Reduction of Visceral Fat Is Associated With Decrease in the Number of Metabolic Risk Factors in Japanese Men

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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 the 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 (aged mean ± SD 48.0 ± 10.5 years, BMI 24.2 ± 2.9 kg/m^2), who were employees of Amagasaki City Office, an urban area, and had undergone annual health check-ups in both 2004 and 2005. After the health check-up, the medical staff provided risk factor–oriented, rather than obesity-oriented, health promotion programs to select 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/m^2 (10). We investigated the presence of three metabolic risk factors: elevated blood pressure (systolic blood pressure ≥130 mmHg and/or diastolic blood pressure ≥85 mmHg), dyslipidemia, and dysglycemia/impaired glucose tolerance. 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/impaired glucose tolerance 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 protected least significant difference test and Kruskal-Wallis were used to analyze the relationship between the number of metabolic risk factors and body fat distribution and between change in the number of metabolic risk factors and change in VFA, respectively. Significance 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. 1*A*). Visceral fat accumulation was defined as VFA of ≥100 cm^2 (10,14). Among 1,497 nonobese subjects (BMI <25 kg/m^2), 401 (26.8%) had visceral fat accumulation. The mean number of metabolic risk factors in subjects with VFA ≥100 cm^2 was significantly higher than in those with VFA <100 cm^2, irrespective of BMI. Importantly, the mean number of metabolic risks was significantly higher in subjects with VFA ≥100 cm^2 plus BMI <25 kg/m^2 than in those with VFA <100 cm^2 plus BMI ≥25 kg/m^2 ($P < 0.0001$) (Fig. 1*A*). These results suggest that assessment of visceral fat accumulation is important in identifying subjects with multiple risk factors.

Next, we investigated the correlation between a 1-year change in VFA (ΔVFA) and change in the number of metabolic risk factors (Δn) within the same period in the 2,336 subjects. VFA decreased within 1 year in 53.1% (1,241 of 2,336) of participants, increased in 33.2% (776 of 2,336), and did not change in 13.7% (319 of 2,336).

We divided these subjects into six bins of ΔVFA (every 15 cm^2). ΔVFA correlated significantly with Δn ($P < 0.0001$) (Fig. 1*B*). 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).

CONCLUSIONS

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

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Abbreviations: BIA, bioelectrical impedance analysis; VFA, visceral fat area.

A table elsewhere in this issue shows conventional and Système International (SI) units and conversion factors for many substances.

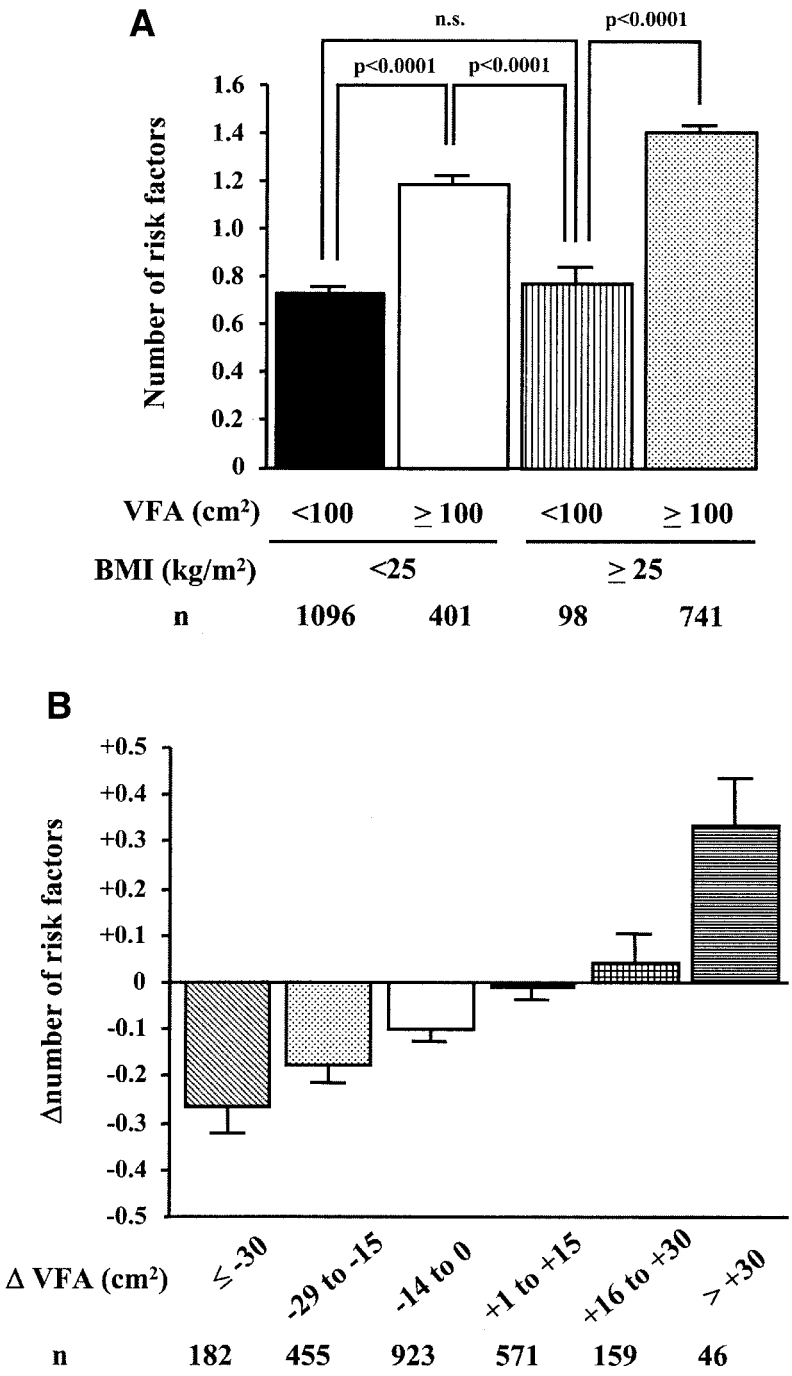

Figure 1—A: *Relationship between number of metabolic risk factors and body fat distribution. Subjects were divided according to their BMI (cutoff value 25 kg/m^2) and VFA (cutoff value 100 cm^2), measured in 2004. Data are means ± SE.* B: *Correlation between changes in VFA and changes in the number of metabolic risk factors. Δnumber of metabolic risk factors represents changes in the number of metabolic risk factors from 2004 to 2005. ΔVFA indicates change in VFA from 2004 to 2005. Subjects were divided into six 15-cm^2 bins of ΔVFA. Data are means ± SE.*

Importantly, our results also demonstrated that subjects with visceral fat accumulation but without overall obesity (VFA ≥100 cm^2 plus BMI <25 kg/m^2) exhibited significantly more metabolic risk factors than overall obese subjects without visceral fat accumulation (VFA <100 cm^2 plus BMI ≥25 kg/m^2). 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 groups for atherosclerotic cardiovascular diseases.

Our results also demonstrated in a large population sample that changes in VFA within 1 year correlated significantly with Δ*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 1 year correlated significantly with changes in the number of metabolic risk factors. These results suggest that intervention strategies directed toward reduction of visceral fat could result in the 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.

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