

# Prevalence of the Metabolic Syndrome Among Korean Adults According to the Criteria of the International Diabetes Federation

HYE SOON PARK, MD, PHD, MPH<sup>1</sup>  
SANG YEOUN LEE, MD, PHD<sup>2</sup>  
SEON MEE KIM, MD, PHD<sup>3</sup>

JEE HYE HAN, MD<sup>4</sup>  
DAE JUNG KIM, MD<sup>5</sup>

was conducted using SAS Version 8.1. All analyses were two-tailed, and a *P* value <0.05 was considered statistically significant.

**T**he metabolic syndrome is associated with increased cardiovascular morbidity and mortality (1,2). In 2005, the International Diabetes Federation (IDF) formulated a new, clinically accessible worldwide definition of the metabolic syndrome in a global consensus statement (3) built on earlier definitions (4,5).

According to the IDF, central obesity is an essential component of the metabolic syndrome. Moreover, central obesity must be determined by ethnicity- and sex-specific cutoff values for waist circumference. The IDF also sets the cutoff value for raised fasting plasma glucose concentration at 100 mg/dl, which is 10 mg/dl lower than that of the NCEP ATP III (National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, Adult Treatment Panel III) (5). In agreement with the IDF proposal, the Korean Society for the Study of Obesity defined the cutoff values of waist circumference for central obesity among Korean adults as 90 cm for men and 85 cm for women (6).

There is insufficient data about the prevalence of the metabolic syndrome according to the new worldwide definition proposed by the IDF. We therefore assessed the prevalence of the metabolic

syndrome according to IDF criteria, using ethnicity- and sex-specific cutoff values for central obesity.

## RESEARCH DESIGN AND METHODS

— The Korean Ministry of Health and Welfare conducted the Korean National Health and Nutrition Examination Survey in noninstitutionalized Korean civilians in 1998. A stratified multistage probability sampling design was used. Of 8,465 participants, data from subjects younger than 20 years (*n* = 1,542) and older than 80 years (*n* = 99) of age were excluded, leaving data from 6,824 respondents available for analysis. Anthropometric parameters and blood pressures were measured by standard methods. Plasma glucose, total cholesterol, triglycerides, and HDL cholesterol were analyzed at a central, certified laboratory.

Adopting IDF criteria (3), the metabolic syndrome in South Korean adults was defined by central obesity (waist circumference ≥90 cm for men and ≥85 cm for women) (6) plus two of the following four factors: serum triglyceride ≥150 mg/dl, HDL cholesterol <40 mg/dl for men and <50 mg/dl for women, systolic blood pressure ≥130 mmHg or diastolic blood pressure ≥85 mmHg, and fasting plasma glucose ≥100 mg/dl. Statistical analysis

**RESULTS** — The age-adjusted prevalence of each component of the metabolic syndrome and the clustering of metabolic components are shown in Table 1. The age-adjusted prevalence of the metabolic syndrome was 13.5% in men and 15.0% in women. The age-adjusted prevalence of central obesity, defined as a waist circumference of ≥90 cm for Korean men and ≥85 cm for Korean women, was 19.4% in men and 22.5% in women. Elevated serum triglyceride concentrations were detected in 35% of men and 20% of women, low HDL cholesterol was observed in 25% of men and 46.2% of women, elevated blood pressure was detected in 44.2% of men and 29% of women, and increased fasting plasma glucose concentration or previously diagnosed type 2 diabetes was observed in 39.1% of men and 34.6% of women. The age-adjusted prevalence of central obesity plus any one, two, three, or four metabolic components was 17.9, 13.5, 7.1, and 1.7%, respectively, in Korean men, and 20.5, 15.0, 7.5, and 2.4%, respectively, in Korean women. Under age 50 years, the prevalence of the metabolic syndrome was higher in men than in women, but this was reversed among participants over age 50 years. In both men and women, the prevalence of the metabolic syndrome significantly increased linearly with BMI.

**CONCLUSIONS** — Using IDF criteria (3), the prevalence of the metabolic syndrome was 13.5% for Korean men and 15.0% for Korean women. This was similar to the results seen using the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, Adult Treatment Panel III criteria, which found that the prevalence of the metabolic syndrome was 14.2% for Ko-

From the <sup>1</sup>Department of Family Medicine, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea; the <sup>2</sup>Department of Family Medicine, College of Medicine, Pusan University, Pusan, Korea; the <sup>3</sup>Department of Family Medicine, College of Medicine, Korea University, Seoul, Korea; the <sup>4</sup>Department of Family Medicine, Eulji General Hospital, Eulji Medical University, Seoul, Korea; and the <sup>5</sup>Department of Endocrinology and Metabolism, Ajou University School of Medicine, Suwon, Korea.

Address correspondence and reprint requests to Hye Soon Park, Department of Family Medicine, University of Ulsan College of Medicine, 388-1 Poongnap-dong, Songpa-gu, Seoul, South Korea, 138-736. E-mail: hyesoon@amc.seoul.kr.

Received and accepted for publication 11 January 2006.

**Abbreviations:** IDF, International Diabetes Federation.

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

© 2006 by the American Diabetes Association.

The costs of publication of this article were defrayed in part by the payment of page charges. This article must therefore be hereby marked "advertisement" in accordance with 18 U.S.C. Section 1734 solely to indicate this fact.

