Original

Three Consecutive Years of Research on the Stratification of Specific Health Checkups, Abnormal Criteria Values and Healthy Lifestyles among Stage of Changes

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Abstract

Objective: The present study aimed to assess the longitudinal effects of stage of changes (SOC) on the results of specific health checkups (SHCs) in occupational field.

Methods: Participants were Japanese male employees aged ≥40 years who underwent SHCs from 2009 to 2011 at a private university in Osaka, Japan. We surveyed the distribution of participants in the stratifications of SHCs and SOC groups (I: precontemplation, II: contemplation and preparation, III: action and maintenance). We compared the different SOC groups with regard to the distribution of participants with healthy lifestyles and their clinical data.

Results: Across all three years of the study, the proportions of participants at a positive support level and in SOC III increased. Those with abnormal BMI, waist circumference and serum glucose indices comprised the highest proportion in SOC II and the second highest in SOC III. The proportion with the most abnormal serum glucose indices and hypertension increased significantly for the three years regardless of SOC category. The highest proportion of subjects who exercised was in the SOC III category. No significant changes in dietary habits were identified across the three years or by SOC group.

Conclusions: An increase in the proportion of subjects in SOC III would suggest that subjects tended to aspire to a healthy physical condition through an improved lifestyle. However, increases in the proportions of subjects with hypertension could also be associated with aging. The proportion of subjects with hyperglycemia increased markedly with time, regardless of SOC. As such, we surmise that modifications in lifestyle noted in the present study were insufficient to achieve noticeable improvements in SHCs results, especially for middle-aged and older men.

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—Key words—

specific health checkups, stage of change, criteria for determination, lifestyle modification

Introduction

In 2013, the Ministry of Health, Labor and Welfare (MHLW) in Japan reported an increase in the national mean rate of implementation of specific health checkups (SHCs), from 41.3% in 2008 to 45.0% in 2011. In addition, the mean proportion of those eligible to receive additional health counseling due to abnormal SHCs results in 2011 was 17.8%. Although the number of participants who attended health counseling increased each year from 2008 to 2011, the rate of implementation for attending additional health counseling was only 15.9% in 2011. However, apparent differences in implementation rates were noted across various age groups and types of insurance[1]. Health counseling following an SHCs should be coordinated with the stage of change (SOC) as presented in the transtheoretical model[2] and applied effectively in order to prevent lifestyle diseases through

the maintenance of a healthy lifestyle. As emphasized by Oka[3], the relationship between SOC for exercise and behaviors of self-efficacy among middle-aged Japanese adults is important for actual modifications in lifestyle.

While items concerning SOC are included in standard questionnaires of SHCs, data from these items have not been adequately utilized in the context of health counseling in Japan. Previously, we reported results from our cross-sectional study which examined two years of physical activity and dietary habits from the perspective of SOC category and metabolic syndrome (MetS) criteria as outlined in employee insurance policies[4]. The present study aimed to survey longitudinally the stratifications of SHCs and the SOC among middle-aged men in the same occupational field. The effects of SOC on abnormal clinical data among other SHCs criteria and healthy lifestyles of standard questionnaire by SHCs are assessed.

Participants and Methods

Participants

Study participants included 1,138 subjects, all of whom were employees who performed primarily sedentary work at a private university in Osaka, Japan. Of these, 851 had attended SHCs in 2009. Male participants were divided further into two groups by age: <40 years old (mean ± SD, 33.6 ± 4.4 years; n = 119) and ≥ 40 years old (mean ± SD, 53.8 ± 7.5 years; n = 363) as of 2009.

Questionnaire on lifestyle and smoking

Data on diet and exercise were collected from a questionnaire used as part of the "Standard Program of SHCs and Specific Health Guidance" initiated by the Ministry of Health, Labor and Welfare. Table 1 displays the questions, answers, and abbreviations for healthy lifestyle choices. Smoking history was assessed according to smoking habits in 2011 and/or a smoking index score ≥ 100[5].

