Epidemiologic Analysis of Metabolic Syndrome and Chronic Kidney Disease on General Health Examination in Japanese women

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Epidemiologic Analysis of Metabolic Syndrome and Chronic Kidney Disease on General Health Examination in Japanese women

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Abstract

We examined the association between the metabolic syndrome (MetS) and risk for chronic kidney disease (CKD) in subjects who had undergone health examinations twice in two years (2006–2007) at a rural internal medicine clinic. We measured the waist circumference of 391 women aged 50 to 96 and determined MetS and CKD prevalence. MetS was defined according to the Japanese diagnostic criteria. CKD was defined as dipstick proteinuria (≧1+) or estimated glomerular filtration rate (eGFR) less than 60 ml/min/1.73㎡ calculated by the Modification of Diet in Renal Disease (MDRD) formula for three months or more. The prevalences of MetS and CKD were 7.9% and 7.4%, respectively. Prevalence of CKD was significantly greater in subjects with MetS compared with those having no metabolic risk factors (29.0% versus 3.2%; P<0.001). Prevalence of CKD was significantly greater in subjects with visceral obesity plus one metabolic abnormality compared with those having no metabolic risk factors (13.4% versus 3.2%; P<0.001). The mean serum creatinine level was higher among persons with MetS compared with those without visceral obesity (P<0.001). The mean eGRF showed a decreasing trend in subjects with MetS. Prevalence of proteinuria in subjects with MetS was significantly higher that in subjects without MetS (P=0.009). The present study indicated that MetS might be an important factor in the etiology of CKD in Japanese women.

Key Words: metabolic syndrome, chronic kidney disease, medical health checkup

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INTRODUCTION

The prevalence of metabolic disorders such as diabetes and dyslipidemia is increasing in the Japanese elderly population, along with the westernization of lifestyle. Since the proposal of syndrome X [1], metabolic syndrome (MetS) has been highlighted as a clustering of risk factors for cardiovascular disease (CVD) [2-4].

The prevalence of chronic kidney disease (CKD) is also rising; about 20% of the Japanese adult population are predicted to have stage 3 to 5 CKD, which is defined as kidney damage or a glomerular filtration rate (GFR) of less than 60 ml /min per 1.73 m^2 for at least three months regardless of cause [5]. CKD is a major risk factor for end-stage renal disease and cardiovascular disease [6-7]. Cross-sectional studies have demonstrated a link between the MetS and CKD [8-9].

We examined the prevalence of MetS and CKD in women who had undergone a routine medical health checkup at our Internal Medicine clinic. We also investigated the association between the MetS and risk for CKD and proteinuria

SUBJECTS AND METHODS

Subjects and Characteristics

We examined the prevalence of MetS in subjects who had undergone health examinations twice between June 2006 and October 2007 at our Internal Medicine Clinic. We measured the waist circumference of 391 women aged 50 to 96. The age distribution of all subjects is shown in Table 1. If an individual was receiving drug therapy for high BP or diabetes mellitus, each item was recorded as a positive finding regardless of the test data. Subjects with a clinical history of stroke, or myocardial infarction were excluded. Informed consent by word of mouth was obtained from participants.

Table 1 Age distribution of all subjects

Age Range	Subjects
50-59	64
60-69	138
70-79	141
80+	48
Total	391

Measurements

Anthropometric data were obtained from the subjects as height, weight, body mass index (BMI), and waist circumference. The waist circumference was measured horizontally at the level of the umbilicus. Venous blood was drawn in fasting or non-fasting states, using vacutainer tubes for biomedical evaluation. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were taken basically from the upper right arm with the subject sitting in a chair.

A urine test result of (1+) or greater was considered positive for proteinuria and results of (−) or (±) were considered negative for proteiuria. Estimated GFR was calculated using the following equation [10]:

$eGFR = 0.741 \times 175 \times age^{-0.203} \times sCr\,(mg/dl)^{-1.154} \times 0.742$

CKD was defined as a eGFR of less than 60 ml/min/1.73 m^2 or dipstick proteinuria (≧1+) for three months or more regardless of cause [6,11].

Diagnostic criteria of MetS

The diagnostic criteria for MetS used were those of the Japanese Society of Internal Medicine [12-13]. MetS was defined as a waist circumference of at least 90 cm for women, which was considered the essential marker of visceral fat accumulation, as well as at least two of the following three items: 1) HDL cholesterol of less than 40 mg/dl; 2) high BP (SBP of 130 mmHg or more or DBP of 85 mmHg or more); and 3) HbA_{1c} level (5.5 % or above) instead of fasting glucose level [13-14]. We left out the serum triglycerides (TG) and fasting glucose levels from the diagnostic criteria because it is known that serum TG and glucose levels change before and after meals.

