

## 保健指導の希望, 行動変容ステージ, メタボリックシンドロームおよび内臓脂肪の状況による特定保健指導の優先順位の検討

Review of Priority for Health Counseling after Mandatory Routine Health Checkups Using Application, Stage of Change, Presence of Metabolic Syndrome, and Visceral Adiposity

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### 抄録

目的は特定保健指導を受けるべき対象者の優先順位についての検討である。対象者は大阪府の私立総合大学の男性40歳以上の教職員であった。選定要因は保健指導の希望, 行動変容ステージ, メタボリックシンドローム (MetS) の判定, 腹囲と体組成計による内臓脂肪量である。約半数が保健指導を希望した。希望者のうち無関心期・関心期と準備期・実行期と維持期は13%, 3%, 34%であった。MetSと予備群は17%, 20%であった。腹囲と内臓脂肪がともに基準以上が30%, 内臓脂肪のみ基準以上が44%であった。保健指導はMetSあるいは予備群に対して, 既に実行・維持している者より無関心期, 関心期, 準備期の方が優先されるべきである。また内臓脂肪のみ基準以上のかくれ肥満の場合は, 過剰な内臓脂肪に自覚がない。従って予備群やかくれ肥満にも予防医学的見地から要注意である。以上より健診後, 有効に指導対象者を絞るための優先順位の方策が必要である。

### Abstract

Objective: The purpose of this study was to review how to take priority for applicants who should receive health counseling. Methods: Participants were Japanese male employees aged  $\geq 40$  years undergoing mandatory routine health checkups (MRHCs) in a private university in Osaka, Japan. The selection factors were request for counseling, stage of change (SOC) in the transtheoretical model for behavioral change, presence of metabolic syndrome (MetS), waist circumference (WC), visceral fat area (VFA)

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measured by the bioimpedance method. Results: Half of the participants requested health counseling. Proportions of participants in SOC I (precontemplation), II (contemplation and preparation), and III (action and maintenance) were 13%, 53%, and 34%, respectively. Proportions of those with MetS and pre-MetS were 17% and 20%, respectively. Proportions of those with potential obesity ( $WC < 85 \text{ cm}$  &  $VFA \geq 100 \text{ cm}^2$ ) and visceral obesity ( $WC \geq 85 \text{ cm}$  &  $VFA \geq 100 \text{ cm}^2$ ) were 30% and 44%, respectively. Conclusion: These results suggest that counseling should be performed for applicants with MetS or pre-MetS in SOC I or II, because more than half of SOC III participants had no MetS, and SOC III participants with MetS or pre-MetS were already in the action and maintenance stages of lifestyle modification. Those in the potential obesity group were unaware of excess visceral fat accumulation. Attentions for pre-morbid conditions including pre-MetS and potential visceral adiposity should also be emphasized in preventive health. Therefore, some strategies of priority would be needed to efficiently target individuals for health counseling through MRHCs.

## I. Introduction

The 34<sup>th</sup> Health Science Council of the Ministry of Health, Labor and Welfare (MHLW) introduced objectives for the Healthy Japan 21 project for the upcoming decade starting in 2013 (Ministry of Health, Labor, and Welfare, 2013). They emphasized the importance of effective health counseling strategies for lifestyle modifications for metabolic syndrome (MetS) after mandatory routine health checkups (MRHCs) (Ministry of Health, Labor and Welfare, 2007). A standard MRHCs questionnaire is used to assess physical activity and dietary habits of counseling applicants. Although the request for health counseling and stage of change (SOC) of the transtheoretical model for behavioral change (Prochaska, 1982) are items included in the questionnaire, the results have not been adequately utilized to provide counseling to applicants. The MHLW reported that while 4.06 million people requested health counseling at MRHCs in 2010, but just only 0.556 million actually received counseling (13.7% implementation rate (Ministry of Health, Labor and Welfare, 2010)). The discrepancy between the number of people requesting and receiving health