Categorization by SOC

After completing the questionnaire, participants answered questions concerning the five SOCs. Steps taken by participants to correct problematic behaviors were classified into the following three SOC categories. SOC I (precontemplation): "I have no plans to start"; SOC II (contemplation and preparation): "I'm going to start in the future (e.g., within 6 months)" and "I'm going to start soon (e.g., in a month)"; and SOC III (action and maintenance): "I already started (<6 months ago)" and "I already started (<6 months ago)." Table 1 also shows the SOC categories used in this study.

Clinical data

Blood levels of the following parameters were measured after a 12-hour fasting period: triglycerides (TG,

Table 1 Standard questionnaire for specific health checkups (SHCs) comprising questions on diet, exercise and lifestyle modifications according to the Ministry of Health, Labor and Welfare, with choices and abbreviations for healthy lifestyles and categories of stage of change.

Questions about diet and exercise	Choices	Abbreviations
Do you skip breakfast ≥three days per week? ① Yes ② No	② No	Eats breakfast
Do you have an evening meal within two hours before bedtime three days or more per week? ① Yes ② No	② No	No bedtime supper
Do you eat after your evening meal (fourth meal)≥three days per week? ① Yes ② No	② No	No snacking
How fast do you eat compared to others? ① Faster ② Normal ③ Slower	③ Slower	Eats slowly
During the last year, have you exercised at least two days per week for at least 30 minutes each time at an intensity that causes light perspiration? ① Yes ② No	① Yes	Exercises ≥30 min
Do you walk for at least one hour every day or perform the equivalent physical activity in your daily life? ① Yes ② No	① Yes	Walks ≥1 h
Do you walk faster than other people of the same sex and age? ① Yes ② No	① Yes	Fast walker
Do you get enough sleep? ① Yes ② No	① Yes	Sufficient sleep

Are you going to start or have you started any lifestyle modifications (e.g., increase physical activity, improve dietary habits) ?	Choices	SOC category
① I have no plans to start.	①	SOC I
② I plan to start in the future (e.g., within 6 months). ③ I plan to start soon (e.g., in a month).	② or ③	SOC II
④ I have already started (<6 months ago). ⑤ I have already started (≥ 6 months ago).	④ or ⑤	SOC III

mg/dL, enzymatic method by analytical chemistry), high-density lipoprotein cholesterol (HDL-C, enzymatic method by analytical chemistry), low-density lipoprotein cholesterol (LDL-C, mg/dL, calculated by LDL－C＝TG－[HDL－C＋TG/5]), and glucose (Glu, glucose oxidase method used by the Japan Diabetes Society). Blood pressure (BP, mmHg) was also measured in accordance with hypertension treatment guidelines. Waist circumference (WC) was measured as the minimum circumference at the level of the umbilicus to the nearest 0.5 cm at the end of normal expiration.

SHCs criteria and determination of support level

The following threshold values were used to evaluate SHCs criteria: (1) WC ≥85 cm for men and ≥90 cm for women; (2) body mass index (BMI) ≥25; (3) BP: systolic BP ≥130 mmHg, diastolic BP ≥85 mmHg, or use of hypertension medications; (4) Glu: fasting plasma levels ≥100 mg/dL, HbA1c (JDS) (%) ≥5.2, or current treatment for diabetes mellitus; (5) dyslipidemia (Lipid): TG ≥150 mg/dL and/or HDL-C ＜40 mg/dL, or use of hyperlipidemia medications; and smoking history based on a smoking index score ≥100 and/or smoking status in 2011. Support level was determined according to the combination of these parameters. Positive support level (PSL) included (1) and two or more from (3), (4), and (5); or (2), (3), (4), and (5); or (1) and one from (3), (4), and (5) plus smoking history; or (2) and two from (3), (4), and (5) plus smoking history. Motivational support level (MSL) included one from (3), (4), and (5) plus no smoking history; or (2) and two from (3), (4), and (5) plus no smoking history; or (2) and one from (3), (4), and (5). Any other parameter combinations were categorized as a healthy level for a clean bill of health (CB)[5].

Statistical analysis

Participant distribution in the various SHCs support levels, SOCs and SOC categories were assessed from 2009 to 2011. Proportions of participants with 1) abnormal criteria values and 2) healthy lifestyles were compared by age and SOC groups. Pearson's χ^2 test was used to analyze categorical variables. Statistical analysis was performed using SPSS® 12.0 J software (SPSS Inc., Chicago, IL), with statistical significance set as $p<0.05$.

