0.9% in the intervention group and 3.4%, 1.8% and 1.1% in the control group at the 1st examination, respectively. There was no significant difference between the two groups. At the 4th examination, the prevalence was 4.6%, 2.5%, 0.9% in the intervention group, and 4.5%, 2.0% and 1.6% in the control group, respectively. There was a significant difference only in the prevalence of anti-diabetic users, which was lower in the intervention group than in the control group (data not shown in the table).

Table 2 indicates the number of participants at the 4th examination who had participated in the baseline survey. The return participation rate was 72.2% for the intervention group and 74.9% for the control group (χ^2=5.43, P=0.02). The return participation rate of the two non-factory populations (Companies A and L) was much lower than that in the other companies.

The trends of the participants at the baseline survey for SBP and DBP, non-HDL cholesterol, HDL cholesterol, BMI and urinary salt excretion between the 1st and 4th examinations (3 years) are shown in Table 3. The trends were similar to those of the population trends shown in Table 1. The 3-year increase in SBP or DBP, HDL cholesterol and BMI was greater in the intervention group than in the control group, whilst the 3-year increase in non-HDL cholesterol was lower in the intervention group than that in the control group. There was no difference in the urinary salt excretion trend between the two groups.

The trends of the participants at the baseline survey for the prevalence of hypertriglycemia, high plasma glucose and current smokers are shown in Table 4. For both groups, the prevalence of current smokers was significantly decreased, and the prevalence of fasting high plasma glucose was significantly increased. There was no significant change in the prevalence of hypertriglycemia either in the intervention or the control group. The significant difference between the two groups observed in the prevalence of hypertriglycemia detected with fasting blood samples from the baseline survey disappeared at the 4th examination. The 3-year decrease in the prevalence of current smokers was significantly greater in the intervention group compared to that in the control group.

Discussion

In the interim assessment of the HIPOP-OHP study, we showed a population improvement in the serum level of HDL cholesterol, urinary salt excretion, and the prevalence of current smokers and hypertriglycemia. Furthermore, the serum levels of non-HDL cholesterol and the prevalence of hypertriglycemia and high plasma glucose detected with fasting blood samples in the intervention group did not increase, whilst they significantly increased in the control group. These changes were mainly due to serial examinations of returning participants during the 3 years. However, the average DBP increased in the intervention group, whilst it did not change in the control group. The 3-year increases in SBP and DBP in the returning participants were also higher in the intervention group than those in the control group.

We have already reported that the intervention group had a significantly higher risk of cardiovascular disease, especially due to dyslipidemia and high plasma glucose, than the control group at the baseline survey because of a non-randomized design (18). Furthermore, although there were no differences between the two groups in SBP and DBP averages at the baseline survey, the urinary salt excretion for the intervention group was significantly higher than that of the control group (18).

Accordingly, we have been focused on the improvement of dyslipidemia, high plasma glucose and urinary salt excretion in the first half of our intervention. Generally speaking, cardiovascular risk factors deteriorated year by year due to aging. However, concerning the lipid factors, the average level of HDL cholesterol in the intervention group was significantly increased and the average level of non-HDL cholesterol remained nearly stable, whilst both of these factors in the control group deteriorated. Furthermore, the prevalence of hypertriglycemia detected with fasting blood samples in the intervention group was decreased in the returning participants, although the statistical analysis did not reach a significant level, whilst it was increased in the control group. Thus, we seemed to achieve some success in improvement, or at least lack of deterioration, for the above-mentioned risk factors.

The INTERSALT study suggested that urinary sodium excretion would be associated with increased blood pressure in the future (22). Therefore, the difference in the change in blood pressure between the two groups might be partially affected by the initial difference in urinary salt excretion, which was nearly equivalent to that of dietary salt intake. We are going to devote additional and continuous effort to reducing salt intake in the intervention period until the end of this study. Furthermore, effective strategies to decrease or at least maintain the mean blood pressure level are necessary in the intervention group.

There have been some health promotion trials employing a population strategy, especially in Western populations (9–15). Several of these have shown the difficulty of inducing individuals to change their behaviour by only providing information about a healthy lifestyle (11–13). In the British population of a European collaborative trial for the multifactorial prevention of coronary heart disease that included both high-risk and population strategies, Rose et al. reported a disappointingly low response to mass advice using posters, evening meetings, film showings and question–and-answer sessions (23). Because we have also been facing this same problem in the present study, in addition to mass advice, we have also attempted to make specific environmental changes such as decreasing sodium content in the food of the company dining rooms and constructing pathways or making maps for walking in the workplaces. However, the effects of environmental change in the intervention group were considered limited, for example, because one company had no dining room in the workplace (Company F), another had only a few customers at their dining room in the workplace (Company E), and we were able to construct a walking pathway in the factory only for Company B. Therefore, the main effects of our intervention study are being influenced strongly by the personal response to the information presented by mass advice. Thus, this study remains important in that effective methods are being developed for presenting information to induce individuals to change their behaviour.

The main limitation of the present study is the influence of periodic or non-periodic personnel changes in the participating companies. The population at the end of this study will not be

the same as that at the baseline examination. During the 3 years, about 30% of the participants were moved from their worksites. This rate will increase at the endpoint of this study. These personnel changes were not due only to retirement. A few years ago, most Japanese employees were hired for a permanent job and retired at the age of 60. However, due to the recent long recession in the Japanese economy, lay-offs of employees before retirement age or company mergers have frequently occurred in Japanese companies. In our study population, Company C was merged with another company during the 3 years, and there were unexpected rates of lay-offs in the other companies. When we excluded participants at the baseline survey who were aged 57 years or older and would have reached the retirement age of 60 at the 4th examination, the return participation rate at the 4th examination was not substantially affected (75.3% for the intervention group and 77.0% for the control group). These return participation rates were much lower than those expected before the commencement of this trial.

However, the HIPOP-OHP study involved many researchers cooperating with the staff in each company with the aim of improving cardiovascular risk factors based on high-risk and population strategies (18), and, at present, intervention is being conducted in the intervention group. It is anticipated that the protocol developed in this study will contribute greatly to occupational health promotion in Japan.

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References

(1) Ueshima H, Mikawa K, Baba S, Sasaki S, Ozawa H, Tsushima M, et al. Effect of reduced alcohol consumption on blood pressure in untreated hypertensive men. Hypertension 1993; 21: 248–252.
(2) Fielding JE, Knight K, Mason T, Klesges RC, Pelletier KR. Evaluation of the IMPACT blood pressure program. J Occup Med 1994; 36: 743–746.
(3) Iso H, Imano H, Nakagawa Y, Kiyama M, Kitamura A, Sato S, et al. One-year community-based education program for hypercholesterolemia in middle-aged Japanese: a long-term outcome at 8-year follow-up. Atherosclerosis 2002; 164: 195–202.
(4) Fisher KJ, Glasgow RE, Terborg JR. Worksite smoking cessation: a meta-analysis of long-term quit rates from controlled studies. J Occup Med 1990; 32: 429–439.
(5) Kadowaki T, Watanabe M, Okayama A, Hishida K, Ueshima H. Effectiveness of smoking-cessation intervention in all of the smokers at a worksite in Japan. Ind Health 2000; 38: 396–403.
(6) Muto T, Yamauchi K. Evaluation of a multicomponent workplace health promotion program conducted in Japan for improving employees' cardiovascular disease risk factors. Prev Med 2001; 33: 571–577.
(7) Rose G. Sick individuals and sick populations. Int J Epidemiol 2001; 30: 427–432 (Reiteration).
(8) Stamler J, Rose G, Stamler R, Elliott P, Dyer A, Marmot M. INTERSALT study findings. Public health and medical care implications. Hypertension 1989; 14: 570–577.
(9) Scheuermann W, Razum O, Scheidt R, Wiesemann A, von Frankenberg H, Topf G, et al. Effectiveness of a decentralized, community-related approach to reduce cardiovascular disease risk factor levels in Germany. Eur Heart J 2000; 21: 1591–1597.
(10) Steyn K, Steyn M, Swanepoel AS, Jordaan PC, Jooste PL, Fourie JM, et al. Twelve-year results of the Coronary Risk Factor Study (CORIS). Int J Epidemiol 1997; 26: 964–971.
(11) Luepker RV, Rastam L, Hannan PJ, Murray DM, Gray C, Baker WL, et al. Community education for cardiovascular disease prevention. Morbidity and mortality results from the Minnesota Heart Health Program. Am J Epidemiol 1996; 144: 351–362
(12) Fortmann SP, Varady AN. Effects of a community-wide health education program on cardiovascular disease morbidity and mortality: the Stanford Five-City Project. Am J Epidemiol 2000; 152: 316–323.
(13) World Health Organisation European Collaborative Group. :European collaborative trial of multifactorial prevention of coronary heart disease: final report on the 6-year results. Lancet 1986; 1(8486): 869–872.
(14) Vartiainen E, Jousilahti P, Alfthan G, Sundvall J, Pietinen P, Puska P. Cardiovascular risk factor changes in Finland, 1972–1997. Int J Epidemiol 2000; 29: 49–56.
(15) Iso H, Shimamoto T, Naito Y, Sato S, Kitamura A, Iida M,, et al. Effects of a long-term hypertension control program on stroke incidence and prevalence in a rural community in north-eastern Japan. Stroke 1998; 29: 1510–1518.
(16) Iso H, Shimamoto T, Yokota K, Ohki M, Sankai T, Kudo M, et al. Changes in 24-hour urinary excretion of sodium and potassium in a community-based heath education program on salt reduction (in Japanese). Nippon Koshu Eisei Zasshi 1999; 46: 894–903.
(17) Okamura T, Tanaka T, Yoshita K, Chiba N, Takebayashi T, Kikuchi Y, et al. Specific alcoholic beverage and blood pressure in a middle-aged Japanese population: the High-risk and Population Strategy for Occupational Health Promotion (HIPOP-OHP) Study. J Hum Hypertens 2004; 18: 9–16.
(18) Okamura T, Tanaka T, Babazono A, Yoshita K, Chiba N, Takebayashi T, et al. The High-risk and Population Strategy for Occupational Health Promotion (HIPOP-OHP) Study. –Study Design and Cardiovascular Risk Factors at the Baseline Survey–. J Hum Hypertens (in press, 2004 Jan 29, Epub ahead of print).