**Table 1—Age-adjusted prevalence of each component of the metabolic syndrome and clustering of components according to IDF criteria among Korean adults, Korean National Health and Nutrition Examination Survey 1998**

Variables	Men	Women
n	3,057	3,767
Age (years)	44.3 ± 14.6	44.6 ± 15.3
BMI (kg/m <sup>2</sup> )	23.1 ± 3.0	23.3 ± 3.3
Waist circumference (cm)	82.8 ± 8.6	78.6 ± 9.6
Central obesity	19.4	22.5
Raised triglyceride	35.0	20.0
Low HDL cholesterol	25.0	46.2
Raised blood pressure	44.2	29.0
Raised fasting blood glucose	39.1	34.6
Central obesity plus one or more components	17.9	20.5
Central obesity plus two or more components*	13.5	15.0
Central obesity plus three or more components	7.1	7.5
Central obesity plus four components	1.7	2.4

Data are means ± SD or percent. \*The metabolic syndrome was defined in South Korean adults as central obesity (waist circumference ≥90 cm for men and ≥85 cm for women) plus two of the following four factors: serum triglyceride ≥150 mg/dl (≥1.7 mmol/l) or specific treatment for this lipid abnormality, HDL cholesterol <40 mg/dl (<1.03 mmol/l) for men and <50 mg/dl (<1.29 mmol/l) for women or specific treatment for this lipid abnormality, systolic blood pressure ≥130 mmHg or diastolic blood pressure ≥85 mmHg or treatment of previously diagnosed hypertension, and fasting plasma glucose ≥100 mg/dl (≥5.6 mmol/l) or previously diagnosed type 2 diabetes.

rean men and 17.7% for Korean women (7).

A prominent feature of the IDF definition of the metabolic syndrome is that central obesity is an essential, not an optional, component of the metabolic syndrome (3), with recommendations for central obesity defined according to ethnicity-specific values of waist circumference (5,8–10). The Korean Society for the Study of Obesity defined the cutoff values of waist circumference for central obesity in Koreans as ≥90 cm for men and ≥85 cm for women based on analysis of representative data (6). Using these ethnicity-specific cutoff values of waist circumference, the prevalence of central obesity was ~20% in both Korean men and women.

Another feature of the IDF criteria for the metabolic syndrome is the cutoff value for fasting plasma glucose ≥100 mg/dl, which is 10 mg/dl lower than the cutoff value of the NCEP ATP III. Among Koreans, the prevalence of raised fasting

plasma glucose, defined as ≥100 mg/dl, was 39.1% for men and 34.6% for women. However, only 2.3% of the Korean population was obese, as defined by BMI ≥30 kg/m<sup>2</sup>.

In conclusion, our study showed that using IDF criteria, the prevalence of the metabolic syndrome among Korean adults was 13.5% for men and 15.0% for women. Using ethnicity-specific cutoff values for waist circumference, the prevalence of central obesity was ~20% in both men and women. Our findings suggest the need to apply ethnicity-specific cutoff values for waist circumference to assess the metabolic syndrome.

## References

1. Isomaa B, Almgren P, Tuomi T, Forsen B, Lahti K, Nissen M: Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care* 24: 683–689, 2001
2. Lakka HM, Laaksonen DE, Lakka TA, Niskanen LK, Kumpusalo E, Tuomilehto J,

Salonen JT: The metabolic syndrome and total and cardiovascular disease mortality in middle-aged men. *JAMA* 288:2709–2716, 2002

3. International Diabetes Federation Press Conference: The IDF consensus worldwide definition of the metabolic syndrome [article online], 2005. Available from [http://www.idf.org/webdata/docs/IDF\\_Metasyndrome\\_definition.pdf](http://www.idf.org/webdata/docs/IDF_Metasyndrome_definition.pdf). Accessed 14 April 2005
4. Alberti KG, Zimmet PZ: Definition, diagnosis and classification of diabetes mellitus and its complications. Part 1: diagnosis and classification of diabetes mellitus provisional report of a WHO consultation. *Diabet Med* 15:539–553, 1998
5. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults: Executive summary of the third report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *JAMA* 285:2486–2497, 2001
6. Korean Society for the Study of Obesity: Report on cut-off point of body mass index and waist circumference for criteria of obesity and abdominal obesity among Korean. In *Proceedings of the Symposium for Criteria of Obesity and Abdominal Obesity Among Korean*, Seoul, Korea, 2005. Anyang, GyeongGi-Do, Korean Society for the Study of Obesity, 2005, p. 2–3
7. Park HS, Oh SW, Cho SI, Choi WH, Kim YS: The metabolic syndrome and associated lifestyle factors among South Korean adults. *Int J Epidemiol* 33:328–336, 2004
8. Balkau B, Charles MA: Comment on the provisional report from the WHO consultation: European Group for the Study of Insulin Resistance (EGIR) (Letter). *Diabet Med* 16:442–443, 1999
9. International Obesity Task Force: *Asia-Pacific Perspective: Redefining Obesity and Its Treatment*. Sydney, Australia. Health Communications Australia, 2000
10. Examination Committee of Criteria for “Obesity Disease” in Japan, the Japan Society for the Study of Obesity: New criteria for “obesity disease” in Japan. *Circ J* 66:987–992, 2002