Original

Comparison of the Prevalence of Metabolic Syndrome, Related Clinical Data, and Subcutaneous and Visceral Fat Parameters Based on Japanese and International Criteria

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Abstract

In 2005, a committee of the Japanese Association of Medical Sciences (JAMS) defined specific metabolic syndrome (MetS) criteria for which waist circumference (WC) is an obligatory component. Harmonized international criteria (HIC) were recently proposed in 2009. The present study, conducted at a private university in Osaka, Japan in 2011, compared HIC and JAMS criteria and estimated adiposity volume using bioelectrical impedance analysis. Prevalence of MetS based on HIC was significantly higher than prevalence based on JAMS criteria, and pre-MetS was lower in men ≥40 years. The majority of No MetS/pre-MetS cases were classified by both criteria. Fasting plasma glucose (FPG) cutoff values contributed to differences in the prevalence of MetS and pre-MetS. FPG < the cutoff value was present in 40% and 80% of MetS and pre-MetS determinations from both criteria, respectively. Thus, weather WC is an obligatory component also a contributing factor to these differences. Although JAMS criteria preferentially selected MetS from non-No MetS/pre-MetS participants, it should be noted that nearly half of individuals classified as pre-MetS using JAMS criteria were classified as MetS using HIC. Excess visceral adiposity was present in the majority of MetS and pre-MetS cases and more than half of No MetS/pre-MetS cases. Health improvements should also be promoted in apparently healthy individuals with potential visceral adiposity.

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—Key words—

metabolic syndrome, criteria, comparison, visceral adiposity

Introduction

Various diagnostic metabolic syndrome (MetS) criteria have been proposed by different organizations in the past decade. The most widely used criteria to diagnose MetS were established by the International Diabetes Federation (IDF), the United States Adult Treatment Panel III of the National Cholesterol Education Program (ATPIII) and the American Heart Association/National Heart, Lung and Blood Institute (AHA)[1)~3)]. IDF criteria place more emphasis on waist circumference (WC). The prevalence of MetS, cardiovascular events and related complications have been compared using different definitions in several developed countries[4)~6)]. However, understanding the clinical indicators and prognosis of MetS is increasingly difficult due to inconsistent results.

There have been several attempts to unify criteria between major organizations[7)]. Harmonized international criteria (HIC) were recently proposed in 2009. WC is not an obligatory component of the HIC. National or regional WC cutoff values can be used for international comparative research[8)]. These criteria have recently been applied in developing countries without original standards, and HIC have been re-evaluated in several countries[9)~11)]. A committee of the Japanese Association of Medical Sciences (JAMS) defined WC as an obliga-

tory component in criteria specific to the Japanese population in 2005[12]. Because MetS is becoming a worldwide epidemic in developed and developing countries[13)~15)], it is necessary to consider the issue from an international perspective. There are several comparative reports based on JAMS and other criteria, such as AIP III and HIC, within Japanese populations[16)17)]. While WC could continue to be a useful preliminary screening tool, WC and BMI do not necessarily correlate with visceral and abdominal adiposity. Internal composition would need to be measured as supplemental information[18)19)].

In this study, we aimed to compare classification results based on HIC and JAMS criteria and estimated adiposity volume in Japanese participants.

Participants and Methods

Participants

Study participants included 502 male employees (<40 years: 174, mean age, 31.5, standard deviation, 5.2; ≥40 years: 328, mean age, 53.8, standard deviation, 8.7) and 382 female employees (<40 years: 160, mean age, 30.8, standard deviation, 5.4; ≥40 years: 222, mean age, 48.8, standard deviation, 6.4) at a private university in Osaka, Japan. Jobs were primarily sedentary. All participants underwent a mandatory routine health checkup (MRHC) after a 12-hour fasting period in October 2011, except for those who had a comprehensive medical examination.

Methods

Clinical data

The following data were collected after a 12-hour 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: analytical chemistry-based enzymatic method), high-density lipoprotein cholesterol (HDL-C, analytical chemistry-based enzymatic method), low-density lipoprotein cholesterol (LDL-C, mg/dL: LDL-C = TG − (HDL-C + TG/5) 20), blood glucose (glucose oxidase method according to the Japan Diabetes Society), HbA1c (%) and blood pressure (mmHg; in accordance with 2009 hypertension treatment guidelines[21)]). Body mass index (BMI, kg/m^2) was also calculated. The minimum WC was measured at the umbilicus to the nearest 0.5 cm at the end of expiration[22)].

