Reduction of visceral fat is associated with decrease in the number of metabolic risk factors in Japanese men

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Yukiyoshi Okauchi, MD¹, Hitoshi Nishizawa, MD³, Tohru Funahashi, MD¹, Tomoko Ogawa, RN², Midori Noguchi, RN², Miwa Ryo, MD¹, Shinji Kihara, MD¹, Hiromi Iwahashi, MD¹, Kazuya Yamagata, MD¹, Tadashi Nakamura, MD¹, Ichiro Shimomura, MD¹, Yuji Matsuzawa, MD³

¹Metabolic Medicine, Graduate School of Medicine, Osaka University, Suita, Japan
²Amagasaki City Office, Hyogo, Japan
³Sumitomo Hospital, Osaka, Japan.

Reduction of visceral fat and metabolic risk factors

Corresponding author:
Hitoshi Nishizawa,
Email: hitoshin@imed2.med.osaka-u.ac.jp
Visceral fat accumulation is associated with the development of metabolic disorders such as glucose intolerance, dyslipidemia, hypertension, and atherosclerotic cardiovascular diseases (1-8). However, the relationship between reduction of visceral fat and decrease in the number of metabolic risk factors has not been defined in general population. Recently, we developed a new technique, the abdominal bioelectrical impedance analysis (BIA), to evaluate visceral fat area (VFA) (9). The aim of this study was to investigate whether reduction of visceral fat, estimated by the BIA, is associated with a decrease in the number of metabolic risk factors.

Research Design and Methods
The study group comprised 2,336 Japanese men (age: 48.0±10.5 years, BMI 24.2±2.9 kg/m², mean ±SD), who were employees of Amagasaki city office, an urban area, and had undergone annual health check-up both in 2004 and 2005. After the health check-up, the medical staff provided risk factor-oriented, rather than obesity-oriented, health promotion programs to selected individuals with visceral fat accumulation and multiple risk factors, with the aim of encouraging a scientific understanding of the spectrum of metabolic syndrome from visceral fat accumulation to atherosclerotic cardiovascular diseases. In this study, we used VFA estimated by the BIA, which was shown to correlate significantly with VFA determined by computed tomography (9). The measurement of VFA by BIA complied with the Guidelines of the Ethical Committees of Osaka University. Informed consent was obtained from all subjects.

Overall obesity was defined as BMI of ≥25 kg/m² (10). We investigated the presence of three metabolic risk factors; elevated blood pressure (systolic BP ≥130 mmHg and/or diastolic BP ≥85 mmHg), dyslipidemia, and dysglycemia/impaired glucose tolerance (IGT). Dyslipidemia represented hypertriglyceridemia [fasting or postprandial triglyceride of ≥1.69 or 2.27 mmol/l (11, 12), respectively, and/or low HDL cholesterol (HDL cholesterol <1.04 mmol/l)]. Dysglycemia/IGT represented hyperglycemia [fasting or postprandial serum glucose concentration of ≥6.1 or ≥7.77 mmol/l (13), respectively]. Subjects who received specific treatment(s) for each of the metabolic risk factors were considered positive for that factor.

Statistical Analysis; Fischer’s PLSD test and Kruskal-Wallis test were used to analyze relationship between the number of metabolic risk factors and body fat distribution, and that between change in the number of metabolic risk factors and change in VFA, respectively. Significant level was set at p <0.05.

Results
BMI and VFA varied considerably among individuals. We divided subjects into two groups according to BMI and into two groups according to VFA (Fig. 1a). Visceral fat accumulation was defined as VFA of ≥100 cm² (10, 14). Among 1,497 non-obese subjects (BMI <25), 401 (26.8%) had visceral fat accumulation. The mean number of metabolic risk factors in subjects with VFA ≥100 cm² was significantly higher than in those with VFA <100 cm², irrespective of BMI. Importantly, the mean number of metabolic risks was significantly higher in subjects with VFA ≥100 cm² plus BMI<25 kg/m², than in those with VFA <100 cm² plus BMI ≥25 kg/m² (p<0.0001, Fig. 1a). These results suggest that assessment of visceral fat accumulation is important to identify subjects with multiple risk factors.

Next, we investigated the correlation between one-year change in VFA (∆VFA) and change in the number of metabolic risk factors (∆n) within the same period in the 2,336 subjects. VFA decreased within one year in 53.1% (1,241/2,336), increased in 33.2% (776/2,336), and did not change in 13.7%
We divided these subjects into six bins of ∆VFA (every 15 cm²). ∆VFA correlated significantly with ∆n (p<0.0001, Fig. 1b). When the subjects who received new treatment after 2004 were excluded from the analysis, reduction of visceral fat was also associated with a significant decrease in the number of metabolic risk factors (p<0.0001, data not shown).

Conclusion
We demonstrated that 1) irrespective of BMI (< or ≥25 kg/m²), subjects with visceral fat accumulation estimated by BIA had a cluster of metabolic risk factors and 2) falls in VFA within one year were associated with a significant decrease in the number of metabolic risk factors.

Importantly, our results also demonstrated that subjects with visceral fat accumulation but without overall obesity (VFA ≥100 cm² plus BMI <25 kg/m²) exhibited significantly more metabolic risk factors than overall obese subjects without visceral fat accumulation (VFA <100 cm² plus BMI ≥25 kg/m²). There is ample evidence for the role of visceral fat accumulation in the development of metabolic disorders (4-8, 15). Collectively, the above results indicate that assessment of visceral fat accumulation using VFA estimated by BIA is useful for identifying high-risk group for atherosclerotic cardiovascular diseases.

Our results also demonstrated in a large population sample that changes in VFA within one year correlated significantly with ∆n. Several reports demonstrated in obese subjects that reduction of visceral fat correlated with improvement in glucose and lipid metabolism (16-19). However, there is little information on the effect of reduction of visceral fat on the number of metabolic risk factors in a large general population sample. Here we showed in 2,336 subjects that changes in VFA within one year correlated significantly with changes in the number of metabolic risk factors. These results suggest that intervention strategies directed towards reduction of visceral fat could result in reduction or disappearance of risks for atherosclerotic cardiovascular diseases. Since BIA is quite simple and noninvasive for evaluation of visceral fat amount, it could be used in routine clinical practice and large-scale studies for assessment of visceral fat accumulation.

In conclusion, we demonstrated that reduction of visceral fat was closely associated with a decrease in the number of metabolic risk factors in Japanese men.
References


Figure 1

a) **Relationship between number of metabolic risk factors and body fat distribution.** Subjects were divided according to their BMI (cutoff value 25 kg/m\(^2\)) and VFA (cutoff value 100 cm\(^2\)) measured in 2004. Data are mean ± SEM.

b) **Correlation between changes in VFA and changes in the number of metabolic risk factors.** ∆number of metabolic risk factors represents changes in the number of metabolic risk factors from 2004 to 2005. ∆VFA indicates change in VFA from 2004 to 2005. Subjects were divided into six 15 cm\(^2\)-bins of ∆VFA. Data are mean ± SEM.