Ethical considerations

This study was approved by the Ethics Committee of Osaka Medical College (No. 679). Written and oral explanations of the study were provided, and informed consent was obtained from all participants. Anonymity was ensured to protect personal information.

Results

Fig. 1 shows proportions of participants in the various support levels. A higher proportion of participants was found in PSL relative to that in MSL across the three years of the study. In 2011, the PSL proportion was higher than 40%, while the MSL proportion was smaller than 10%. Fig. 2 shows participant distribution by SOC category. The proportions for SOC I remained stable. While those for SOC II were the highest of all SOC categories, they showed a decreasing trend, while the proportion in SOC III showed an increasing trend. Participant distribution by SOC category in 2009, 2010 and 2011 was as follows: 24.8%, 27.0% and 25.6%, respectively, for precontemplation; 32.5%, 21.4% and 29.2%, respectively, for contemplation; 18.7%, 15.4% and 14.3%, respectively, for preparation; 8.5%, 9.6% and 9.1%, respectively, for action; and 15.4%, 16.5% and 21.8%, respectively, for maintenance. Table 2 shows the proportions of participants with abnormal and values over the threshold for the SHCs criteria. These data were used to determine the support level. Most BMI, WC, Lipid and BP values were the lowest for participants in the SOC I category, while most BMI, WC, and Glu values trended to be the highest for participants in the SOC II category. In addition, most BMI, WC, Glu, Lipid and BP values of participants in the SOC III category trended to be higher than those values for participants in the SOC I category.

Across all SOC categories, Glu increased significantly each consecutive year. Table 3 shows proportions of participants with healthy lifestyles. Although over 80% of participants were classified as 'Eats breakfast' and 'No snacking' less than 10% were classified as 'Slow eater' within SOC III. With the exception of 'Eats breakfast' we identified no significant year-dependent or category-dependent changes in the various dietary habits. The highest proportions of participants labeled as 'Exercises ≥30 min,' 'Walks ≥1 h' and 'Fast walker' were consistently found in the SOC III category across the three years.

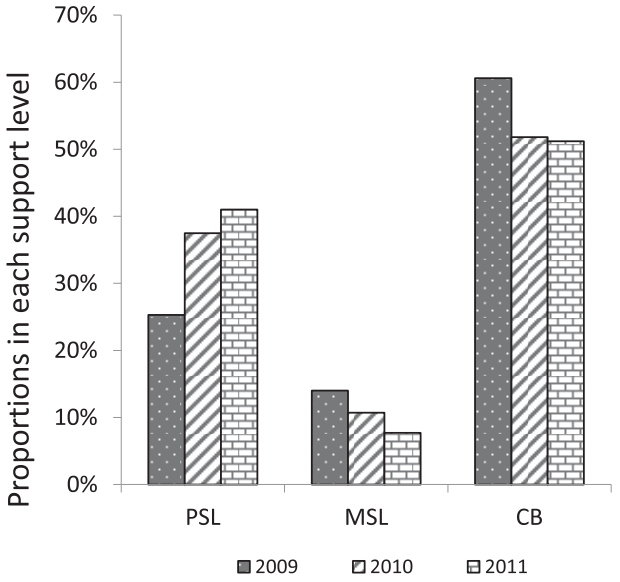

Fig. 1 Participant distribution and proportions across three years of specific health checkups (SHCs) support levels among male employees aged ≥40 years (N = 363) at a private university in Osaka, Japan. PSL, positive support level; MSL, motivational support level; CB, healthy level for a clean bill of health. Significant differences noted between each of the three years ($p < 0.01$) for PSL and MSL (Pearson's $\chi 2$ test).