MetS diagnosis and group classification

MetS in men was defined using criteria established by a committee of the Japanese Association of Medical Sciences (JAMS), including WC ≥85 cm and the presence of two or more (pre-MetS plus one) of the following parameters: (1) triglycerides (TG) ≥150 mg/dL and/or HDL cholesterol <40 mg/dL, or taking medication for hyperlipidemia; (2) systolic BP (SyP) ≥130 mmHg, diastolic BP (DiP) ≥85 mmHg or taking medication for hypertension; and (3) fasting plasma glucose (FPG) levels of ≥110 mg/dL or treatment for diabetes mellitus[12]. Table 1 shows HIC for clinical diagnosis of MetS. Although it is not an obligatory component, WC should continue to be a useful preliminary screening tool. Three or more abnormal findings out of five qualify a diagnosis of MetS. A single set of cutoff points are used for all components except WC, for which national or regional cutoff points can be used. Recommended WC thresholds for abdominal obesity in the Japanese population were applied based on JAMS criteria[8)]. In this study, two abnormal findings out of five indicated pre-MetS for comparison with JAMS criteria.

Participants were categorized as MetS, pre-MetS or No MetS/pre-MetS based on HIC and JAMS criteria according to medical checkup data and medications prescribed for lifestyle-related diseases, such as hypertension, diabetes mellitus (DM) and hyperlipidemia. The prevalence of MetS, pre-MetS or No MetS/pre-MetS was evaluated by gender and age (<40 or ≥40 years).

Body composition

Visceral fat levels (VFLs) and trunk fat volume (TFV) (kg) were measured by bioelectrical impedance analysis (BIA) using the Body Composition Analyzer, MC-190 (Tanita Corp., Tokyo, Japan). Recommended BIA conditions were explained to each participant, and the following instructions were provided: (1) fast for four hours, with no alcohol consumption eight hours prior to measurements; (2) empty bladder prior to measure-

Table 1 Harmonized international criteria for clinical diagnosis of metabolic syndrome

Measure	Categorical cutoff points
Elevated waist circumference	Population- and country-specific definitions
Elevated triglycerides (medication to treat elevated triglycerides is an alternate indicator)	≥150 mg/dL
Reduced HDL cholesterol (medication to treat reduced HDL cholesterol is an alternate indicator)	<40 mg/dL for men and <50 mg/dL for women
Elevated blood pressure (medication to treat elevated blood pressure is an alternate indicator)	Systolic ≥130 mmHg and/or diastolic ≥85 mmHg
Elevated fasting glucose (medication to treat elevated glucose is an alternate indicator)	≥100 mg/dL

Alberti et al., Circulation. 120: 1640-52, 2009.

ments and (3) no exercise eight hours prior to measurements[23]. Participants were instructed to stand and grasp a footplate and handgrip electrodes. Electrodes emitted current distally through the feet and hands, which was detected at the heels and palms. The Body Composition Analyzer applies electricity at frequencies of 5, 50, 250 and 500 kHz through the body. Whole body impedance was measured using a bilateral foot-hand electrical pathway. The 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 converted to visceral fat area (VFA). For example, level 10 is equivalent to a VFA of 100 cm^2. According to Japanese diagnostic criteria for MetS, a WC of 85 cm in men and 90 cm in women is equivalent to a VFA of 100 cm^2 as determined by computed tomography (CT)[24].

Classification of WC and VFL groups

Participants were categorized into the following groups: normal (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). The proportion of men ≥40 years in these groups was calculated based on HIC and JAMS criteria.

Statistical analysis

The proportion of participants classified by HIC and JAMS criteria as MetS, pre-MetS or No MetS/pre-MetS was compared for each gender and age group. Because the number of MetS determinations in men and women <40 years was low, analyses were conducted in men ≥40 years. FPG cutoff values in HIC and JAMS criteria are 100 and 110 mg/dL, respectively.

Prevalence of MetS classifications which were with two cutoff values or more were calculated. Those with the below values were also calculated. Prevalence percentages based on HIC were calculated for MetS, pre-MetS or No MetS/pre-MetS as defined by JAMS criteria.

