Original

Longitudinal Relationships between Stages of Changes in the Transtheoretical Model and Annual Data Changes in Mandatory Routine Health Checkups of University Faculty

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(Received: September 29, 2011)

Abstract

Health counseling for metabolic syndrome (MetS) following mandatory routine health checkups (MRHCs) should be matched to the stage of change (SC) based on the transtheoretical model (TTM) and applied effectively for prevention of MetS. The purpose of this study was to survey the relationship between SCs and MRHC data. Annual changes in data were also investigated to identify causal connections with SCs. MRHCs were performed for all ages at a university in Osaka, Japan in 2009. Faculty members (576 men and 269 women) were categorized by gender and age (<40 and ≥40 years). The prevalence of five SCs was calculated for each group: precontemplation (S1), contemplation (S2), preparation (S3), action (S4) and maintenance (S5). In both age groups, the three stages with highest prevalence were S2, S1, S3 for men and S2, S3, S1 for women. The prevalence of those who applied for health counseling for S1 in both genders ≥40 years were lowest among all SCs. In men ≥40 years, weight and waist circumference (WC) for S2, S3 and S4 were higher than for S1, suggesting a relationship between body shape and behavior modification. Comparison of MRHC data from 2008 to 2009 revealed the following: In men <40 years, increased WC for S3, aspartate transaminase (AST), alanine transaminase (ALT) and γ-glutamyl transpeptidase (γ-GTP) for S2, glucose (Glc) for S1 and decreased high-density lipoprotein-cholesterol (HDL-C) for S2 and S3; In men ≥40 years, increased WC for S1–S3, and diastolic blood pressure for S1–S2 and S5, AST/ALT ratio for S4, γ-GTP for S2, S3, Glc for S2, HbA1c for S2, and decreased weight for S4 and S5, BMI for S4, HDL-C for S1 and S2 and ALT for S4; In women <40 years, increased WC for S3, LDL-C for S3, HbA1c for S2 and S3, and decreased Triglycerides (TG) for S5; In women ≥40 years, increased WC for S2–S4, HbA1c for S1–S3 and S5, and decreased BMI for S5. When considering annual changes of data from 2008 to 2009, data for S1–S3 especially S2 and S3, which do not involve behavior modifications, tended to worsen. In contrast, data for behavior modifications in S4 and S5 tended to improve. However, it is thought that the effect of the behavior modification is not enough understanding from the deterioration of a part of data. These results suggest close and specific relationships between SCs and data changes over a year. Therefore, strategies for health counseling should be developed for effective initiation of lifestyle improvements and maintenance of behavior modifications. Careful follow-up based on SC is necessary as a longitudinal prospective intervention.

(JJOMT, 60: 165—175, 2012)

—Key words—

mandatory routine health checkups, health counseling, metabolic syndrome, stage of change, longitudinal approach

Introduction

The consultation rate for metabolic syndrome was 40.5% for approximately 52 million Japanese who underwent mandatory routine health checkups (MRHCs) in 2009 and 38.9% in 2008. The prevalence of metabolic

Table 1 Demographic distribution of faculty members of a university in Osaka, Japan, who underwent mandatory routine health checkups in 2008 and 2009

	Number (%) by age							
	20s	30s	40s	50s	≥60	<40	≥40	total
Men	26 (4.5%)	110 (19.1%)	129 (22.4%)	164 (28.5%)	147 (25.5%)	136 (23.6%)	440 (76.4%)	576 (100%)
Women	24 (8.9%)	51 (19.0%)	103 (38.3%)	75 (27.9%)	16 (5.9%)	75 (27.9%)	194 (72.1%)	269 (100%)

	Age range		Mean age ± SD		
	min	max	<40	≥40	total
Men	24	77	33.7 ± 4.3	54.9 ± 8.3	49.9 ± 11.7
Women	24	67	32.5 ± 4.8	49.3 ± 6.5	44.6 ± 9.7

syndrome (MetS) was 14.7% in 2009 and 14.4% in 2008, and the total prevalence of MetS and pre-MetS was 27.2% in 2009[1]. The consultation rate is an important index of the national health care project, with a target value of 45% in 2012. The Ministry of Health, Labour and Welfare emphasized the importance of implementing effective strategies for lifestyle modification in health counseling after MRHCs[2]. The intervention of counseling as a result of MRHCs is integral to the project's success. "Standard Questionnaires" are used to assess physical activity and diet of counseling applicants. The transtheoretical model (TTM) is based on four constructs: stage of change (SC), process of change, self-efficacy and decision balance. The SC is the central concept and is composed of five combinations of cognition and behavior status: precontemplation, contemplation, preparation, action and maintenance[3]. The TTM has been applied to modify various problem behaviors. Items about SC are included in MRHC questionnaires, but the results have not been adequately utilized for health counseling in Japan. Although there have been many cross-sectional studies[4)~8)], longitudinal research on the relationship between checkup data and SC has been rarely performed. Our previous cross-sectional study in 2008 examined early indicators of MetS, between MetS, pre-MetS and non-MetS faculty members at a private university in Osaka, Japan[9]. This population has a primarily sedentary occupation, and careful follow-up to prevent MetS is needed for patients with low physical activity. Therefore, this study surveyed SC status and the status of counseling applications from MRHCs for all ages of the university faculty because MetS has recently been developing in people <40 years of age. Naturally, the earlier that signs of MetS are detected during MRHCs, the easier it is to improve health by lifestyle modification. For these reasons, this study investigated the relationship between annual changes in checkup data and SC in the TTM.

