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ARTICLE

Comparison of questionnaire responses regarding awareness of Japanese Society of Hypertension guidelines for the management of hypertension between 2014 and 2019 in primary care

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Abstract

In 2019, the Japanese Society of Hypertension guidelines for the management of hypertension (JSH) were revised. We previously reported the awareness of JSH among general practitioners in 2014, and in the current study, the same questionnaire was administered to determine their awareness of JSH 2019, and their responses were compared. We also sought to identify effective strategies to raise awareness of hypertension. The questionnaires included the same 12 questions as in 2014 and were mailed to members of two professional organizations from October to November 2019. Responses from 256 general practitioners in 2019 and 209 in 2014 were compared using the propensity score matching method to align the responders' backgrounds. Component analysis was performed to classify responders into appropriate clusters. The matched cohort of all 202 responders was analyzed. In both 2014 and 2019, >80% of responders instructed patients to perform home blood pressure monitoring (JSH 2014: 81.7% and JSH 2019: 84.6% in the matched cohort), and >70% instructed patients with hypertension to restrict their salt intake (JSH 2014: 79.7% and JSH 2019: 74.7% in the matched cohort). Regarding the clinical blood pressure measurement method, more responders answered "one time outside the consulting room" in the JSH 2019 group ($p = 0.042$). Fewer general practitioners responded that differential diagnosis for primary aldosteronism was performed in the JSH 2019 group ($p = 0.032$); however, the frequency of checking the aldosterone-renin ratio increased in the JSH 2019 group ($p = 0.055$). We confirmed the change in general practitioners' awareness of hypertension management. The categorized clusters may be useful for the development of effective strategies for higher-quality hypertension management in clinical practice.

Keywords guidelines · hypertension · primary practice · questionnaire

Introduction

Hypertension is one of the most common diseases and is defined as having a systolic blood pressure (SBP) ≥ 140 mmHg, having a diastolic BP ≥ 90 mmHg, or taking BP-lowering agents. The prevalences of hypertension among men and women aged 40–74 are 60% and 41%, respectively [1], and currently, the number of patients with hypertension in Japan is estimated to be 43 million. Hypertension is a major risk factor for cerebral and cardiovascular diseases and is closely related to reduced life expectancy and increased medical costs in an aging society. Therefore, appropriate BP management by general practitioners is one of the most important national strategies. In Japan, this was named "The National Health Promotion Campaign in the 21st Century (Health Japan 21)" and has been promoted by the Ministry of Health, Labor, and Welfare since 2000.

In 2000, advocacy for evidence-based medicine began, and the Japanese Society of Hypertension Guidelines for the Management of Hypertension was first published (JSH 2000). In April 2019, the fifth revision, JSH 2019, was released [2].

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JSH 2019 aimed to standardize hypertension management and prevent cardiovascular disease based on the answers to clinical questions provided by systemic reviews that included new clinical evidence. JSH 2019 recommends stricter BP control based on the results of the systolic blood pressure intervention trial (SPRINT trial) [3] and includes guidelines for hypertension management in older adults with frailty, sarcopenia, or dementia. Furthermore, calcium antagonists or diuretics were added to renin-angiotensin system inhibitors as first-line medications in patients with hypertension and diabetes mellitus who do not have albuminuria.

The global standardization of hypertension management based on these guidelines is recommended, but Liang reported that many medical practices in the real world do not comply with these guidelines, creating evidence-practice gaps [4]. Although 67% of medical practices complied with the guidelines, large variations in practices among general practitioners have been reported [5]. Furthermore, serious concerns that hypertension management is unsatisfactory in Japan remain. Notably, 33% of patients with hypertension were unaware of their hypertension diagnosis, and there are low hypertension control rates among men (40%) and women (45%), with a hypertension treatment rate of 65–70% among those aged 70–79 years [6]. To evaluate the awareness of JSH 2014 and to reveal evidence-practice gaps in hypertension management, we previously conducted a questionnaire about JSH 2014 among general practitioners [7]. In that previous study, many general practitioners had adequate adherence to JSH 2014, and their careful application of the guidelines in clinical practice was observed. However, we also found that general practitioners did not necessarily agree with all the guidelines, and general practitioners sometimes selected an appropriate method for the individual patient as part of patient-centered medical care [7].

To investigate changes in awareness of hypertension management among general practitioners after the JSH 2019 revision, we readministered the questionnaire for JSH 2019. Furthermore, by performing factor analysis of the 2019 survey, we aimed to identify effective strategies for improving hypertension awareness in the future.

Methods

Participants and procedures

The survey targeted all members of the Kanagawa Physicians Association, which is a local Japanese organization consisting of 1500 general practitioners in clinics, and the Sagamihara Medical Association, which is a group of 600 medical doctors in ordinance-designated cities in Kanagawa Prefecture, Japan. We mailed the questionnaire to all members in October 2019, and participants responded voluntarily. We compiled the questionnaire responses by fax from October to November 2019 and found that 323 members responded to the survey, representing approximately 15% of all members. We previously administered the questionnaire for JSH 2014, and 209 medical doctors in the same areas replied [7]. To evaluate the change in awareness of hypertension management, we conducted a comparative cross-sectional study of the survey respondents for JSH 2014 and 2019. Respondents were categorized into two groups based on response year, with 209 respondents in the JSH 2014 group and 323 in the JSH 2019 group. The survey contained general questions about the JSH guidelines and the diagnosis and management of hypertension, and the 2019 questionnaire included the same 12 questions as in our previous survey for the JSH 2014 guidelines [7]. This survey was performed in accordance with the principles of the Declaration of Helsinki. The subjects of the two questionnaire surveys were medical doctors, not patients, and this study did not require approval from the ethics committee. The questionnaire was conducted anonymously, and the need to obtain written informed consent was waived.

