A Lifestyle to Prevent or Combat the Metabolic Syndrome among Japanese Workers: Analyses Using the Health Belief Model and the Multidimensional Health Locus of Control

Yasushi KUDO[1]*, Mitsushi OKADA[2], Masashi TSUNODA[2], Toshihiko SATOH[3] and Yoshiharu AIZAWA[2]

[1]Kitasato University Graduate School of Medical Sciences, 1–15–1 Kitasato, Minami-ku, Sagamihara, Kanagawa 252-0373, Japan
[2]Department of Preventive Medicine and Public Health, Kitasato University School of Medicine, Kanagawa, Japan
[3]Kitasato Clinical Research Center, Kitasato University School of Medicine, Kanagawa, Japan

Abstract: We investigated the predictors significantly associated with a lifestyle to prevent or combat the metabolic syndrome among Japanese workers. We conducted an anonymous self-administered questionnaire survey and analyzed the resulting data using multiple linear regression analysis. The dependent variable was a lifestyle to prevent or combat the metabolic syndrome (7-point scale). Independent variables were: subjects' basic attributes (age, gender, blue or white collar worker, with or without a family physician), Multidimensional Health Locus of Control (7-point scale for each item), with or without the metabolic syndrome being pointed out or not by healthcare providers, and 4 items regarding the metabolic syndrome produced with reference to the Health Belief Model (7-point scale for each item). Those independent variables were all included in this model. The analysis shows the older workers, white-collar workers, and workers who had the metabolic syndrome pointed out by healthcare providers had appropriate lifestyles. Those with high scores in Powerful Others Health Locus of Control also had appropriate lifestyles. Those who realized that the metabolic syndrome was a life-threatening disease and who knew practical ways to prevent or combat the metabolic syndrome also had appropriate lifestyles. Our findings can be applied to various types of medical education regarding the metabolic syndrome.

Key words: Metabolic syndrome, Motivation, Health belief model, Multidimensional health locus of control, Questionnaire, Japanese workers

Introduction

The definitions of the metabolic syndrome are proposed all over the world, e.g., the criteria of the World Health Organization (WHO)[1], the National Cholesterol Education Panel (NCEP)[2], the International Diabetes Federation (IDF)[3], and the Japanese Committee to Evaluate Diagnostic Standards for Metabolic Syndrome[4]. Because there are various definitions, the differential regarding the metabolic syndrome cannot be made easily. However, these criteria focus on multiple risk factors (e.g., elevated triglycerides, obesity, and elevated blood pressure), which cause life-threatening diseases such as cardiovascular events and stroke[1–8].

The metabolic syndrome is largely a problem world

*To whom correspondence should be addressed.
E-mail: ykudo@med.kitasato-u.ac.jp

wide[1–9]. For example, in Japan, among 40–74-yr-old people, 50% of men and 20% of women were strongly suspected to have either the metabolic syndrome or the prodromal metabolic syndrome[9]. If healthcare providers do not take countermeasures against the metabolic syndrome, many people will suffer from life-threatening diseases in the future. They must conduct various educational activities regarding the metabolic syndrome such as health consultations and seminars.

When healthcare providers provide medical education for people, even if people acquire the necessary medical knowledge, they might not have appropriate lifestyles to prevent or combat the metabolic syndrome. Therefore, merely imparting medical information to people will not be sufficient. Proper education is necessary for people to help them make behavioral modifications in their lifestyles. However, we think that many healthcare professionals are keenly aware of the various difficulties in their services. In the field of behavioral sciences regarding health, the concepts of the Health Belief Model and the Multidimensional Health Locus of Control (MHLC) are helpful tools for healthcare providers to conduct the necessary education to affect the desired results[10–18]. These concepts can be applied to the metabolic syndrome.

The Health Belief Model values the perceived factors of severity, susceptibility, benefits, and barriers[10–14]. If many people do not feel the perceived severity of the metabolic syndrome, they may not have appropriate lifestyles. If they do not also recognize the perceived susceptibility of the metabolic syndrome, they may not have the necessary healthy lifestyles. Moreover, they may not recognize the benefits of appropriate lifestyles and/or have barriers toward such lifestyles. This model is frequently used in studies in the behavioral sciences regarding health[10–14]. In the present study, the items were designed to assess the 4 facets described in the Methods.