Participants and Methods

1) Participants

Participants for this study were employees of a private university in Osaka, Japan. MRHCs were provided not only for faculty ≥40 years, but also for those <40 years for early detection of MetS. The participants' jobs consisted primarily of sedentary work. All staff, including teachers and clerks, received the mandatory health checkup after fasting for more than 12 hours, except those who received a comprehensive medical examination. Table 1 shows the demographic distribution of the 576 men (mean age, 49.9 ± 11.7 years) and 269 women (mean age, 44.6 ± 9.7 years) participants.

2) Methods

A) Mandatory health checkup items and timing of implementation

The following data collected in September 2008 and 2009 were used in this study: weight (kg), body mass index (BMI, kg/m^2), waist circumference (WC, cm), blood pressure (Bp, mmHg), high-density lipoprotein-cholesterol (HDL-C, mg/dl), low-density lipoprotein-cholesterol (LDL-C, mg/dl), triglycerides (TG, mg/dL), aspartate transaminase (AST, IU/l), alanine transaminase (ALT, IU/l), γ-glutamyl transpeptidase (γ-GTP, IU/l), glucose (Glc, mg/dl), and HbA1c (%). Bp was measured in accordance with 2009 hypertension treatment guidelines[10].

Table 2 Five stages of changes, psycho-behavioral patterns, durations and abbreviations used in this study

	Psycho-behavioral pattern	Duration	Abbreviation
1) Precontemplation	no intention to change behavior in the foreseeable future	none	S1
2) Contemplation	aware that a problem exists, and seriously considering to overcome it, but have not yet made a commitment to take action	within 6 months	S2
3) Preparation	combines intention and behavioral criteria	in a month	S3
4) Action	individuals modify their behavior	within 6 months	S4
5) Maintenance	work to prevent relapse and consolidate gains attained during action	more than 6 months	S5

B) AST/ALT ratio

The threshold value of the AST/ALT ratio, which differentiates between several types of liver diseases, is proposed to be 0.87 as measured by the Japan Society of Clinical Chemistry (JSCC) consensus method[11]. An increase in ALT and a decrease in AST/ALT ratio are significantly and independently associated with MetS[12][13]. This suggests that the AST/ALT ratio is a marker for MetS development. The AST/ALT ratio was calculated to explore early changes caused by MetS.

C) Assessment of behavior modification for lifestyle improvement

Data regarding physical activity and diet were collected using standard questionnaires as part of the "Standard program of MRHC and health counseling (final version)" by the Ministry of Health, Labour and Welfare[14]. The questionnaire was followed by two additional questions. The first question was: "Are you going to start or have you started lifestyle modifications (e.g., increase physical activity, improve dietary habits)?" The responses included: (1) I don't intend to start, (2) I'm going to start in the future (e.g., within 6 months), (3) I'm going to start soon (e.g., in a month) or have just started some of them, (4) I already started (<6 months ago) and (5) I already started (≥6 month ago). These responses correlate with the five SCs in the TTM[15], and S1–S5 in this study. Table 2 shows the five stages, psycho-behavioral patterns, durations and abbreviations used in this study. Participants answered "yes" or "no" to the second additional question, "Are you willing to get health counseling about lifestyle modifications if the opportunity arises?" Participants who answered "yes" were considered as counseling applicants.

D) SC and the status of application for health counseling

The TTM is a contemporary psychological framework that attempts to explain intentional health behavior change occurring over time as a function of behavioral history and motivation[16]. Therefore, health checkup data are likely to be aggravated by past lifestyle elements in cognitive stages S1–S3, and improved in behavioral stages S4 and S5. In this study, transitional changes in data during the past year were assessed based on SC data from the 2009 questionnaire. Participants were categorized by gender and age (<40 years or ≥40 years). Numbers and prevalence of each stage were calculated for each gender and age group, and SC distributions were compared between age groups for both genders. Frequencies of counseling applicants in each stage were also calculated for each gender and age group.

E) Statistical analyses

Overall differences among SC and health counseling applicant distributions were evaluated by Pearson's χ^2 test. Overall differences among SC groups by year were evaluated with the Tukey-Kramer method. Differences between 2008 and 2009 data were analyzed by the paired Student's t-test. Data are expressed as mean ± SD. Statistical analysis was performed using SPSS® 12.0J software (SPSS Inc., Chicago, IL). Results were considered significant at $p<0.05$.

This study was approved by the Ethics Committee of Osaka Medical College. Written and oral explanations of the study were provided to all participants and informed consent was obtained. Anonymity was ensured to protect personal information.