(19) Tamaki J, Kikuchi Y, Yoshita K, Takebayashi T, Chiba N, Tanaka T, et al. Stages of Change for salt intake and urinary salt excretion: Baseline results from the High-risk and Population Strategy for Occupational Health Promotion (HIPOP-OHP) Study. Hypertens Res 2004; 27: 157–166.
(20) Tanaka T, Okamura T, Miura K, Kadowaki T, Ueshima H, Nakagawa H et al. A simple method to estimate populational 24-h urinary sodium and potassium excretion using a casual urine specimen. J Hum Hypertens 2002; 16: 97–103.
(21) Nakamura M, Sato S, Shimamoto T. Improvement in Japanese clinical laboratory measurements of total cholesterol and HDL-cholesterol by the US cholesterol reference method laboratory network. J Atheroscler Thromb 2003; 10: 145–153.
(22) Stamler J. The INTERSALT Study: background, methods, findings, and implications. Am J Clin Nutr 1997; 65 (2 Suppl): 626S–642S.
(23) Rose G, Heller RF, Pedoe HT, Christie DG. Heart disease prevention project: a randomised controlled trial in industry. BMJ 1980; 280(6216): 747–751.
(24) Crawford D. Population strategies to prevent obesity. Only few studies attempted so far and with limited success. BMJ 2002; 325: 728–729.

Appendix

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Special Issue

Original Article

The Evaluation of Materials to Provide Health-Related Information as a Population Strategy in the Worksite: The High-Risk and Population Strategy for Occupational Health Promotion (HIPOP-OHP) Study

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Abstract

Objective: To examine the effectiveness of newly developed materials for providing health-related information to the worksite population, we compared the amount of attention that employees paid to the materials.

Methods: Study subjects were 2,361 employees in six companies participating in an intervention program between 2002 and 2003. Three kinds of media were used as tools for providing health information: [1] Point Of Purchase advertising menus (POP menus) were placed on all tables in company restaurants, [2] posters were put on walls and [3] leaflets were distributed at health-related events. One year or more after the introduction of these media, we compared the amount of attention paid to each type of medium.

Results: Amongst the three types of media, the POP menu drew the most attention, although results were not consistent in all gender and company groups. Every piece of information provided by the POP menus was "always" or "almost always" read by 41% of the men and 51% of the women surveyed. The corresponding rate for posters was 30% in men and 32% in women. For leaflets, only 16% of men and 22% of women read almost all of the leaflets. More attention was paid to the POP menu when the sample was women, older, and ate at the company restaurant at least three times a week.

Conclusion: The POP menu may provide health-related information to a broader range of people than posters and leaflets, therefore, it is an effective material for population strategy.

Key words: worksite, health and nutrition education, materials for health and nutrition education, attention paid to the medium, characteristics of the medium

Introduction

Methods for decreasing the risk for developing diseases in the entire group include the High-risk Strategy and the Population Strategy (1). The former tries to identify a high-risk group that is more likely to develop diseases, and provides intensive health-related guidance and treatment to that group. However, because the number of high-risk individuals within the target population is generally small, using the high-risk strategy alone is not very effective in decreasing the occurrence of diseases. On the other hand, the Population Strategy assumes that all members of a group are affected by background factors that might cause disease, and modifies environmental factors regu-

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lating the behavior of the group. The Population Strategy affects many people who might be excluded from the target of the High-risk Strategy, enabling more effective reduction of the risk of the entire group. Providing appropriate health information to all group members is one of the methods of the Population Strategy, but there have been few reports about the appropriate media for providing such information.

Working people spend most of their day and evening at their worksite. Therefore, providing them with health information at their worksite should be more effective than offering community-based information. Eating and dietary habits play an important role as a primary disease-prevention measure. The "People's Health Promotion Campaign for the 21st Century (Health Japan 21)" led by the Japanese Ministry of Health, Labor and Welfare, has a goal at the environmental level: to provide working people with more opportunities to learn about health and nutrition at their worksites (2). There have been few studies that objectively measured the effectiveness of the health education and health information provided to all staff at a worksite (3), and even fewer studies that have tried to determine effective tools for providing such information (4).

The objective of this study is to provide information on the primary prevention of cardiovascular diseases to all employees in six companies through several media, and to identify characteristics of each medium as a tool for offering information at a worksite.

Target and methods

Target

The High-risk and Population Strategy for Occupational Health Promotion (HIPOP-OHP) Study is a non-randomized control trial targeting working people. The study includes individual health guidance as a High-risk Strategy, as well as intervention in physical activities, nutrition, smoking, separation of designated smoking areas, and other related environmental factors as a Population Strategy. Both strategies were introduced in 1999–2000 in the intervention companies, and the control companies remained without interventions (5–7). We had 3,355 and 3,991 employees in the intervention and control groups, respectively, at the baseline survey. After the baseline survey, approximately 7,500 (3,391, 3,269 and 3,234 in the intervention group and 4,970, 4,643 and 4,570 in the control group, in the following 3 years, respectively) employees participated in this study every year. Measures to improve the environment included direct methods such as changes in the company restaurant menus and provision of exercise facilities (e.g., suggestion of a walking route), as well as indirect methods such as providing health information to all employees to urge them to change their habits. The design and procedures of this study were examined and approved by the Institutional Review Board of Shiga University of Medical Science for Ethical Issues (No. 10–16).

This study examined the methods for providing health information to the intervention group. The samples were 2,459 people in six companies (Companies A to F) of the intervention group, who participated in the baseline survey between 1999 and 2000 and responded to a self-administered questionnaire between 2002 and 2003. Company A was the head office of a life insurance company, Company D was a factory of a chemical company, and the other four companies were factories of electrical appliance manufacturers. The numbers of employees in Companies A to F at the baseline survey were 468 (66), 960 (338), 533 (52), 570 (76), 385 (152) and 439 (156), respectively (number of women in parentheses). The mean age of each company at the baseline survey was 38.5, 37.7, 39.2, 40.6, 39.2 and 39.2, respectively.

Methods

Because this study was conducted at worksites, we chose the following three materials to convey information to working people during their break time and travel time, without disrupting their work patterns.

(1) Point of Purchase advertising menus (POP menus)

We placed menu stands on all the tables in the company restaurants and displayed 'Point of Purchase advertising menus (POP menus)' (6). The POP menus were horizontally oriented, A5 size, multicolor, and contained a title or eye-catching copy in the top 15% of the area, an explanation below this (45%), and illustrations relevant to the explanation in the remaining 40% of the area. The content of the menu was changed every week in all worksites, but the same or a similar topic was addressed for 4 to 8 weeks.

(2) Posters

Posters were displayed in several designated locations in the worksites. They were vertically oriented, A3 size, multicolor, with text over 40 to 50% of the whole area, and illustrations and figures in the remaining area. The posters were changed once every 4 to 8 weeks.

(3) Leaflets

The leaflets were vertically oriented, A5 size, and unicolor, but used a colored background to draw attention. The ratio of text, illustrations, figures and charts varied with the content. They were distributed at health-related events or exhibitions held several times a year (typically every 2 to 3 months).