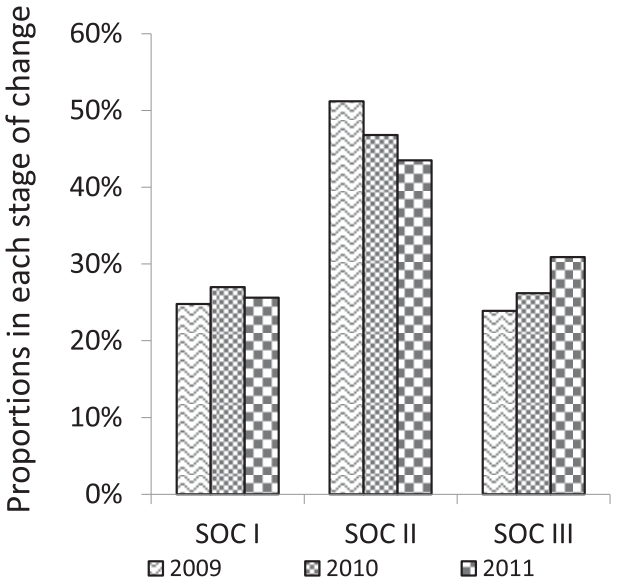

Fig. 2 Participant distribution for stage of change (SOC) across three years among male employees aged ≥40 years (N = 363) at a private university in Osaka, Japan. SOC I: precontemplation, SOC II: contemplation and preparation, SOC III: action and maintenance. No significant changes were observed between any of the three years for any SOC category (Pearson's $\chi 2$ test).

Table 2 Participant distributions across three years for those with abnormal SHCs criteria, classified according to stage of change (SOC) among male employees aged ≥40 years (N = 363) at a private university in Osaka, Japan.

	Year	BMI	WC	Glu	Lipid	BP
SOC I	2009 (90)	20.0% (18)	30.0% (27)	35.6% (32)*	18.9% (17)	43.3% (39)
	2010 (98)	22.4% (22)	42.9% (42)	37.8% (37)*	26.5% (26)	49.0% (48)
	2011 (93)	19.4% (8)	40.9% (38)	52.7% (49)*	14.0% (13)	55.9% (52)
SOC II	2009 (186)	44.1% (82)	62.9% (117)	43.0% (80)*	33.3% (62)	61.3% (114)
	2010 (170)	44.7% (76)	64.7% (110)	40.0% (68)*	30.6% (52)	58.8% (100)
	2011 (158)	44.9% (71)	59.5% (94)	56.3% (89)*	37.3% (59)	65.2% (103)
SOC III	2009 (87)	32.2% (28)	50.6% (44)	34.5% (30)*	32.2% (28)	54.0% (47)
	2010 (95)	36.8% (35)	54.7% (52)	38.9% (37)*	43.2% (41)	57.9% (55)
	2011 (112)	37.5% (42)	48.2% (54)	52.7% (59)*	37.5% (42)	63.4% (71)

Numbers in parentheses indicate, BMI, body mass index; WC, waist circumference; Glu, glucose index; Lipid, dyslipidemia; BP, blood pressure. *: $p < 0.05$ between years and SOC categories (Pearson's $\chi 2$ test).

Discussion

We noted differences in implementation rates of SHCs according to the type of insurance as mentioned in the introduction. When classified by type of fraternal benefit association, the national implementation rate for SHCs was 73.0% in 2011[1]. The implementation rate of 74.8% (851/1,138) noted for the present study was similar to the national rate, likely because the SHCs for this study were implemented by the fraternal benefit association of a private school. The higher implementation rate in the present study relative to the national average of 45.0% is also likely due to the fact that all employees are obligatory to receive SHCs for occupational health according to the industrial safety and health laws[6].

Increases in PSL were primarily due to decreases in MSL, as no remarkable changes were noted in proportions of CB between 2010 and 2011. The prevalence of MetS in Japanese males reportedly increases rapidly once they reach 50 years of age[7]. Therefore, the significant increase in PSL across the three years may be ex-

Table 3 Distribution of 363 male private university employees (≥40 years old) with healthy lifestyles as defined by stage of change (SOC) categories across three years.