Results

Fig. 1 shows SC frequencies in each gender and age group in 2009. In both age groups, SCs with the highest prevalence in men were S2, S1 and S3. In men, the S1 prevalence was higher and S2 prevalence was lower

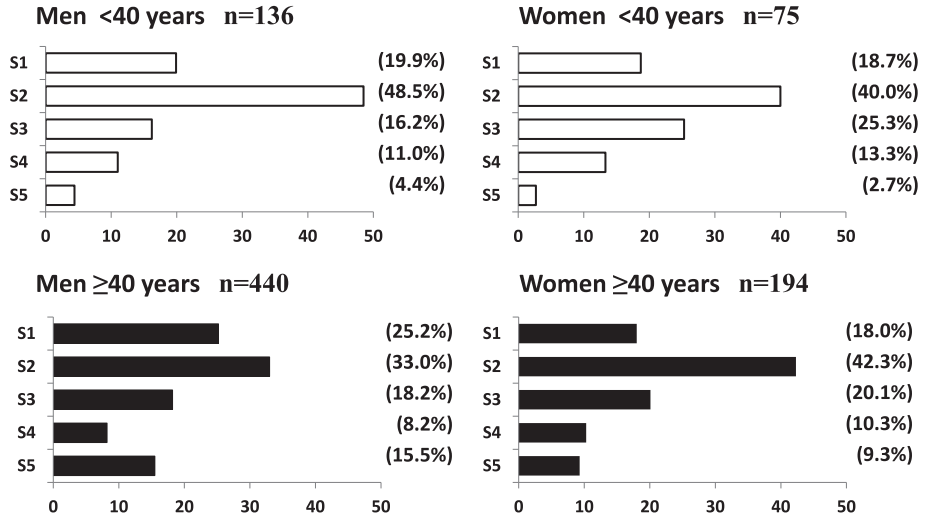

Fig. 1 Proportion of participants in five stages of changes by gender and age among faculty members of a university in Osaka, Japan, who underwent mandatory routine health checkups in 2009

S1) Precontemplation S2) Contemplation S3) Preparation S4) Action S5) Maintenance

$p<0.05$: <40 years vs. ≥40 years in men by Pearson's χ^2 test

Table 3 Proportion of applicants for health counseling by five stages of changes, gender and age among faculty members of a university in Osaka, Japan, who underwent mandatory routine health checkups in 2009

	Age	S1	S2	S3	S4	S5	Total
Men	<40	40.7% (11/27)	69.7% (46/66)	59.1% (13/22)	26.7% (4/15)	100% (6/6)	58.8% (80/136)
	≥40	21.6%* (24/111)	53.1%* (77/145)	57.5% (46/80)	47.2% (17/36)	41.2%* (28/68)	43.6% (192/440)
Women	<40	21.4% (3/14)	60.0% (18/30)	57.9% (11/19)	60.0% (6/10)	50.0% (1/2)	52.0% (39/75)
	≥40	14.3% (5/35)	52.4% (43/82)	41.0% (16/39)	45.0% (9/20)	33.3% (6/18)	40.7% (79/194)

S1) Precontemplation S2) Contemplation S3) Preparation S4) Action S5) Maintenance

*$p<0.05$: <40 years vs. ≥40 years at S1, S2 and S5 in men by Pearson's χ^2 test

in participants ≥40 years compared with those <40 years. In both age groups, SCs with the highest prevalence in women were S2, S3 and S1. For both genders, S5 prevalence was higher in participants ≥40 years than <40 years. There were significant differences in the SC distribution between age groups in men, but not in women.

Table 3 shows the proportion of those who applied for health counseling in each group. Frequencies of applicants in S2 and S3 were greater than 50% in all groups except S3 in women ≥40 years. On the other hand, frequencies of applicants in S1 were the lowest among participants ≥40 years for both genders. For both genders, all SC frequencies were lower in participants ≥40 years compared to those <40 years, with the exception of men in S4. There were significant differences in applicant distribution between age groups at S1, S2 and S5 in men.

MRHC data from 2008 and 2009 were compared for men (Table 4a, b) and women (Table 5a, b). We first compared MRHC data among SCs in each group to S1 in 2008 and 2009. Mean BMI was higher in S4 than in S1 in men <40 years in 2008 (Table 4a). Mean weight, BMI and WC in S2, S3 and S4, diastolic pressure in S3 and S4, and TG in S4 and S5 were higher, and AST/ALT ratios in S3 and S4 were lower than in S1 in men ≥40 years in 2008 (Table 4b). Mean BMI was higher in S2 than in S1 in women ≥40 years in 2008 (Table 5b). Mean systolic and diastolic pressure in S3 were higher than in S1 in men <40 years in 2009 (Table 4a). Mean weight, BMI and WC in S2, S3, TG in S5, ALT and γ-GTP in S3 were higher, and AST/ALT ratios in S2, S3, and S5

Table 4a Mandatory routine health checkup data for men <40 years by five stages of changes in 2008 and 2009 among faculty members of a university in Osaka, Japan