counseling is thought to be greater in small and medium-sized workplaces. Although increasing the number of those requesting health counseling is important, strategies to effectively screen applicants for health counseling are necessary to better allocate limited healthcare resources. Waist circumference (WC) is a mandatory criterion of MetS used to evaluate central obesity in Japan (Medicine Committee of the Japanese association of medical sciences, 2005). However, WC does not necessarily reflect abdominal fat accumulation as it is affected by subcutaneous fat. Bioelectrical impedance analysis methods are available to reliably measure abdominal fat accumulation (Okauchi et al. 2010). Additionally, presences of MetS or pre-MetS don't determine the stratification by MRHC. Moreover, motivation for health counseling was previously thought to be associated with multiple factors classified as subjective (e.g., applicant and SOC) and objective (e.g., MetS results and visceral fat volume (Dote et al., 2013)). The purpose of this study was to discuss an effective priority for applicants for health counseling through a comprehensive assessment of the above factors.

## II. Participants and methods

### 1. Participants

Study participants consisted of 328 of 792 male employees ( $\geq 40$  years; mean age, 54.6 years; standard deviation, 8.5 years) at a private university in Osaka, Japan. A self-administered questionnaire was provided to participants, and those who requested total body composition analysis were included in this study. Their jobs consisted primarily of sedentary work. Participants underwent MRHCs after a 12-hour fasting period during October 2011, except for those who received a comprehensive medical examination.

### 2. Questionnaire on lifestyle, behavior modifications, and health counseling

Data regarding requests for health counseling and SOC were collected using a questionnaire as part of the “Standard Program of MRHC and Health Counseling” initiated by the MHLW (Ministry of Health, Labor and Welfare, 2007).

### 3. Categorization of SOC

Lifestyle modification steps taken by participants were categorized into the following three groups: “I have no plans to start” (SOC I, precontemplation), “I am going to start in the future (e.g., within 6 months)” and “I am going to start soon (e.g., in a month)” (SOC II, contemplation and preparation), and “I already started (<6 months

ago)” and “I have already started ( $\geq 6$  months ago)” (SOC III, action and maintenance). Table 1 shows the standard questions for assessing lifestyles and SOC categories used in this study. Participants who answered “yes” to the last question in Table 1 were considered as health counseling applicants.

### 4. Clinical data

Blood levels of the following were collected after a 12 hours fasting period: aspartate aminotransferase (AST, U/L: MDH-UV method), alanine aminotransferase (ALT, IU/L: MDH-UV method), gamma-glutamyl transpeptidase (GGT, IU/L: MDH-UV method), uric acid (UA, mg/dL: uricase-catalase method), triglycerides (TG, 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:  $LDL-C = TG - [HDL-C + TG/5]$ ) (Friedwald et al., 1972), and glucose (glucose oxidase method according to the Japan Diabetes Society). Blood pressure (BP, mmHg) was also measured in accordance with 2009 hypertension treatment guidelines (Committee of hypertension treatment guideline of The Japanese Society of Hypertension, 2009). 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

Table 1. Questionnaire for standard mandatory routine health checkups and health counseling by the Ministry of Health, Labour and Welfare and categories in this study.

Questions about lifestyle modifications	Choices → SOC category
Are you going to start or have you started lifestyle modifications (e.g., increase physical activity, improve dietary habits)? 1. I have no plans 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). 4. I have already started (<6 months ago). 5. I have already started ( $\geq 6$ months ago).	1 → SOC I 2 or 3 → SOC II 4 or 5 → SOC III
Will you get health counseling about lifestyle modifications if the opportunity arises?	1. Yes 2. No; 1 → applicants for health counseling

SOC, stage of change

(Committee of obesity treatment guideline of the Japan Society for the Study of Obesity, 2006).

### 5. MetS diagnosis and classification of morbidity

MetS in men was diagnosed using criteria established by the Japanese Association of Medical Science. MetS was defined as WC  $\geq$ 85 cm plus two or more of the following: (1) TG  $\geq$ 150 mg/dL, HDL-C  $<$ 40 mg/dL, or taking medication for hyperlipidemia; (2) systolic BP  $\geq$ 130 mmHg, diastolic BP  $\geq$ 85 mmHg, or receiving medication for hypertension; and (3) fasting plasma glucose level  $\geq$ 110 mg/dL or receiving treatment for diabetes mellitus (Medicine Committee of the Japanese association of medical sciences, 2005). Pre-MetS was defined as WC  $\geq$ 85 cm plus one of the other three criteria. Participants were then categorized into the morbidity (MetS or pre-MetS) or non-morbidity group.