The specific themes addressed by these three media were as follows: desirable nutrition and food balance, reducing salt intake, prevention and treatment of obesity, moderate drinking, physical activities and health, disease prevention and diet, and mental health. The company personnel who were coordinating the study at each worksite and researchers discussed topics to be included as necessary. Researchers in the HIPOP-OHP group worked together to create these media, and had them checked by non-specialists such as clerical staff to ensure that the media were easily understood by typical working people.

We conducted a self-administered questionnaire survey on the amount of attention paid to each medium and the level of understanding of the information provided when at least one year had passed since these media were first introduced (Supplement 1). The questionnaire asked about the amount of attention the respondents paid to each medium and their level of understanding of the information presented, as well as how frequently

they used their company restaurant. The return rate of the questionnaire was 96% (2,361 of 2,459). The chi-square test or Wilcoxon signed-rank test was used to determine the statistical significance, and the level of significance was set at 5%. The Wilcoxon signed-rank test was used after we combined the five categories into two categories: "Every time the content is changed" or "Almost every time"=1, others=0, when we compared the amount of attention between POP menus and posters.

Results

Table 1 shows the amount of attention paid to the POP menus placed on the tables in the company restaurants, summarized by worksite and by gender. As for male respondents, 41.1% answered that they read the POP menu "every time the content is changed" or "almost every time". This rate varied from more than 50% in Companies D and F, to less than 25% in Company E. More than 45% of the male respondents in Company E answered that they "did not notice that a POP menu was on the table". Regarding female respondents, 52.6% answered that they read the POP menu "every time the content is changed" or "almost every time", but the percentage in Companies E and A was low, at 16.1% and 26.7%, respectively. In other companies, the rate was between 57.1% and 75.4%, which indicated that in companies other than Companies A and E, women were more likely to read the POP menus than men.

Table 2 shows the amount of attention paid to the posters displayed in the designated spaces at the worksites, summarized by company and by gender. Of the male respondents, 30.6% answered that they read the posters "every time the content is changed" or "almost every time", but the rate for Company E was below 25%; 46.0% "sometimes" read the posters. Of the female respondents, 32.0% read the posters "every time the content is changed" or "almost every time", but the rate was 16% or below in Companies E and A; fewer than 30% "sometimes" read the posters in Companies E and A, but 40.5% did in the other companies. More than 55% of the female respondents in Companies E and A answered "rarely or not at all", or "did not notice".

Table 3 shows the amount of attention drawn by the

Table 1 Amount of attention paid to the POP menu placed on all the tables in the company restaurant

Gender	Company	1. Every time the content is changed		2. Almost every time		3. Sometimes		4. Rarely, or not at all		5. Did not notice		p value†
	A	22	(9.2)	69	(28.9)	85	(35.6)	27	(11.3)	36	(15.1)	
	B	41	(9.0)	103	(22.6)	216	(47.5)	70	(15.4)	25	(5.5)	
	C	51	(15.9)	99	(30.8)	125	(38.9)	26	(8.1)	20	(6.2)	
	D	55	(18.0)	99	(32.5)	108	(35.4)	28	(9.2)	15	(4.9)	p<0.001
	E	17	(9.0)	26	(13.8)	34	(18.1)	26	(13.8)	85	(45.2)	
	F	55	(21.8)	87	(34.5)	81	(32.1)	25	(9.9)	4	(1.6)	
			(13.7)	483	(27.4)	649	(36.9)	202	(11.5)	185	(10.5)	
	A	7	(15.6)	5	(11.1)	12	(26.7)	9	(20.0)	12	(26.7)	
	B	45	(18.8)	92	(38.3)	88	(36.7)	12	(5.0)	3	(1.3)	
	C	16	(42.1)	15	(39.5)	5	(13.2)	2	(5.3)	0	(0.0)	
Women	D	14	(36.8)	11	(28.6)	2	(5.3)	4	(10.5)	7	(18.4)	p<0.001
	E	6	(5.1)	13	(11.0)	8	(6.8)	13	(11.0)	78	(66.1)	
	F	52	(42.6)	40	(32.8)	25	(20.5)	5	(4.1)	0	(0.0)	
	Total	140	(23.3)	176	(29.3)	140	(23.3)	45	(7.5)	100	(16.6)	

Actual number (%), † chi-square test

Table 2 Amount of attention paid to the posters affixed in the designated spaces in the worksite

Gender	Company	1. Every time the content is changed		2. Almost every time		3. Sometimes		4. Rarely, or not at all		5. Did not notice		p value†
	A	5	(2.1)	55	(23.1)	104	(43.7)	37	(15.5)	37	(15.5)	
	B	33	(7.3)	123	(27.1)	226	(49.8)	64	(14.1)	8	(1.8)	
	C	19	(6.0)	72	(22.6)	177	(55.5)	34	(10.7)	17	(5.3)	
	D	13	(4.3)	81	(26.7)	120	(39.6)	66	(21.8)	23	(7.6)	p<0.001
	E	12	(6.3)	32	(16.9)	68	(36.0)	42	(22.2)	35	(18.5)	
	F	14	(5.6)	78	(31.1)	112	(44.6)	39	(15.5)	8	(3.2)	
				441	(25.1)	807	(46.0)	282	(16.1)	128	(7.3)	
	A	4	(9.1)	2	(4.5)	12	(2 .3)	14	(31.8)	12	(27.3)	
	B	17	(7.1)	68	(28.3)	116	(4 .3)	30	(12.5)	9	(3.8)	
	C	4	(10.5)	15	(39.5)	18	(4 .4)	1	(2.6)	0	(0.0)	
Women	D	3	(7.7)	12	(30.8)	15	(3	5	(12.8)	4	(10.3)	p<0.001
	E	0	(0.0)	19	(16.0)	34	(2	15	(12.6)	51	(42.9)	
	F	11	(8.9)	38	(30.9)	49	(3	22	(17.9)	3	(2.4)	
	Total	39		154	(25.5)				(14.4)	79	(13.1)	

Actual number (%), † chi-square test

Table 3 Amount of attention paid to the leaflets distributed at health-related events and exhibitions

Gender	Company	1. Almost all of every leaflet		2. Only when the content interests me		3. Read part of the leaflet only, e.g., the title		4. Rarely		5. Never		6. Did not know there were such events or exhibitions		p value†
Women	A	27	(11.3)	82	(34.5)	66	(27.7)	35	(14.7)	9	(3.8)	19	(8.0)	p<0.001
	B	69	(15.4)	231	(51.4)	92	(20.5)	49	(10.9)	8	(1.8)			
	C	43	(13.4)	146	(45.3)	84	(26.1)	36	(11.2)	13	(4.0)			
	D	51	(16.8)	128	(42.1)	69	(22.7)	41	(13.5)	15	(4.9)			
	E	38	(20.4)	78	(41.9)	36	(19.4)	21	(11.3)	13	(7.0)			
	F	43	(17.1)	116	(46.2)	63	(25.1)	26	(10.4)	3	(1.2)			
	Total	271	(15.5)	781	(44.6)	410	(23.4)	208	(11.9)	61				
	A	5	(11.1)	19	(42.2)	10	(22.2)	4	(8.9)	2	(4.4)	5		p<0.001
	B	54	(22.6)	135	(56.5)	42	(17.6)	8	(3.3)	0	(0.0)	—		
	C	5	(13.2)	25	(65.8)	6	(15.8)	2	(5.3)	0	(0.0)	—		
	D	14	(35.0)	18	(45.0)	5	(12.5)	2	(5.0)	1	(2.5)	—		
	E	27	(23.1)	59	(50.4)	16	(13.7)	12	(10.3)	3	(2.6)	—		
	F	24	(20.0)	65	(54.2)	23	(19.2)	6	(5.0)	2	(1.7)	—		
	Total	129	(21.5)	321	(53.6)	102	(17.0)	34	(5.7)	8	(1.3)	5	(0.8)	

Actual number (%), † chi-square test

* Only the questionnaire for Company A offered the choice of answer: "Did not know that there were such events or exhibitions." This was not used in the statistical analysis.

