25] and work was performed in accordance with the Helsinki Declaration of 1975 (revised in 2000).[26]

RESULTS

In the baseline survey, 3358 hypertensive patients were initially registered by 72 of 120 physician members of the Fukushima Hypertension Conference. Thirty-eight of the registered patients were excluded due to missing data on BP or lack of prescribed medications; thus, 3320 patients were entered into the present analysis, and 2743 of them could be followed for 1 year (follow-up rate of 82.6%). Median age of patients was 72 years (24–99 years) and the percentage of men was 44.8% (Table I). Median BMI was 24.3 kg/m^2 (13.2–45.4 kg/m^2), and median waist circumference was 85.0 cm (53.0–134.0 cm) for men and 87.5 cm (59.0–126.0 cm) for women. For family history, prevalence of hypertension was most frequent (57.1%), followed by stroke (29.0%), diabetes mellitus (17.4%), and heart disease (15.2%). Prevalence of alcohol use (daily consumption) was 21.7%, and 11.6% were current smokers. Median systolic and diastolic BPs were 134 mm Hg (84–212 mm Hg) and 76 mm Hg (36–124 mm Hg), respectively. Fifty-eight percent of patients were given instructions on how to measure their BP at home, 44.4% of patients were treated with 1 antihypertensive drug, and the median duration of hypertension treatment was 9.0 years (0.5–60.0 years). Proportion of those with diabetes mellitus was 30.4%, and 44.2% had dyslipidemia. Cardiovascular complications were reported in 19.6% of patients,

neurological complications in 13.4%, and renal complications in 9.0%.

Table II shows changes in success rates in achieving BP goals (defined by JSH 2004) across all seasons. Among elderly patients without diabetes mellitus or renal disease, the success rate significantly dropped from 65.9% to 61.6% in January 2007 compared with baseline (July 2006). Figure 1 shows the distribution of changes in systolic BPs of elderly patients without diabetes mellitus or renal disease. Mean change was 1.43 mm Hg (standard deviation [SD] 15.69 mm Hg) ranging from −68 mm Hg to 66 mm Hg. Also, Figure 2 shows the distribution for diastolic BPs, and mean change was 0.54 mm Hg (SD 9.93 mm Hg) and ranged from −36 mm Hg to 46 mm Hg.

Among elderly patients without diabetes mellitus or renal disease, 30.8% were successful in achieving their BP goals across all seasons, while 9.4% were unsuccessful. In contrast, for nonelderly patients without these diseases, year-round success and failure rates were 3.9% and 42.9%, respectively, and for patients with these diseases, year-round success and failure rates were 4.1% and 45.5%, respectively (Table III).

Multivariate analysis showed that factors significantly associated with all-season failure to achieve treatment goals in elderly patients without diabetes mellitus or renal disease were the use of ≥2 antihypertensive drugs (OR, 2.08; 95% CI, 1.34–3.25 and OR, 4.45; 95% CI, 2.68–7.40), and the presence of organ damage or CVD (OR, 0.55; 95% CI, 0.36–0.84) (Table IV). For nonelderly patients without these diseases, significant factors associated with all-season failure to achieve goals were male sex (OR, 0.63; 95% CI, 0.43–0.92), BMI ≥25 kg/m^2 (OR, 2.11; 95% CI, 1.44–3.07), and presence of organ damage or CVD (OR, 0.47; 95% CI, 0.28–0.79) (Table IV). For patients with these diseases, a family history of hypertension (OR, 1.40; 95% CI,1.07–1.83), daily alcohol consumption (OR, 1.64; 95% CI, 1.15–2.32), current smoking status (OR, 1.53; 95% CI, 1.02–2.30), receiving instruction in home BP measurement (OR, 1.41; 95% CI, 1.07–1.86), dyslipidemia (OR, 1.35; 95% CI, 1.07–1.77), and presence of organ damage or CVD (OR, 0.58; 95% CI, 0.44–0.76) were significantly associated with year-round failure to achieve treatment goals (Table IV).

We performed a power calculation for the presence of organ damage or CVD, which was a significant factor in all subgroups, and estimated the power as 98.3%.