### 6. Measurement of body composition

Visceral fat levels (VFLs) were measured by bioelectrical impedance analysis (BIA) using a Body Composition Analyzer (MC-190; Tanita Corp., Tokyo, Japan). Recommended BIA measurement conditions were explained to each participant and the following instructions were provided: (1) fast for four hours and do not drink alcohol for eight hours prior to measurements; (2) empty bladder prior to measurements; and (3) do not exercise for eight hours prior to measurements (Tanimoto et al., 2012). Participants were instructed to stand on the footplate and grasp the handgrip with electrodes. Current emitted from the electrodes through the feet and hands was detected at the heels and palms. The Body Composition Analyzer applies electricity at frequencies of 5, 50, 250, and 500 kHz throughout the body. Whole body impedance was then measured using a bilateral foot-hand electrical pathway. This analyzer automatically calculates percent body fat using equations preprogrammed by the manufacturer.

The coefficient of variation for BIA measurements was 0.4%, as determined by five repeated measurements in seven adult participants. VFLs ranging from 1 to 59 were translated into values. For example, level 10 is equivalent to a visceral fat area (VFA) value of 100 cm<sup>2</sup>. According to Japanese diagnostic criteria, WCs of 85 cm in men and 90 cm in women are equivalent to a VFA value of 100 cm<sup>2</sup> determined by computed tomography (CT) (Japan Society for the Study of Obesity, 2002).

### 7. WC and VFL groups

Participants were divided into the following obesity categories: non-obesity group (WC  $<$ 85 cm and VFL  $<$ 10), apparent obesity group (WC  $\geq$ 85 cm and VFL  $<$ 10), potential obesity group (WC  $<$ 85 cm and VFL  $\geq$ 10), and visceral obesity group (WC  $\geq$ 85 cm and VFL  $\geq$ 10). Both the potential obesity and visceral obesity groups were assumed to have increased visceral fat.

### 8. Statistical analysis

For each SOC category, rates of the following characteristics were compared by Pearson's  $\chi^2$  test: health counseling applicants and non-applicants, MetS categories, and obesity categories. This study focused on participants in SOC I or II, because those in SOC III were already executing lifestyle modifications. Proportions of participants in different MetS categories were calculated in health counseling applicants in SOC I or II. Obesity categories were compared for each MetS classification by Pearson's  $\chi^2$  test.

Furthermore, this study focused on participants in the morbidity group (MetS or pre-MetS) or potential obesity or visceral obesity group (those with increased visceral fat), because they should preferentially receive health counseling. Selection rates of dietary and exercise habits were calculated in health counseling applicants with MetS, pre-MetS, or VFLs  $\geq$ 10 in SOC I or II.

Statistical analysis was performed using SPSS® 12.0 J (SPSS Inc., Chicago, IL).  $p < 0.05$  was considered statistically significant.

### 9. 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 each participant. Anonymity was ensured to protect personal information.

### III. Results

Table 2 shows the distribution of participants in each SOC group, as well as health counseling applicants and non-applicants in each group. Nearly half of all participants applied for health counseling. The combined percentage of SOC I and II for all applicants was 71%. Proportions of

applicants were nearly 25% in SOC I and 60% each in SOC II and III. Table 3 shows the distribution of applicants in each SOC group, as well as proportions of MetS, pre-MetS and non-MetS applicants in each SOC group. Proportions of applicants in SOC I, II, and III were 13.5%, 52.5%, and 34.0%, respectively. The combined proportion of participants with MetS and pre-MetS was 37%, with 18.2% in SOC I, 36.4% in SOC II, and 45.4% in SOC III. Table 4 compares the distribution of applicants in obesity categories by SOC group. Proportions of applicants in potential and visceral obesity groups were about 30% and 44%, respectively. Nearly half of SOC I, a quarter of SOC II, and 35% of SOC III applicants were in the potential obesity group. Nearly a quarter of SOC I and half of both SOC II and III applicants were in the visceral obesity

Table 2. Stages of change (SOCs) of health counseling applicants and non-applicants.