MetS and pre-MetS in JAMS were included as MetS in HIC. Clinical data were compared between MetS and pre-MetS based on HIC and pre-MetS based on JAMS criteria in men ≥40 years. WC, BMI, VFLs and TFV were compared for MetS, pre-MetS and No MetS/pre-MetS based on HIC and JAMS criteria in men ≥40 years. Differences between groups were examined using Student's unpaired t-test or Tukey's HSD test for continuous variables and Pearson's χ^2 test for categorical variables.

Statistical analysis was performed using SPSS® 12.0 J software (SPSS Inc., Chicago, IL), with significance set at $P<0.05$. This study was approved by the Ethics Committee of Osaka Medical College (No. 679). Written and oral explanations were provided, and informed consent was obtained from each participant. Anonymity was ensured to protect personal information[25].

Results

Table 2 shows the prevalence of MetS, pre-MetS and No MetS/pre-MetS based on both criteria by gender and age group. A total of 17.7% and 20.1% men ≥40 years were classified as MetS and pre-MetS using JAMS criteria and 27.1% and 11.9% using HIC, respectively. Although there were no differences between No MetS/pre-MetS, prevalence of MetS based on HIC was significantly higher and pre-MetS was lower than that based

Table 2 Prevalence of MetS based on JAMS criteria and HIC in employees at a university in Osaka, Japan following a mandatory routine health checkup in 2011.

Gender, years	JAMS criteria (2005)			HIC (Alberti et al., 2009)		
	MetS	pre-MetS	No MetS/pre-MetS	MetS	pre-MetS	No MetS/pre-MetS
Men, <40 (174)	3.4% (6)	12.6% (22)	83.9% (146)	4.0% (7)	13.8% (24)	82.2% (143)
Men, ≥40 (328)	17.7% (58)	20.1% (66)	62.2% (204)	27.1% (89)	11.9% (39)	61.0% (200)
Women, <40 (160)	0% (0)	0.6% (1)	99.4% (159)	0% (0)	0.6% (1)	99.4% (159)
Women, ≥40 (222)	0.5% (1)	1.4% (3)	98.2% (218)	1.8% (4)	1.4% (3)	96.8% (215)

MetS (Metabolic syndrome), JAMS (Japanese Association of Medical Sciences committee), HIC (Harmonized international criteria) Men aged ≥40 years, $p<0.01$ between both criteria by $\chi 2$ test

Table 3 Prevalence of MetS, pre-MetS and No MetS/pre-MetS using two cut-off levels of FPG according to JAMS criteria and HIC in 328 men aged ≥40 years.

	MetS		pre-MetS		No MetS/pre-MetS	
	JAMS	HIC	JAMS	HIC	JAMS	HIC
FPG (mg/dL)	100% (58)	100% (89)	100% (66)	100% (39)	100% (204)	100% (200)
≥100	70.7% (41)	61.8% (55)	24.2% (16)	15.4% (6)	18.6% (38)	17.0% (34)
≥110	51.7% (30)	33.7% (30)	3.0% (2)	5.1% (2)	6.9% (14)	7.0% (14)
<100	29.3% (17)	38.2% (34)	75.8% (50)	84.6% (33)	81.4% (166)	83.0% (166)
<110	48.3% (28)	66.3% (59)	97.0% (64)	94.9% (37)	93.1% (190)	93.0% (186)

Upper two rows indicates the prevalence of MetS classifications with cut-off values or more. Lower two rows indicated those with the below values. MetS (Metabolic Syndrome), FPG (fasting plasma glucose), JAMS (Japanese Association of Medical Sciences committee), HIC (Harmonized International Criteria)

Table 4 Percentage of prevalence based on HIC in MetS, pre-MetS and No MetS/pre-MetS classified by JAMS criteria in 328 men aged ≥40 years.

HIC	JAMS criteria		
	MetS (58)	pre-MetS (66)	No MetS/pre-MetS (204)
MetS	100% (58)	47% (31)	0% (0)
pre-MetS	0% (0)	53% (35)	2% (4)
No MetS/pre-MetS	0% (0)	0% (0)	98% (200)

HIC (Harmonized international criteria), JAMS (Japanese Association of Medical Sciences committee), MetS (Metabolic syndrome)

on JAMS criteria. There were no differences in classification between men and women <40 years.

Table 3 shows prevalence of MetS classifications which were with two cutoff values or more of FPG in men ≥40 years.