Male employees aged ≥40 years (N = 363)		Eats breakfast	No bedtime supper	No snacking	Eats slowly	Exercises ≥30 min	Walks ≥1 h	Fast walker	Sufficient sleep
SOC I	2009 (90)	94.4% (85)	75.6% (68)	87.8% (79)	10.0% (9)	31.1% (28)	34.4% (31)	57.8% (52)	65.6% (59)
	2010 (98)	100% (98)	72.4% (71)	92.9% (91)	9.2% (9)	33.7% (33)	37.8% (37)	58.2% (57)	68.4% (67)
	2011 (93)	94.6% (88)	71.0% (66)	91.4% (85)	9.7% (9)	31.2% (29)	32.3% (30)	57.0% (53)	64.5% (60)
SOC II	2009 (186)	90.3% (168)*	65.1% (121)	84.4% (157)	10.2% (19)	15.1% (28)	22.0% (41)	54.3% (101)	48.4% (90)
	2010 (170)	97.1% (165)*	67.6% (115)	81.8% (139)	8.2% (14)	17.1% (29)	23.5% (40)	55.9% (95)	47.1% (80)
	2011 (158)	87.3% (138)*	72.2% (114)	84.6% (129)	6.3% (10)	19.6% (31)	29.1% (46)	58.2% (92)	51.3% (81)
SOC III	2009 (87)	94.3% (82)	77.0% (67)	90.8% (79)	8.0% (7)	39.1% (34)	52.9% (46)	65.5% (57)	52.9% (46)
	2010 (95)	100% (95)	74.7% (71)	89.5% (85)	9.5% (9)	42.1% (40)	50.5% (48)	65.3% (62)	49.5% (47)
	2011 (112)	93.8% (105)	79.5% (89)	84.8% (95)	10.7% (12)	38.4% (43)	43.8% (49)	66.1% (74)	54.5% (61)

Abbreviations for healthy lifestyle parameters are defined in Table 1. *: $p<0.05$ between years and SOC categories (Pearson's $\chi 2$ test).

plained by the fact that most participants were in their early fifties.

Rates of attendance for health counseling with the fraternal benefit association for PSL or MSL were reportedly only 12.6% in 2011[1]. Although attendance rates for health counseling were unknown due to the outsourcing agreement of the present study, low rates of attendance may partially explain the increase in PSL observed in our study.

The decreasing trend of participants in SOC II may have been derived from the decrease in both contemplation and preparation proportions. In addition, the increasing trend of those in SOC III was likely due to the increase in the maintenance proportion across the three years of the present study. Previously, we reported that proportions of those in the contemplation, preparation, and maintenance categories were 33.0%, 18.2% and 15.5%, respectively, among 440 males ≥40 years old in 2008[8]. We also surmise that the increases in the maintenance proportion, particularly from 2010 to 2011 in the present study, explain the relative lack of change in those rates between 2008 and 2009 observed by Nakayama et al.[8].

Most parameters measured in SOC II and SOC III participants were higher than those for participants in SOC I, the latter of whom may have felt less necessity for lifestyle modification due to their relatively healthy physical conditions. However, motivation levels among participants in SOC II and SOC III may be derived primarily from an aversion to health risks and obesity rather than from positive health promotion. In a previous study, we found that subjects with MetS or pre-MetS statuses comprised 25% of SOC I, 50% of SOC II and 40% of SOC III in 2009[9]. As such, proportions of those with MetS or pre-MetS statuses among the SOC II or SOC III categories may also have been higher than those among the SOC I category in 2010 and 2011.

In all SOC categories of the present study, the proportion of those with high BP tended to increase across the three years while no increases were identified for the proportion of those with abnormal WC or BMI results in all categories in this study. While high BP levels are still classified as pre-hypertension when obesity is not involved, the synergistic effects of age and high BP can contribute to the progression of arterial hardening[10]. Therefore, the increase in the proportion with high BP might also be associated with aging and sustained hypertension.

Participants in all SOC categories showed significant increases in Glu during the three years of this study. For the SHCs, the fasting glucose criteria have a fairly low threshold value, relative to those for the MetS criteria (≥100 mg/dL), but HbA1c is an additional parameter included in the SHCs criteria. Therefore, many studies which targeted Asian subjects evaluated the utility of HbA1c levels as a predictor of incident diabetes mellitus[11)~14)]. Based on increases in the percentage of those with abnormal glucose values in the present study, we would reason that prevalence of hyperglycemia in men ≥40 years is increasing overall.