Men<40 years	S1 (n=27)		S2 (n=66)		S3 (n=22)		S4 (n=15)		S5 (n=6)	
year	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Weight (kg)	68±12	68±11	67±9	67±10	73±11	74±11	75±11	74±11	68±11	66±12
BMI (kg/m^2)	22.7±3.7	22.8±3.5	22.8±3.0	22.9±3.2	24.7±3.2	24.9±3.2	25.7±4.0†	25.4±4.3	23.6±2.4	22.7±2.4
WC (cm)	79±10	80±9	80±8	81±9	84±8	85±9*	85±11	86±10	83±8	80±9
Bp (mmHg)										
Systolic (above)	122±12	118±12	119±11	120±10	129±13	128±16†	127±7	126±9	120±10	123±15
Diastolic (below)	73±8	73±9	73±8	74±8	78±10	81±8†	76±8	77±7	74±7	76±7
HDL-C (mg/dl)	59±11	57±12	57±11	56±12*	59±12	54±13*	57±19	57±18	59±12	58±15
LDL-C (mg/dl)	116±26	114±27	121±32	123±31	122±27	128±35	119±28	121±25	110±29	115±29
TG (mg/dl)	84±41	74±36	112±71	121±102	91±38	89±32	114±63	116±67	105±38	83±33
AST (IU/l)	23±11	23±13	21±6	24±10*	20±7	23±9	25±14	26±19	21±6	19±3
ALT (IU/l)	25±17	22±15*	26±17	32±24*	27±16	31±19	35±39	36±42	26±17	19±5
AST/ALT ratio	1.00±0.28	1.11±0.32	0.95±0.35	0.92±0.34	0.89±0.27	0.88±0.32	0.90±0.31	0.91±0.32	0.95±0.35	1.07±0.25
γ-GTP (IU/l)	41±41	39±35	33±23	42±33*	32±24	34±29	29±16	31±23	40±21	42±34
Glc (mg/dl)	86±8	89±7*	88±10	87±14	91±10	91±7	87±3	88±7	86±7	88±7
HbA_{1c} (%)	4.8±0.3	4.8±0.3	4.8±0.4	4.8±0.3	4.8±0.4	4.9±0.4	4.8±0.2	4.7±0.2	4.7±0.1	4.8±0.1

S1) Precontemplation S2) Contemplation S3) Preparation S4) Action S5) Maintenance
S1 vs. other stages in each year using the Tukey-Kramer method $^{\dagger}p<0.05$
2008 vs. 2009 by paired Student's t-test $^{*}p<0.05$
(Items)
BMI: body mass index
WC: waist circumference
Bp: Blood pressure
HDL-C: high density lipoprotein-cholesterol
LDL-C: low density lipoprotein-cholesterol
TG: triglyceride
AST: aspartate aminotransferase
ALT: alanine aminotransferase
γ-GTP: gamma-glutamyl transpeptidase
Glc: glucose
HbA1c: hemoglobin A1c

were lower than in S1 in men ≥40 years in 2009 (Table 4b). Mean weight and BMI in S3 and WC in S2 were higher than in S1 in women ≥40 years in 2009 (Table 5b).

We also compared MRHC data between 2008 and 2009. In men <40 years, mean WC for S3 was higher in 2009 than in 2008. Mean HDL-C for S2 and S3 was lower in 2009 than in 2008. Mean TG for S5 tended to be lower in 2009 than in 2008. Mean ALT for S1 was lower, and mean AST, ALT, and γ-GTP for S2 were higher in 2009 than in 2008. Mean AST and ALT for S5 tended to be lower in 2009 than in 2008. Mean Glc for S1 was higher in 2009 than in 2008 (Table 4a).

In men ≥40 years, mean weight for S4 and S5, BMI for S4 were lower and WC for S1, S2 and S3 was higher in 2009 compared to 2008. Mean diastolic blood pressure for S1, S2, and S5 was higher in 2009 compared to 2008. Mean HDL-C for S1 and S2 was lower in 2009 compared to 2008. Mean TG for S4 and S5 tended to be lower in 2009 than in 2008. Mean ALT for S4 was lower, AST/ALT ratios for S1 and S4 were higher in 2009 than in 2008. Mean γ-GTP for S2 and S3 was higher in 2009 than in 2008. Glc for S2 was higher in 2009 than in 2008. HbA1c for S2 was higher in 2009 than in 2008 (Table 4b).

In women <40 years, mean WC for S1, S2, S3 and S4 tended to be higher in 2009 than in 2008 and significantly higher for S3. But WC for S5 tended to be lower in 2009 than in 2008. Mean LDL-C for S3 was higher in 2009 than in 2008. Mean TG for S4 and S5 in 2009 tended to be lower than in 2008, and significantly lower for S5. Mean HbA1c for S2 and S3, was higher in 2009 than in 2008 (Table 5a).

In women ≥40 years, mean BMI for S5 was lower in 2009 than in 2008. Mean WC for S2, S3 and S4 was higher in 2009 than in 2008. Mean HDL-C for S2 in 2009 was lower than in 2008. Mean HbA1c for S1, S2, S3 and S5 in 2009 was higher than in 2008 (Table 5b).