MHLC scales are also used to investigate preventive health behaviors[10–18]. The MHLC scales are used to measure the beliefs concerning one's health. These scales are composed of the following three dimensions: 1. Chance Health Locus of Control (CHLC), the belief that the status of one's health is ruled by chance; 2. Internal Health Locus of Control (IHLC), the belief that the control over one's health depends on oneself; and 3. Powerful Others Health Locus of Control (PHLC), the belief that one's health condition depends on the influence from healthcare providers such as physicians and nurses.

In the present study, with the aim of establishing appropriate medical education regarding the metabolic syndrome, we investigated the predictors significantly associated with a lifestyle to prevent or combat the metabolic syndrome by using an anonymous self-administered questionnaire. These predictors were examined: the subjects' basic attributes, the MHLC, with or without the metabolic syndrome being pointed out or not by healthcare providers, and the items regarding the metabolic syndrome produced with reference to the Health Belief Model.

Methods

Participants

The subjects were 2,287 workers in a Japanese manufacturing plant. People in charge of occupational health were not subjects in this study. In January 2009, the anonymous self-administered questionnaires (original version in Japanese, see the Appendix) and envelopes for the return of the questionnaires were distributed to the subjects. To obtain truthful answers, the subjects returned their questionnaires in the sealed envelopes about two weeks later.

The Japanese explanations of this study were also distributed to the subjects. These explanations included, e.g., the study methods, that submitting the questionnaire indicates the respondent's consent to participate in the study, privacy protection, and the first author's contact information.

The questionnaire was composed of: 1. items related to the metabolic syndrome (i.e., 'The metabolic syndrome being pointed out or not by healthcare providers', the items regarding the metabolic syndrome with reference to the Health Belief Model, and 'A lifestyle to prevent or combat the metabolic syndrome'), 2. items related to the worksite health checkups, 3. the MHLC, and 4. the subjects' basic attributes. Because the aim of this study was to prevent or combat the metabolic syndrome, we did not use the items that were related to the worksite health checkups. The data regarding those checkups were previously reported[14].

Questions

1) Subjects' basic attributes

We asked the workers their basic attributes: age, gender, occupation (blue-collar or white-collar), and whether or not they had a family physician (yes or no). In one of our previous studies, age and occupation significantly affected the degree of the workers' use of the results of their annual health checkups[13]. In another of our studies, age and gender significantly affected the motivation to manage one's lifestyle using the worksite health checkups[14]. In yet another of our studies regarding health consultations with an occupational physician[19], the presence or absence of a family physi-

cian and gender significantly affected the workers' need for health consultations by an occupational physician. Therefore, we examined whether or not these variables significantly also affect a lifestyle to prevent or combat the metabolic syndrome.

2) The MHLC

The MHLC scales have two forms, A and B, each composed of 18 items[15]. Kuwahara *et al*. translated Form A into Japanese[16]. The Cronbach's alphas were 0.62, 0.69, and 0.76 for CHLC, IHLC, and PHLC, respectively[16]. Because those values were approximates to each scale of the original MHLC developed by Wallston *et al*., Kuwahara *et al*. reported that the MHLC translated into Japanese was adequate for Japanese people[16]. On the other hand, Horige also translated the same MHLC developed by Wallston *et al*. into Japanese[17, 18]. Although Horige conducted factor analysis of the MHLC among Japanese people, IHLC, PHLC, and CHLC were not extracted[17, 18]. Horige produced her own Japanese MHLC to suit Japanese people[17, 18]. It would be worthwhile to further examine the MHLC for the Japanese people as in Horige's reports. We have, therefore, also made such an attempt.

The MHLC is an important tool for people to encourage preventive health behaviors[10–18]. In this study, we hypothesize that these scales also affect a lifestyle to prevent or combat the metabolic syndrome. Outside Japan, people with high scores on the PHLC did not practice appropriate preventive health behaviors[10–12]. However, in one of our studies of Japanese workers[13], although the PHLC was not significantly associated with the degree of the workers' use of their worksite checkup results by using multiple linear regression analysis, there was a significant positive Pearson's correlation coefficient between that degree of the use of their checkup results and the PHLC. Moreover, in another of our studies[14], those workers with high PHLC scores felt significantly motivated to use the results of their worksite health checkups in their daily health management. We examined whether or not the same results were observed.