Table 4 Difference in amount of attention paid by participants between POP menu and poster

Gender	Company	Medium for providing information	(1) 'Every time the content is changed' or 'Almost every time'		(2) others		Total (%)		p value†
Men	A	POP menu	89	(46.6)	102	(53.4)	191	(100.0)	p<0.001
		Poster	60	(31.4)	131	(68.6)	191	(100.0)	
	B	POP menu	141	(33.2)	284	(66.8)	425	(100.0)	0.345
		Poster	151	(35.5)	274	(64.5)	425	(100.0)	
	C	POP menu	146	(50.3)	144	(49.7)	290	(100.0)	p<0.001
		Poster	88	(30.3)	202	(69.7)	290	(100.0)	
	D	POP menu	150	(55.4)					
		Poster	94	(34.7)					
Women	D	POP menu							
		Poster							
		POP menu							
		Poster							
		POP menu							
		Poster							
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		Poster							
		POP menu							
		Poster							

Actual number (%), † Wilcoxon signed-rank test

Table 5 Relationship between the age group and the amount of attention paid to the POP menu

Gender	Age group	(1) 'Every time the content is changed' or 'Almost every time'	(2) Sometimes		(3) Rarely, or not at all		Total (%)		
Men	29 or less	151	156	(43.7)	50	(14.0)	357	(100.0)	<0.001
	30–39	247	288	(46.2)	88	(14.1)	623	(100.0)	
	40 or more	326	205	(34.5)	64	(10.8)	595	(100.0)	
Women	29 or less	85	45	(30.2)	19	(12.8)	149	(100.0)	<0.01
	30–39	103	59	(33.3)	15	(8.5)	177	(100.0)	
	40 or more	128	36	(20.6)	11	(6.3)	175	(100.0)	

Actual number (%), † chi-square test

Table 6 Relationship between the frequency of using the company restaurant and the amount of attention paid to POP menu

Gender	Frequency of using the company restaurant	(1) 'Every time the content is changed' or 'Almost every time'	(2) Sometimes		(3) Rarely, or not at all		Total (%)	p value†
Men	Almost every day	578	438	(39.8)	84	(7.6)	1100 (100.0)	<0.001
	3–4 times/week	96	99	(46.9)	16	(7.6)	211 (100.0)	
	Less than 2 times/week	48	111	(42.7)	101	(38.8)	260 (100.0)	
Women	Almost every day	270	88	(24.2)	5	(1.4)	363 (100.0)	<0.001
	3–4 times/week	29	21	(40.4)	2	(3.8)	52 (100.0)	
	Less than 2 times/week	16	30	(35.7)	38	(45.2)	84 (100.0)	

Actual number (%), † chi-square test

leaflets distributed at health-related events and exhibitions, summarized by company and by gender. Only 15.5% of men and 21.5% of women answered that they read "almost all of every leaflet". About 70% of both men and women read "only when the content interests them" or "read part of the leaflet only, e.g., the title".

There were significant differences between companies in the results of Tables 1 to 3 because of the large sample size, although the trend of the amount of attention paid to each media was similar.

Table 4 compares the difference in the amount of attention paid to the POP menus and the posters, by comparing the answers to the same questions asked for both items. We categorized the five answer choices into two groups, as shown in Table 5. The result demonstrated that the POP menus attracted more attention from both men and women than the posters, except for the men in Company B and both the men and women in Company E.

Table 5 indicates the relationship between the age group and the amount of attention paid to the POP menus. For this analysis, we categorized the respondents into three age groups: 29 years old or younger, 30 to 39 years old, and 40 years old and older. We regrouped the four answer choices into three groups by combining the No. 1 choice: "every time the content is changed" and the No. 2 choice: "almost every time", to make one group giving considerable attention to the medium. The result indicated that the older people paid more attention to the POP menus. At least 95% of respondents in all of the age groups answered that the POP menu was "easy to understand" or "understandable for the most part" (not shown in tables).

Table 6 shows the relationship between the frequency of using the company restaurant and the amount of attention paid to the POP menus. Here, we combined answers No. 3: "1 to 2 times a week", No. 4: "2 to 3 times a month", and No. 5: "rarely", to make one category of less frequent restaurant users. The attention analysis was based on the three categories, as shown in Table 4. The result indicated that the more frequently people used their company's restaurant, the more attention they paid to the POP menus. This was true of both men and women. More than 95% of the respondents answered, regardless of how often they used the restaurant, that the POP menus were "easy to understand" or "understandable for the most part" (not shown in the table).

Discussion

It is important for individuals to establish an appropriate lifestyle for health promotion and disease prevention and treatment (8). However, unless an "unhealthy" lifestyle continues for a long period of time, symptoms serious enough to affect quality of life are not likely to develop. In addition, much of health-related guidance and education is focused on high-risk individuals, or those who have risk factors. This leaves many low-risk individuals without any special measures taken. It is therefore important to establish an appropriate Population Strategy in Japan, and the first thing we need for this approach is an appropriate method for providing information.

All of the three media used in this study are established tools that have been used at numerous worksites (9, 10). However, the effectiveness of these tools is unclear, and they often presented information that was too difficult, or irrelevant, especially in the presentation order, or outdated. Therefore, we conducted this study to compare the effectiveness of these materials as media for providing information for the purpose of primary prevention. We had the companies introduce the materials we provided in the same manner without informing the general employees, except the members of the Safety and Health Committee, which examined the intervention plan and ethical problems.

Of the three media, the POP menus attracted the most

attention. This result may be attributed to several factors. First, a large number of POP menus were displayed, so that workers eating at the company restaurants could always see them. Second, the content of the POP menus was updated every week, which helped retain attention. Third, the POP menus carried information with a series of related themes for 4 to 8 weeks. Although the POP menus could provide only a limited amount of information, presenting related themes for a certain period of time had the effect of linking every bit of information, probably producing a synergistic effect. By contrast, the posters and leaflets did not prove as effective as we had expected. The reasons for this are as follows. Only a limited number of posters were shown due to space restrictions. To understand the content of a poster, readers had to approach the poster to clearly see what was written on it. Posters may possibly be useful in places where individuals have enough time to pay attention, such as in trains, buses, or waiting rooms of stations. As Table 6 indicates, posters might be a more effective medium for providing health-related information than POP menus, for workers who do not use or rarely use company restaurants.

Leaflets were provided only at health-related events, which were held several times a year. They might not have reached all the respondents, and some may have resented the leaflet being handed out (whether they liked it or not) during their break time, while some enthusiastic participants thought that it was very useful and read it repeatedly even after the event. We consider that such factors conspired to make the leaflets less appealing.

The findings of this study indicate that conditions drawing more attention to media for health promotion are as follows: [1] The health education materials should be viewed and easily read by targeted people without requiring their special attention. [2] The information should be placed where it can be seen by the targeted people 3 or more times a week. Placing POP menus on the tables of the company restaurants is one way of achieving the above-mentioned conditions. We can also expect media fulfilling these conditions such as the use of e-mail or wallpaper on a computer screen to prove similar by effective. At some worksites of our present study, none of the media used sufficiently attracted attention, such as at Company E (no full-time nurse or health professional existed at this company). This indicates the need to develop new media for effective presentation of information.

The effective use of such media plays an important role in helping the targeted people to change their lifestyle, by providing promotional information (11, 12). However, apart from our preliminary study (4), few studies have examined the appropriate types of media in accordance with the characteristics of the target population (9, 10, 13). The findings of this study indicate that we must choose appropriate media depending upon the situation of each population, so that more people can actually view and read the materials.

There are some limitations in the present study. First, we examined only three kinds of media that were presented in our intervention protocol, and the results of the present study may not be generalized for other settings. It remains to be further examined whether the result of this study can be applied to other worksites or to local communities. It has been clarified that we have to choose appropriate media after evaluating the characteristics of the target population.

As Rose pointed out (1), one of the obstacles in promoting the Population Strategy is getting the target group members to understand the significance of the strategy. When the target group consists of young and healthy working people, potential causes of diseases in the distant future are unlikely to draw their attention. We have to make a considerable effort to devise an effective way to provide information in order to motivate such people to change their lifestyle.

In conclusion, the present study clarified that POP menus provide health-related information to a broader range of workers than posters and leaflets in worksites.

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References

(1) Rose G. The population strategy of prevention. In The Strategy of Preventive Medicine. Oxford University Press, Oxford, 1992: 95–106.
(2) The Japan Dietetic Association. Activity by the dietitian and healthy Japan 21. Daiichi Publishers, Inc., Tokyo, 2000: 18–19. (in Japanese)
(3) Ueshima H, Okayama A. Healthy education on decreases cholesterol. Hokendojin Publishers, Inc., Tokyo, 1994: 68–91. (in Japanese)
(4) Yoshita K, Kimura R, Touda K, Morikawa Y, Nishijo M, Tabata M, Nakagawa H. Preliminary study on the effectiveness of basic nutrition education materials in a work site. Hokuriku J. public health 2003; 29: 52–57. (in Japanese)
(5) Okamura T, Tanaka T, Yoshita K, Chiba N, Takebayashi T, Kikuchi Y, Tamaki J, Tamura U, Minai J, Kadowaki T, Miura K, Nakagawa H, Tanihara S, Okayama A, Ueshima H. Specific alcoholic beverage and blood pressure in a middle-aged Japanese population: the High-risk and Population Strategy for Occupational Health Promotion (HIPOP-OHP) Study. J. Hum. Hypertens. 2004; 18: 9–16.
(6) Okamura T, Tanaka T, Babazono A, Yoshita K, Chiba N, Takebayashi T, Nakagawa H, Yamato H, Miura K, Tamaki J, Kadowaki T, Okayama A, Ueshima H. The High-risk and Population Strategy for Occupational Health Promotion