Table 4b Mandatory routine health checkup data for men ≥40 years by five stages of changes in 2008 and 2009 among faculty members of a university in Osaka, Japan

Men≥40 years	S1 (n = 111)		S2 (n = 145)		S3 (n = 80)		S4 (n = 36)		S5 (n = 68)	
year	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Weight (kg)	65 ± 9	65 ± 9	70 ± 10†	70 ± 10†	73 ± 11†	73 ± 11†	74 ± 10†	73 ± 10*	68 ± 9	67 ± 9*
BMI (kg/m^2)	22.9 ± 2.6	22.8 ± 2.6	24.3 ± 3.0†	24.3 ± 3.0†	25.3 ± 3.0†	25.4 ± 3.0†	25.1 ± 2.6†	24.6 ± 2.5*	23.8 ± 2.7	23.6 ± 2.8
WC (cm)	82 ± 8	83 ± 8*	86 ± 8†	87 ± 8*†	87 ± 8†	89 ± 9*†	88 ± 7†	88 ± 8	84 ± 7	85 ± 8
Bp (mmHg)										
Systolic (above)	129 ± 15	129 ± 17	130 ± 17	132 ± 20	133 ± 15	133 ± 14	132 ± 14	131 ± 16	130 ± 15	130 ± 15
Diastolic (below)	79 ± 10	82 ± 11*	81 ± 11	85 ± 12*	84 ± 9†	85 ± 10	85 ± 11†	85 ± 10	81 ± 10	83 ± 9*
HDL-C (mg/dl)	63 ± 15	61 ± 15*	60 ± 14	58 ± 14*	60 ± 15	58 ± 13	56 ± 13	55 ± 13	59 ± 14	59 ± 13
LDL-C (mg/dl)	124 ± 28	124 ± 30	130 ± 31	131 ± 30	130 ± 31	132 ± 28	132 ± 26	134 ± 22	125 ± 28	125 ± 30
TG (mg/dl)	104 ± 59	103 ± 53	127 ± 74	132 ± 74	133 ± 91	139 ± 133	156 ± 107†	139 ± 78	170 ± 162†	157 ± 134†
AST (IU/l)	24 ± 18	23 ± 11	24 ± 10	24 ± 11	25 ± 9	27 ± 17	26 ± 9	25 ± 10	23 ± 7	25 ± 16
ALT (IU/l)	23 ± 11	22 ± 14	28 ± 18	28 ± 18	30 ± 16	32 ± 22†	32 ± 16	28 ± 12*	27 ± 16	27 ± 17
AST/ALT ratio	1.07 ± 0.32	1.14 ± 0.38*	0.97 ± 0.32	0.98 ± 0.28†	0.95 ± 0.32†	0.95 ± 0.29†	0.89 ± 0.33†	0.97 ± 0.30*	0.97 ± 0.29	1.00 ± 0.30†
γ-GTP (IU/l)	52 ± 67	46 ± 39	54 ± 42	58 ± 50*	62 ± 57	71 ± 77*†	53 ± 40	48 ± 41	58 ± 49	57 ± 47
Glc (mg/dl)	95 ± 14	96 ± 14	96 ± 15	98 ± 18*	98 ± 19	101 ± 21	98 ± 16	104 ± 34	100 ± 23	99 ± 20
HbA_{1c} (%)	5.1 ± 0.5	5.1 ± 0.5	5.0 ± 0.6	5.1 ± 0.7*	5.1 ± 0.7	5.2 ± 0.7	5.2 ± 0.6	5.2 ± 0.9	5.3 ± 1.0	5.2 ± 0.8

S1) Precontemplation S2) Contemplation S3) Preparation S4) Action S5) Maintenance
S1 vs. other stages in each year using the Tukey-Kramer method †$p<0.05$
2008 vs. 2009 by paired Student's t-test *$p<0.05$
(Items)
BMI: body mass index
WC: waist circumference
Bp: Blood pressure
HDL-C: high density lipoprotein-cholesterol
LDL-C: low density lipoprotein-cholesterol
TG: triglyceride
AST: aspartate aminotransferase
ALT: alanine aminotransferase
γ-GTP: gamma-glutamyl transpeptidase
Glc: glucose
HbA1c: hemoglobin A1c

Discussion

The criteria for MetS in Japan were set by the Medicine Committee of the Japanese Association of Medical Sciences (MCJ)[17]. Our 2008 study showed that the prevalence of MetS and pre-MetS by MCJ criteria in 582 men ≥40 years in this university were 20% and 20%, respectively[9]. Combining the morbid group with MetS and pre-MetS included 40% of men ≥40 years. On the other hand, our previous study distinguished significant differences in prevalence across different criteria sets in both morbid and pre-morbid groups[18]. Yearly progress reports of the National Health and Nutrition Survey (NHNS, 2008) based on different glucose and lipoprotein criteria showed that prevalences of strongly suspected MetS and assumed pre-MetS were 26% and 25%, respectively, in 958 men ≥40 years and <70 years[19]. Our 2008 study reported prevalences (by NHNS criteria) of 12% and 24% in men, respectively, in this university[18], suggesting that the prevalence of strongly suspected MetS in this university is lower than national levels. However, it is necessary that appropriate strategies are implemented effectively for improvement and prevention of MetS.