3) The items related to the metabolic syndrome
3-1) The metabolic syndrome being pointed out or not by healthcare providers

Healthcare insurance providers have been mandated to provide health checkups to their insured customers between the ages of 40–74 from April 2008 by Japanese law[20, 21]. Insurance providers must give people with the risks of the metabolic syndrome opportunities to undergo health consultations[20, 21]. As Japanese law traditionally stipulates that all workers must undergo annual health checkups, occupational health staffs and healthcare insurance providers must collaborate together in order to improve workers' health status[20, 21].

Because there is an issue of social concern regarding the metabolic syndrome[20, 21], we hypothesize that the experience of having the metabolic syndrome pointed out by healthcare providers itself affects their attitudes toward it. To determine the item, 'The metabolic syndrome being pointed out by healthcare providers or not by healthcare providers', was a simple 'yes' or 'no' response.

3-2) The 4 items regarding the metabolic syndrome produced with reference to the Health Belief Model

'Effectiveness of a healthy lifestyle to prevent or combat the metabolic syndrome', 'Realization that the metabolic syndrome is a life-threatening disease', 'The metabolic syndrome leading to a serious health condition', and 'Practical ways to prevent or combat the metabolic syndrome' were produced with reference to the perceived factors of benefits, severity, susceptibility, and barriers, respectively. The subjects selected their responses from a 7-point scale from 'Definitely disagree' to 'Definitely agree'.

Although the concept 'Practical ways to prevent or combat the metabolic syndrome' was produced with reference to the perceived barriers, this idea may stretch those barriers. However, some workers do not get enough exercise because it is difficult for busy workers to allocate sufficient time to exercise. Practical advice, such as using stairs rather than elevators, would be feasible for such workers. We think that there are many barriers for workers to lead appropriate lifestyles in their lives to prevent or combat the metabolic syndrome. It is necessary for healthcare providers to instruct people on how to adopt appropriate lifestyles. We, therefore, produced this item.

3-3) A lifestyle to prevent or combat the metabolic syndrome

'A lifestyle to prevent or combat the metabolic syndrome' was determined by the question, 'I have an appropriate lifestyle to prevent or combat the metabolic syndrome in my daily life'. The subjects selected their responses from a 7-point scale from 'Definitely disagree' to 'Definitely agree'.

Statistical analyses

Regarding the MHLC, factor analysis (the principal factor method and promax rotation) was conducted to examine the 3 dimensions: CHLC, IHLC, and PHLC. Factors with eigenvalues of ≥ 1 were retained. For the item with factor loadings of <|0.4|, this item was omit-

ted. We subsequently conducted factor analysis (the principal factor method and promax rotation).

To investigate the predictors associated with 'A lifestyle to prevent or combat the metabolic syndrome', standard partial regression coefficients were computed using multiple linear regression analysis. 'A lifestyle to prevent or combat the metabolic syndrome' was a dependent variable. The items related to the metabolic syndrome, the MHLC, and the subjects' basic attributes were independent variables. These independent variables are all included in this analysis. Regarding the relationships between the dependent variable and the independent variables, Pearson's correlation coefficients also were calculated or Mann-Whitney U tests were performed.

PASW® Statistics 18.0 was used for all statistical analyses. The significant level was set at *p*<0.05.

Subjects analyzed

Questionnaires from 1,906 respondents among the 2,287 subjects were collected for a return ratio of 83.34%. The questionnaires, which had one or more missing values in the items used in this study (i.e., the subjects' basic attributes, the MHLC, 'The metabolic syndrome being pointed out or not by healthcare providers', the four items regarding the metabolic syndrome produced with reference to the Health Belief Model, 'A lifestyle to prevent or combat the metabolic syndrome', except for the items related to the worksite health checkups) were excluded for the analyses. Consequently, a total of 1,789 questionnaires were analyzed (effective response rate, 78.22%). The average age of the analyzed subjects was 41.92 yr (standard deviation [SD], 13.41 yr). The average ages of the male and female analyzed subjects were 42.28 yr (SD, 13.83 yr) and 39.78 yr (SD, 10.35 yr), respectively.