We observed 19%, 21.2% and 11.7% increases in MetS, pre-MetS and No MetS/pre-MetS, respectively, applying JAMS criteria to participants with FPG ≥100 compared to ≥110 mg/dL. We also observed 28.1%, 10.3% and 10.0% increases in MetS, pre-MetS and No MetS/pre-MetS, respectively, applying HIC among participants with FPG ≥100 compared to ≥110 mg/dL. It also shows those with the below values were also calculated. There was a 48.3% in MetS and 97.0% in pre-MetS using JAMS criteria in participants with FPG <110 mg/dL. There was a 38.2% in MetS and 84.6% in pre-MetS and using HIC in participants with FPG <100 mg/dL, respectively.

Table 4 shows prevalence percentages based on HIC in MetS classifications by JAMS criteria in men ≥40 years. There was 100% agreement between HIC and JAMS criteria regarding classification of MetS. A total of 47% and 53% of pre-MetS classifications based on JAMS criteria were classified as MetS and pre-MetS, respectively, by HIC. A total of 2% of No MetS/pre-MetS cases determined by JAMS were classified as pre-MetS by HIC.

Table 5 Clinical data and body composition between MetS and pre-MetS based on HIC in men aged ≥40 years classified as pre-MetS according to JAMS criteria.

HIC (N)	Age (yrs.)	WC (cm)	BMI (kg/m^2)	VFL	TFV (kg)	SyP (mmHg)	DiP (mmHg)	FPG (mg/dL)	HbA1C (%)	TG (mg/dL)	HDL-C (mg/dL)
MetS (31)	56.4±8.1	90.6±4.2	25.7±1.8	13.5±1.8	9.9±2.3	137±17	87.2±11	96.1±8.3	5.22±0.31	114±45	54.3±14
pre-MetS (35)	55.9±9.0	90.7±5.3	25.4±2.6	13.2±2.3	9.6±2.7	137±16	86.8±9.3	91.8±9.5	5.19±0.38	131±94	54.8±11

MetS (Metabolic syndrome), HIC (Harmonized international criteria), JAMS (Japanese Association of Medical Sciences committee), WC (Waist circumference), BMI (Body mass index), VFL (Visceral fat level), TFV (Trunk fat volume), SyP (Systolic pressure), DiP (Diastolic pressure), FPB (Fasting plasma glucose), HbA1c (Hemoglobin A1c), TG (Triglyceride), HDL-C (High density lipoprotein), Mean±SD, MetS vs. pre-MetS not significant by t-test

Table 6 Adiposity parameters according to JAMS criteria and HIC in 328 men aged ≥40 years.

Parameters	JAMS criteria (N)			HIC (N)		
	MetS (58)	pre-MetS (66)	No MetS/pre-MetS (204)	MetS (89)	pre-MetS (39)	No MetS/pre-MetS (200)
WC (cm)	94.7±6.7#	90.7±4.7	80.9±6.1	93.2±6.2	90.8±5.2	80.7±5.9
BMI (kg/m^2)	26.9±2.8#	25.6±2.2	22.5±2.2	26.5±2.6*	25.4±2.5	22.5±2.1
VFL	14.2±2.5	13.3±2.1	9.6±2.7	14.0±2.3	13.2±2.3	9.6±2.6
TFV (kg)	11.3±2.9*	9.6±2.5	6.5±2.4	10.8±2.8*	9.6±2.6	6.4±2.4

JAMS (Japanese Association of Medical Sciences committee), HIC (Harmonized international criteria), MetS (Metabolic syndrome), WC (Waist circumference), BMI (Body mass index), VFL (Visceral fat level), TFV (Trunk fat volume)
Mean±SD, MetS vs. No MetS/pre-MetS and pre-MetS vs. No MetS/pre-MetS, $p<0.01$; MetS vs. pre-MetS, *$p<0.05$, #$p<0.01$ in both criteria by Tukey's HSD

Table 7 Proportion of participants in four obesity groups according to JAMS criteria and HIC in 328 men aged ≥40 years.