	SOC I (27.4%;90/328)	SOC II (43.6%;143/328)	SOC III (29.0%;95/328)
Applicants (49.4%; 162/328)	24.4% (22/90)	59.4% (85/143)*	57.9% (55/95)*
Non-applicants (50.6%; 166/328)	75.6% (68/90)	40.6% (58/143)*	42.1% (40/95)*

SOC I: precontemplation, SOC II: contemplation and preparation, SOC III: action and maintenance

\* $p < 0.01$  between SOC categories vs SOC I (Pearson's  $\chi^2$  test)

Table 3. Stages of change (SOCs) and metabolic syndrome (MetS) classifications in health counseling applicants.

Classifications	SOC I (13.5%;22/162)	SOC II (52.5%;85/162)	SOC III (34.0%;55/162)
MetS (17.3%; 28/162)	0% (0/22)	18.8% (16/85)*	21.8% (12/55)*
Pre-MetS (19.7%; 32/162)	18.2% (4/22)	17.6% (15/85)*	23.6% (13/55)*
Non-MetS (63.0%; 102/162)	81.8% (18/22)	63.5% (54/85)*	54.5% (30/55)*

SOC I: precontemplation, SOC II: contemplation and preparation, SOC III: action and maintenance

MetS and pre-MetS were diagnosed using criteria established by the Medicine Committee of the Japanese Association of Medical Science.

\* $p < 0.01$  between SOC categories vs SOC I (Pearson's  $\chi^2$  test)

Table 4. Stages of change (SOCs) and obesity category based on waist circumference (WC) and visceral fat levels (VFLs).

Obesity category	SOC I (13.5%;22/162)	SOC II (52.5%;85/162)	SOC III (34.0%;55/162)
Non-obesity group (23.4%;38/162)	27.3% (6/22)	27.1% (23/85)	16.4% (9/55)
Apparent obesity group (2.5%;4/162)	4.5% (1/22)	2.4% (2/85)	1.8% (1/55)
Potential obesity group (30.2%; 49/162)	45.5% (10/22)	23.5% (20/85)	34.5% (19/55)
Visceral obesity group (43.8%;71/162)	22.7% (5/22)	47.0% (40/85)	47.3% (26/55)

SOC I: precontemplation, SOC II: contemplation and preparation, SOC III: action and maintenance  
 Participants were divided into non-obesity (WC <85 cm and VFL <10), apparent obesity (WC ≥85 cm and VFL <10), potential obesity (WC <85 cm and VFL ≥10), and visceral obesity (WC ≥85 cm and VFL ≥10) groups. VFLs were measured by bioelectrical impedance analysis using a Body Composition Analyzer (MC-190).  
 No significant difference between SOC categories (Pearson's  $\chi^2$  test)

group. Table 5 shows the distribution of SOC I or II applicants in each obesity category by MetS status. Proportions of visceral obesity were 100% and 94.7% for MetS and pre-MetS applicants, respectively, and the combined proportion of potential and visceral obesity was 57.0% in non-MetS applicants.

#### IV. Discussion

In this study, we found that health counseling applicants were more interested in lifestyle modification than non-applicants. Indeed, proportions of participants in SOC I, II, and III were 27%, 44%, and 29%, respectively, and proportions of health counseling applicants in SOC I, II, and III were 14%, 53%, and 34%, respectively. Compared to all participants, the

Table 5. Metabolic syndrome (MetS) classifications and obesity categories based on waist circumference (WC) and visceral fat levels (VFLs) in health counseling applicants in stage of change (SOC) I or II.