Results

The results of the factor analyses (the principal factor method and promax rotation) of the MHLC are shown in Table 1. We first conducted the factor analysis of

Table 1. Factor loadings of the Multidimensional Health Locus of Control (MHLC)

Factor	Factor 1	Factor 2	Factor 3
Factor 1. Chance Health Locus of Control (CHLC), Cronbach's alpha = 0.913			
2. Luck's part in the recovery period from an illness	**0.933**	0.003	–0.017
3. Luck's part in complete recovery from an illness	**0.905**	|<0.001|[a]	0.017
1. Luck's part in maintaining health	**0.804**	–0.037	–0.002
Factor 2. Internal Health Locus of Control (IHLC), Cronbach's alpha = 0.800			
6. Shortening the recovery time from an illness with effort	0.039	**0.866**	–0.021
7. Effort in complete recovery from an illness	0.054	**0.863**	0.022
5. Maintaining one's health with effort	–0.071	**0.647**	–0.033
8. Self-responsibility for one's illness	–0.078	**0.475**	0.037
Factor 3. Powerful Others Health Locus of Control (PHLC), Cronbach's alpha = 0.722			
11. Physicians' ability related to complete recovery from an illness	–0.002	–0.008	**0.751**
12. Shorter recovery time from an illness depending on good physicians	0.004	0.044	**0.725**
10. Not worrying about illness at hospitals that have good healthcare providers	0.022	–0.089	**0.553**
9. Healthcare providers' part in health maintenance	–0.026	0.058	**0.493**

Interfactor correlations			
Factor	Factor 1	Factor 2	Factor 3
Factor 1 (CHLC)	1		
Factor 2 (IHLC)	–0.241	1	
Factor 3 (PHLC)	0.140	0.136	1

[a]An absolute value was used because factor loadings can be either positive (+) or negative (–).
To conduct the factor analyses, the following system was used. Concerning each item of the MHLC, 1 to 7 points were given from 'Definitely disagree' to 'Definitely agree'. Factor analysis (the principal factor method and promax rotation) of the 12 items of the MHLC was performed (see the MHLC in the Appendix). Factors with eigenvalues of ≥ 1 were retained. The factor loadings of item 4, 'Difficulty predicting factors that affect health' were <|0.4|. That item, therefore, was excluded. We subsequently conducted factor analysis (the principal factor method and promax rotation) again for the 11 items concerning the MHLC. Bold-faced type shows factor loadings ≥ 0.4. The 3 dimensions (i.e., CHLC, IHLC, and PHLC) accounted for 66.56% of the total variance of the 11 items before the rotation, and the eigenvalues of factors 1–3 were: 3.154, 2.471, and 1.696, respectively. Subsequently, to calculate the Cronbach's alpha of each factor, concerning each item of the MHLC, 1 to 7 points were given from 'Definitely disagree' to 'Definitely agree'.

the MHLC. Because the factor loadings of item 4 (i.e., difficulty predicting factors that affect health, see the Appendix) were <|0.4|, that item was excluded. We subsequently conducted the factor analysis (the principal factor method and promax rotation) again for the 11 items concerning the MHLC. The Cronbach's alphas for the CHLC, IHLC, and PHLC were 0.913, 0.800, and 0.722, respectively.

Table 2 shows the relationships between the characteristics of the analyzed subjects and a lifestyle to prevent or combat the metabolic syndrome. There is a positive correlation between age and a lifestyle to prevent or combat the metabolic syndrome. The results of the Mann-Whitney U tests showed that the white-collar workers had more appropriate lifestyles to prevent or combat the metabolic syndrome than did the blue-collar workers. The workers with a family physician had more appropriate lifestyles than did those without one. The workers who had the metabolic syndrome pointed out to them by healthcare providers also had more appropriate lifestyles than did those who did not.

Pearson's correlation coefficients are shown in Table 3. A lifestyle to prevent or combat the metabolic syndrome had positive correlations with IHLC, PHLC, effectiveness of a healthy lifestyle to prevent or combat the metabolic syndrome, realization that the metabolic

syndrome is a life-threatening disease, the metabolic syndrome leading to a serious health condition, and practical ways to prevent or combat the metabolic syndrome. On the other hand, a lifestyle to prevent or combat the metabolic syndrome had a negative correlation with CHLC.