Table II. Success Rates in Achieving Goal Blood Pressure Levels Across All Seasons

	Elderly Patients Without Diabetes Mellitus or Renal Disease (N=1319)			Nonelderly Patients Without Diabetes Mellitus or Renal Disease (N=482)			Patients With Diabetes Mellitus or Renal Disease (N=942)		
	Mean (SD) SBP/DBP, mm Hg	No. (%)	*P* Value[a]	Mean (SD) SBP/DBP, mm Hg	No. (%)	*P* Value[a]	Mean (SD[b]) SBP/DBP, mm Hg	No. (%)	*P* Value[a]
Baseline (July 2006)	134.1 (13.5)/74.5 (9.0)	869 (65.9)		133.2 (12.5)/80.2 (8.7)	141 (29.3)		135.4 (14.1)/75.5 (10.5)	231 (24.5)	
First follow-up (October 2006)	134.3 (13.2)/74.6 (9.1)	874 (66.3)	.89	134.7 (12.9)/81.2 (8.6)	119 (24.7)	.07	135.3 (14.6)/75.5 (9.7)	229 (24.3)	1.00
Second follow-up (January 2007)	135.5 (14.0)/75.0 (9.4)	813 (61.6)	.01	135.0 (13.3)/80.7 (9.4)	117 (24.3)	.07	136.1 (15.6)/75.4 (10.6)	242 (25.7)	.55
Third follow-up (April 2007)	135.3 (13.6)/75.0 (9.2)	830 (62.9)	.08	134.1 (12.5)/80.8 (9.1)	142 (29.5)	1.00	135.5 (14.8)/75.5 (10.9)	249 (26.4)	.30

Abbreviations: DBP, diastolic blood pressure; SBP, systolic blood pressure; SD, standard deviation. [a]Seasonal changes in success rates were compared with the McNemar test baseline data in each group.

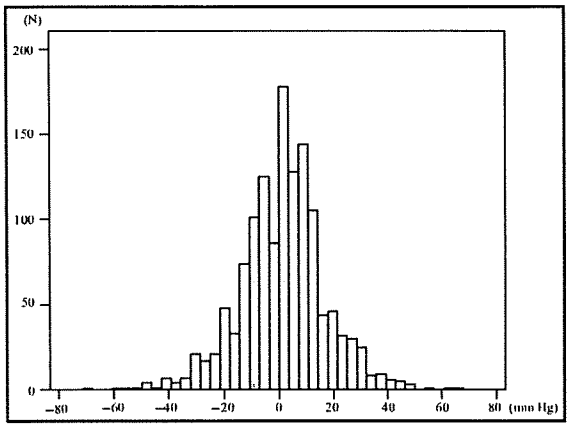

Figure 1. Distribution of changes in systolic blood pressure between measurements between second follow-up and baseline survey among elderly patients without diabetes mellitus or renal disease.

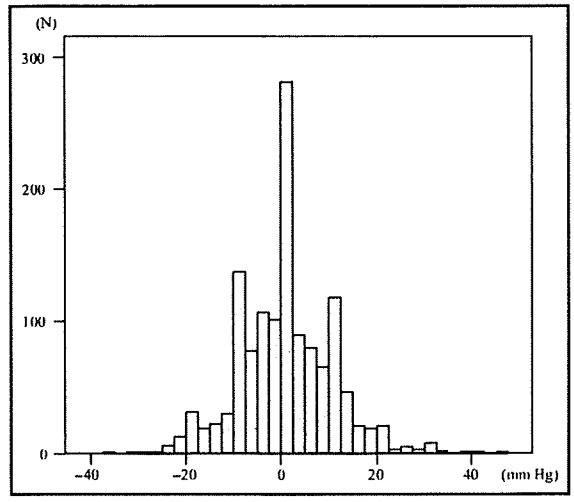

Figure 2. Distribution of changes in diastolic blood pressure between measurements between second follow-up and baseline survey among elderly patients without diabetes mellitus or renal disease.

DISCUSSION

To the best of our knowledge, this is the first Japanese community-based prospective study evaluating hypertension treatment according to JSH 2004 guidelines. Overall results seemed to show excellent control of BP with a median BP <140/90 mm Hg throughout the year. However, in terms of JSH 2004 treatment goals, all-season success rates were extremely low in nonelderly Japanese hypertensive patients without diabetes mellitus or renal disease and in all patients with these diseases. In our previous report analyzing baseline survey data obtained in the summer,[24] we reported low rates of success in achievement of BP goals among nonelderly without diabetes mellitus or renal disease and among patients with these diseases. Adding to these findings, the proportion of patients who had success across all seasons in the present follow-up survey was as low as 5% in nonelderly without diabetes mellitus or renal disease as well as in patients with these diseases, highlighting the difficulty in consistently maintaining BP in these patients. Furthermore, success rates showed statistical significance, but the slight drop during the winter among elderly patients without diabetes mellitus or renal disease indicates that ambient temperature may be an important factor in the management of hypertension among these patients. A number of studies have shown that BP is subject to seasonal influences and is lower in hot seasons than in cold ones.[27–30] A population-based prospective study among the elderly reported that outdoor temperature and BP levels were strongly correlated.[30] Accordingly, cardiovascular events are known to occur at a higher rate in winter.[19,20,31] In addition, as vitamin D deficiency is known to lower BP, and may occur in winter due to reduced sun exposure, this may explain some seasonal changes in BP levels.[32] In the present study, seasonal variation was observed only among elderly patients without diabetes mellitus or renal disease. It is possible that these patients may be more vigilant in maintaining their BP in the winter compared with patients without these diseases, and their attending doctors may be more aggressive in their treatment of these patients. These results indicate that clinicians and patients should pay greater attention to BP maintenance during cold seasons.