Obesity category	MetS (14.9%;16/107)	Pre-MetS (17.8%;19/107)	Non-MetS (67.3%;72/107)
Non-obesity group (27.1%;29/107)	0% (0/16)	0% (0/19)*	40.3% (29/72)*
Apparent obesity group (2.8%;3/107)	0% (0/16)	5.3% (1/19)*	2.8% (2/72)*
Potential obesity group (28.0%;30/107)	0% (0/16)	0% (0/19)*	41.7% (30/72)*
Visceral obesity group (42.1%;45/107)	100% (16/16)	94.7% (18/19)*	15.3% (11/72)*

SOC I: precontemplation, SOC II: contemplation and preparation  
 MetS and pre-MetS were diagnosed using criteria established by the Medicine Committee of the Japanese Association of Medical Science. Participants were divided into non-obesity (WC <85 cm and VFLs <10), apparent obesity (WC ≥85 cm and VFLs <10), potential obesity (WC <85 cm and VFLs ≥10), and visceral obesity (WC ≥85 cm and VFLs ≥10) groups. VFLs were measured by bioelectrical impedance analysis using a Body Composition Analyzer (MC-190).

\*p<0.01 between MetS categories vs MetS (Pearson's  $\chi^2$  test)

proportion of health counseling applicants in SOC I was lower, but higher in SOC II and SOC III. The combined percentage of MetS and pre-MetS was 37% in health counseling applicants. In our 2009 and 2010 surveys of all employees undergoing MRHCs, this percentage was over 40% in men aged  $\geq 40$  years (Hayashi et al., 2012). This suggests that those who requested health counseling are concerned with lifestyle behaviors, but have yet to adequately improve their health. The combined percentage of MetS and pre-MetS was 18.2% in SOC I, 36.4% in SOC II, and 45.4% in SOC III. In the 2009 national survey, proportions of participants aged  $\geq 40$  years with MetS or pre-MetS who requested health counseling were  $>20\%$  in SOC I and  $>50\%$  in SOC II and III (Ministry of Health, Labor, and Welfare, 2009). The prevalence of MetS in employees of our university was lower than the national level in our previous study, suggesting that participants of the present study had better health status compared to the national average (Hayashi et al., 2011). More than half of SOC III participants had no MetS or pre-MetS, and the rest were already in the action or maintenance stage in the transtheoretical model of behavioral change, suggesting that counseling should be prioritized for applicants with MetS or pre-MetS in SOC I and II. Excessive intervention reportedly can have adverse effects, thus an appropriate length of intervention should be determined (Fukumoto et al., 2011). Furthermore, from a practical standpoint, the frequency of health counseling sessions should be kept to a minimum in order to minimize absence from work (Munakata et al., 2008). Proportions of participants in potential obesity categories were about 30%. It has been reported that proportions of those with WC  $<85$  cm and VFA determined by CT  $\geq 100$  cm<sup>2</sup> among healthy Japanese men aged

$>20$  years during a complete medical checkup were 20.2% (Sato et al., 2008) and 25.7% (Ohmachi et al., 2010), respectively. The higher potential obesity rate in the present study compared to previous reports likely reflects the older age of our study population (age  $\geq 40$  years). A quarter of SOC I and half of SOC II and III participants in the visceral obesity group may have been aware of abdominal obesity. Half of SOC I participants and a quarter of SOC II participants in the potential obesity group were in precontemplation, presumably because they were unaware of excess visceral fat accumulation. Most health counseling applicants with MetS and pre-MetS had visceral obesity and the combined percentage of potential and visceral obesity was nearly 60% in non-MetS participants in SOC I and II. These results suggest that excess visceral adiposity was present in most MetS and pre-MetS participants, and in the majority of non-MetS participants as well. While health intervention should be preferentially provided to established MetS applicants, it should also be provided to applicants with pre-morbid conditions such as pre-MetS, pre-hypertension, or pre-diabetes (Petrella et al., 2013, Sakane et al., 2013).

### Limitations

Participants of the present study were university employees who had a higher health status than the national average. Furthermore, only 41% (328/792) of the eligible population participated, and participation was limited to those who agreed to the body composition analysis. Participants may thus have been more health-conscious than non-participants, leading to selection bias. Therefore, findings of this study may not be directly applicable to the general population.

## V. Conclusion

Levels of counseling were stratified by only criteria of MRHC. However, evaluation for pre-morbid conditions including pre-MetS and potential visceral adiposity is also important for preventive health in addition to application and SOC. Therefore, candidates for health counseling should be efficiently selected for based on a comprehensive assessment of essential factors.

## Conflict of interest

The authors declare no conflict of interest.

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