Propensity score matching

Propensity score (PS) matching is primarily used in observational studies to reduce bias due to covariates. In this study, because the groups were not divided randomly, there may be differences in respondents' characteristics (age distribution, workplace, and specialty) between the two groups. These differences, especially within a specialty, could influence the results. Therefore, we used the PS model to match each group based on their characteristics, and we then compared the two matched groups. We calculated the PS for respondents for JSH 2019 using a logistic regression model to estimate the probability of the assignment of respondents based on the following characteristics: age distribution, workplace, and specialty. We established a model using PS matching with the following algorithm: 1:1 nearest neighbor match with a 0.016 caliper value that was equivalent to 0.2 times the standard deviation of the PS [8] and no replacement. This model was used to investigate any imbalance in the respondents' characteristics and to compare how hypertension awareness and management changed between the JSH 2014 and 2019 groups.

Component and cluster analyses

Reliability analysis was performed before the cluster analysis was conducted. Cronbach's alpha was used to assess reliability, as it is the most common measure of internal consistency ("reliability"). It is an analytical method used to examine the reliability of a set of scales or test items, such as questionnaire data.

Table 1 Responder characteristics of JSH 2014 and 2019 groups in unmatched and matched models

		Unmatched model			Matched model			
		JSH 2014 ($n = 209$)	JSH 2019 ($n = 324$)	p-value	JSH 2014 ($n = 202$)	JSH 2019 ($n = 202$)	p-value	Standardized difference
Age distribution	20's	2 (1.0%)	5 (1.5%)	$p = 0.050$	2 (1.0%)	1 (0.5%)	$p = 0.988$	0.34
	30's	4 (1.9%)	19 (5.9%)		4 (2.0%)	5 (2.5%)		0.11
	40's	39 (18.7%)	40 (12.3%)		32 (15.8%)	32 (15.8%)		0.0
	50's	67 (32.1%)	89 (27.5%)		67 (33.2%)	70 (34.7%)		0.03
	60's	43 (20.6%)	92 (28.4%)		43 (21.3%)	45 (22.3%)		0.03
	over 70	36 (17.2%)	55 (17.0%)		36 (17.8%)	31 (15.3%)		0.09
	no answer	18 (8.6%)	35 (7.4%)		18 (8.9%)	18 (8.9%)		0.0
Workplace	Clinic	114 (54.5%)	163 (50.3%)	$p = 0.141$	110 (54.5%)	111 (55.0%)	$p = 0.958$	0.01
	Hospital	28 (13.4%)	65 (20.1%)		28 (13.9%)	26 (12.6%)		0.04
	no answer	67 (32.1%)	96 (29.6%)		64 (31.7%)	65 (32.2%)		0.01
Specialty	Nephrologist or cardiologist	66 (31.6%)	106 (32.8%)	$p = 0.263$	62 (30.7%)	63 (31.2%)	$p = 0.961$	0.01
	other internal medicine	107 (51.2%)	156 (48.3%)		105 (52.0%)	108 (53.5%)		0.03
	other than internal medicine	9 (4.3%)	27 (8.4%)		9 (4.5%)	8 (4.0%)		0.06
	no answer	27 (12.9%)	31 (10.5%)		26 (12.9%)	23 (11.4%)		0.07

Values are n/total n (%)

P values by chi-square test

The answer choices for the workplace, specialty (Table 1), and questions 1, 2, 4, 5, 7, 9, 11, and 12 (Table 2) were replaced with ordinal variables in the 317 responders in the JSH 2019 group who answered all these questions (out of a total of 324). In the statistical analysis, we excluded the component of age distribution due to the low Cronbach's alpha value and questions 2, 3, 6, 8, and 10 because the answers to these questions were difficult to transform into ordinal variables. We also performed component and cluster analyses of the data. To perform the component analysis, we reclassified the seven answers for question 2 into three ordinal variables; in other words, the low variable was changed to one BP value, the high variables were changed to the average of multiple BP values, and the middle variable was changed to neither answer.

Statistical analysis

The respondent characteristics and all question responses were changed to ordinal variables. The differences between the two groups were analyzed using chi-square tests. P-values < 0.05 were considered statistically significant. Most analyses were performed using SPSS 25.0 software (IBM Inc., Armonk, NY, USA), and for the calculation of sample size, EZR 1.50 software (Jichi Medical University, Saitama, Japan) [9] was used.

Results

Participant characteristics

The respondents' characteristics in the two groups (the JSH 2014 and JSH 2019 groups) in the unmatched cohort are shown in Table 1, including those in the JSH 2014 group, which were previously published [7].

Regarding the responders in the JSH 2019 group, the age structure of the group consisted of five members (1.5%) in their 20 s, 19 (5.9%) in their 30 s, 40 (12.3%) in their 40 s, 89 (27.5%) in their 50 s, 92 (28.4%) in their 60 s, and 35 (7.4%) in their 70 s. With regard to the workplace, 163 members (50.3%) worked in their own offices, and 65 members (20.1%) worked in hospitals. In terms of medical specialty, 106 members (32.8%) specialized in nephrology or cardiology, 156 (48.3%) specialized in other internal medicine fields, and 27 (8.4%) specialized in fields other than internal medicine.

