Prevalence of the Metabolic Syndrome Among US Adults
Findings From the Third National Health and Nutrition Examination Survey

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People with the metabolic syndrome are at increased risk for developing diabetes mellitus and cardiovascular disease as well as increased mortality from cardiovascular disease and all causes. The recently released Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATP III) draws attention to the importance of the metabolic syndrome and provides a working definition of this syndrome for the first time. The prevalence of the metabolic syndrome as defined by ATP III in the United States is unknown. Because the implications of the metabolic syndrome for health care are substantial, we sought to establish the prevalence of this condition.

METHODS

Between 1988 and 1994, a representative sample of the civilian noninstitutionalized US population was recruited into the Third National Health and Nutrition Examination Survey (NHANES III) using a multistage, stratified sampling design. After an interview in the home, participants were invited to attend 1 of 3 examination sessions: morning, afternoon, or evening.

As detailed in the ATP III report, participants having 3 or more of the following criteria were defined as having the metabolic syndrome:

1. Abdominal obesity: waist circumference >102 cm in men and >88 cm in women;
2. Serum triglycerides level of at least 150 mg/dL (1.69 mmol/L);
3. High-density lipoprotein cholesterol level of less than 40 mg/dL (1.04 mmol/L) in men and 50 mg/dL (1.29 mmol/L) in women;
4. Blood pressure of at least 130/85 mm Hg;
5. Serum glucose level of at least 110 mg/dL (6.1 mmol/L).

CONTEXT

The Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (ATP III) highlights the importance of treating patients with the metabolic syndrome to prevent cardiovascular disease. Limited information is available about the prevalence of the metabolic syndrome in the United States, however.

OBJECTIVE

To estimate the prevalence of the metabolic syndrome in the United States as defined by the ATP III report.

DESIGN, SETTING, AND PARTICIPANTS

Analysis of data on 8814 men and women aged 20 years or older from the Third National Health and Nutrition Examination Survey (1988-1994), a cross-sectional health survey of a nationally representative sample of the noninstitutionalized civilian US population.

MAIN OUTCOME MEASURES

Prevalence of the metabolic syndrome as defined by ATP III (>3 of the following abnormalities): waist circumference greater than 102 cm in men and 88 cm in women; serum triglycerides level of at least 150 mg/dL (1.69 mmol/L); high-density lipoprotein cholesterol level of less than 40 mg/dL (1.04 mmol/L) in men and 50 mg/dL (1.29 mmol/L) in women; blood pressure of at least 130/85 mm Hg; or serum glucose level of at least 110 mg/dL (6.1 mmol/L).

RESULTS

The unadjusted and age-adjusted prevalences of the metabolic syndrome were 21.8% and 23.7%, respectively. The prevalence increased from 6.7% among participants aged 20 through 29 years to 43.5% and 42.0% for participants aged 60 through 69 years and aged at least 70 years, respectively. Mexican Americans had the highest age-adjusted prevalence of the metabolic syndrome (31.9%). The age-adjusted prevalence was similar for men (24.0%) and women (23.4%). However, among African Americans, women had about a 57% higher prevalence than men did and among Mexican Americans, women had about a 26% higher prevalence than men did. Using 2000 census data, about 47 million US residents have the metabolic syndrome.

CONCLUSIONS

These results from a representative sample of US adults show that the metabolic syndrome is highly prevalent. The large numbers of US residents with the metabolic syndrome may have important implications for the health care sector.

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2. Hypertriglyceridemia: ≥150 mg/dL (1.69 mmol/L);
3. Low high-density lipoprotein (HDL) cholesterol: <40 mg/dL (1.04 mmol/L) in men and <50 mg/dL (1.29 mmol/L) in women;
4. High blood pressure: ≥130/85 mm Hg;
5. High fasting glucose: ≥110 mg/dL (≥6.1 mmol/L).

We counted participants who reported currently using antihypertensive or antidiabetic medication (insulin or oral agents) as participants with high blood pressure or diabetes, respectively. Serum triglycerides were measured enzymatically after hydrolyzation to glycerol (Hitachi 704 Analyzer; Hitachi, Tokyo, Japan). Details about the laboratory procedures of all these tests are published elsewhere. We measured triglyceride concentration (Cobas Mira assay; Roche, Basel, Switzerland). Details about the laboratory procedures of all these tests are published elsewhere. Details about the laboratory procedures of all these tests are published elsewhere.7

RESULTS

Among men, whites and Mexican Americans had the highest age-adjusted prevalences of abdominal obesity, hypertriglyceridemia, and low HDL cholesterol concentration (TABLE 1). African American men had the highest age-adjusted prevalence of hypertension, and Mexican American men had the highest age-adjusted prevalence of hyperglycemia. Among women, Mexican Americans and African Americans had the highest age-adjusted prevalence of abdominal obesity. African American women had the highest age-adjusted prevalence of high blood pressure, and Mexican American women had the highest age-adjusted prevalences of hypertriglyceridemia, low HDL cholesterol concentration, and hyperglycemia.