The predictors associated with a lifestyle to prevent or combat the metabolic syndrome are shown in Table 4. We conducted the multiple linear regression analysis. The independent variables were all included in this model. The predictors were: age, occupation, the PHLC, the metabolic syndrome being pointed out or not by healthcare providers, realization that the metabolic syndrome is a life-threatening disease, and practical ways to prevent or combat the metabolic syndrome.

Discussion

The people who realized that the metabolic syndrome is a life-threatening disease had lifestyles to prevent or combat it. That the metabolic syndrome is a life-threatening disease was produced with reference to the perceived severity in the Health Belief Model[10–14]. Nexoe *et al.* also reported that the perceived severity of influenza was a significant predictor that would get patients to accept the influenza vaccination[11]. The metabolic

Table 2. Relationships between 'A lifestyle to prevent or combat the metabolic syndrome' and the analyzed subjects' characteristics

Characteristic	Definitely agree	Agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Disagree	Definitely disagree	Total	Pearson's correlation coefficient	p value of Mann-Whitney U test
Age										
–29	11 (2.8%)	24 (6.0%)	86 (21.6%)	82 (20.6%)	50 (12.5%)	58 (14.5%)	88 (22.1%)	399 (100%)		
30–39	15 (3.1%)	38 (7.9%)	118 (24.7%)	103 (21.5%)	63 (13.2%)	59 (12.3%)	82 (17.2%)	478 (100%)		
40–49	15 (5.2%)	32 (11.0%)	92 (31.6%)	61 (21.0%)	26 (8.9%)	32 (11.0%)	33 (11.3%)	291 (100%)	0.275	
50–	37 (6.0%)	111 (17.9%)	220 (35.4%)	122 (19.6%)	47 (7.6%)	45 (7.2%)	39 (6.3%)	621 (100%)	(p<0.001)	
Gender										
Male	66 (4.3%)	181 (11.8%)	433 (28.3%)	309 (20.2%)	154 (10.1%)	171 (11.2%)	215 (14.1%)	1,529 (100%)		
Female	12 (4.6%)	24 (9.2%)	83 (31.9%)	59 (22.7%)	32 (12.3%)	23 (8.8%)	27 (10.4%)	260 (100%)		0.414
Occupation										
Blue-collar worker	34 (4.3%)	83 (10.5%)	171 (21.7%)	195 (24.7%)	89 (11.3%)	88 (11.2%)	129 (16.3%)	789 (100%)		
White-collar worker	44 (4.4%)	122 (12.2%)	345 (34.5%)	173 (17.3%)	97 (9.7%)	106 (10.6%)	113 (11.3%)	1,000 (100%)		<0.001
Family physician										
Yes	34 (5.0%)	111 (16.3%)	224 (32.8%)	131 (19.2%)	64 (9.4%)	62 (9.1%)	56 (8.2%)	682 (100%)		
No	44 (4.0%)	94 (8.5%)	292 (26.4%)	237 (21.4%)	122 (11.0%)	132 (11.9%)	186 (16.8%)	1,107 (100%)		<0.001
The metabolic syndrome being pointed out or not by healthcare providers										
Yes	18 (5.8%)	57 (18.4%)	111 (35.9%)	46 (14.9%)	29 (9.4%)	31 (10.0%)	17 (5.5%)	309 (100%)		
No	60 (4.1%)	148 (10.0%)	405 (27.4%)	322 (21.8%)	157 (10.6%)	163 (11.0%)	225 (15.2%)	1,480 (100%)		<0.001
Total	78 (4.4%)	205 (11.5%)	516 (28.8%)	368 (20.6%)	186 (10.4%)	194 (10.8%)	242 (13.5%)	1,789 (100%)		

To calculate the Pearson's correlation coefficient, the actual age was used as a continuous variable, and concerning 'A lifestyle to prevent or combat the metabolic syndrome', 1 to 7 points were given in the order from 'Definitely disagree' to 'Definitely agree'.

