Risk of Metabolic Syndrome Persists Twenty Years after the Cessation of Smoking

Takashi Wada¹, Mitsuyoshi Urashima² and Tsutomu Fukumoto¹

Abstract

Object Metabolic syndrome (MetS) develop by accumulation of excess central obesity occurring insulin resistance. In 2005, the Japanese Society of Internal Medicine, in collaboration with seven other Japanese societies defined the diagnostic criterion for Japan-specific MetS. Smoking also causes insulin resistance to develop. To clarify whether smoking is correlated with MetS and how long MetS remains after smoking cessation we undertook a retrospective study.

Methods The subjects comprised of 22,892 Japanese who visited the Health-Care Center at Jikei University Hospital in Tokyo for medical check-ups. The participants completed a simple, self-administered questionnaire on their lifestyle including smoking information. MetS was diagnosed with the above criterion. The odds ratio (OR) with a 95% confidential interval (95%CI) of MetS was calculated using multiple logistic regression analysis adjusted by age and gender.

Results Compared with never smokers (n=9,434; 41%), the odds ratio (95% CI) of MetS onset for current smokers (n=7,634; 33%) and past smokers (n=5,824; 25%) were 1.20 (1.07-1.35) and 1.21 (1.08-1.37). In the current smokers, the odds ratio of MetS increased with the smoking number, and it significantly occurred by smoking ≥ 20 cigarettes per day. After quitting, the longer cessation period is related to the lesser chance of developing of MetS. But, MetS remained for at least 10 years and over in the subjects who smoked 20 or more cigarettes per day, and for over 20 years in the subjects who smoked 40 cigarettes and more.

Conclusion Not only current smoking habits but also past smoking may contribute to the occurrence of MetS.

Key words: lifestyle, metabolic syndrome, smoking

(Introduction)

Metabolic abnormalities including central obesity, glucose intolerance, dyslipidemia and hypertension co-occur in an individual as metabolic syndrome (MetS), which is associated with an increased risk of cardiovascular disease (1-4). In April 2005, a committee of specialists from eight Japan Societies: the Japan Society for the study of obesity; the Japan Atherosclerosis Society; the Japan Diabetes Society; the Japanese Society of Hypertension; the Japanese Circulation Society; the Japanese Society of Nephrology; the Japanese Society on Thrombosis and Hemostasis; the Japanese Society of Internal Medicine specified a diagnosis criterion of Japan-specific MetS appropriate for the Japanese population (5).

Several previous studies showed that smoking develops insulin resistance (6). Increased insulin resistance may result in the clustering of the metabolic abnormalities (7). Both former and current smoking were associated with an increased incidence of metabolic syndrome defined by the modified-National Education Program criteria (8, 9). There has been no report examining the relationship between the smoking state and Japan-specific MetS, and the smoking number before cessation, duration after cessation and MetS.

In the present study, we assessed the impact of smoking and the effect after quitting smoking on the prevalence of MetS in retrospective data of a large population of Japanese indi-
Subjects and Methods

The subjects comprised 22,892 Japanese, aged 20 to 93 years old, [16,535 males (72.2%), mean age 47.9 ± 10.7 years and 6,357 females; mean age 44.6 ± 11.2 years] who visited the Health Science Center at Jikei University Hospital, between January 2000 and December 2004, for “ningen-dock”. Of the subjects who attended more than twice during the study period, only data from the last visit were used. Subjects whose age was less than 20 years old were excluded.

Variables

All participants completed a simple self-administered questionnaire regarding life-styles. The subjects were divided into three groups: never smoked, current smokers and past smokers. The smoking number and duration was collected in the current and past smokers. The quitting age was also collected in the past smokers.

Following this short questionnaire, anthropometrical examination included height, weight and waist circumference measurements, was performed by trained stuff. Blood samples were collected after overnight fast (no food intake for more than 12 hours).

The criterion of MetS is as follows (5). Abdominal obesity: waist circumference: ≥ 85 cm in men and ≥ 90 cm in women was obligatory for a diagnosis of MetS. In addition to abdominal obesity, any two of the following three abnormalities should be observed: A: dyslipidemia: triglyceride ≥ 150 mg/dL or HDL-C<40 mg/dL or use of anti-dyslipidemia medication; B: hypertension: systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg or use of antihypertensive medication; C: hyperglycemia: fasting plasma glucose ≥ 110 mg/dL or use of hypoglycemic medication.

Statistics

Data were expressed as means ± SD. The differences in mean values were assessed using the t-test. Multiple logistic regression analysis was applied to detect the correlation of smoking habits and MetS. These data were shown as an odds ratio (OR) with a 95% confidence interval (95%CI). All statistical analyses were performed with STATA 8.0 software (STATA Corporation, College Station, TX).

Results

The characteristics of the subjects are shown in the Table 1. When comparing to never smokers, the odds ratio (95% CI) of MetS onset for current smokers and past smokers were 1.20 (1.07-1.35) and 1.21 (1.08-1.37), respectively, adjusted by age and sex. In the current smokers, the number of cigarettes smoked per day in the subjects with MetS was 8.8 ± 13.2, which was significantly higher than that (6.5 ± 11.0) in the subjects with non-MetS.