Overall, the unadjusted and age-adjusted prevalences of the metabolic syndrome were 21.8% and 23.7%, respectively (TABLE 2). The prevalence increased from 6.7% among participants aged 20 through 29 years to 43.5% and 42.0% for participants aged 60 through 69 years and 70 years or older, respectively (FIGURE 1). The prevalence differed little among men (24.0%) and women (23.4%). It was highest among Mexican Americans (31.9%) and lowest among whites (23.8%), African Americans (21.6%), and people reporting an “other” race or ethnicity (20.3%). Among whites and participants of the other race or ethnic group, men and women had a similar prevalence of the metabolic syndrome (FIGURE 2). Among African Americans, women had about a 57% higher prevalence than men did. Among Mexi-


<table>
<thead>
<tr>
<th>Race or ethnicity</th>
<th>Abdominal Obesity</th>
<th>Hypertension</th>
<th>Low HDL Cholesterol</th>
<th>High Blood Pressure</th>
<th>High Fasting Glucose</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>3599</td>
<td>37.2 (0.9)</td>
<td>31.1 (1.3)</td>
<td>37.9 (1.5)</td>
<td>32.8 (1.0)</td>
</tr>
<tr>
<td>African American</td>
<td>2412</td>
<td>44.6 (1.2)</td>
<td>17.7 (0.8)</td>
<td>28.8 (1.3)</td>
<td>46.3 (0.9)</td>
</tr>
<tr>
<td>Mexican American</td>
<td>2449</td>
<td>45.7 (1.3)</td>
<td>37.7 (1.0)</td>
<td>39.6 (1.5)</td>
<td>36.6 (1.2)</td>
</tr>
<tr>
<td>Other</td>
<td>354</td>
<td>33.6 (5.2)</td>
<td>27.3 (3.3)</td>
<td>37.1 (4.5)</td>
<td>29.6 (2.9)</td>
</tr>
<tr>
<td>Men</td>
<td>4265</td>
<td>29.8 (1.2)</td>
<td>35.1 (1.7)</td>
<td>35.2 (1.5)</td>
<td>38.2 (1.4)</td>
</tr>
<tr>
<td>Women</td>
<td>4549</td>
<td>46.3 (1.2)</td>
<td>24.7 (0.9)</td>
<td>39.3 (1.4)</td>
<td>29.3 (0.8)</td>
</tr>
<tr>
<td>Total</td>
<td>8814</td>
<td>38.6 (0.8)</td>
<td>30.0 (1.1)</td>
<td>37.1 (1.2)</td>
<td>34.0 (0.8)</td>
</tr>
</tbody>
</table>

*HDL indicates high-density lipoprotein.

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can Americans, women had about a 26% higher prevalence than men did. Application of the age-specific prevalence rates to US census counts from 2000 suggests that 47 million US residents have the metabolic syndrome.

**COMMENT**

Using ATP III's new definition, we estimate that approximately 22% of US adults (24% after age adjustment) have the metabolic syndrome. Previous estimates of the prevalence of the metabolic syndrome in the United States and Europe have differed because of differences in definitions and populations studied. The unrelenting increase in the prevalence of obesity in the United States suggests that the current prevalence of the metabolic syndrome is now very likely higher than that estimated from 1988-1994 NHANES III data. Even if prevalence rates remained unchanged, the total number of people with the metabolic syndrome would have increased because of population growth during the 1990s.

Insulin resistance is thought to be an underlying feature of the metabolic syndrome. Genetic abnormalities, fetal malnutrition, and visceral adiposity may play roles in the pathophysiology of insulin resistance and the metabolic syndrome. Although insulin resistance among patients with the individual components of the metabolic syndrome is common, significant proportions of these patients do not have insulin resistance. Some studies have suggested that hypertension is not strongly linked to the metabolic syndrome.

The cornerstones of treatment are the management of weight and ensuring appropriate levels of physical activity. Recent studies demonstrate that dietary modification and enhanced physical activity may delay or prevent the transition from impaired glucose tolerance to type 2 diabetes mellitus and provide relevant treatment paradigms for patients with the metabolic syndrome. While proper management of the individual abnormalities of this syndrome can re-
duce morbidity and mortality, it seems unlikely that management of the individual abnormalities of this syndrome provides better outcomes than a more integrated strategy.

Education and training will be critical to ensure that health care providers have the knowledge and skills necessary to properly treat patients with the metabolic syndrome. Lack of reimbursement for weight management and physical activity interventions constitutes a major barrier. Significant efforts are needed to close the gap between current and desirable practice patterns.

The high prevalence of this condition may also have serious implications for US health care costs. Thus, studies of the direct medical costs associated with the metabolic syndrome are urgently needed. Because the root causes of the metabolic syndrome for the overwhelming majority of patients are improper nutrition and inadequate physical activity, the high prevalence of this syndrome underscores the urgent need to develop comprehensive efforts directed at controlling the obesity epidemic and improving physical activity levels in the United States.

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