(HIPOP-OHP) Study.—Study Design and Cardiovascular Risk Factors at the Baseline Survey—. J. Hum. Hypertens. J. Hum. Hypertens. (in press, 2004 Jan 29, Epub ahead of print).
(7) Tamaki J, Kikuchi Y, Yoshita K, Takebayashi T, Chiba N, Tanaka T, Okamura T, Kasagi F, Minai J, Ueshima H. Stages of Change for salt intake and urinary salt excretion: Baseline results from the High-risk and Population Strategy for Occupational Health Promotion (HIPOP-OHP) Study. Hypertens. Res. 2004; 27: 157–66.
(8) Life style diseases prevention study meeting. 2003 Guide of the life style diseases. Social insurance publishing company, Tokyo, 2003: 10–14. (in Japanese)
(9) Tanaka K. Method and technique of nutrition education. In Futami D ed. Nutition education. Dobunshyoin publishing company., Tokyo, 2002: 15–24. (in Japanese)
(10) Kumazawa A. Method of nutrition education. In Sakamoto M ed. Nutition education. Daiichi Publishers, Inc., Tokyo, 2001: 91–100. (in Japanese)
(11) Prochaska JO, DiClemente CC, Norcross JC. In Search of How People Change: Applications of Addictive Behaviors. American Psychologist 1992; 47: 1102–1114.
(12) Komatsu T. Skill up of nutrition education. Nutrition Japan. 2002; 1: 4–15. (in Japanese)
(13) Motegi S, ed. Nutrition education. Gakkensyoin publishing company., Tokyo, 2002: 50–68. (in Japanese)

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(Supplement 1)

Questions in the self-administered questionnaire on the amount of attention paid to each material and the respondent's level of understanding of the information presented

1. How often do you use your company's restaurant? (include when you eat a lunch that you brought to the restaurant)
   1. Almost every day 2. 3–4 times a week
   3. 1–2 times a week 4. 2–3 times a month 5. Rarely
2. How often do you read the POP menus placed on each table in the company restaurant?
   1. Every time the content is changed 2. Almost every time
   3. Sometimes 4. Rarely, or not at all
   5. Did not notice that a POP menu was on the table.
3. Is the content presented on the POP menu easy to understand?
   1. Easy to understand (Too easy) 2. Easy to understand (Appropriate level: not too difficult, not too easy)
   3. Understandable for the most part
   4. Not really understandable (Too difficult)
4. How often do you read the posters on such topics as nutrition, exercise and smoking, which are posted in the company

restaurant, on bulletin boards, and in smoking areas?
1. Every time the content is changed 2. Almost every time
3. Sometimes 4. Rarely, or not at all

5. How often do you read the leaflets handed out at health promotion-related events and exhibitions?
1. Almost all of every leaflet
2. Only when the content interests me
3. Read part of the leaflet only, e.g., the title 4. Rarely
5. Never

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ORIGINAL ARTICLE

What factors are associated with high plasma B-type natriuretic peptide levels in a general Japanese population?

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There are few community-based epidemiologic studies that have dealt with risk factors for heart failure in non-Western populations. It has been reported that the measurement of plasma B-type natriuretic peptide (BNP) is useful for detecting patients with asymptomatic heart failure. To clarify the determinants of high plasma BNP level, the association of BNP with cardiovascular risk factors in community dwelling residents was examined. The plasma BNP levels were measured in 686 residents aged 35–69 years who received annual health check-up. The relationship of BNP to blood pressure, blood haemoglobin, serum cholesterol (total and high-density lipoprotein cholesterol), plasma glucose, electrocardiographic (ECG) findings, urinary salt excretion, and lifestyle factors (smoking and alcohol consumption) were cross-sectionally analysed. The plasma BNP geometric mean was 13.7 pg/ml. Both linear and logistic regression analyses indicated that the plasma BNP levels were positively associated with age, urinary salt excretion, higher blood pressure, high R-wave voltage in the 12-lead ECG (Minnesota Code 3-1 or 3-3), and female gender. Plasma BNP levels were inversely associated with blood haemoglobin levels. Gender-specific analysis showed similar results. However, plasma BNP did not correlate with other cardiovascular risk factors such as serum lipids.
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Introduction

Approximately 15% of deaths in Japan are due to heart diseases, of which about one-third are due to heart failure.[1] In 2001, mortality due to heart failure was 36.9 per 100 000 person-years, which is approximately two-thirds of that due to coronary heart disease (56.4 per 100 000 person-years).[1] The risk factors for coronary heart disease have been well described in several epidemiologic studies in Japan.[2–6] However, there are few available epidemiologic studies that deal with the risk factors for heart failure, even though it is a major problem in the Japanese population.[7,8] Accordingly, it is very important to clarify the risk factors for heart failure in Japan.

Congestive heart failure is usually regarded as the end-stage of the progressive deterioration of left ventricular function, which cannot be compensated for by cardiovascular homeostatic mechanisms.[9,10] Although heart failure is usually progressive, it can remain asymptomatic for many years. Thus, it would be of benefit to identify latent patients who have asymptomatic left ventricular dysfunction. However, in the general population, it is difficult and expensive in the primary care setting to screen the general population using Doppler echocardiography or exercise tolerance tests to diagnose left ventricular dysfunction.

B-type natriuretic peptide (BNP) is synthesized and released from the myocardium in response to an increase in ventricular filling pressure.[11] Recently, it was reported that the measurement of plasma BNP has a high sensitivity and a high specificity for detecting patients with asymptomatic heart failure or left ventricular dysfunction.[12–15] However, there are only a few studies that have examined the factors that are associated with high plasma BNP levels in the non-Western population.[16,17]

The purpose of this study is to clarify the risk factors for high plasma BNP levels, which is an important marker of asymptomatic heart failure, in a Japanese general population.

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Population and methods

Study population

The participants were 957 residents aged 35–69 years, who received regular annual health check-ups for the residents except for employees under the Health and Medical Service Law for the Aged, in SA town, Shiga Prefecture, a rural community in Western Japan. Well-trained nurses interviewed each participant to obtain a medical history and lifestyle information such as smoking and alcohol consumption. Of the 827 participants who gave informed consent, 13 participants did not have the complete data needed for the analysis. Of a total of 814 eligible participants, 128 were excluded for the following reasons: past or present history of coronary heart disease ($n=18$), diabetes mellitus ($n=48$), atrial fibrillation ($n=2$), and having symptoms suspected of heart failure, such as some clinical conditions that preclude physical exercise ($n=60$). No participants had a past or present history of renal disease. Thus, 686 residents aged 35–69 years participated in the study (209 men and 477 women; mean age$\pm$s.d., 56.1$\pm$9.7 years).

All the procedures of this study were reviewed and approved by the Institutional Review Board of Shiga University of Medical Science (No.14-10, 2002).

Clinical examination

The body mass index (BMI) was calculated as weight (kg) divided by the square of height (m). The blood pressure was measured twice after 5 min of rest using an automatic sphygmomanometer (COLIN CORPORATION, BP-103i II, Aichi, Japan) placed on the right arm of participants in the sitting position. The mean of the two measurements was used for this analysis. The blood pressure was classified into the following four categories using WHO criteria of 1999:[18] optimal and normal—systolic blood pressure (SBP) under 130 mmHg and diastolic blood pressure (DBP) under 85 mmHg; high normal—SBP 130–139 mmHg and/or DBP 85–89 mmHg; grade 1—SBP 140–159 mmHg and/or DBP 90–99 mmHg; and grades 2 and 3—SBP 160 mmHg or greater and/or DBP 100 mmHg or greater.

Blood samples were drawn from an antecubital vein of nonfasting participants, and then analysed in one laboratory (KINKIYOKEN, Shiga). Plasma samples for the BNP measurements were transferred immediately to tubes with 1.0 mg/ml of EDTA-2Na and 500 kallikrein inhibitory units (KIU)/ml of aprotinin. Plasma was obtained by centrifugation at 3000 rpm for 10 min at 4°C and stored at −80°C until analysis. Plasma BNP concentration was measured with specific immunoradiometric assays for human BNP (ShionoRIA BNP kit, Shionogi & Co., Ltd, Osaka, Japan).[12–14,16,19,20] For BNP, the intra- and inter-assay coefficients of variation for this assay were 1.3 and 3.2%, respectively. Plasma BNP level of 18 pg/ml or greater were considered indicative of potential left ventricular dysfunction. This was based on a previous study conducted in the UK that showed this BNP cutoff value had a sensitivity of 77% and a specificity of 87% in 1252 participants aged 25–74 years for diagnosing left ventricular systolic dysfunction (left ventricular ejection fraction 30% or less).[15]

Total cholesterol and high-density lipoprotein (HDL) cholesterol in serum were measured enzymatically. Lipid measurement at the reporting laboratory has been standardized at the Osaka Medical Center for Health Science and Promotion, by a member of the Cholesterol Reference Method Laboratory Network (CRMLN).[21,22] Plasma glucose was measured by the hexokinase method. Blood haemoglobin was determined by the latex coagulation method.

