Prevalence of Metabolic Syndrome Determined on the Basis of Direct Visceral Fat Area Measurement Using Computed Tomography

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ABSTRACT

Introduction One diagnostic criterion for metabolic syndrome (MS) as a conventional method is the measurement of abdominal circumference size. The aim of this study is to investigate the prevalence of MS precisely based on direct measurement of the visceral fat area (VFA) using computed tomography (CT).

Methods The VFAs were assessed by CT in 470 individuals, including 262 men (aged 47.6±10.2: mean±SD) and 208 women (aged 43.9±8.5) during a 3-year period. Blood pressure, fasting blood glucose, and lipid profiles were also measured. For those who had VFA>or=100cm2, MS was defined as the presence of at least two of the following criteria: a triacylglycerol level>or=150mg/dl, high-density lipoprotein cholesterol level<40mg/dl, blood pressure>or=130/85mmHg, and fasting glucose level>or=110mg/dl.

Results The mean VFA size was 91.6±43.2 in men and 35.5±29.4 in women respectively. 99 (37.8%) of men and 9 (4.3%) of women demonstrated the VFA of>or=100cm2. As a result, 11.1% (29/262) of men and 1.9% (4/208) of women were diagnosed to have MS, which is lower than previously reported in Japan.

Conclusion Our results suggest that prevalence of MS assessed based on the direct measurement of VFA might therefore be lower than previously reported, especially in case of women.

Key Words Metabolic Syndrome, Prevalence, Visceral Fat, Waist Circumference, Computed Tomography

INTRODUCTION

There are some internationally recognized definitions of metabolic syndrome (MS), proposed by the International Diabetes Federation (IDF), National Cholesterol Education Program’s Adult Treatment Panel III (NCEP III) and the World Health Organization (WHO). One diagnostic criterion for MS is the measurement of waist circumference (WC), which is a conventional method; further, the abovementioned organizations have different WC cut-off values. For example, the WC cut-off value stipulated by NCEP III is 102cm and 88cm in men and women, respectively. The Japanese Committee of the Criteria for Metabolic Syndrome (JCCMS) stipulated the WC cut-off value for practical use in Japan in 2005. Currently, the JCCMS has stipulated the WC cut-off value as 85cm and 90cm in men and women, respectively. These cut-off values were defined by considering the abdominal visceral fat area (VFA) to be 100cm². However, few studies have estimated the prevalence of MS on the basis of VFA measurement directly.

The aim of this study is to investigate the prevalence of MS precisely on the basis of direct VFA measurement using computed tomography (CT).

MATERIALS AND METHODS

Subjects

Among Japanese who underwent medical examination consecutively for 3 years (from April 1, 2007 to March 31, 2010) at our institution (Healthcare Center, Shinjuku-oiwake Clinic, Shinjuku-ku, Tokyo, Japan), individuals who also underwent CT for VFA measurement were enrolled in this study. Totally, this study consisted of 470 individuals, including 262 men (aged 26 ~ 72 years) and 208 women (aged 25 ~ 70 years).

The present study was conducted in accordance with the ethical principles, and each participant was fully respected and security of personal information was provided to participants.

Measurement

The blood pressure (BP) was measured using an automatic BP monitor after the individual had rested for at least 5 minutes. Blood was drawn for measuring fasting blood glucose and lipid profiles. CT for VFA and subcutaneous fat area (SFA) measurement was performed at the level of the navel (ROBUSTO; Hitachi, Tokyo, Japan). The WC was also measured at the naval in these individuals.

For those who had VFA>or=100cm², MS was defined as the presence of at least two of the following JCCMS criteria: a triacylglycerol level>or=150mg/dl, high-density lipoprotein cholesterol level<40mg/dl, blood pressure>or=130/85mmHg, and fasting glucose level>or=110mg/dl.