Further multivariate analysis revealed factors associated with all-season failure to achieve BP goals. It is noteworthy that these risk factors were different in each group. Among elderly patients without diabetes mellitus or renal disease, the only risk factor was an increased number of medications. We propose two possible explanations for this. For one, these elderly patients without diabetes mellitus or renal disease may have fewer risk factors such as obesity, family history, and lifestyle factors, which may have played a role in the multivariate analysis of the other two groups. One of our previous studies conducted in a Japanese community showed that elderly patients had healthier lifestyles and a lower proportion of obesity compared with nonelderly patients.[33] Another possible explanation is that physicians may be more careful in adding medications for elderly patients due to their known susceptibility to variability in BP and widening of pulse pressure.[15] Accordingly, in our

Table III. Proportions of Year-Round Failure and Success in Achieving Blood Pressure Goals

	Year-Round Failure, No. (%)	Year-Round Success, No. (%)
Elderly patients without diabetes mellitus or renal disease (n=1320)	124 (9.4)	407 (30.8)
Nonelderly patients without diabetes mellitus or renal disease (n=482)	207 (42.9)	19 (3.9)
Patients with diabetes mellitus or renal disease (n=941)	429 (45.5)	39 (4.1)

Table IV. Risk Factors for Failure to Achieve Blood Pressure Goals in Patients With or Without Diabetes Mellitus or Renal Disease Across All Seasons (Multivariate Logistic Regression Analysis)

Significant Variables	No. (%)	Odds Ratio	95% Confidence Interval	*P* Value
Elderly patients without diabetes mellitus or renal disease				
No. of antihypertensive drug used				
1	632 (47.9)	1.00 (Reference)		
2	508 (38.5)	2.08	1.34–3.25	<.01
≥3	180 (13.6)	4.45	2.68–7.40	<.01
Presence of organ damage or cardiovascular disease	475 (36.0)	0.55	0.36–0.84	<.01
Nonelderly patients without diabetes mellitus or renal disease				
Sex (male)	274 (56.8)	0.63	0.43–0.92	<.01
Body mass index ≥25 kg/m^2	204 (42.6)	2.11	1.44–3.07	<.01
Presence of organ damage or cardiovascular disease	88 (18.3)	0.47	0.28–0.79	<.01
Patients with diabetes mellitus or renal disease				
Family history of hypertension (yes)	508 (53.9)	1.40	1.07–1.83	<.01
Alcohol consumption (daily)	175 (18.7)	1.64	1.15–2.32	<.01
Current smoking status	128 (13.6)	1.53	1.02–2.30	<.01
Hypertension-related factors				
Instruction in home blood pressure measurement (yes)	560 (59.6)	1.41	1.07–1.86	<.01
Dyslipidemia (yes)	511 (54.4)	1.35	1.03–1.77	<.01
Presence of organ damage or cardiovascular disease	459 (48.8)	0.58	0.44–0.76	<.01

study, median BP of elderly patients without diabetes mellitus or renal disease treated with ≥2 medications was significantly higher than in nonelderly patients without these diseases. The proportion of patients with diastolic BPs <60 mm Hg was also significantly higher among elderly patients than nonelderly patients.

As for the nonelderly group without diabetes mellitus or renal disease, female sex and BMI >25 kg/m^2 were major risk factors. For sex-specific BP control, NHANES 1999–2004[34] reported that the proportion of men with uncontrolled BP was 50.8% and for women was 55.9%. The most recent survey indicated that hypertension medications were prescribed more often for men than for women, which was consistent with our survey. Sex hormones may also contribute to the sex-specific differences in BP control. Androgen, for example, may be a major contributor toward increases in BP among postmenopausal women.[35]

As for obesity, it has been clearly demonstrated that BMI is positively associated with high BP.[36–39] The Atherosclerosis Risk in Communities (ARIC) study[38] has shown that weight gain leads to increased systolic and diastolic BP levels. Assessment of sex-specific characteristics and body weight should be recognized as important factors for the management of hypertension among nonelderly patients.

Several factors were associated with high BP in patients with diabetes mellitus or renal disease: family history, health habits, and metabolic variables were shown to be risk factors by multivariate regression analysis. The relationship between hypertension and a family history of this disease has been previously reported,[40–42] and genetic, biochemical, and behavioral components are implicated in this relationship.[42] Dekkers and colleagues[40] reported that a family history of essential hypertension was associated with increased systolic BP and formation of left ventricular mass in childhood. As for health habits, daily alcohol consumption and

current smoking status increased the risk of failure to achieve BP goals. Excessive intake of alcohol and smoking are well-known to increase BP, and restriction of these habits is recommended in hypertension management guidelines.[12–15, 43–46] Dyslipidemia is frequently observed in hypertensive patients and should be considered as an important factor for hypertension treatment, as stated in the guidelines.[12–15] Our present results indicate the importance of assessing family history and making lifestyle modifications for better management of hypertension among patients with diabetes mellitus or renal disease.