Electrocardiography (ECG) was performed by standard 12-lead ECG after the patient had rested sufficiently. Findings of high R-wave voltage, ST-T depression, and an inverse- or flat-T-wave in the ECG were defined according to the Minnesota Code (MC).[23] High R-wave voltage in the 12-lead ECG was defined by the following: an R-wave in V5 or V6 of 2.6 mV or greater (MC 3-1) and/or the height of the R-wave in V1 plus V5 or V6 of 3.5 mV or greater (MC 3-3). Other findings that were documented if present included ST-T depression (MC 4-1 or 4-3), and inverse or flat T-waves (MC 5-1 or 5-3).

Daily salt excretion was estimated by Tanaka's formulas,[24] which estimate populational daily urinary salt excretion from the sodium and creatinine levels in casual urine samples. Using a self-reported questionnaire administered by well-trained nurses, the participants were asked about daily alcohol intake and smoking habits.

Statistical analyses

The possible determinants of BNP were divided into quartiles or categories. Geometric means of BNP were used for the analysis of each determinant because the distribution of BNP was positively skewed. To compare these with the crude geometric means of BNP in each quartile or category, analysis of variance was used. Comparisons with age- and gender-adjusted geometric means of BNP were performed using analysis of covariance. Gender-specific analysis was also performed.

Linear regression analysis was used to clarify the contribution of each independent variable to BNP. Multiple logistic regression analysis was used to assess the contribution of each independent variable to a high plasma BNP level (18 pg/ml or greater). The significance of the interaction of sex with risk factors related to BNP was tested using an inter-

action term in multivariate models in the gender-combined analysis.

The Statistical Package for the Social Sciences (SPSS Japan Inc., version 11.0J, Tokyo, Japan) was used for the analyses. All probability values were two-tailed and all confidence intervals were estimated at the 95% level.

Results

Table 1 shows the means and the prevalence of risk factors. The mean plasma BNP was 13.7 pg/ml in the entire population, 10.7 pg/ml in men and 15.3 pg/ml in women.

There was no relationship between BNP level and each quartile for BMI, DBP, total cholesterol, HDL cholesterol, plasma glucose, and current smoking. Table 2 shows the geometric means of BNP according to the quartiles or categories (blood pressure category, high R-wave voltage, and current alcohol consumption) for each risk factor that was statistically significant in the analysis of variance or covariance. SBP, Grade 2 or severe hypertension category (SBP$\geqslant$160 mmHg and/or DBP$\geqslant$100 mmHg), high R-wave voltage in the ECG, and daily salt excretion were positively associated with BNP, and their values were higher in the higher BNP quartiles. There was a statistically significant relationship between the BNP levels and haemoglobin quartiles, with higher BNP levels in patients with haemoglobin values in the lower quartiles.

Since the interaction term between sex and risk factors related to BNP was not statistically significant in the multivariate regression analyses,

Table 1 Levels and prevalence of risk characteristics for males, females, combined among 686 subjects aged 35–69 years old in SA-Town, Shiga, Japan, 2002

Variables	*Males (n = 209)*	*Females (n = 477)*	*Combined (n = 686)*
	mean±s.d.	*mean±s.d.*	*mean±s.d.*
Age (years)	57.1±9.1	55.6±9.9	56.1±9.7
Body mass index (kg/m)	23.8±2.9	23.0±3.0	23.3±3.0
Systolic blood pressure (mmHg)	130.1±18.0	124.0±18.3	125.8±18.4
Diastolic blood pressure (mmHg)	82.4±11.1	75.5±11.1	77.6±11.5
Total cholesterol (mmol/l)	5.29±0.79	5.59±0.91	5.50±0.89
High density lipoprotein (HDL) cholesterol (mmol/l)	1.39±0.38	1.63±0.39	1.56±0.40
Plasma glucose (mmol/l)	5.31±0.77	5.07±0.50	5.15±0.60
Haemoglobin (g/dl)	14.7±1.0	12.9±1.1	13.5±1.4
Salt excretion (g/day, estimated)	12.6±3.4	12.1±3.3	12.3±3.3
B type natriuretic peptide (BNP) (pg/ml, geometric mean)	10.7	15.3	13.7
	Prevalence (%)	*Prevalence (%)*	*Prevalence (%)*
ECG findings			
High R-wave voltage[a]	13.4	5.9	8.0
ST-depression[b]	0.0	1.9	1.3
Inverse or flat T-wave[c]	1.4	2.1	1.9
Blood pressure category[d]			
Optimal+normal	47.4	62.5	57.9
High–normal	16.3	14.5	15.0
Grade 1	27.8	17.6	20.7
Grade 2+3	8.6	5.5	6.4
Subject using antihypertensive agents	14.4	14.7	14.6
Smoking habit			
Nonsmoker	24.4	91.8	71.3
Ex smoker	23.4	1.9	8.5
Current smoker	52.2	6.3	20.3
Alcohol consumption			
Nondrinker	22.5	76.7	60.2
Ex drinker	1.0	0.4	0.6
Current drinker	76.6	22.9	39.2
Menopause	—	69.0	—
High plasma BNP (18 pg/ml or greater)	24.4	43.2	37.5

[a]High R-wave voltage:high R criteria:V5 or V6>2.6 mV, and/or V1 and V5 or V6>3.5 mV.
[b]ST-depression: the criteria for ST depression was the Minnesota Code 4-1 or 4-3.
[c]Inverse- or flat-T-wave: the criteria for inverse- or flat-T was the Minnesota Code 5-1 or 5-3.
[d]Blood pressure category: Optimal+normal: SBP<130 mmHg and DBP<85 mmHg, high–normal: SBP 130–139 mmHg and/or DBP 85–89 mmHg, grade 1:SBP 140–159 mmHg and/or DBP 90–99 mmHg, grade 2+3: SBP$\geqslant$160 mmHg and/or DBP$\geqslant$100 mmHg.

Table 2 Plasma BNP levels and quintiles for proportional variables among 686 males and females aged 35–69 years old in SA-Town, Shiga, Japan, 2002

Variables	*Number of subjects*	*Crude geometric mean (pg/ml)*	P*	*Age- and gender-adjusted geometric mean (pg/ml)*	P**
Systolic blood pressure (mmHg)					
Quartile 1 –111.3	171	12.7	0.004	13.6	0.041
Quartile 2 111.4–123.4	170	13.0		13.3	
Quartile 3 123.5–138.9	169	12.9		12.5	
Quartile 4 139.0–	176	16.5		15.5	
Blood pressure category[a]					
Optimal+normal	397	12.7	0.001	13.2	0.047
High–normal	103	14.1		13.2	
Grade 1	142	15.0		14.6	
Grade 2+3	44	19.5		17.8	
Haemoglobin (g/dl)					
Quartile 1 –12.5	159	17.5	0.000	17.0	0.000
Quartile 2 12.6–13.3	168	15.6		15.2	
Quartile 3 13.4–14.2	175	13.6		13.2	
Quartile 4 14.3–	184	10.0		10.8	
High R-wave voltage in the ECG[b]					
–	631	13.3	0.000	13.3	0.000
+	55	20.3		19.7	
Salt excretion (g/day, estimated)					
Quartile 1 –9.9	166	11.0	0.000	11.7	0.000
Quartile 2 10.0–11.8	171	12.3		12.3	
Quartile 3 11.9–13.9	171	15.7		15.1	
Quartile 4 14.0–	178	16.5		16.2	
Alcohol consumption					
Non-/ex drinker	417	14.4	0.037	13.1	0.053
Current drinker	269	12.7		14.8	

[a]Blood pressure category: Optimal+normal: SBP < 130 mmHg and DBP < 85 mmHg, high–normal: SBP 130–139 mmHg and/or DBP 85–89 mmHg, grade 1: SBP 140–159 mmHg and/or DBP 90–99 mmHg, grade 2+3: SBP ⩾ 160 mmHg and/or DBP ⩾ 100 mmHg.
[b]High R-wave voltage+high R criteria: V5 or V6 > 2.6 mV, and/or V1 and V5 or V6 > 3.5 mV.
*P: analysis of variance, **P: analysis of covariance.

the following analyses were carried out to combined men and women with adjustment for gender.