The characteristics of the responders in both groups in the matched cohort are also shown in Table 1. No significant differences were found between the two groups in either model. An absolute standardized difference $<1.96\ \sqrt{2/n}$ for the measured covariates suggested an appropriate balance between the groups [10]. This value was considered

Table 2 Questionnaire results of the JSH 2014 and JSH groups in the unmatched cohort and matched model

		Unmatched model			Matched model		
		JSH 2014[a] ($n = 209$)	JSH 2019 ($n = 324$)	*p*-value	JSH 2014 ($n = 202$)	JSH 2014 ($n = 209$)	*p*-value
Q1	Do you instruct your patients with hypertension to check their BP in the early morning at home?						
	Do not instruct	0 (0%)	4 (1.2%)	$p = 0.293$	0 (0%)	4 (2.0%)	$p = 0.091$
	Instruct case-by-case	23 (11.0%)	29 (9.0%)		22 (10.9%)	10 (5.0%)	
	Instruct about half	14 (6.7%)	23 (7.1%)		14 (6.9%)	15 (7.4%)	
	Instruct about 70–80% as frequency	79 (37.8%)	103 (31.8%)		75 (37.1%)	71 (35.1%)	
	Instruct all	92 (44.0%)	161 (49.7%)		90 (44.6%)	100 (49.5%)	
	No answer	1 (0.5%)	4 (1.2%)		1 (1.0%)	2 (0.5%)	
Q2	How often do you instruct patients to check their BP in the early morning at home?						
	One time	41 (19.6%)	48 (14.8%)	$p = 0.033$	39 (19.3%)	29 (14.4%)	$p = 0.082$
	Two times	92 (44.0%)	169 (52.2%)		89 (44.1%)	108 (53.5%)	
	Three times	25 (12.0 %)	20 (6.2%)		25 (12.4%)	13 (6.4%)	
	As many times as the patient decides	47 (22.5%)	73 (22.5%)		45 (22.3%)	44 (21.8%)	
	Others	1 (0.5%)	9 (2.8%)		1 (0.5%)	5 (2.5%)	
	No answer	3 (1.4%)	5 (1.5%)		3 (1.5%)	3 (1.5%)	
Q3	How many times do you check the BP of your patients with hypertension at your office?						
	Do not check in the office	0 (3.3%)	7 (2.2%)	$p = 0.003$	0 (0.0%)	5 (2.5%)	$p = 0.042$
	One time in the consulting room	107 (51.2%)	153 (47.2%)		106 (52.5%)	100 (49.5%)	
	More than two times in the consulting room	62 (29.7%)	58 (17.9%)		58 (28.7%)	38 (18.8%)	
	One time outside the consulting room	21 (10.0%)	59 (18.2%)		20 (9.9%)	32 (15.8%)	
	More than two times outside the consulting room	5 (2.4%)	14 (4.3%)		4 (2.0%)	7 (3.5%)	
	One time outside and inside the consulting room	6 (2.6%)	13 (4.0%)		6 (3.0%)	7 (3.5%)	
	Others	7 (3.3%)	15 (4.6%)		7 (3.5%)	10 (5.0%)	
	No answer	1 (0.5%)	5 (1.5%)		0 (0%)	2 (1.2%)	
Q4	Which do you prefer to use as the BP value in the morning for the diagnosis of hypertension or evaluating the achievement of the target BP?						
	The value of the first time	44 (21.1%)	52 (16.0%)	$p = 0.634$	42 (20.8%)	32 (15.8%)	$p = 0.801$
	The average of the two times	60 (28.7%)	116 (35.8%)		58 (28.7%)	69 (34.2%)	
	The value of the second time	21 (10.0%)	36 (11.1%)		20 (9.9%)	23 (11.4%)	
	The lowest value of more than two times	37 (17.7%)	56 (17.3%)		37 (18.3%)	41 (20.3%)	
	The average of more than three times	17 (8.1%)	20 (6.2%)		17 (8.4%)	13 (6.4%)	
	Any values that the patient decides	12 (5.7%)	21 (6.5%)		11 (5.4%)	11 (5.4%)	
	Others	15 (7.2%)	18 (5.6%)		14 (6.9%)	11 (5.4%)	
	No answer	3 (1.4%)	5 (1.5%)		3 (1.5%)	2 (1.0%)	
Q5	Do you possess and use an ambulatory blood pressure monitoring device?						
	Do not possess	166 (79.4%)	257 (79.3%)	$p = 0.994$	163 (80.7%)	166 (82.2%)	$p = 0.775$
	Possess but hardly use	20 (9.6%)	29 (9.0%)		19 (9.4%)	14 (6.9%)	
	Possess and use sometimes	18 (8.6%)	31 (9.6%)		15 (7.4%)	19 (9.4%)	
	Possess and use often	3 (1.4%)	4 (1.2%)		3 (1.5%)	2 (1.0%)	
	No answer	2 (1.0%)	3 (0.9%)		2 (1.0%)	1 (0.5%)	
Q6	Which do you prefer to use as the BP value for the diagnosis of hypertension or evaluating the achievement of the target BP?						
	Only the value in the early morning at home	19 (9.1%)	46 (14.2%)	$p = 0.011$	18 (8.9%)	23 (11.4%)	$p = 0.069$
	Only the value at the office	7 (3.3%)	5 (1.5%)		7 (3.5%)	3 (1.5%)	
	Only the value of ABPM	0 (0.0%)	1 (0.1%)		0 (0.0%)	1 (0.5%)	
	Case-by-case (at home or office)	163 (78.0%)	219 (67.6%)		158 (78.2%)	145 (71.8%)	
	Case-by-case (at home or office or ABPM)	17 (8.1%)	27 (8.3%)		16 (7.9%)	15 (7.4%)	
	The value in the morning and at night at home	0 (0.0%)	11 (3.4%)		0 (0.0%)	6 (3.4%)	
	Other	1 (0.5%)	8 (2.5%)		1 (0.5%)	5 (2.5%)	
	No answer	2 (1.0%)	7 (2.2%)		2 (1.0%)	4 (2.0%)	
Q7	Do you perform a differential diagnosis for hypertension?						
	Do not perform	5 (2.4%)	14 (4.3%)	$p = 0.846$	5 (2.5%)	6 (3.0%)	$p = 0.717$
	Perform at other hospitals	20 (9.6%)	34 (10.5%)		20 (9.9%)	21 (10.4%)	
	Perform sometimes	62 (29.7%)	90 (27.8%)		61 (30.2%)	64 (31.7%)	
	Perform often	72 (34.4%)	116 (35.8%)		69 (34.2%)	76 (37.6%)	
	Perform always	47 (22.5%)	65 (20.1%)		45 (22.3%)	33 (16.3%)	
	Other	0 (0.0%)	1 (1.2%)		0 (0.0%)	1 (0.5%)	