RESULTS

Characteristics of the study subjects were shown in Table 1. Out of 262 men, 99 (37.8%) demonstrated a VFA of>or=100cm², whereas out of 208 women, only 9 (4.3%) had a VFA of>or=100cm² (Fig. 1). Among the individuals who had a VFA of>or=100cm², 29 (11.1%) men and 4 (1.9%) women were diagnosed with MS (Fig. 2a); this figure is lower...
than that previously reported in Japan. On the other hand, 120 (45.8%) out of 262 men and 13 (6.3%) out of 208 women showed a WC of $\geq 85 \text{cm}^2$ and $\geq 90 \text{cm}^2$, respectively (data not shown). According to the WC criteria, the prevalence of MS is 12.2% (32/262) in men, and 2.4% (5/208) in women (Fig. 2b). We also found that most of individuals diagnosed with MS were older than 40 years (30/33), and a few individuals diagnosed with MS were under 39 years (3/33). MS prevalence between these 2 groups was compared, and is shown in Fig. 3. We also investigated the correlation between VFA and WC in each group (Fig. 4a and 4b). There are linear correlations between VFA and WC in each group.

**DISCUSSION**

Abdominal fat distribution is associated with a number of cardiovascular risk factors and insulin resistance. MS is considered an important public health problem, and excess
VFA (>or=100cm²) is essential for determining the presence of MS. [11],[12] In clinical practice, measurement of WC in order to estimate the VFA may be useful for determining the prevalence of MS. [13] The current cut-off value stipulated by the JCCMS for WC in men and women is 85cm and 90cm, this cut-off value was determined by considering the VFA to be 100cm². Measurement of WC is simple and effective, however, false positive and false negative cases are included.[14] In addition, a different cut-off value is necessary for adequately reflecting the prevalence of MS in different populations (e.g., race and sex).[15]-[21]

The purpose of the present study is to investigate the prevalence of MS precisely on the basis of direct VFA measurement using CT. As shown in Table 1, the mean VFA in women (35.5cm²) is smaller than that in men (91.6cm²), and only 4.3% of the women showed a VFA>or=100cm². Finally, 11.1% of the men and 1.9% of the women were diagnosed to have MS by CT-based analysis. Thus, we found that the prevalence of MS is lower than that described in previous reports on studies conducted in Japan.[18],[22] We wonder why the prevalence of MS is low compared to that recorded in previous data. In fact, this study population consisted of healthy urban Japanese individuals who live around Tokyo, and underwent a medical check-up consecutively. Moreover, the average age in this population is higher than 40 years (mean age; 46.0±9.7 years), which is not so different from previous studies [8],[18],[22]. Therefore, we consider that the eligible population in our study is not uncommon (e.g., average age, consecutive sample, and race). Most of previous Japanese studies did not investigate the WC size with the directly measured VFA using CT.
scan. Whereas, in the present study, both WC and VFA for MS prevalence were measured, and we showed the MS prevalence based on the VFA measurement is slight low compared to that of WC measurement (Fig. 2a and 2b). Our result suggests that previous studies based on the WC measurement contain a few false positive samples and might cause discrepancy from our current result. It seems that the abdominal visceral fat in Japanese individuals may be less than that expected to trigger a low risk of cardiovascular disorder and may contribute to a long-term life of Japanese people, especially in the case of women.

In this study, we also found that the mean VFA in women is much smaller than that in men; nevertheless, the mean SFA is almost equivalent in each group (135.5 in men vs. 141.4 in women). From our data, it seems that the difference in WC between men and women reflects the difference in VFA itself. From this point of view and the correlation shown in Fig. 4a and 4b, it seems that the WC currently stipulated by JCCMS for men and women (85cm and 90cm) is reasonable when the WC cut-off value was determined considering the VFA to be 100cm², although previous Japanese studies have recommended low WC cut-off value for women. [6][20][21][24]

Finally, the prevalence of MS determined on the basis of the diagnostic criterion of VFA measurement may therefore be lower than that previously reported, although further studies confirming of this finding are needed.

CONCLUSION

The result suggests that the prevalence of MS determined on the basis of direct VFA measurement by CT is lower than that in previous reports, especially in the case of women.

The summary of the current study was presented at the 24th Annual Meeting of the International Health Evaluation and Promotion Association (IHEPA) in Honolulu, Hawaii, USA on February 11 and 12, 2011.

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REFERENCES