Table 3 shows the partial regression coefficients from the linear regression analysis. In this model, age, daily salt excretion, high R-wavé voltage, female gender, and SBP were positively associated with plasma BNP levels. Blood haemoglobin was negatively associated with BNP levels. The multiple correlation coefficient (R) of this model was 0.49 and the degrees of freedom (df)-adjusted coefficient of determination (R^2) was 0.23 ($F = 30.0$, $P < 0.001$). Alcohol consumption was positively associated with BNP levels, although it did not reach statistical significance ($P = 0.051$). BMI showed no association with BNP levels.

Table 4 shows the odds ratios of each risk factor with a high plasma BNP level (18 pg/ml or greater) determined using multiple logistic regression analysis. Age, daily salt excretion, high R-wave voltage, female gender, and grade 2 or greater hypertension were positively associated with high plasma BNP levels, and blood haemoglobin concentration was negatively associated. The significant relationship between BNP and salt excretion was also observed even after we excluded participants with high R-wave voltage or participants taking antihypertensive agents, although the relationship between BNP and SBP or hypertension disappeared when these patients were excluded.

Gender-specific analysis showed that plasma BNP levels were significantly correlated with age, urinary salt excretion, and low haemoglobin for each gender. We also observed positive relations of plasma BNP levels with SBP and high R-wave voltage for each gender, which indicated similar magnitude of regression coefficients or odds ratio, although the relation with SBP for women and high R-wave voltage for men did not reach statistical significance.

Further analysis adjusting for administration of antihypertensive agents, smoking, serum lipids, and plasma glucose did not substantially affect the results shown in Tables 3 (data not shown in the table).

Table 3 Determinants of plasma BNP levels: linear regression analysis, 686 males and females aged 35–69 years old in SA-Town, Shiga, Japan, 2002

Variables	*Partial regression coefficients*	*s.e.*[a]	t	p
Age (10 years)	0.210	0.029	7.296	0.000
Haemoglobin (1 s.d., 1.36 g/dl)	−0.196	0.034	−5.681	0.000
Salt excretion (1 s.d., 3.4 g/day)	0.133	0.027	4.892	0.000
High R-wave voltage in the ECG (0 = no, 1 = yes)[b]	0.325	0.098	3.326	0.001
Gender (0 = male, 1 = female)	0.251	0.080	3.140	0.000
Systolic blood pressure (1 s.d., 18.4 mmHg)	0.070	0.029	2.454	0.014
Alcohol consumption (0 = non- or ex drinker, 1 = current drinker)	0.123	0.062	1.987	0.051
Body mass index (1 s.d., 3.0 kg/m^2)	−0.021	0.028	−0.759	0.448

[a]Standard error.
[b]High R-wave voltage was defined by height of R-wave in the ECG ;V5 or V6 is 2.6 mV or greater, and/or height of R-wave for V1 plus V5 or V6 is 3.5 mV or greater.

Table 4 Multivariate odds ratio and 95% confidence intervals for having high plasma BNP (⩾18.0 pg/ml), 686 males and females aged 35–69 years old in SA-Town, Shiga, Japan, 2002

Variables	*Odds ratio*	*95% confidence interval*		
Age (years)	1.05	1.03	—	1.07
Haemoglobin (g/dl)	0.69	0.58	—	0.81
Salt excretion (g/day)	1.09	1.03	—	1.15
High R-wave voltage in the ECG (0 = no, 1 = yes)[a]	2.05	1.10	—	3.81
Gender (0 = male, 1 = female)	2.01	1.18	—	3.41
Blood pressure category[b]				
Optimal+normal	1.00		—	
High–normal	0.92	0.56	—	1.51
Grade 1	1.28	0.82	—	2.01
Grade 2+3	2.09	1.04	—	4.22
Alcohol consumption (0 = non- or ex drinker, 1 = current drinker)	1.45	0.97	—	2.17
Body mass index (kg/m^2)	0.99	0.93	—	1.06

[a]High R-wave voltage was defined by height of R-wave in the ECG; V5 or V6 is 2.6 mV or greater, and/or height of R-wave for V1 plus V5 or V6 is 3.5 mV or greater.
[b]Blood pressure category: Optimal+normal: SBP < 130 mmHg and DBP < 85 mmHg, high–normal: SBP 130–139 mmHg and/or DBP 85–89 mmHg, grade 1: SBP 140–159 mmHg and/or DBP 90–99 mmHg, grade 2+3: SBP ⩾ 160 mmHg and/or DBP ⩾ 100 mmHg.

Discussion

The present study suggests that higher blood pressure, urinary salt excretion (a surrogate measure of dietary salt intake), high R-wave voltage in the ECG, and low blood haemoglobin as well as age and female gender are important determinants of plasma BNP levels in a general Japanese population.

Previous studies have reported a positive relationship between heart failure and hypertension.[19,25] The present study has also shown a positive relationship between grade 2 or greater hypertension and high levels of plasma BNP. Similar to previous reports dealing with Western populations, hypertension of moderate or greater degree may be one of the risk factors for asymptomatic heart failure or left ventricular dysfunction in the Japanese population. Hypertension, which is derived mainly from increased systemic vascular resistance and/or expanded intravascular volume, causes a sustained increase in left ventricular afterload that decreases cardiac output or ejection fraction, ultimately resulting in congestive heart failure.[19]

In general, urinary salt excretion is nearly equal to the dietary salt intake. High salt intake is an important factor that can expand intravascular volume, and it is a major causal risk factor for hypertension.[26–29] A recent study suggested that high salt intake *per se*, independent of hypertension, can have a harmful effect on the general population owing to the high risk of total mortality and mortality due to coronary heart disease and stroke.[30,31] A previous study reported that chronic high dietary salt intake increases the plasma concentration of BNP, even in the absence of hypertension.[32] It has also been reported that high dietary salt intake is related to the incidence of congestive heart failure in overweight men and women in the United States.[20] Furthermore, it has been emphasized that high salt intake is a risk factor for left ventricular hypertrophy.[33–35] High salt intake may be directly correlated to plasma BNP concen-

tration due to an increase in the circulating blood volume, which may indirectly lead to an increase in myocardial mass due to hypertension. The relationship between BNP and daily salt excretion was present after exclusion of subjects taking antihypertensive agents or those who had high R-wave voltage.

BNP, as a cardioprotective factor, has a diuretic effect that promotes the excretion of water and sodium by the kidneys.[36,37] As a result of the high sodium excretion promoted by BNP, the amount of urinary salt excretion may overestimate the actual dietary salt intake in participants with high plasma BNP levels. However, participants with high urinary salt excretion are continually exposed to high salt intake, which results in a situation that high BNP secretion is needed in order to protect their circulatory system. Consequently, we believe that a high salt intake may be a causal risk factor for heart failure or left ventricular dysfunction.

Left ventricular hypertrophy, which is usually accompanied by hypertension, is an example of target organ damage caused by an increase in circulating blood volume and/or vascular resistance occurring over many years. In the Framingham study, cardiac mass was assessed using echocardiography.[12] In the present study, we used the presence of high R-wave voltage in the 12-lead ECG as an index of left ventricular hypertrophy. An ECG is a more convenient and inexpensive method than an echocardiogram, and it is suitable for mass screening in the community. Moreover, people aged 40 years or greater in Japan are able to have an annual ECG under the Health and Medical Service Law for the Aged or the Industrial Safety and Health Law. In a previous study, significantly higher BNP levels were noted in patients with heart disease or hypertension who had abnormal electrocardiographic findings, such as high R-wave voltage.[38] Our finding seems to be consistent with this previous study, although our participants were healthy community dwelling residents.

Hypertension, high salt excretion, and high R-wave voltage in the ECG, which are associated with high BNP levels, are also the classical risk factors for stroke reported in previous Japanese cohort studies.[39–42] However, serum total cholesterol, which is a risk factor for ischaemic heart disease and not for stroke in Japan,[2–5] was not associated with plasma BNP levels. Since mortality due to ischaemic heart disease in Japan is lower than that in Western populations,[1,6,43] it may be reasonable to assume that the risk factors for latent heart failure are similar to those for stroke in the Japanese population.

Another interesting finding in the present study was the negative correlation between blood haemoglobin and BNP. It has been reported that anaemia is an independent prognostic factor for mortality in congestive heart failure patients living in the community.[44] Our result suggests that a low blood haemoglobin concentration, even within the clinically normal range, is associated with high plasma BNP. A reduced haemoglobin concentration might be a maker for advanced heart failure that may occur as a result of haemodilution due to volume overload and renal insufficiency.[44] Other factors in heart failure that are associated with anaemia include iron deficiency, chronic inflammation, and impaired erythropoietin production.[45]

Several limitations of this study should be acknowledged. First, we dealt with high R-wave voltage in the ECG as a marker for left ventricle hypertrophy, which may not always reflect true cardiac mass. Although body mass may affect R-wave amplitude, we statistically adjusted for the effect of body mass index. Unfortunately, due to the low prevalence of other abnormal findings in the ECG such as ST-T depression (1.3%) and inverse or flat T-waves (1.9%), we were not able to use these findings in our analysis. Second, our study used a cross-sectional design, which does not prove causal relations between plasma BNP levels and the above-mentioned risk factors.