Because those classified as 'Eats breakfast' and 'No snacking' comprised over 80%, there is likely very little room for improvement. On the other hand, those who were classified as 'Eats slowly' accounted for less than 10% across all SOC categories. Previous reports showed that eating quickly was significantly associated with risk of MetS[15)16)]. The proportions of those who exercise ≥30 min accounted for approximately 40% of SOC III participants in this study. The National Health and Nutrition Examination Survey (NHNE) of 2011 reported

that the proportions of Japanese men who exercise ≥30 min were 26.6% in their 40's, 24.1% in their 50's and 41.9% in their 60's[17]. This report by the MHLW noted that the proportions of those who exercise ≥30 min in their study were higher than those at the national level. NHNE also reported that the mean number of steps taken each day by Japanese men was 8,090, 7,693, and 7,307 for those in their 40's, 50's, and 60's, respectively[18]. However, the 2nd component of the Healthy Japan 21 aims to increase the number of steps per day to 9,200 in men[19]. This would require more than 1.5 hours to accomplish, because roughly 6,000 steps can be taken in 1 hour of walking. Of all SOC categories, the SOC III had the largest proportion of those who walk ≥1 h in the present study. However, we are not confident that 'walks ≥1 h' is necessarily conducted for minimum physical exercise. Therefore, we would recommend that walking time should be evaluated in terms of 'walks ≥1.5 h' criterion in future SHCs surveys. As noted above, lifestyle modification in SOC III participants may not effectively improve any abnormalities in the various criteria. Busy middle-aged men may find it quite difficult to secure the time required for adequate physical activity and for eating in an unhurried manner. Combining the SOC model with motivational interviewing may represent a helpful strategy for health care providers as they assist patients in changing unhealthy lifestyle behaviors[20]. Effective interventional health counseling must identify and cater to each individual's SOC.

Limitations

Participants were classified into various groups according to their SOC categories, each of which reflected the various combinations of SHCs criteria. The results revealed the effects on motivation and lifestyle modification. Further studies should examine the stratification process of the SHCs.

Conclusions

From 2009 to 2011, we noted an increase in the proportion of males ≥40 years old with PSL. The increase in those classified as maintenance would indicate an aspiration for a healthy physical condition through lifestyle improvement. However, we suspect that insufficient improvements could be made in the SHCs results with the lifestyles as they were at the time of the study, especially among middle-aged and older men.

Conflict of Interest

The authors declare no conflict of interest.

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特定健診の階層状況および行動変容ステージ別の判定基準および健康的な生活習慣の該当者割合の連続三年間の検討

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特定健康診査，行動変容ステージ，判定基準，生活習慣

【目的】職域の特定健診結果における行動変容ステージの縦断的影響を検討した．
【方法】大阪の私立総合大学において，2009 年から 2011 年までの特定健診が実施された．対象者は連続 3 年間受診した，40 歳以上の邦人男性教職員とした．特定健診の階層および行動変容ステージ群（SOC）（I：無関心期，　II：関心期・準備期，III：実行期・維持期）の分布状況を把握した．SOC 群別の判定基準および健康的な生活習慣の該当者割合を比較した．
【結果】3 年間を通じ，積極的支援および SOC III の該当者割合は増加した．SOC II 群において，BMI，腹囲，血糖指標の判定該当者割合が最も高く，SOC III 群が準じた．すべての SOC 群において，血糖指標および血圧異常該当者割合は 3 年間に，明らかに増加した．運動習慣者の割合は，SOC III 群において最も高かった．一方，SOC 群間および 3 年間においても，健康的な食習慣の該当者割合に著変はなかった．
【考察】生活習慣改善により，健康的な身体状況を求める者が SOC III 群において増加したと考えられた．しかし，血圧の基準該当者の増加は，加齢の関与も考えられた．血糖指標の該当者割合の増加は，SOC 群に関わりなく，明らかに経年的に増加したと推察された．本研究の事例で示された生活習慣の変容状況と，特定健診結果の明らかな改善との関連性は，特に中年以降の男性にとって，低いと考えられた．

（日職災医誌，62：328—335，2014）