Group	JAMS criteria (N)			HIC (N)		
	MetS (58)	pre-MetS (66)	No MetS/pre-MetS (204)	MetS (89)	pre-MetS (39)	No MetS/pre-MetS (200)
Visceral obesity	94.8% (55)	97.0% (64)	13.2% (27)	96.6% (86)	94.9% (37)	11.5% (23)
Potential obesity	0% (0)	0% (0)	42.2% (86)	0% (0)	0% (0)	43.0% (86)
Apparent obesity	5.2% (3)	3.0% (2)	1.0% (2)	3.4% (3)	5.1% (2)	1.0% (2)
Normal	0% (0)	0% (0)	43.6% (89)	0% (0)	0% (0)	44.5% (89)

JAMS (Japanese Association of Medical Sciences committee), HIC (Harmonized international criteria), MetS (Metabolic syndrome), WC (Waist circumference), VFL (Visceral fat level), Visceral obesity group (WC ≥85 cm and VFL ≥10), Potential obesity group (WC <85 cm and VFL ≥10), Apparent obesity group (WC ≥85 cm and VFL <10) and Normal group (WC <85 cm and VFL <10)
$p<0.01$ by $\chi 2$ test among the four obesity groups

Table 5 compares clinical data and body composition between individuals classified as MetS and pre-MetS using HIC in men ≥40 years who were classified as pre-MetS according to JAMS criteria. WC, SyP and DiP in both groups were higher than criteria cutoff values. Mean BMI and VFLs were greater than 25 kg/m^2 and 10, respectively. Mean glucose, HbA1c and TG values were less than and HDL-C was greater than cutoff values. There were no significant differences between MetS and pre-MetS classified by HIC in all parameters.

Table 6 compares adiposity parameters between classifications according to JAMS criteria and HIC. Parameter means in MetS and pre-MetS were significantly higher than means in No MetS/pre-MetS based on both criteria. BMI and TFV in MetS were significantly higher than pre-MetS using both criteria. WC in MetS was significantly higher than pre-MetS using JAMS criteria.

Table 7 shows the proportion of participants categorized into four obesity groups according to HIC and JAMS criteria. Visceral obesity exceeded 94% in MetS and pre-MetS using both criteria. Although visceral and potential obesity exceeded 10% and 40%, respectively, in No MetS/pre-MetS using both criteria, values in the normal group were below 45% in No MetS/pre-MetS using both criteria.

Discussion

The prevalence of MetS diagnosed based on HIC was significantly higher and pre-MetS was lower than the prevalence determined using JAMS criteria in men ≥40 years (Table 2). There were no apparent differ-

ences in other gender and age groups. The prevalence of MetS in this study population was significantly lower than previously reported national values in men and women <40 years[26]. Table 3 shows that 28.1% increases in MetS applying HIC and 19% increases in MetS applying JAMS criteria to participants with FPG ≥100 compared to ≥110 mg/dL.

Cutoff values of both criteria contributed to differences in the prevalence of MetS and pre-MetS. Table 3 also shows that 48.3% of the MetS and 97.0% of the pre-MetS participants, as defined by the JAMS criteria, were below the cut-off value (FPG <110 mg/dL). In contrast, 38.2% of the MetS and 84.6% of the pre-MetS as defined by the HIC, were below 100 mg/dL. As such, differences between criteria in MetS classifications could be partially dependent on whether WC is an obligatory component.

FPG levels of 100 mg/dL would likely miss a substantial number of individuals with impaired glucose tolerance without performing an oral glucose-tolerance test[27]. However, HIC could screen for more people with a higher risk of developing type 2 diabetes compared with JAMS criteria.

Table 4 shows that 47% of individuals classified as pre-MetS using JAMS criteria were classified as MetS using HIC. The majority of No MetS/pre-MetS cases were classified by both criteria. JAMS criteria preferentially selected MetS from MetS or pre-MetS participants. Although there is some disagreement regarding the WC cutoff in JAMS criteria[28][29], WC is an obligatory component[30]. Although the No MetS/pre-MetS classifications were compatible between both criteria, pre-MetS and MetS are grouped together by HIC. Several reports have suggested that MetS criteria have limited practical utility as a diagnostic or management tool[31)~34)]. Definitions based on dichotomization and aggregation constitute a fundamental issue because potential information can be lost through two-step transformation[35].

Classification of MetS may be reduced to prognostic value and clinical usefulness[36]. The American Diabetes Association reported that MetS is not a disease, but a cluster of risk factors, and that the original intention of identifying MetS was to increase attention to a specific lifestyle. It was also stressed that MetS was never meant to be used as a predictor of heart disease or diabetes[37]. HIC reportedly did not improve discrimination or risk prediction of cardiovascular disease (CVD) compared with existing definitions, such as those proposed by ATPIII and IDF[38]. In contrast, several reports have suggested that popularization of the MetS concept leads to the detection of more people at high risk for DM and CVD[39]. Clinical emphasis should be placed on effectively treating CVD risk factors[40].