From initial studies of problem behaviors such as smoking and eating disorders[20][21], the TTM rapidly expanded in scope to include a broad range of health behaviors. The TTM posits that health behavior change involves progression through six SCs (SC1–5 and a termination stage of maintaining for more than five years)[22]. Recently, five SCs have been applied to improvement strategies for lifestyle diseases, such as obesity and MetS in other countries[23][24]. There were no national survey reports regarding SCs and MRHCs in Japan. On the other hand, there have been NHNS reports about the will to lose weight in 2008, and diet and exercise practices in 2009 for three BMI classifications (<18.5, ≥18.5 and <25, and ≥25)[19]. NHNS in 2009 reported that total percentages of "I don't intend to start," "I intend to start but feel insecure," "I intend to start and feel sure," and "I

Table 5a Mandatory routine health checkup data for women <40 years by five stages of changes in 2008 and 2009 among faculty members of a university in Osaka, Japan

Women<40 years	S1 (n=14)		S2 (n=30)		S3 (n=19)		S4 (n=10)		S5 (n=2)	
year	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Weight (kg)	52±6	51±7	50±6	50±6	51±5	52±6	52±5	52±6	45±0	45±0
BMI (kg/m^2)	20.0±1.6	19.7±2.1	19.8±2.1	19.7±2.1	20.4±1.6	20.4±1.7	20.6±2.1	20.4±2.3	18.5±0.1	18.6±0.0
WC (cm)	70±6	72±7	70±6	72±6	71±4	74±6*	73±5	75±7	71±1	70±2
Bp (mmHg)										
Systolic (above)	113±17	112±17	106±12	104±10	110±10	107±11	107±8	105±7	114±2	103±4
Diastolic (below)	69±11	71±14	66±7	66±6	68±6	69±7	69±9	68±3	75±0	66±6
HDL-C (mg/dl)	75±14	79±12	72±11	70±12	70±9	71±12	73±9	68±12	83±23	87±20
LDL-C (mg/dl)	97±31	94±26	109±27	105±26	101±27	109±28*	104±26	103±20	106±10	110±14
TG (mg/dl)	50±18	52±22	63±32	59±23	53±19	60±35	64±32	50±5	69±22	53±23*
AST (IU/l)	17±3	17±3	16±4	17±4	19±6	18±4	15±3	17±4*	18±3	21±4
ALT (IU/l)	12±4	12±3	12±4	12±4	14±10	13±5	10±5	12±5	13±2	15±5
AST/ALT ratio	1.59±0.37	1.52±0.33	1.47±0.39	1.52±0.44	1.58±0.54	1.55±0.55	1.66±0.50	1.56±0.47	1.44±0.02	1.46±0.25
γ-GTP (IU/l)	17±7	18±7	16±6	19±12	18±10	17±7	13±6	15±3	18±6	21±7
Glc (mg/dl)	86±8	85±6	84±5	84±6	86±4	86±8	84±6	84±5	85±3	83±5
HbA_{1c} (%)	4.7±0.3	4.7±0.3	4.6±0.2	4.8±0.2*	4.8±0.3	4.9±0.3*	4.6±0.3	4.7±0.2	4.7±0.4	4.9±0.4

S1) Precontemplation S2) Contemplation S3) Preparation S4) Action S5) Maintenance
S1 vs. other stages in each year using the Tukey-Kramer method $^{\dagger}p<0.05$
2008 vs. 2009 by paired Student's t-test $^{*}p<0.05$
(Items)
BMI: body mass index
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AST: aspartate aminotransferase
ALT: alanine aminotransferase
γ-GTP: gamma-glutamyl transpeptidase
Glc: glucose
HbA1c: hemoglobin A1c

already started" were 14%, 23%, 35% and 28% in 3,347 men ≥20 years, and 9%, 30%, 37% and 24% in 4,343 women ≥20 years, respectively[25]. The four items of the NHNS survey correlate to the five SCs of our study as follows: "I don't intend to start" (S1), "I intend to start but feel insecure" (S2), "I intend to start and feel sure" (S3), and "I already started" (S4 and S5). The result in this study suggest that more participants of both genders were in the precontemplation and contemplation stages, and fewer were in the action and maintenance stages compared to national levels.