Table 3. Pearson's correlation coefficients of 'A lifestyle to prevent or combat the metabolic syndrome' and the variables

Variable	Mean	Standard deviation	Pearson's correlation coefficient
Chance Health Locus of Control (CHLC)	8.62	4.40	–0.077 (*p*=0.001)
Internal Health Locus of Control (IHLC)	20.44	3.96	0.137 (*p*<0.001)
Powerful Others Health Locus of Control (PHLC)	15.92	4.31	0.166 (*p*<0.001)
Effectiveness of a healthy lifestyle to prevent or combat the metabolic syndrome	5.79	1.36	0.193 (*p*<0.001)
Realization that the metabolic syndrome is a life-threatening disease	4.99	1.45	0.248 (*p*<0.001)
The metabolic syndrome leading to a serious health condition	3.37	1.68	0.073 (*p*=0.002)
Practical ways to prevent or combat the metabolic syndrome	3.87	1.75	0.477 (*p*<0.001)

The following system was used to calculate the means, standard deviations, and Pearson's correlation coefficients. Concerning 'A lifestyle to prevent or combat the metabolic syndrome', 'Effectiveness of a healthy lifestyle to prevent or combat the metabolic syndrome', 'Realization that the metabolic syndrome is a life-threatening disease', 'The metabolic syndrome leading to a serious health condition', and 'Practical ways to prevent or combat the metabolic syndrome', 1 to 7 points were given in the order from 'Definitely disagree' to 'Definitely agree'. For each item of the MHLC, 1 to 7 points were given in the same order from 'Definitely disagree' to 'Definitely agree', and the summed scores of the items for each dimension were then used. The summed score of CHLC was the total of the 1 to 7 points given for each item: 1. 'Luck's part in maintaining health' + 2. 'Luck's part in the recovery period from an illness' + 3. 'Luck's part in complete recovery from an illness'. The summed score of IHLC was the total of the 1 to 7 points given for each item: 5. 'Maintaining one's health with effort' + 6. 'Shortening the recovery time from an illness with effort' + 7. 'Effort in complete recovery from an illness' + 8. 'Self-responsibility for one's illness'. The summed score of PHLC was the total of the 1 to 7 points given for each item: 9. 'Healthcare providers' part in health maintenance' + 10. 'Not worrying about illness at hospitals that have good healthcare providers' + 11. 'Physicians' ability related to complete recovery from an illness' + 12. 'Shorter recovery time from an illness depending on good physicians'. See Table 1 and the Appendix.

Table 4. Predictors associated with 'A lifestyle to prevent or combat the metabolic syndrome'

Independent variable	Standard partial regression coefficient	*p* value	VIF
Age	0.124	<0.001	1.353
Gender	–0.022	0.299	1.119
Occupation	–0.054	0.009	1.100
Family physician	0.035	0.102	1.176
Chance Health Locus of Control (CHLC)	–0.023	0.266	1.112
Internal Health Locus of Control (IHLC)	0.005	0.814	1.183
Powerful Others Health Locus of Control (PHLC)	0.094	<0.001	1.089
The metabolic syndrome being pointed out or not by healthcare providers	0.069	0.001	1.171
Effectiveness of a healthy lifestyle to prevent or combat the metabolic syndrome	0.038	0.090	1.242
Realization that the metabolic syndrome is a life-threatening disease	0.134	<0.001	1.325
The metabolic syndrome leading to a serious health condition	0.015	0.466	1.144
Practical ways to prevent or combat the metabolic syndrome	0.391	<0.001	1.167

Adjusted R^2 = 0.297; VIF, variance inflation factor

The dependent variable was 'A lifestyle to prevent or combat the metabolic syndrome'. The independent variables were: age, gender, occupation, family physician, each of the summed scores of the CHLC, IHLC, and PHLC, 'The metabolic syndrome being pointed out or not by healthcare providers', 'Effectiveness of a healthy lifestyle to prevent or combat the metabolic syndrome', 'Realization that the metabolic syndrome is a life-threatening disease', 'The metabolic syndrome leading to a serious health condition', and 'Practical ways to prevent or combat the metabolic syndrome'. All of these independent variables were included in this model.