Table 2 (continued)

		Unmatched model			Matched model		
		JSH 2014[a] ($n = 209$)	JSH 2019 ($n = 324$)	*p*-value	JSH 2014 ($n = 202$)	JSH 2014 ($n = 209$)	*p*-value
	No answer	3 (1.4%)	4 (1.2%)		2 (1.0%)	1 (0.5%)	
Q8	Do you perform a differential diagnosis for primary aldosteronism?						
	Yes	196 (93.8%)	279 (86.6%)	$p = 0.009$	189 (93.6%)	175 (87.5%)	$p = 0.038$
	No	13 (6.2%)	43 (13.4%)		13 (6.4%)	25 (12.5%)	
	Regarding the examinations for the diagnosis of primary aldosteronism,						
	Q8-1 Do you check the serum renin- aldosterone ratio?						
	Yes	163 (78.0%)	269 (83.0%)	$p = 0.148$	157 (77.7%)	172 (85.1%)	$p = 0.055$
	No	46 (22.0%)	55 (17.0%)		45 (22.3%)	30 (14.9%)	
	Q8-2 Do you perform an adrenal CT scan or MRI?						
	Yes	62 (29.7%)	61 (18.8%)	$p = 0.004$	59 (29.2%)	35 (17.3%)	$p = 0.005$
	No	147 (70.3%)	263 (81.2%)		143 (70.8%)	167 (82.7%)	
	Q8-3 Do you perform the discrimination test (for example, captopril test, standing test, or saline loading test)?						
	Yes	6 (2.9%)	21 (6.5%)	$p = 0.063$	6 (3.0%)	9 (4.5%)	$p = 0.430$
	No	203 (97.1%)	303 (93.5%)		196 (97.0%)	193 (95.5%)	
Q9	Do you instruct patients with hypertension to restrict their salt intake?						
	Do not instruct	3 (1.4%)	8 (2.5%)	$p = 0.726$	3 (1.5%)	6 (3.0%)	$p = 0.711$
	Instruct sometimes	26 (12.4%)	45 (13.9%)		26 (12.9%)	30 (14.9%)	
	Instruct about half as frequency	11 (5.3%)	22 (6.8%)		10 (5.0%)	14 (6.9%)	
	Instruct always (about 70–80% as frequency)	83 (39.7%)	109 (33.6%)		83 (41.1%)	73 (36.1%)	
	Instruct all	83 (39.7%)	136 (42.0%)		78 (38.6%)	78 (38.6%)	
	No answer	3 (1.4%)	4 (1.2%)		2 (1.0%)	1 (0.5%)	
Q10	How do you instruct patients with hypertension to restrict their salt intake?						
	Q10-1 GP indicates verbally						
	Yes	168 (80.4%)	259 (79.9%)	$p = 0.900$	162 (80.2%)	166 (82.2%)	$p = 0.611$
	No	41 (19.6%)	65 (20.1%)		40 (19.8%)	36 (17.8%)	
	Q10-2 GP indicates with a brochure						
	Yes	85 (40.7%)	109 (33.6%)	$p = 0.100$	80 (39.6%)	73 (36.1%)	$p = 0.473$
	No	124 (59.3%)	215 (66.4%)		122 (60.4%)	129 (63.9%)	
	Q10-3 medical staff indicates verbally						
	Yes	12 (5.7%)	28 (8.6%)	$p = 0.215$	11 (5.4%)	17 (8.4%)	$p = 0.240$
	No	197 (94.3%)	296 (91.4%)		191 (94.6%)	185 (91.6%)	
	Q10-4 medical staff indicates with a brochure						
	Yes	17 (18.1%)	25 (7.7%)	$p = 0.861$	16 (7.9%)	15 (7.4%)	$p = 0.852$
	No	192 (91.9%)	299 (92.3%)		186 (92.1%)	187 (92.6%)	
	Q10-5 dietician instructs directly						
	Yes	45 (21.5%)	79 (24.4%)	$p = 0.447$	44 (21.8%)	42 (20.8%)	$p = 0.808$
	No	164 (78.5%)	245 (75.6%)		158 (78.2%)	160 (79.2%)	
Q11	How do you assess the salt intake of your patients with hypertension?						
	Q11-1 through a practitioner interview						
	Yes	119 (56.9%)	158 (48.8%)	$p = 0.065$	114 (56.4%)	99 (49.0%)	$p = 0.135$
	No	90 (43.1%)	166 (51.2%)		88 (43.6%)	103 (51.0%)	
	Q11-2 through a spot urine assay with sodium and creatinine level						
	Yes	37 (17.7%)	55 (17.0%)	$p = 0.828$	35 (17.3%)	35 (17.3%)	$p = 1.0$
	No	172 (82.3%)	269 (83.0%)		167 (82.7%)	167 (82.7%)	
	Q11-3 through an assay of urine accumulated for 24 h						
	Yes	6 (2.9%)	9 (2.8%)	$p = 0.949$	6 (3.0%)	196 (97.0%)	$p = 0.522$
	No	203 (97.1%)	315 (97.2%)		4 (2.0%)	198 (98.0%)	
	Q13-4 through the dietitian interview						
	Yes	21 (10.0%)	33 (10.2%)	$p = 0.959$	21 (10.4%)	16 (7.9%)	$p = 0.388$
	No	188 (90.0%)	291 (89.8%)		181 (89.6%)	186 (92.1%)	
Q12	Do you perform a urine check of hypertensive patients at the first visit?						
	Do not perform	12 (5.7%)	36 (11.1%)	$p = 0.061$	11 (5.4%)	26 (12.9%)	$p = 0.056$
	Perform sometimes	33 (15.8%)	56 (17.3%)		33 (16.3%)	38 (18.8%)	