Table 5 shows no significant difference between MetS and pre-MetS classifications using HIC based on all parameters evaluated. WC, blood pressure, BMI and VFLs were higher than cutoff points stated in the criteria. Several components, including WC and blood pressure, were associated with classification. Elevated blood pressure was reported to be significantly associated with a higher rate of all-cause mortality as a MetS parameter in Japanese men. Slight elevation of blood pressure, even in the high-normal range, had detrimental effects on Japanese men with MetS[41]. Discrepancies between the prognosis of individuals with MetS and risk of CVD may be due to alterations in the natural course of MetS by medication or the presence of overt DM. JAMS criteria may be more applicable to the Japanese population than ATP III guidelines for MetS because Japanese people are generally not obese.

This study highlighted the importance of identifying MetS in apparently healthy subjects. Table 6 shows that most adiposity parameters were properly classified using both criteria. Trunk and visceral adiposity were comparably estimated by both criteria. Table 7 shows that visceral obesity was present in more than 94% of MetS and pre-MetS cases and 55% of No MetS/pre-MetS cases using both criteria. Excess visceral adiposity was present in most MetS and pre-MetS cases and more than half of No MetS/pre-MetS cases with both criteria. Accurate quantification of visceral adiposity using sophisticated imaging techniques, such as CT and MRI, is necessary[42)~44)]. However, simpler indices using BIA have also been used as proxies of visceral and total abdominal adipose tissue in large scale surveys because expensive imaging systems are often impractical[45]. BIA is a useful tool for early identification of individuals at risk of developing MetS. Favorable lifestyle changes should be promoted in healthy individuals with potential visceral adiposity.

There are several limitations to this study. First, more women and men aged <40 years should be studied. Populations in other professions and regions should be evaluated because participants in this study were re-

stricted to an urban area and worked at desk jobs. Second, this study measured VFA values by BIA, which is less accurate than CT and MRI. The results of BIA should be evaluated as a complement to WC and BMI[46].

Conclusions

JAMS criteria preferentially selected MetS compared to HIC. There were no apparent differences between MetS and pre-MetS using HIC for all parameters evaluated. FPG and WC cutoff values contributed to differences in prevalence of MetS and pre-MetS. BIA in conjunction with WC and BMI could be a useful tool for early identification of healthy subjects categorized as No MetS/pre-MetS who are at risk of developing MetS.

Conflict of Interest

The authors declare no conflict of interest.

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日本と世界の判定基準によるメタボリックシンドロームの判定結果と内臓・皮下脂肪量等の比較検討

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―キーワード―
メタボリックシンドローム，判定基準，国際間比較，内臓脂肪量

【目的】日本と世界の判定基準によるメタボリックシンドローム（MetS）判定結果および各該当区分における内臓脂肪量等の検査項目を比較し，両基準の結果に及ぼす影響を検討した．

【方法】対象者は大阪府内の某総合大学の 40 歳以上の男性教・職員で，調査項目は平成 23 年度特定健診項目および業務用多周波体組成計による内臓脂肪レベル・体幹部脂肪量（kg）等とした．両基準による判定区分割合および各判定区分における肥満指標等を比較した．さらに内臓脂肪レベルと腹囲の基準により腹部区分し，両基準の判定区分における腹部区分該当者割合を比較した．

【結果】日本の判定基準は世界基準に比し，MetS を少なく，予備群を多く該当した．また日本の判定基準では予備群でも，その約半分は世界基準では MetS に該当した．一方，両判定基準とも“該当しない”は同等であった．両基準において，MetS と予備群間では BMI や体幹部脂肪量に差があった．内臓脂肪量において両基準とも MetS と予備群該当者は殆どが腹囲と内臓脂肪レベルが基準以上であったが，“該当しない”でも，10% 以上が内臓脂肪レベルと腹囲の両方の増加者であった．

【考察】日本の判定基準は世界統一基準より MetS を少なく選出した理由として，血糖値のカットオフ値が高いことが挙げられるが，血糖値のカットオフ値未満が MetS に 40%，予備群に 80% 含まれていたため，腹囲が必須項目であることも関与したと考えられた．また両基準とも MetS および予備群では腹部区分による判定ではほぼ一致し，MetS と予備群の実質的な判別には肥満指標の参考も有用と考えられた．しかし，両基準で“該当しない”と判定される見た目健常者でも潜在的な内臓脂肪量の増加者が少なからず存在していると考えられ，保健対策の必要性が示唆された．

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