Interestingly, we found a positive association between history of organ and vascular complications and year-round achievement of BP goals in all groups. This seemingly paradoxical result may be due to increased awareness in managing BP levels by both doctors and patients once a complication occurs. A previous study has pointed out that a lack of disease awareness is a patient-related factor associated with poor BP control.[47] Our study provides an important indication of the necessity of appropriately managing hypertension by both physicians and patients prior to the onset of complications.

LIMITATIONS

The first limitation of our study was selection bias. Physicians who participated in our study were all members of the Fukushima Hypertension Conference, and the number of patients was reduced from 3320 to 2743 during the follow-up period. It is possible that participating physicians and patients might be more aware of hypertension management practices compared with nonparticipants. Success rates might be lower if nonparticipants were included. Second, some important factors, such as the patients' health behavior and disease awareness, and physician's awareness and daily practices, were not obtained in our survey. Inclusion of these additional factors in the multivariate analysis model might have altered our results. Use of multiple medications and instruction in home BP measurement were found to be risk factors. Without more detailed data about physicians in our study, we are unable to determine whether results reflect inadequacies in physicians' oversight of medication regimens and instruction in home monitoring in patients with poor control, or whether poor control is a direct result of multiple medications and home monitoring.

CONCLUSIONS

The present cohort study revealed low success rates in achieving treatment goals for hypertensive patients during 1 year, especially in patients with diabetes mellitus or renal disease, and patients younger than 65 years without these diseases. Analysis of associated factors indicated the importance of weight control for nonelderly patients without diabetes mellitus or renal disease, lifestyle modification, family history assessment for patients with these diseases, and better BP management before atherosclerotic complications arise for all hypertensive patients.

Acknowledgments and disclosure: The authors thank physicians of the Fukushima Hypertension Conference for their crucial assistance in data collection and staff members of the Department of Public Health and Fukushima Medical University School of Medicine for data management. This study was funded by a Fukushima-ken Igaku Shinkoukai (Fukushima Medical Foundation) grant (2006).

REFERENCES

1 Murray CJ, Lopez AD. Global mortality, disability, and the contribution of risk factors: Global Burden of Disease Study. *Lancet*. 1997;349:1436–1442.
2 World Health Organization. Ten statistical highlights in global public health. World Health Statistics 2006. http://www.who.int/whosis/whostat2006_10highlights.pdf. 2006 Accessed April 1, 2009.
3 World Health Organization. Global health: today's challenges. The World Health Report 2003. http://www.who.int/whr/2003/en/Chapter1-en.pdf. 2003 Accessed April 5, 2009.
4 World Health Organization. Cardiovascular diseases. http://www.who.int/cardiovascular_diseases/en/. Accessed April 7, 2009.
5 Lida M, Ueda K, Okayama A, et al. Impact of elevated blood pressure on mortality from all causes, cardiovascular diseases, heart disease and stroke among Japanese: 14 year follow-up of randomly selected population from Japanese – Nippon data 80. *J Hum Hypertens*. 2003;17:851–857.
6 Antikainen R, Jousilahti P, Tuomilehto J. Systolic blood pressure, isolated systolic hypertension and risk of coronary heart disease, strokes, cardiovascular disease and all-cause mortality in the middle-aged population. *J Hypertens*. 1998;16:577–583.
7 World Health Organization. The atlas of heart and stroke. Risk factor: blood pressure. http://www.who.int/cardiovascular_diseases/en/cvd_atlas_05_HBP.pdf. Accessed April 5, 2009.
8 Lewington S, Clarke R, Qizilbash N, et al. Age-specific relevance of usual blood pressure to vascular mortality: a meta-analysis of individual data for one million adults in 61 prospective studies. *Lancet*. 2002; 14;360: 1903–360: 1913.
9 Tunstall-Pedoe H, Woodward M, Tavendale R, et al. Comparison of the prediction by 27 different factors of coronary heart disease and death in men and women of the Scottish Heart Health Study: cohort study. *BMJ*. 1997;20:315:722:729.
10 Pocock SJ, McCormack V, Gueyffier F, et al. A score for predicting risk of death from cardiovascular disease in adults with raised blood pressure, based on individual patient data from randomised controlled trials. *BMJ*. 2001;7304:75–81.
11 Zanchetti A, Hansson L, Clement D, et al. Benefits and risks of more intensive blood pressure lowering in hypertensive patients of the HOT study with different risk