Table 2 (continued)

	Unmatched model			Matched model		
	JSH 2014[a] ($n=209$)	JSH 2019 ($n=324$)	*p*-value	JSH 2014 ($n=202$)	JSH 2014 ($n=209$)	*p*-value
Perform about half	6 (2.9%)	20 (6.2%)		6 (3.0%)	13 (6.4%)	
Perform often	38 (18.2%)	47 (14.5%)		37 (18.3%)	30 (14.9%)	
Perform always	102 (48.8%)	128 (39.5%)		97 (48%)	78 (38.6%)	
Perform always not only at the first visit and also constantly	17 (8.1%)	33 (10.2%)		17 (8.4%)	15 (7.4%)	
No answer	1 (0.5%)	4 (1.2%)		1 (0.5%)	3 (1.0%)	

Values are *n*/total *n* (%)

P values by chi-square test

[a]The data of the JSH 2014 group on the unmatched model was previously reported (Ref. [7])

Table 3 Eigenvalues calculated by component analysis

	Factor 1	Factor 2	
Q12: Regarding the frequency of the urine check of hypertensive patients at the first visit.	0.88	−0.35	Component 1
Q7: Regarding the frequency of a differential diagnosis for the secondary hypertension	0.62	0.20	
Q9: Regarding the frequency of the instruction of the restriction of the salt intake.	0.51	0.44	
Q11: Regarding the method of the instruction of the restriction of the salt intake.	0.44	−0.02	
Q4: Regarding the trend to use as the BP value in the morning for the diagnosis of hypertension or evaluating the achievement of the target BP.	0.21	0.78	Component 2
Q1: Regarding the frequency of the instruction of home BP monitoring	0.32	0.41	

borderline in the matched cohort ($n=202$ in each group, then $1.96\sqrt{2/n}$ equals 0.20), as most of the standardized differences between the responders' characteristics were less than 0.11, except for the small number of respondents in their 20 s. The well-balanced histograms of the groups' characteristics in the matched cohort after PS matching are shown in Fig. S1.

Comparison between the JSH 2014 and 2019 groups in the matched cohort

The matched cohort of each group of 202 general practitioners was analyzed. The questionnaire results of the two groups in the unmatched and matched cohorts are shown in Table 2, including the JSH 2014 group responses that were previously published [7].

In both surveys, more than 80% of the general practitioners instructed patients to perform BP monitoring at home more often (81.7% in the JSH 2014 group and 84.6% in the JSH 2019 group in the matched cohort), and more than 70% of the general practitioners instructed patients with hypertension to restrict their salt intake (79.7% in the JSH 2014 group and 74.7% in the JSH 2019 group in the matched cohort).

Regarding the method of BP measurement at the office, more general practitioners answered "one time outside the consulting room" in the JSH 2019 group ($p=0.042$). Fewer general practitioners indicated that they performed differential diagnosis for primary aldosteronism, especially adrenal CT or MRI, in the JSH 2019 group ($p=0.032$); however, the frequency of checking the aldosterone-renin ratio seemed to be higher in the JSH 2019 group ($p=0.055$). Other than these three questions, there were no significant differences between the JSH 2014 and JSH 2019 groups.

Component and cluster analyses

The Cronbach's alpha for the workplace, specialty, and questions 1, 2, 4, 5, 7, 9, 11, and 12 was 0.565, which indicated reliability. These characteristics were then analyzed using factor analysis.

The Kaiser–Meyer–Olkin's value and *p*-value for the Bartlett test were 0.732 and <0.0001, respectively, which indicated that this analysis was relevant. Principal component analysis was then applied to determine the first and second components and their factor analysis scores. The first component had an eigenvalue of 3.23 and explained 33.3% of the variance, and the second component had an eigenvalue of 1.70 and explained 17.5% of the variance. A K-means cluster analysis was then performed based on the factor analysis scores and the first and second components.

The first component was a combination of questions 7, 9, 11, and 12, which mainly indicated "strict and compliant and therefore exemplary hypertension management." The second component was a combination of questions 1 and 4, which mainly indicated an "emphasis on home BP monitoring and comprehensive judgment using multiple opportunities" (shown in Table 3).

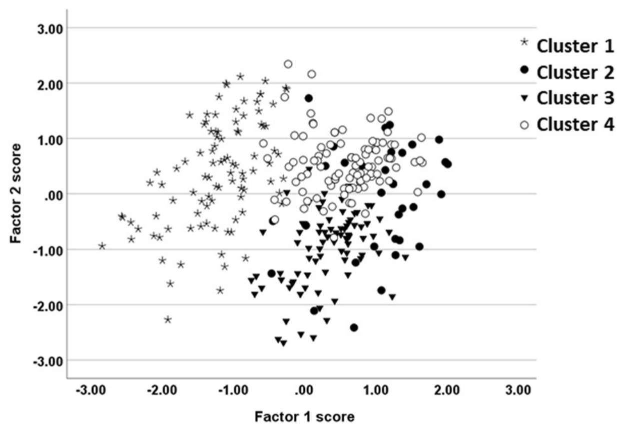

Fig. 1 Distribution of principal component scores in four clusters

Figure 1 shows the distribution of the factor analysis scores in four clusters, with the first component assigned to the *x*-axis and the second component to the *y*-axis. Cluster 1 ($n = 99$) mainly included the responders who emphasized home BP monitoring, although strict management was not always achieved. Clusters 2 ($n = 34$), 3 ($n = 86$) and 4 ($n = 98$) included responders who performed strict and compliant and therefore exemplary hypertension management. Among these three clusters, responders in Cluster 2 tended to be more compliant than those in the other clusters, and component factor 2 was markedly different between Cluster 3 and Cluster 4.