In the current smokers, the cigarettes numbers correlated with the odds ratio of MetS, and the the smokers of 20 or more cigarettes occurred significantly MetS (Table 2). In the past smoking group, the cigarettes of 20 and over group occurred significantly MetS (Table 2). We studied the correlation between the duration after cessation and odds ratio of MetS. The OR (1.36 ± 1.16-1.60, p<0.000) of MetS in the duration under five years was the highest among all investigated period. After 5 years, the OR decreased gradually, 1.28 (95% CI: 1.05-1.59, p=0.02) in the 6-10 years, 1.19 (95% CI: 1.10-1.40, p=0.03) in the 11-20 years, and 1.0 (95%CI: 0.86-1.21, ns) in the 21 years over. Table 3 shows OR in the cigarette number and after cessation. Cigarette numbers under 20 did not affect MetS in all durations investigated. But cigarette numbers of 20 and over showed significant development of MetS for over 10 years. In the 40 cigarettes and over smoking group, the effect of developing MetS continued for over 20 years.

Discussion

We found a positive dose-response relationship between the daily number of cigarettes and the MetS in the retro-
Table 2. Odds Ratio of Metabolic Syndrome According to the Number of Cigarette Smoking Per Day in Current Smokers and Past smokers, Compared with Never Smokers, Adjusted by Age and Sex

<table>
<thead>
<tr>
<th>cigarettes per day</th>
<th>Current smokers</th>
<th>Past smokers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds ratio (95% CI)</td>
<td>p value</td>
</tr>
<tr>
<td>1-9</td>
<td>0.75 (0.51-1.09)</td>
<td>0.07</td>
</tr>
<tr>
<td>10-19</td>
<td>1.08 (0.91-1.29)</td>
<td>0.36</td>
</tr>
<tr>
<td>20-39</td>
<td>1.25 (1.01-1.52)</td>
<td>0.001</td>
</tr>
<tr>
<td>40=&gt;</td>
<td>1.88 (1.51-2.33)</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Table 3. Odds Ratio of Metabolic Syndrome According to the Number of Cigarette Smoking Per Day Duration 5 Years After Cessation of Smoking, Adjusted by Age and Sex

<table>
<thead>
<tr>
<th>cigarettes per day</th>
<th>0-5 years</th>
<th>6-10 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds ratio (95% CI)</td>
<td>p value</td>
</tr>
<tr>
<td>1-10</td>
<td>1.06 (0.60-1.86)</td>
<td>0.84</td>
</tr>
<tr>
<td>10-19</td>
<td>0.97 (0.70-1.35)</td>
<td>0.87</td>
</tr>
<tr>
<td>20-39</td>
<td>1.48 (1.21-1.81)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>40=&gt;</td>
<td>2.06 (1.49-2.87)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>cigarettes per day</th>
<th>11-20 years</th>
<th>&gt;20 years</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds ratio (95% CI)</td>
<td>p value</td>
</tr>
<tr>
<td>1-10</td>
<td>0.88 (0.50-1.60)</td>
<td>0.64</td>
</tr>
<tr>
<td>10-19</td>
<td>0.78 (0.55-1.09)</td>
<td>0.14</td>
</tr>
<tr>
<td>20-39</td>
<td>1.25 (0.71-1.54)</td>
<td>0.04</td>
</tr>
<tr>
<td>40=&gt;</td>
<td>2.13 (1.57-2.90)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

spective study. After cessation of smoking, the odds ratio increased and was the highest (1.36 : 1.16-1.60) for the first 5 years. The subjects who had smoked 20 or more cigarettes before quitting had the risk of MetS for the next 20 years.

MetS is a constellation of interrelated abnormalities that increase the risk for cardiovascular diseases. Insulin resistance is the major underlying metabolic abnormality (10, 11). Several studies have shown that smoking induces insulin resistance (6, 12) or hyperinsulinemia (13). Cigarette smoking may also induce an increase in abdominal obesity, as well as cause elevated triglyceride levels and lower HDL-cholesterol by increasing sympathetic activity. Thus, cigarette smoking may provoke the metabolic perturbations and may increase the risk of MetS.

The prevalence of MetS was higher in both current and past smokers compared with the never smoked group in the present study. Nakanishi et al (9) reported that OR of MetS was 1.7 in smokers of >30 cigarettes per day, compared with those who never smoked. Ishizaka et al (8) also reported that current smoking was associated with MetS with an odds ratio of 2.38.

The prevalence of MetS was significantly higher in past smokers (OR: 1.21) compared with those who never smoked in the present study, as well as in the reports by Ishizaka et al (OR: 1.77) (8) or Nakanishi et al (OR: 1.30) (9). The reason why the prevalence of MetS after quitting smoking increases is unclear. Nakanishi et al (9) reported that body weight gain was significantly higher in smokers who quit smoking than in never smokers in the analysis of body weight change according to smoking status during the follow-up period. This result indicates that quitting smoking is associated with the risk of the MetS owing to the subsequent body weight gain. The mechanism of weight gain after quitting smoking may be increased energy intake, decreased resting metabolic rate, decreased physical activity (14, 15). Nicotine is the main ingredient in cigarette smoke causing insulin resistance, but the withdrawal of another, unknown ingredient in cigarette smoke is responsible for the weight gain associated with smoking cessation (16).

Several potential limitations should be considered. First, the design was cross-sectional, which permitted us to demonstrate a time sequence between lifestyle factors and MetS itself as outcome. Second, recall bias might have been introduced. Third, dietary variables were not included.

We have reported that the prevalence of MetS, by analysis of the retrospective data of 22,896 Japanese subjects, may be associated with lifestyle factors of smoking, amounts of meals and alcohol consumption, more exercise and rest as well as with family history of hypertension and diabetes (17). In the present study, we investigated the risk of smoking status on the impact of MetS. This relationship was dependent on the number of cigarettes smoked daily. In those who smoked over 40 cigarettes per day before cessation, the risk of MetS was found to remain over 20 years after quitting. It is necessary to advise cessation of smoking and to watch the development of MetS after quitting smoking.
References


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