Excessive visceral fat accumulation (VFA) is associated with the onset of various lifestyle-related diseases such as hypertension, dyslipidemia, and hyperglycemia, all of which are risk factors for cardiovascular disease (CVD).

In individuals with excessive VFA, these CVD risk factors often coexist, resulting in an increased risk of metabolic syndrome. Thus, individuals with metabolic syndrome are at extremely high risk of developing CVD in the future. On the other hand, excessive VFA can be reduced by changing lifestyle habits, and cardiometabolic risk can be reduced in proportion to the degree of visceral fat reduction.

Together with metabolic syndrome, smoking is a powerful risk factor for CVD and was recently reported to increase the risk of metabolic syndrome itself. However, it is also true that smokers often have a lower body weight and a lower body mass index (BMI). Therefore, lower BMI and metabolic syndrome, which would appear to conflict, are both present in some smokers. Several mechanisms linking smoking to the onset of metabolic syndrome could be present, one being an excessive increase in visceral fat as a result of smoking.

The relationship between weight, BMI, and waist circumference (WC) in smokers has long been reported. In smokers, fat distribution patterns change and the waist-hip ratio becomes high despite low body weight and BMI. The mechanisms behind this increase in WC in smokers are also related to an unhealthy lifestyle such as increased alcohol consumption and an irregular eating pattern associated with smoking. An increase...

**Figure.** Possible mechanisms linking smoking and visceral fat accumulation.
in cortisol secretion and the presence of insulin resistance in smokers could be related to the change in fat distribution.\textsuperscript{10} However, the relationship between smoking and VFA can be said to be inconsistent based on visceral fat assessed by computed tomography (CT).\textsuperscript{1,11,12} One reason for the confusion is the lack of VFA measurement in real clinical practice. In Asians, including Japanese, reports investigating the relationship between smoking and the amount of visceral fat in both men and women are still lacking.

In this issue of the Journal, Nakanishi et al\textsuperscript{13} report that VFA in female smokers was significantly larger than that in female non-smokers. VFA was also greater in male smokers than in male non-smokers, but the difference was not statistically significant. A significant correlation was seen between smoking and VFA particularly in women with an average age at menopause of less than 50 years, whereas no correlation was seen between smoking and VFA in women aged 50 years or older. These findings suggest that future cardiometabolic risk is greatly increased in smokers through the accumulation of visceral fat, and that the degree of accumulation may be influenced by changes in sex hormone levels associated with age or menopause (Figure).

The National Health and Nutrition Survey by the Ministry of Health, Labour and Welfare in 2012 found that the smoking rate among men was 34.1\% and 9.0\% among women.\textsuperscript{14} Although the smoking rate for men showed a major downward trend, the number of smokers in their 20s–50s remains high in Japan. We previously reported that in a male study population, smokers had more metabolic syndrome component abnormalities than non-smokers despite low BMI and small WC.\textsuperscript{15} When the results of both reports\textsuperscript{14,15} are combined, early intervention from a young age should be done in order to reduce the cardiometabolic risk in smokers, regardless of sex.

Nakanishi et al also found that healthy female smokers had a significantly larger increase in intima-media thickness than non-smokers, which indicates that arteriosclerosis is already progressing in smokers prior to metabolic syndrome identification. Moreover, levels of the inflammatory cytokine, interleukin 6, were high in smokers. Increased inflammation throughout the body would be strongly involved in future VFA and the onset of cardiovascular events. These findings mean that smokers should remain cautious even if no abnormalities are identified on metabolic checkups.

Several limitations should be kept in mind when interpreting the results of Nakanishi et al’s study, as the authors also note: sample size was small, assessment of physical activity and eating habits was insufficient, selection bias may have occurred because it was a case-control study and patient selection was only based on age matching, and under-reporting bias typically occurs in regard to smoking. All of these limitations affect the results. Furthermore, specific populations may attend medical checkups at the University Health Care Center. In fact, the mean ages of the women and men were the same with consistent standard deviations, indicating the likelihood of a biased population. Further study is required to ascertain whether cohort studies would obtain the same results as the present study.

The findings of Nakanishi et al are not strictly confined to individuals with metabolic syndrome. All the subjects examined were healthy individuals, and parameters were within the normal ranges, excluding triglycerides. On comparing the cutoff values (100 cm\(^2\)) for abdominal obesity based on measurements with CT, the VFA of women in the present study was quite small. Therefore, it is clear that smoking accelerates VFA well before the development of metabolic syndrome in young women.

Nakanishi et al used abdominal bioelectrical impedance, instead of CT, as an estimation of VFA. CT measurements were not conducted in the present study, so we cannot confirm an actual correlation between VFA and smoking. However, the work by Nakanishi et al is the first examination of a correlation between VFA measured by abdominal impedance, smoking status, and inflammation marker in Japanese, making their findings of considerable significance.

\section*{References}