Table 4 shows the results with regard to background and questionnaire responses in all four clusters. The workplace, specialty, and answers to questions 2, 4, 5, 7, 9, 11, and 12 differed significantly among the four clusters according to the chi-square test (*p*-values: 0.021, <0.001, <0.001, 0.022, <0.001, <0.001, <0.001, and <0.001, respectively).

Discussion

Our previous survey revealed that JSH 2014 was well accepted by general practitioners, and many general practitioners instructed patients with hypertension to monitor their BP at home according to JSH 2014, although there were variations in the number of home BP measurements in the morning that the general practitioners encouraged to patients. A low proportion of general practitioners performed differential diagnoses for secondary hypertension, and an insufficient proportion of practitioners evaluated the salt intake of patients with hypertension. A high proportion of practitioners who advised their patients to conduct home BP monitoring was also observed in the 2019 survey results. PS matching analysis was used to reduce bias due to imbalanced background characteristics, and the results did not show significant differences between the two surveys. There were significant differences in the answers to some questions, and we will expand on whether the JSH 2019 revision influenced these differences.

Among the new evidence included in JSH 2019, the SPRINT trial was one of the most successful trials. The SPRINT trial revealed the superiority of management targeting a lower BP with regard to cerebrocardiovascular disease [3]. In the SPRINT study, an automated office BP measurement was performed, which yields different results from BP measurements performed at home or in the office, and its usefulness and the adoption of strict BP management strategies were shown [3]. Both JSH 2014 and 2019 recommend home BP monitoring, and our 2014 and 2019 surveys revealed that the use of home BP monitoring was adequately promoted, and many Japanese general practitioners recommended home BP monitoring to patients with hypertension (as shown in question 1 results). In this survey, we also included supplementary questions about the emphasis of the SPRINT trial results cited in JSH 2019; 35% of responders were almost convinced, 54% were partially convinced, and only 10% were not convinced by these results. Of note, automated office BP measurements are different from home BP monitoring, and the target BP may be different; however, automated office BP measurements are accepted by general practitioners in Japan. The results of survey question 3 indicated that BP was measured significantly less frequently at the general practitioners' offices in 2019 than in 2014, which may reflect this trend. From the results of our 2014 and 2019 surveys, it was observed that the general practitioners valued home BP measurements, and they were interested in new BP measurements that could help them assess the BP status of their patients. The automated office BP measurement supported by many general practitioners in the 2019 survey is considered a new progressive practice in hypertension management. However, more evidence regarding automated office BP measurements, especially their use in clinical practice, is needed in the future.

Given that primary aldosteronism is found in 3.3–10% of patients with hypertension and is the most common cause of secondary hypertension [11], the increasing proportion of responders in the JSH 2019 group who did not perform differential diagnosis for primary aldosteronism is a serious concern. The frequency at which the general practitioners assessed their patients' aldosterone-renin ratios increased, although the increase was not statistically significant, while the frequency at which the general practitioners used imaging modalities (computerized tomography or magnetic resonance imaging) to observe the adrenal glands significantly decreased. This survey could not clarify the reasons for this trend, although the changes in aldosterone-related hypertension management over the past few years may be related. Adrenal vein sampling is required