In the multiple linear regression analysis, the following system was used. Concerning 'A lifestyle to prevent or combat the metabolic syndrome', 'Effectiveness of a healthy lifestyle to prevent or combat the metabolic syndrome', 'Realization that the metabolic syndrome is a life-threatening disease', 'The metabolic syndrome leading to a serious health condition', and 'Practical ways to prevent or combat the metabolic syndrome', 1 to 7 points were given in the order from 'Definitely disagree' to 'Definitely agree'. The actual age was used as a continuous variable. The coding of dichotomous variables was: gender (male=1, female=0), occupation (blue-collar worker=1, white-collar worker=0), family physician (yes=1, no=0), and 'The metabolic syndrome being pointed out or not by healthcare providers (yes=1, no=0)'. For each item of the MHLC, 1 to 7 points were given in the order from 'Definitely disagree' to 'Definitely agree', and the summed scores of the items for each dimension were used. The summed score of CHLC was the total of the 1 to 7 points given for each item: 1. 'Luck's part in maintaining health' + 2. 'Luck's part in the recovery period from an illness' + 3. 'Luck's part in complete recovery from an illness'. The summed score of IHLC was the total of the 1 to 7 points given for each item: 5. 'Maintaining one's health with effort" + 6. 'Shortening the recovery time from an illness with effort' + 7. 'Effort in complete recovery from an illness' + 8. 'Self-responsibility for one's illness'. The summed score of PHLC was the total of the 1 to 7 points given for each item: 9. 'Healthcare providers' part in health maintenance' + 10. 'Not worrying about illness at hospitals that have good healthcare providers' + 11. 'Physicians' ability related to complete recovery from an illness' + 12. 'Shorter recovery time from an illness depending on good physicians'. See Table 1 and the Appendix.

syndrome causes life-threatening diseases such as coronary heart disease and stroke[1–8]. However, some people may not actually understand the severity of it. If people do not realize that the metabolic syndrome is a life-threatening disease, they hesitate to practice preventive health behaviors that would prevent it. Therefore, healthcare providers should carefully teach people about the severity of the metabolic syndrome.

The workers who knew practical ways to prevent or combat the metabolic syndrome had appropriate lifestyles to prevent or combat it. In our previous studies regarding the worksite health checkups[13, 14], the workers who knew practical ways to practice preventive behaviors had appropriate attitudes toward their health checkups, which is consistent with the findings in the present study.

Healthcare providers must be aware of the barriers that disturb people's preventive health behavior. Even if workers acquire medical knowledge, as long as they learn practical ways to use that knowledge, they can maintain their appropriate lifestyles. When healthcare providers must provide medical education, merely imparting medical knowledge to people is not sufficient. Healthcare providers instruct people in practical ways on how to adapt their acquired medical knowledge in their daily lives.

Those with high PHLC scores led appropriate lifestyles to prevent or combat the metabolic syndrome. Murray and McMillan reported that women in Northern Ireland with low PHLC scores practiced breast self-examination significantly more than did those with high scores[10]. On the other hand, the PHLC was not significantly associated with attendance for cervical smear test[10]. In another previous study outside Japan[11, 12], the PHLC did not significantly affect appropriate attitudes toward preventive health behaviors that would lead to more healthy lifestyles. However, in our previous study in Japan[14], the Japanese workers with high PHLC scores significantly feel motivated to use the results of their worksite health checkups in their daily lives. In another of our studies[13], the PHLC had positive Pearson's correlation with the degree of the workers' use of the results of their worksite checkups.

According to Japanese health laws[22], all Japanese people can receive health checkups throughout their lives in Japan. Moreover, from April 2008, according to the Japanese law[20, 21], healthcare insurance providers must provide health checkups to their insured customers between the ages of 40–74. There after, if there are people with risk of the metabolic syndrome, insurance providers must provide them with opportunities to undergo health consultations with healthcare professionals[20, 21].

The health of Japanese people is checked and protected against disease by health checkups[20–22]. Some Japanese may misunderstand that if they become ill, healthcare providers will help them and treat them properly. Especially because those with high PHLC scores believe that their health conditions depend on the influence of healthcare providers[10–18], they are interested in health checkups given by healthcare providers.

However, healthcare providers cannot protect the health of all workers completely without them making their own efforts to do so. They must encourage those workers not to have excessive expectations of their services. They must also teach the workers the importance of practicing daily health management by themselves.

The workers who had the experience of having the metabolic syndrome pointed out to them by healthcare providers had appropriate lifestyles to prevent or combat the metabolic syndrome. As we mentioned above, health consultations were given to the people with the risk of the metabolic syndrome[20, 21]. The popularity of these consultations could be causing an increase in the upsurge of Japanese public interests and raise the people's attitudes toward the metabolic syndrome. Those interests could also contribute to make a healthy culture in Japan.