In conclusion, we clarified the relationship between the elevated plasma BNP and hypertension, urinary salt excretion, high R-wave voltage in the ECG, age, and low haemoglobin concentration in a Japanese general population. We found some possible determinants for the elevation of plasma BNP in the Japanese general population. These factors — age, urinary salt excretion, hypertension — are similar to the classical risk factors for stroke in Japan.

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References

1 Statistics and Information Department. Ministry of Health and Welfare, Labor. *Vital Statistics of Japan 2001*. Health and Welfare Statistics Association: Tokyo, 2003, pp 390–391.
2 Shimamoto T *et al*. Trends for coronary heart disease and stroke and their risk factors in Japan. *Circulation* 1989; **79**: 503–515.
3 Kiyohara Y, Ueda K, Fujishima M. Smoking and cardiovascular disease in the general population in Japan. *J Hypertens* 1990; **8**(Suppl): S9–S15.
4 Ueshima H. Changes in dietary habits, cardiovascular risk factors and mortality in Japan. *Acta Cardiol* 1989; **44**: 475–477.
5 Ueshima H, Tatara K, Asakura S. Declining mortality from ischemic heart disease and changes in coronary risk factors in Japan, 1956–1980. *Am J Epidemiol* 1987; **125**: 62–72.

6 Okamura T *et al.* What cause of mortality can we predict by cholesterol screening in the Japanese general population? *J Intern Med* 2003; **253**: 169–180.
7 Itoh A *et al.* Prognosis of patients with congestive heart failure: its determinants in various heart diseases in Japan. *Intern Med* 1992; **31**: 304–309.
8 Tsuchihashi M *et al.* Clinical characteristics and prognosis of hospitalized patients with congestive heart failure—a study in Fukuoka, Japan. *Jpn Circ J* 2000; **64**: 953–959.
9 McKee PA *et al.* The natural history of congestive heart failure: the Framingham study. *N Engl J Med* 1971; **285**: 1441–1446.
10 The SOLVD Investigators. Effect of enalapril on mortality and the development of heart failure in asymptomatic patients with reduced left ventricular ejection fractions. *N Engl J Med* 1992; **327**: 685–691.
11 Levin ER, Gardner DG, Samson WK. Natriuretic peptides. *N Engl J Med* 1998; **339**: 321–328.
12 Wang TJ *et al.* Impact of age and sex on plasma natriuretic peptide levels in healthy adults. *Am J Cardiol* 2002; **90**: 254–258.
13 Nakamura M *et al.* Value of plasma B type natriuretic peptide measurement for heart disease screening in a Japanese population. *Heart* 2002; **87**: 131–135.
14 Vasan RS *et al.* Plasma natriuretic peptides for community screening for left ventricular hypertrophy and systolic dysfunction: the Framingham heart study. *JAMA* 2002; **288**: 1252–1259.
15 McDonagh TA *et al.* Biochemical detection of left-ventricular systolic dysfunction. *Lancet* 1998; **351**: 9–13.
16 Kato J *et al.* Plasma levels of adrenomedullin and atrial and brain natriuretic peptides in the general population: their relations to age and pulse pressure. *Hypertens Res* 2002; **25**: 887–892.
17 Matsuda M. The significance of plasma BNP measurement in the health check up. *Kyorin Igakkai Zasshi* 1999; **30**: 73–83 (in Japanese).
18 WHO guideline subcommittee. 1999 World Health Organization—International Society of Hypertension guidelines for the management of hypertension. *J Hypertens* 1999; **17**: 151–179.
19 Strauer BE. Hypertension and the heart: clinical studies. In: Zanchetti A, Tarazi RC (eds). *Handbook of Hypertension*, Vol. 7. Elsevier: New York, 1986.
20 He J *et al.* Dietary sodium intake and incidence of congestive heart failure in overweight US men and women: first National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. *Arch Intern Med* 2002; **162**: 1619–1624.
21 Myers GL *et al.* A reference method laboratory network for cholesterol: a model for standardization and improvement of clinical laboratory measurements. *Clin Chem* 2000; **46**: 1762–1772.
22 Nakamura M, Sato S, Shimamoto T. Improvement in Japanese clinical laboratory measurements of total cholesterol and HDL-cholesterol by the US Cholesterol Reference Method Laboratory Network. *J Atheroscler Thromb* 2003; **10**: 145–153.
23 Prineas RJ, Crow RS, Blackburn H. *The Minnesota Code Manual of Electrocardiographic Findings: Standards and Procedures for Measurement and Classification.* John Wright-PSG Inc.: Litteleton, MA, 1982.
24 Tanaka T *et al.* A simple method to estimate populational 24-h urinary sodium and potassium excretion using a casual urine specimen. *J Hum Hypertens* 2002; **16**: 97–103.
25 Ghali JK *et al.* Precipitating factors leading to decompensation of heart failure. Traits among urban blacks. *Arch Intern Med* 1988; **148**: 2013–2016.
26 Jackson FL. An evolutionary perspective on salt, hypertension, and human genetic variability. *Hypertension* 1991; **17**(Suppl 1): 129–132.
27 Law MR, Frost CD, Wald NJ. By how much does dietary salt reduction lower blood pressure? I: Analysis of observational data among populations. *BMJ* 1991; **302**: 811–815.
28 Midgley JP *et al.* Effect of reduced dietary sodium on blood pressure: a meta-analysis of randomized controlled trials. *JAMA* 1996; **275**: 1590–1597.
29 INTERSALT Co-operative Research Group. The INTERSALT study. *J Hum Hypertens* 1989; **3**: 279–331.
30 Tuomilehto J *et al.* Urinary sodium excretion and cardiovascular mortality in Finland: a prospective study. *Lancet* 2001; **357**: 848–851.
31 Nagata C *et al.* Sodium intake and risk of death from stroke in Japanese men and women. *Stroke* 2004; **35**: 1543–1547.
32 Ishimitsu T *et al.* Responses of natriuretic peptides to acute and chronic salt loading in normotensive and hypertensive subjects. *Hypertens Res* 1998; **21**: 15–22.
33 Kupari M, Koskinen P, Virolainen J. Correlates of left ventricular mass in a population sample aged 36 to 37 years. Focus on lifestyle and salt intake. *Circulation* 1994; **89**: 1041–1050.
34 Beil AH, Schmieder RE. Salt intake as a determinant of cardiac hypertrophy. *Blood Press* 1995; **2**(Suppl): 30–34.
35 Seta H *et al.* Analysis of factors influencing left ventricular mass and diastolic function in normotensive men. *J Cardiol* 2001; **37**: 249–256 (in Japanese).
36 Mukoyama M *et al.* Brain natriuretic peptide as a novel cardiac hormone in humans. Evidence for an exquisite dual natriuretic peptide system, atrial natriuretic peptide and brain natriuretic peptide. *J Clin Invest* 1991; **87**: 1402–1412.
37 Yasue H *et al.* Localization and mechanism of secretion of B-type natriuretic peptide in comparison with those of A-type natriuretic peptide in normal subjects and patients with heart failure. *Circulation* 1994; **90**: 195–203.
38 Hirata Y *et al.* Measurement of plasma brain natriuretic peptide level as a guide for cardiac overload. *Cardiovasc Res* 2001; **51**: 585–591.
39 Tanaka H *et al.* Epidemiologic studies of stroke in Shibata, a Japanese provincial city: preliminary report on risk factors for cerebral infarction. *Stroke* 1985; **16**: 773–780.
40 Tanaka H *et al.* Risk factors for cerebral hemorrhage and cerebral infarction in a Japanese rural community. *Stroke* 1982; **13**: 62–73.
41 Lin CH *et al.* Cerebrovascular diseases in a fixed population of Hiroshima and Nagasaki, with special reference to relationship between type and risk factors. *Stroke* 1984; **15**: 653–660.
42 Ueshima H *et al.* Multivariate analysis of risk factors for stroke. Eight-year follow-up study of farming villages in Akita, Japan. *Prev Med* 1980; **9**: 722–740.

43 Sekikawa A *et al*. A "natural experiment" in cardiovascular epidemiology in the early 21st century. *Heart* 2003; **89**: 255–257.
44 Ezekowitz JA, McAlister FA, Armstrong PW. Anemia is common in heart failure and is associated with poor outcomes: insights from a cohort of 12 065 patients with new-onset heart failure. *Circulation* 2003; **107**: 223–225.
45 Okonko DO, Anker SD. Anemia in chronic heart failure: pathogenetic mechanisms. *J Card Fail* 2004; **10**(Suppl 1): S5–S9.

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