Table 4 Backgrounds and questionnaire results in four clusters

	Cluster ($n = 99$)	Cluster 2 ($n = 34$)	Cluster 3($n = 86$)	Cluster 4 ($n = 98$)	p-value
Workplace					
Clinic	49 (49.5%)	9 (26.5%)	48 (55.8%)	54 (55.1%)	0.021
Hospital	50 (50.5%)	25 (73.5%)	38(44.2%)	44 (44.9%)	
Specialty					
Nephrologist or cardiologist	18 (18.2%)	19 (55.9%)	36 (41.9%)	31 (31.6%)	<0.001
The other	81 (81.8%)	15 (44.1%)	50 (58.1%)	67 (68.4%)	
Q1: Do you instruct your patients with hypertension to check their BP in the early morning at home?					
Do not instruct	1 (1.0%)	0 (0%)	1 (1.2%)	1 (1.0%)	0.074
Instruct case-by-case	11 (11.1%)	6 (17.6%)	7 (8.1%)	5 (5.1%)	
Instruct about half	12 (12.1%)	0 (0%)	7 (8.1%)	4 (4.1%)	
Instruct about 70–80% as frequency	36 (36.4%)	6 (17.6%)	27 (31.4%)	34 (34.7%)	
Instruct all	39 (39.4%)	22 (64.7%)	44 (51.2%)	54 (55.1%)	
Q4: Which do you prefer to use as the BP value in the morning for the diagnosis of hypertension or evaluating the achievement of the target BP?					
The value of the first time	19 (19.2%)	7 (20.6%)	25 (29.1%)	0 (0%)	<0.001
The value of the second time or the lowest value of more than two times	28 (28.3%)	5 (14.7%)	59 (68.6%)	0 (0%)	
Any values that the patient decides	19 (19.2%)	7 (20.6%)	2 (2.3%)	10 (10.2%)	
The average of two three times	29 (29.3%)	13 (38.2%)	0 (0%)	74 (75.5%)	
The average of three or more times	4 (4.0%)	2 (5.9%)	0 (0%)	14 (14.3%)	
Q5: Do you possess and use an ambulatory blood pressure monitoring device?					
Do not possess	91 (91.9%)	24 (70.6%)	70 (81.4%)	70 (71.4%)	0.022
Possess but hardly use	3 (3.0%)	4 (11.8%)	9 (10.5%)	12 (12.2%)	
Possess and use sometimes	5 (5.1%)	6 (17.6%)	6 (7.0%)	13 (13.3%)	
Possess and use often	0 (0%)	0 (0%)	1 (1.2%)	3 (3.1%)	
Q7: Do you perform a differential diagnosis for hypertension?					
Do not perform	9 (9.1%)	0 (0%)	4 (4.7%)	0 (0%)	<0.001
Perform at other hospitals	21 (21.2%)	0 (0%)	8 (9.3%)	5 (5.1%)	
Perform sometimes	37 (37.4%)	8 (23.5%)	24 (27.9%)	23 (23.5%)	
Perform often	25 (25.3%)	16 (47.1%)	31 (36.0%)	44 (44.9%)	
Perform always	7 (7.1%)	10 (29.4%)	19 (22.1%)	26 (26.5%)	
Q9: Do you instruct patients with hypertension to restrict their salt intake?					
Do not instruct	3 (3.0%)	1 (2.9%)	3 (3.5%)	0 (0%)	<0.001
Instruct sometimes	25 (25.3%)	2 (5.9%)	12 (14.0%)	6 (6.1%)	
Instruct about half as frequency	10 (10.1%)	1 (2.9%)	3 (3.5%)	9 (9.2%)	
Instruct always (about 70–80% as frequency)	30 (30.3%)	6 (17.6%)	36 (41.9%)	35 (35.7%)	
Instruct all	31 (31.3%)	24 (70.6%)	32 (37.2%)	48 (49.0%)	
Q11: How do you assess the salt intake of your patients with hypertension?					
Do not assess	33 (33.3%)	0 (0%)	22 (25.6%)	23 (23.5%)	<0.001
Through a practitioner interview	57 (57.6%)	0 (0%)	47 (54.7%)	48 (49.0%)	
Through a spot urine assay with sodium and creatinine level	6 (6.1%)	0 (0%)	17 (19.8%)	27 (27.6%)	
Through an assay of urine accumulated for 24 h	0 (0%)	6 (17.6%)	0 (0%)	0 (0%)	
Through the dietitian interview	3 (3.0%)	28 (82.4%)	0 (0%)	0 (0%)	
Q12: Do you perform a urine check of hypertensive patients at the first visit?					
Do not perform	35 (35.4%)	0 (0%)	0 (0%)	0 (0%)	<0.001
Perform sometimes	53 (53.5%)	2 (5.9%)	0 (0%)	1 (1.0%)	
Perform about half	11 (11.1%)	3 (9.8%)	2 (2.3%)	4 (4.1%)	
Perform often	0 (0%)	5 (14.7%)	15 (17.4%)	27 (27.6%)	
Perform always	0 (0%)	13 (38.2%)	59 (68.6%)	55 (56.1%)	
Perform always not only at the first visit and also constantly	0 (0%)	11 (32.4%)	10 (11.6%)	11 (11.2%)	

Values are n/total n in each cluster (%)

P values by chi-square test

for the definitive diagnosis of primary aldosteronism; however, the risks associated with catheterization, such as bleeding or infection, are unavoidable and are a major barrier to achieving a definitive diagnosis. Furthermore, the frequencies of bilateral adrenal hyperplasia and bilateral aldosterone-producing adenoma were reported to be 3.2% and 11.8%, respectively, and these are not indications for surgical treatment [12]. These results suggest that there may be more patients who have indications for the administration of mineralocorticoid receptor blockers (MRBs). In addition to spironolactone and eplerenone, esaxerenone is a drug in one of the new generations of MRBs and was recently approved for use in patients with hypertension in Japan. Esaxerenone is associated with low incidences of the adverse effects of hyperkalemia and gynecomastia and exerts a strong BP-lowering effect; furthermore, it can be administered to patients with hypertension and diabetic nephropathy in Japan. Our survey may indicate the real-world clinical practice, in which general practitioners evaluate only the aldosterone-renin ratio and readily administer MRBs to patients, including those with high aldosterone-renin ratios, without further differential diagnostic examinations.

Based on the results of the present survey, the assessment of the aldosterone-renin ratio is a common practice; however, there is a need to encourage general practitioners to perform the appropriate differential diagnosis of aldosterone-related hypertension, including primary aldosteronism, as they should not administer MRBs as a first-line therapy without having achieved a definitive diagnosis. Furthermore, future revisions of the JSH guidelines need to recommend an efficient method of identifying primary aldosteronism that is accepted by many general practitioners.