Processes of changes can be specifically applied in the five SCs. SCs in which particular processes of changes are emphasized are: consciousness raising, dramatic relief and environmental reevaluation in S1; self-reevaluation in S2; self-liberation in S3; and contingency management, helping relationships, counterconditioning and stimulus control in S4 and S5[15][22]. Patients in the precontemplation stage are the most resistant and least active clients[15]. It will be difficult to approach study participants in S1 about moving to the next stage. The process "environmental reevaluation," which is defined as assessing how one's problems affect the physical environment, such as empathy training and documentaries, is applied during the precontemplation stage (S1)[15]. In this study, proportion of application was lowest for both genders ≥40 years in S1. Furthermore, those rates were lower in men ≥40 years than <40 years at S1. Therefore, medical data must be strictly checked and followed up, especially in study participants in S1 who are opposed to counseling (in particular, men ≥40 years). More than 50% of men in S2 and S3 applied for counseling in this study. Although the process "helping relationships," which is defined as being open and trusting about problems with someone, such as a therapeutic alliance or social support and self-help groups, was essentially applied for S4 and S5[15], appropriate counseling is also expected to improve behavior modification in S2 and S3 with this process.

Mean weight, BMI and WC in S2, S3 were higher than in S1 in men ≥40 years in 2008 and 2009. Compar-

Table 5b Mandatory routine health checkup data for women≥40 years by five stages of changes in 2008 and 2009 among faculty members of a university in Osaka, Japan

Women≥40 years	S1 (n = 35)		S2 (n = 82)		S3 (n = 39)		S4 (n = 20)		S5 (n = 18)	
year	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Weight (kg)	50 ± 6	50 ± 6	53 ± 8	53 ± 8	54 ± 6	54 ± 7 †	53 ± 6	52 ± 6	52 ± 7	51 ± 7
BMI (kg/m^2)	19.9 ± 2.1	19.9 ± 2.2	21.4 ± 3.1 †	21.4 ± 3.2	21.5 ± 2.2	21.7 ± 2.6 †	21.4 ± 2.3	21.1 ± 2.2	21.3 ± 2.3	20.9 ± 2.0 *
WC (cm)	73 ± 7	73 ± 7	75 ± 9	79 ± 11 * †	75 ± 7	78 ± 7 *	74 ± 6	77 ± 7 *	75 ± 7	78 ± 7
Bp (mmHg)										
Systolic (above)	116 ± 13	116 ± 13	122 ± 22	121 ± 20	119 ± 15	121 ± 17	113 ± 11	113 ± 12	111 ± 9	110 ± 7
Diastolic (below)	72 ± 10	74 ± 8	76 ± 12	77 ± 13	74 ± 10	77 ± 11	70 ± 8	72 ± 8	68 ± 6	71 ± 6
HDL-C (mg/dl)	77 ± 15	75 ± 14	73 ± 14	72 ± 16 *	75 ± 11	73 ± 13	74 ± 14	74 ± 17	71 ± 13	72 ± 15
LDL-C (mg/dl)	118 ± 28	117 ± 30	124 ± 31	122 ± 34	120 ± 30	119 ± 33	125 ± 25	122 ± 27	130 ± 23	125 ± 21
TG (mg/dl)	76 ± 42	84 ± 86	80 ± 40	78 ± 34	77 ± 38	84 ± 38	78 ± 30	66 ± 23	104 ± 54	116 ± 101
AST (IU/l)	18 ± 5	19 ± 4	20 ± 15	20 ± 10	21 ± 11	21 ± 5	19 ± 4	19 ± 4	20 ± 7	20 ± 4
ALT (IU/l)	14 ± 9	14 ± 6	17 ± 15	16 ± 12	19 ± 27	18 ± 12	14 ± 4	14 ± 4	17 ± 13	16 ± 5
AST/ALT ratio	1.51 ± 0.37	1.48 ± 0.34	1.35 ± 0.37	1.41 ± 0.35	1.45 ± 0.48	1.36 ± 0.33	1.43 ± 0.34	1.41 ± 0.32	1.31 ± 0.36	1.26 ± 0.26
γ-GTP (IU/l)	22 ± 23	23 ± 16	22 ± 18	24 ± 15	35 ± 75	29 ± 28	16 ± 3	17 ± 3	18 ± 8	21 ± 10
Glc (mg/dl)	87 ± 8	87 ± 8	89 ± 10	89 ± 10	88 ± 7	90 ± 8	87 ± 6	88 ± 5	89 ± 5	89 ± 8
HbA$_{1c}$ (%)	4.8 ± 0.3	4.9 ± 0.3 *	4.9 ± 0.4	5.0 ± 0.3 *	4.8 ± 0.3	5.0 ± 0.3 *	5.0 ± 0.2	5.0 ± 0.2	4.9 ± 0.3	5.0 ± 0.3 *

S1) Precontemplation S2) Contemplation S3) Preparation S4) Action S5) Maintenance
S1 vs. other stages in each year using the Tukey-Kramer method † $p<0.05$
2008 vs. 2009 by paired Student's t-test * $p<0.05$
(Items)
BMI: body mass index
WC: waist circumference
Bp: Blood pressure
HDL-C: high density lipoprotein-cholesterol
LDL-C: low density lipoprotein-cholesterol
TG: triglyceride
AST: aspartate aminotransferase
ALT: alanine aminotransferase
γ-GTP: gamma-glutamyl transpeptidase
Glc: glucose
HbA1c: hemoglobin A1c

ing cross-sectional data by year between SCs suggested that increases in weight and WC influenced behavior modification in men ≥40 years.