Data Analysis

The results are expressed as the mean value ± standard deviation. Differences in the means were evaluated by analysis of variance (ANOVA). Relationships between MetS and CKD or proteinuria were tested using a χ^2-test. Differences

with $p<0.05$ were considered significant.

RESULTS

The mean age of the subjects was 69.2 ± 8.9 years for women. Using the Japanese diagnostic criteria for MetS, we determined the prevalence of MetS (Table 2). The overall prevalence of MetS was 7.9% in women. The prevalence of visceral obesity plus one metabolic abnormality was about twice the prevalence of MetS.

Table 2 shows the difference of BMI, waist circumference, BP, HbA_{1c} and HDL-C levels with visceral obesity, visceral obesity plus one metabolic abnormality, and MetS or without visceral obesity in this population. Systolic and diastolic BP were higher in the MetS and visceral obesity plus one metabolic abnormality groups. The level of HDL-C was significantly lower in the MetS than in the group without visceral obesity (P<0.01). The level of HbA_{1c} was significantly higher in the MetS than in the group without visceral obesity (P<0.001).

The mean serum creatinine level was significantly higher among persons with MetS compared with those without visceral obesity (P< 0.001). The mean eGRF showed a decreasing trend in subjects with MetS. The mean uric acid level showed an increasing trend in subjects with MetS and visceral obesity plus one metabolic abnormality. Prevalence of proteinuria in subjects with MetS was significantly higher that in subjects without visceral obesity (P=0.009; Table 3).

The prevalence of CKD was 7.4% in this study (Fig.1). Prevalence of CKD was significantly greater in subjects with MetS compared with those no metabolic risk factors (29.0% versus 3.2%; P< 0.001). Prevalence of CKD was significantly greater in subjects with visceral obesity plus one

Table 2　Patients profiles in each group

	Non-MetS	Visceral obesity only	Visceral obesity +1 risk factor	MetS
number (%)	281(71.9)	12 (3.1)	67 (17.1)	31 (7.9)
age (years)	68.8±9.0	65.6±7.8	70.4±8.7	72.4±8.7
BMI (kg/m^2)	22.0±2.6	25.9±3.8 ***	26.7±3.1 ***	27.8±2.8***
WC (cm)	80.7±6.2	94.9±5.4 ***	96.3±5.1***	97.2±5.4***
Systolic BP (mm/Hg)	129.7±18.4	119±7.7	143.4±13.8***	137.6±13.1***
Diastolic BP (mm/Hg)	70.4±10.8	69.3±9.4	75.1±11.0**	71.5±11.4*
HbA1c (%)	5.1±0.6	5.0±0.2	5.1±0.3	6.3±1.3***
HDL-C (mg/dl)	60.5±14.7	57.1±12.0	57.9±11.7	51.8±13.2**
Serum Cr (mg/dl)	0.60±0.12	0.58±0.13	0.61±0.15	0.70±0.25***
eGFR ($ml/min/1.73m^2$)	76.6±17.2	80.7±19.8	76.4±20.3	68.6±22.5
Uric Acid (mg/dl)	5.1±4.8	4.7±1.1	5.9±7.3	5.3±1.4

MetS, Metabolic syndrome; BMI, body mass index;　WC, waist circumference; BP, blood pressure; HDL-C, high-density lipoprotein cholesterol; Serum Cr, Serum creatinine; eGFR, estimated glomerular filtration rate; Values are mean±standard deviation. *P<0.05 vs Non-MetS, **P<0.01 vs Non-MetS, ***P<0.001 vs Non-MetS

Table 3　Prevalence of proteinuria in each group

Proteiuria	Non-MetS	Visceral obesity only	Visceral obesity +1 risk factor	MetS
(−)	253 (90.0)	11 (91.7)	52 (77.6)	24 (77.4)
(±)	19 (6.8)	1 (8.3)	10 (14.9)	2 (6.5)
(≧1+)	9 (3.2)	0 (0)	5 (7.5)	5 (16.1)*

(　): percentage of subjects classified into Non-MetS, visceral obesity only, visceral obesity + 1 risk factor, and MetS group. *P=0.009 by χ^2-test

