Changes in the Characteristics of Metabolic Syndrome in Korea Over the Period 1998–2001 as Determined by Korean National Health and Nutrition Examination Surveys

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Metabolic syndrome has been shown to be associated with cardiovascular morbidity and mortality (1,2). In the U.S., 23.7% of the population was classified as having metabolic syndrome by the National Cholesterol Education Program (NCEP) Adult Treatment Panel III definition when the Third National Health and Nutrition Examination Survey (NHANES III) data were used (3). According to the recent study by Ford et al. (4), the age-adjusted prevalence of metabolic syndrome was 27.0% based on data from the U.S. NHANES 1999–2000 study. Thus, the number of individuals with metabolic syndrome is increasing, and an increasing trend has been observed in Asian countries (5,6).

During the period 1970–1980, Korea experienced an epidemiologic switchover from infectious diseases to chronic degenerative diseases (7). A westernization of diet and a reduction in physical activity seem to have evoked metabolic imbalance, obesity, and an explosive increase in cardiovascular disease and diabetes. In particular, Korea experienced an economic crisis during the period 1997–1998 due to a collapse in the value of the currency, which was followed by an increase in the death rate (8).

Thus, we considered that changes in the prevalence of metabolic syndrome around this time would be of interest. In 1998, when the Korean economy was in crisis, and in 2001, when it returned to recovery, nationwide surveys referred to as the Korean National Health and Nutrition Examination Surveys (KNHANESs) were conducted. In the present study, we investigated the change in the prevalence of metabolic syndrome and its components by applying the NCEP definition to the data obtained during these two studies.

**RESEARCH DESIGN AND METHODS** — The KNHANESs were conducted in noninstitutionalized Korean civilians in 1998 and 2001. A stratified multistage probability sampling design was used (9). Of 9,734 and 7,918 participants in 1998 and 2001 surveys, 7,945 and 5,703 >20 years of age were available for analysis (age 43.4 ± 15.0 and 45.2 ± 15.5 years, respectively [means ± SD]). To assure the equal probability of being sampled, weightings were assigned to each respondent.

Anthropometric parameters and blood pressure were measured by standardized methods. Fasting plasma glucose, total cholesterol, triglyceride, and HDL cholesterol levels were measured in a central, certified laboratory.

Metabolic syndrome was diagnosed according to the NCEP-Adult Treatment Panel III criteria (10) with the Asia-Pacific abdominal obesity criterion (waist circumference >90 cm in men and >80 cm in women) (11). All data are presented as percent (±SE). To age adjust statistics, we directly standardized the data to the Korean population aged ≥20 years in the year 2001 (12). Statistical analyses were conducted using t test and χ² test and statistical significance was defined as a P <0.05.

**RESULTS** — The age-adjusted prevalence of metabolic syndrome was significantly higher in the 2001 survey than in 1998 survey (28.0 vs. 23.6%, P < 0.01). This represents an 18.6% increase in prevalence over 3 years (i.e., ~6% per annum). When the original NCEP criteria of waist circumference were used (102 cm for men and 80 cm for women), 17.3 and 20.0% of the population were classified as having metabolic syndrome in the 1998 and 2001 surveys.

Table 1 shows the prevalence (percent ± SE) of the metabolic syndrome and its components according to the U.S. NHANES III (3) and KNHANES 1998 and 2001. Compared with the U.S. NHANES III survey, the two Korean studies showed a higher prevalence of the blood pressure and fasting glucose component but a lower prevalence of abdominal obesity, despite the fact that a lower criterion was used for the latter. Of the five components, Korean subjects with a low HDL cholesterol level increased most
(36.6%) over the 3-year period, followed by hypertriglyceridemia and abdominal obesity (18.0 and 17.0% increases, respectively). In contrast, the prevalences of the high blood pressure and fasting glucose components decreased.

**CONCLUSIONS** — **Table 1** Prevalence of individual metabolic abnormalities of metabolic syndrome and clustering of metabolic syndrome components in the U.S. NHANES III, KNHANES 1998, and KNHANES 2001

<table>
<thead>
<tr>
<th></th>
<th>U.S. NHANES III*</th>
<th>KNHANES 1998</th>
<th>KNHANES 2001</th>
<th>Percent change†</th>
<th>P‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>8,814</td>
<td>7,945</td>
<td>5,703</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Abdominal obesity§</td>
<td></td>
<td></td>
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<tr>
<td>&gt;102 cm for men; &gt;88 for women</td>
<td>38.6 ± 0.8</td>
<td>—</td>
<td>—</td>
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<td></td>
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<tr>
<td>&gt;90 cm for men; &gt;80 for women</td>
<td>—</td>
<td>30.6 ± 0.5</td>
<td>35.8 ± 0.6</td>
<td>17.0</td>
<td>&lt;0.001</td>
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<tr>
<td>Hypertriglyceridemia (≥150 mg/dl)</td>
<td>30.0 ± 1.1</td>
<td>28.3 ± 0.5</td>
<td>33.4 ± 0.6</td>
<td>18.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Low HDL cholesterol (&lt;40 mg/dl for men; &lt;50 for women)</td>
<td>37.1 ± 1.2</td>
<td>36.1 ± 0.5</td>
<td>49.3 ± 0.7</td>
<td>36.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Blood pressure (≥130/85 mmHg or medication)</td>
<td>34.0 ± 0.8</td>
<td>39.1 ± 0.6</td>
<td>37.7 ± 0.6</td>
<td>—6.3</td>
<td>0.002</td>
</tr>
<tr>
<td>Fasting plasma glucose (≥110 mg/dl or medication)</td>
<td>12.6 ± 0.5</td>
<td>20.2 ± 0.5</td>
<td>17.4 ± 0.5</td>
<td>—13.9</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Metabolic syndrome</td>
<td>23.7 ± 0.8</td>
<td>23.6 ± 0.5</td>
<td>28.0 ± 0.6</td>
<td>18.6</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Data are % ± SE unless otherwise indicated. *Cited from ref. 3 with permission. †Percent change of individual metabolic abnormalities from KNHANES 1998 to KNHANES 2001. ‡Comparison between KNHANES 1998 and 2001. §Original NCEP Adult Treatment Panel III and Asia-Pacific criteria for abdominal obesity were used for the U.S. NHANES III and KNHANES, respectively.

meals could explain in part the observed decrease in blood pressure and fasting glucose level, respectively (17). Second, there was a dramatic increase in the diabetes mortality rate from 18.8/100,000 in 1996 to 22.6/100,000 in 2000 (18). This increase was much higher than that of the earlier 3-year period and may be associated with the economic crisis from 1997. The resultant marked socioeconomic changes increased all-cause mortality, especially mortality from diabetes and cardiovascular disease (19). This effect is likely to be transient, and the prevalence of diabetes is expected to rise in the future, considering the high fat intake and sedentary lifestyles (20).

In conclusion, the prevalence of metabolic syndrome has markedly increased in Korea over the 1998–2001 period, mainly because of dyslipidemia and abdominal obesity, despite the fact that blood pressure and fasting glucose criteria did not contribute. A national prevention strategy is required to reverse this trend. The first priority should be on reducing dyslipidemia and abdominal obesity. A change of dietary patterns and the importance of regular exercise should be emphasized.

### References


Metabolic syndrome in Korea