When considering annual changes of data from 2008 to 2009, data for S1–S3 especially S2 and S3, which do not involve behavior modifications, tended to worsen. In contrast, data for behavior modifications in S4 and S5 tended to improve. The weight and BMI were lower and AST/ALT ratio for S4 was higher in 2009 than in 2008 in men ≥40 years. These data suggest the possibility that men ≥40 years in S4 have improvement sign of MetS[12)16)]. Visceral adiposity is associated with increases in blood pressure, ALT and TG[26)~28)]. ALT and γ-GTP are significantly higher in patients with MetS[13)], and HbA1c is associated with MetS, even in apparently healthy patients[29)]. Consistent with these previous reports, comparing 2008 and 2009 data suggested associations between the status of MetS and changes of ALT, TG, γ-GTP, HbA1c, particularly in men ≥40 years. Thus, it is possible that MetS can be improved or prevented by early behavior modification based on annual changes of these data in addition to WC and weight. However, it is thought that the effect of the behavior modification is not enough understanding from the deterioration of a part of data. These results suggest close and specific relationships between SCs and data changes over a year. Therefore, strategies for health counseling should be developed for effective initiation of lifestyle improvements for S1-S3 especially S2 and S3, and maintenance of behavior modifications for S4 and S5.

Longitudinal studies are necessary for prospective research because most people with addictive behaviors move through the SCs in a spiral pattern, rather than a linear progression[8)15)]. For effective health counseling, processes of change need to be fully applied based on the status of SC. Furthermore, decision balance and self-efficacy based on the TTM had to be carefully considered for various participants in addition to SC and processes of change[6)8)30)]. For this reason, it is important especially that health care providers (e.g. nurses) are opti-

mally positioned to help their clients initiate and maintain regular behavior modifications in clinical and community settings[5)8)31)32)].

A number of limitations are worth noting. First, although this was a longitudinal study for one year, longer observation periods will be necessary to confirm the data. Second, all participants were well-educated and belonged to a sedentary occupation. Accordingly, caution should be exercised when generalizing the findings of this study.

Conclusion

Strategies for health counseling should be developed for effective initiation of lifestyle improvements and maintenance of behavior modifications. Careful follow-up with processes of change applied for the SC is necessary as a longitudinal prospective intervention.

Acknowledgment

We thank all the members who participated in this research.

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大学職員を対象とした行動変容ステージと特定健康診査との縦断的な関連

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—キーワード—
特定健康診査，特定保健指導，メタボリックシンドローム，行動変容ステージ，縦断的検討

特定健診では受診者の行動変容ステージ（Stage of change：SC)（無関心期：S1・関心期：S2・準備期：S3・実行期：S4・維持期：S5）に応じた保健指導の実施が望ましい．そこでSCの該当者と保健指導の希望者の状況を調査し，SCと健診結果との関連性を検討した．大阪府内の某総合大学での2008と2009年度の職員健診（男性576名・女性269名）の結果および2009年度における上記状況を性・年齢区分（40歳未満・以上）別に調査した．SCの該当者割合は両年齢区分において男性はS2，S1，S3，女性はS2，S3，S1の順に高かった．また各SCにおける保健指導の希望者割合は男女とも40歳以上のS1で最低であった．次に両年度において健診結果をSC間で比較した．男性40歳以上ではS2，S3，S4における体重や腹囲はS1に比し増加したため，行動変容と体型の関連性が示唆された．さらに年度間比較では男性40歳未満において腹囲はS3，AST，ALT，γ-GTPはS2，glucose（Glc）はS1にて増加し，HDL-cholesterol（HDL-C）はS2，S3にて減少した．男性40歳以上において腹囲はS1，S2，S3，拡張期血圧はS1，S2，S5，γ-GTPはS2，S3，Glc，HbA1cはS2にて増加した．体重はS4，S5，BMIはS4，HDL-CはS1，S2，ALTはS4にて減少し，AST/ALT比はS4にて増加した．女性40歳未満の腹囲とLDL-CはS3，HbA1cはS2，S3にて増加し，中性脂肪はS5にて減少した．女性40歳以上の腹囲はS2，S3，S4，HbA1cはS1，S2，S3，S5にて増加し，BMIはS5にて減少した．年度間の健診結果を総合的に比較するとS1からS3，特にS2およびS3までは増悪し，S4およびS5では改善傾向が示唆された．しかし，S4およびS5でも一部データは悪化しており，行動変容改善の効果は十分でないと考えられた．S2，S3では，生活習慣の改善意思があるにも関わらず，いまだ行動が伴わないことで健診結果が悪化していると推測され，効果的な早期の保健指導が必要と考えられる．またS4，S5ではより長期にわたる行動変容の持続が求められる．以上よりSC状況と健診結果の年度間推移には関連性が推察され，これら行動変容ステージを保健指導に有効活用することが肝要と考えられた．

（日職災医誌，60：165—175，2012）