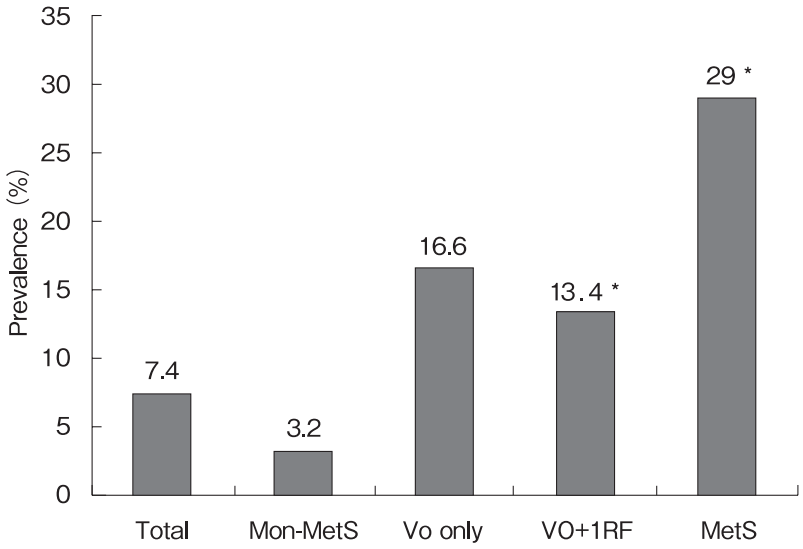

Fig 1 Prevalence of chronic kidney disease (CKD) according to the non-MetS, metabolic syndrome (MetS), visceral obesity (VO) plus one risk factor (RF), and visceral obesity. *P<0.001 by χ^2-test.

metabolic abnormality compared with those having no metabolic risk factors (13.4% versus 3.2%; P< 0.001), but there was no differences from the prevalence of CKD in subjects with visceral obesity only.

DISCUSSION

We previously reported the prevalence of MetS in men and women was 21.2% and 9.9%, respectively, in A city, Japan in 2006[14]. In this study the prevalence of MetS in women was 7.9%. We found that about twice as many people with MetS had visceral obesity and one risk factor in women, indicating a potential for the prevalence of MetS to increase in the future. Another study reported a similar prevalence of MetS in Japanese women [15].

Several previous studies reported on the prevalence of CKD in the general population in Japan. Tanaka [9] et al. reported that the prevalence of CKD in individuals included in a hospital-based registry was 13.7%. The prevalence of CKD in the Japanese general population was predicted to be 18.7% (about 19 million) based on a nationwide epidemiological study in 527,594 individuals aged 20 years and older (211,034 males and 316,560 females) who participated in an annual health examination program conducted in 2000–2004[5]. The prevalence of CKD is higher in the Japanese adult population than in the United States population (about 11%)[16]. The prevalence of CKD seems to have been smaller in this study than in the previous reports. Although the reason for the discrepancy between our results and a nationwide epidemiological study has not been determined, it may be due to the difference of the equation used to evaluate renal function [5,10].

MetS is associated with an increase of CKD in cross-sectional and longitudinal studies in Japan. We examined 391 screened subjects in a cross sectional study in women, and determined that the MetS group and visceral obesity plus one metabolic abnormality group were significantly associated with CKD. Ninomiya et al.[17] followed up 1,440 community-dwelling individuals in the Hisayama Study, Japan, without CKD for 5 years and found that MetS remained an independent risk factor for the occurrence of CKD. This longitudinal study also suggest that MetS is a risk factor for developing CKD in the Japanese.

Additionally, our findings showed that MetS in women using criteria in Japan were associated with proteinuria. Miyatake et al.[18] reported the association of proteinuria with MetS. These studies raise an

important issue about the association of MetS with proteinuria.

There are several mechanisms underlying the effects of MetS on renal function and proteinuria. A clinical study suggested that obesity is associated with renal hyperfiltration and hyperfusion [19]. Previous epidemiological surveys showed that individual components of MetS including glucose intolerance, hypertension, and dyslipidemia could act directly as risk factors for renal damage through renal or systemic atherosclerosis [20-21].

In conclusion, this study showed that MetS was associated with CKD in women. Early detection and treatment of those with MetS are essential to prevent CKD.

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要旨

2006年から2007年度に２回連続して内科医院の健診に参加した住民のメタボリックシンドローム(MetS)と慢性腎臓病（CKD）について調査し，その関連性について検討した．対象は腹囲を測定した50～96歳までの女性391名であった．MetS はわが国の診断基準を用いた．CKD の定義は推定糸球体濾過量（eGFR）が 60 ml/min/1.73㎡以下，あるいは蛋白尿（１＋）以上，またはその組み合わせが３ヵ月以上続いた場合とした．MetS および CKD の頻度はそれぞれ7.9%，7.4%であった．MetS と MetS 予備群（腹部肥満＋危険因子１項目）では CKD の有病率が29%，13.4%と有意に高かった(Non-MetS:3.2%)．腎機能検査では血清クレアチニンが MetS で有意に高値であった．eGFR は MetS で低下傾向を示したが有意な差は認めなかった．また，MetS では蛋白尿の陽性率が有意に高かった．これらの結果，日本人女性における MetS は CKD 発症に関与する重要な因子であることが明らかとなった．

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