This survey aimed to disseminate and encourage the proper use of the JSH guidelines to promote the high-quality management of hypertension. We hope that these responses from the general practitioners, including the comparisons with the previous survey, will inform future updates of the JSH guidelines. The low response rate (15%) was a serious concern regarding this survey, as it led to selection bias. Many general practitioners subscribe to Japanese medical associations, and some of them automatically joined our associations. Therefore, not all members are necessarily interested in the activities of our associations. Furthermore, those respondents who were interested were more likely to answer the questionnaires; in other words, the general practitioners who were not interested in hypertension management tended not to respond to our survey. The response rate was 20% in our other questionnaire survey about authorized generic medications [13]. There might be more interest in authorized generic medications than in hypertension management. Hypertension is one of the most common diseases worldwide, and physicians should not be permitted to overlook the BP status of any patient. We believe that the opinions of general practitioners who are not interested in hypertension management should also be considered. Adding benefits, such as providing an additional medical fee or points needed to be upgraded to a specialist status, might be an effective means of improving the response rate. Another reason for the low response rate is the method of communication about and administering the present survey; we mailed the questionnaire only once because of the limited funds and announced it only on our website. Due to the coronavirus disease 2019 pandemic, remarkable progress has been made in the technology used for conferences and meetings with the Internet of Things. Our survey methods included mail and fax, which may have seriously limited this study. In this survey, we administered selected supplemental questionnaires. With regard to the method of obtaining JSH 2019, 15% of the responders purchased it at bookstores, 42% had it provided by medical or pharmaceutical companies, 21% purchased it online, and 12% obtained a downloaded version. New methods of conducting questionnaires using email or computer and cellphone applications with high levels of security may increase the number of respondents and provide more representative results.

The insufficiency in the evaluation of the salt intake of patients with hypertension by general practitioners remains a serious concern. Although the long-term prognosis for cerebrovascular and cardiovascular events with the restriction of salt intake requires further evidence, the antihypertensive effect associated with the restriction of salt intake is well understood. However, only 13.2% of male and 25.7% of female Japanese patients with hypertension achieved a restriction of salt intake to <6 g/day [14]. In JSH 2019, which emphasizes stricter BP management, repeated assessments of salt intake using urine samples are recommended to achieve a restricted salt intake. Regarding question 12, the degrees of freedom were 6, and a chi-square value of greater than 14.5 was needed to detect significance. However, the result of the chi-square test for question 12 in the matched cohort was 12.3, which was close to the threshold. A larger sample size might have enabled us to detect a significant difference in the number of general practitioners in the JSH 2019 and JSH 2014 groups who answered: “I do not perform a urine test”. A urine test is mandatory for the assessment of salt intake in patients with hypertension, for the diagnosis of chronic kidney disease, and for the evaluation of diabetic nephropathy in patients with diabetes mellitus. Therefore, the trend of more general practitioners not performing urine analyses yearly is also a serious concern in clinical practice, and a nationwide campaign to promote urine tests is needed.

The cluster analysis performed for the questionnaires in the JSH 2019 group did not include all the questions; however, the present analysis identified four characteristic clusters. A concrete strategy for the future promotion of hypertension management should be considered for each cluster based on the unique cluster characteristics.

With regard to Cluster 2, the responders frequently worked in a hospital and had a noticeable tendency to comply with JSH 2019, based on their responses to many of the questions. All the responders who answered that they used 24-hour urine collections to inform salt intake restriction strategies belonged in Cluster 2, and 82.4% collaborated with dietitians to instruct patients with hypertension to restrict their salt intake. Many responders in Cluster 2 provided specialized treatment, and the general practitioners who belonged in this cluster may act as opinion leaders with regard to educational activities. In contrast, the responders in Cluster 1 had inadequate hypertension management practices, with the exception of promoting home BP monitoring. There is a possibility that this cluster contained many nonspecialists, and it is logical that this group could serve as a precise target for future educational activities about hypertension management. Responders in clusters 3 and 4 had characteristics in common with those in Cluster 2 and overall complied with the guidelines. However, between the respondents in clusters 3 and 4, there was a significant difference in the use of morning BP values for the diagnosis of hypertension or the evaluation of the achievement of the target BP (Question 2). General practitioners are able to choose the BP value they use for diagnosis and monitoring purposes according to the individual patient's status using a patient-centered approach, and the use of this approach was observed in both the 2014 and 2019 surveys. It might be interesting to conduct a debate between these two groups, enabling a deeper understanding of the two viewpoints. Additional comparisons between the respondents in cluster 3 and those in cluster 4 are shown in Supplementary Table S2, which shows the results of the questions that were not used in the component analysis (these questions were excluded from the component analysis because the answer choices were difficult to replace with ordinal values). Based on the answer to the questions regarding the number of measurements of BP taken at home or in the office (ambulatory blood pressure monitoring), the respondents in Cluster 3 reported that they evaluated multiple values, which may suggest that they paid more attention to variations in BP.

Study limitations

The estimated sample size needed to detect significant differences in questions with binary answer choices is shown in supplementary Table S1, and the small sample size is one of the most serious concerns regarding this survey.

Since the responders in the JSH 2014 and 2019 groups were not the same (even though members of Kanagawa Physicians Associations were surveyed and the same questionnaire administration method was used), we could not eliminate the possibility of selection bias. To reduce this bias, we used the PS matching method to align the responders' backgrounds. In this survey, the background characteristics of the two groups were well balanced, and the use of the matched cohort enabled the performance of statistical comparisons without significant differences in background characteristics. However, selection bias remained, as the results of the responders who were excluded from the matched cohort were not analyzed.

The number of responders who worked in clinics was more than double the number of responders who worked in hospitals, and thus, the results may be more representative of general practitioners who work in clinics. The age distribution of medical doctors who work in clinics that were officially reported by the Japan Ministry of Health, Labor and Welfare in 2006 was as follows: 7.3% in their 30 s, 24.3% in their 40 s, 30.2% in their 50 s, 15.2% in their 60 s, and 22.8% in their 70 s [15]. These proportions were similar to those in this survey in the JSH 2019 group. Therefore, this survey may accurately represent the overall trend among general practitioners, although the low response rate (15%) was a significant limitation of this survey.

Conclusions

Through two questionnaire surveys conducted 5 years apart, we confirmed the transition in the awareness of hypertension management among general practitioners. The clusters identified in this study may be useful when developing effective strategies to achieve higher-quality hypertension management in Japan.

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Compliance with ethical standards

Conflict of interest The authors declare no competing interests.

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