The older workers had appropriate lifestyles to prevent or combat the metabolic syndrome than younger workers. Moreover, the results of our previous study revealed that many older people had stronger attitudes toward their health checkups than do younger people[13, 14]. It is necessary to improve young people's awareness of the importance of practicing preventive health behaviors.

The white-collar workers had more appropriate lifestyles to prevent or combat the metabolic syndrome than did the blue-collar workers. Moreover, according to the results of our previous study, it is necessary to provide health education for the blue-collar workers[13]. The white-collar workers have a higher level of education than do the blue-color workers in this plant. They, therefore, may also have more opportunities to receive health-related education. Such opportunities may affect their preventive healthcare behaviors. More of such opportunities for healthcare education are provided for the blue-collar workers by healthcare providers.

Limitations

The first limitation was that because we did not employ the random sampling method, the generalizability of our findings was limited. The second limitation was that the questionnaires that were not collected, and those that had one or more missing values in the items

used in the present study, were not analyzed. The third limitation was that we employed a cross-sectional study. Therefore, we could not identify any casual relationships. Moreover, regarding a lifestyle to prevent or combat the metabolic syndrome, we only asked workers one item. In future studies, it will be necessary to have several related questions designed to measure this item.

Conclusions

In the present study, the older people had more appropriate lifestyles to prevent or combat the metabolic syndrome than did the younger people. Likewise, the white-collar workers had more appropriate lifestyles to prevent or combat the metabolic syndrome than did the blue-collar workers. The workers who had the metabolic syndrome pointed out by healthcare providers also had appropriate lifestyles to prevent or combat the metabolic syndrome. Those who knew practical ways to prevent and combat the metabolic syndrome incorporated them into their lifestyles as did those who realized that the metabolic syndrome was a life-threatening disease. Characteristically, those with high scores in PHLC also had appropriate lifestyles.

Healthcare providers must provide various activities regarding the awareness of the metabolic syndrome such as health consultations and seminars. Our findings can be applied to healthcare consultations, medical seminars, and producing appropriate educational manuals on how to prevent and combat the metabolic syndrome.

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Appendix: The contents of the questionnaire (original version in Japanese)
Items related to the metabolic syndrome
The metabolic syndrome being pointed out or not by healthcare providers

1. I had the experience of the metabolic syndrome being pointed out to me by healthcare providers.

Effectiveness of a healthy lifestyle to prevent or combat the metabolic syndrome

2. I think that it is effective to maintain a healthy lifestyle to prevent or combat the metabolic syndrome.

Realization that the metabolic syndrome is a life-threatening disease

3. I think the metabolic syndrome is a disease that could threaten a person's life.

The metabolic syndrome leading to a serious health condition

4. If I am diagnosed with the metabolic syndrome and I do not improve it, I may develop a serious health condition in the near future.

Practical ways to prevent or combat the metabolic syndrome

5. I know practical ways to prevent or combat the metabolic syndrome.

A lifestyle to prevent or combat the metabolic syndrome

6. I have an appropriate lifestyle to prevent or combat the metabolic syndrome in my daily life.

The Multidimensional Health Locus of Control (MHLC)

Chance Health Locus of Control (CHLC)

1. Luck plays a big part in whether I can maintain my health or not.
2. Luck plays a big part in the recovery period from an illness.
3. Luck plays a big part in whether recovery from an illness can be complete or not.
4. It is difficult to predict factors that affect the health.

Internal Health Locus of Control (IHLC)

5. I can maintain my health by my own effort.
6. I can shorten the recovery time from an illness by my own effort.
7. My own effort plays a big part in whether I can make a complete recovery from an illness or not.
8. If I become ill, the responsibility lies in my own behavior.

Powerful Others Health Locus of Control (PHLC)

9. Healthcare providers in hospitals play a big part in whether I maintain my health or not.
10. One needs not worry about becoming ill at hospitals that have good healthcare providers.
11. The ability of physicians plays a big part in whether recovery from an illness can be complete or not.
12. As long as I have good physicians, recovery time from an illness can be shortened.