

Ethnic-Specific Criteria for the Metabolic Syndrome

Evidence from China

JING LIU, MD^{1,2}
SCOTT M. GRUNDY, MD, PHD²
WEI WANG, MD¹
SIDNEY C. SMITH, JR., MD³
GLORIA LENA VEGA, PHD²

ZHAOSU WU, MD, MPH¹
ZHECHUN ZENG, MD¹
WENHUA WANG, MD¹
DONG ZHAO, MD, PHD¹

The metabolic syndrome is a constellation of interrelated abnormalities, including dyslipidemia, elevated blood pressure and glucose, and prothrombotic and proinflammatory states (1). Because of the growing prevalence of the metabolic syndrome, several organizations have attempted to set forth clinical criteria for its diagnosis (1–5). The most recent are those proposed by the International Diabetes Federation (IDF) definition (5) and the American Heart Association's National Heart, Lung, and Blood Institute (1). The latter updated the National Cholesterol Education Program Adult Treatment Panel III (ATPIII) criteria (2). Both IDF and updated ATPIII criteria emphasized the importance of adiposity in the etiology of the metabolic syndrome and recommended specific thresholds for central obesity in different ethnic groups. Thresholds in the two reports were identical for Asian populations. A significant difference between the two criteria is that the IDF makes central obesity necessary for diagnosis, whereas updated ATPIII criteria did not. Whether the prerequisite of central obesity has any impact on the prevalence or the classification of the syndrome in the Chinese population is unknown. The objective of this study is to assess the prevalence of the metabolic syndrome in the Chinese population us-

ing the ethnic-specific obesity definition for Chinese and to compare the agreement of diagnoses by IDF and ATPIII criteria.

RESEARCH DESIGN AND METHODS

The Chinese Multi-provincial Cohort Study was a nationwide, multicenter, prospective cohort study on cardiovascular disease in China. The detailed information of the participants has been reported elsewhere (6–8). Briefly, a total of 29,564 subjects (aged 35–64 years) free of cardiovascular disease were recruited from 11 provinces in mainland China in 1992 for the baseline examination using the World Health Organization MONICA (Multinational Monitoring of Trends and Determinants in Cardiovascular Disease) protocol of risk factor survey (9,10). Complete data of anthropometric and metabolic measurements were available for 26,972 subjects (91.2% of the participants) and were used in this analysis.

Clinical criteria for the metabolic syndrome

The updated ATPIII criteria for the diagnosis of metabolic syndrome (1) included three or more of the following: triglyceride ≥ 150 mg/dl (1.7 mmol/l), HDL cholesterol < 40 mg/dl (1.03 mmol/l) in men and < 50 mg/dl (1.29 mmol/l) in women,

fasting glucose ≥ 100 mg/dl (5.6 mmol/l) or previously diagnosed with type 2 diabetes, blood pressure $\geq 130/85$ mmHg or on antihypertensive medication, and central obesity (defined as waist circumference ≥ 90 cm in men and ≥ 80 cm in women, according to the ethnic criteria for Asians). The IDF requires central obesity (defined as waist circumference ≥ 90 cm in men and ≥ 80 cm in women for Asians, except for Japanese) plus two of the following four factors: triglycerides ≥ 150 mg/dl, HDL cholesterol < 40 mg/dl in men and < 50 mg/dl in women, fasting glucose ≥ 100 mg/dl or previously diagnosed with type 2 diabetes, and blood pressure $\geq 130/85$ mmHg or on treatment for hypertension (5).

Statistical analysis

Data are presented as means \pm SD or percentages. Age-standardized means or prevalence rates were calculated by the direct standardization method according to the distribution of the Chinese population in the 2000 China population census (11). The agreement between the two definitions was tested by using κ , and the values were interpreted according to Landis and Koch (12). All statistical analyses were carried out by using SPSS (version 12.0).

RESULTS— Among the 26,972 participants, 54.2% were men and 45.8% women. The mean age for men and women was 47.3 ± 8.0 and 45.8 ± 7.8 years, respectively.

The mean values of blood pressure, triglycerides, HDL cholesterol, fasting glucose, and waist circumference are presented in Table 1, as well as the prevalence rates of the metabolic syndrome and its components. Elevated blood pressure and central obesity were the most prevalent components in men and women, respectively. According to the thresholds for Asians recommended by both criteria, 20.2% of men and 35.8% of women were classified as having central obesity. The age-standardized prevalence of the metabolic syndrome was 9.8% in men and 16.6% in women by IDF criteria, com-

From the ¹Capital University of Medical Sciences attached Beijing Anzhen Hospital, Beijing Institute of Heart, Lung and Blood Vessel Diseases, Beijing, China; the ²Center for Human Nutrition, University of Texas Southwestern Medical Center, Dallas, Texas; and the ³Center for Cardiovascular Science and Medicine, University of North Carolina School of Medicine, Chapel Hill, North Carolina.

Address correspondence and reprint requests to Dong Zhao, MD, PhD, Department of Epidemiology, Beijing Institute of Heart, Lung and Blood Vessel Diseases, Beijing-100029, China. E-mail: deezhao@anzhen.org.

Received and accepted for publication 2 March 2006.

Abbreviations: ATPIII, Adult Treatment Panel III; IDF, International Diabetes Federation.

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

DOI: 10.2337/dc06-0481

© 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.

pared with rates of 14.4% in men and 20.0% in women by ATP III criteria. Overall, ATP III criteria diagnosed 4% more people with metabolic syndrome by detecting three or more metabolic components without the requirement of central obesity. The majority of the participants (95.3% of men and 96.7% of women) fell into the same category (either with or without metabolic syndrome) when diagnosed by the two criteria, given the same thresholds for central obesity (the thresholds for Asians). The agreement between the two diagnoses was “substantial” in men ($\kappa = 0.786$) and “almost perfect” in women ($\kappa = 0.887$).

CONCLUSIONS— In our study, one-fifth of men and one-third of women were classified as having central obesity using the ethnic criteria for Asians. Although the IDF places more emphasis on central obesity in the causation of the metabolic syndrome, our study indicated that the requirement of abdominal obesity did not increase the prevalence or the classification of the metabolic syndrome compared with ATP III in this large Chinese population. Indeed, ATP III identified somewhat more people with metabolic syndrome because three or more metabolic disorders were present without the coexistence of central obesity, the prerequisite of the IDF diagnosis. The majority of the participants fell into the same category when diagnosed by ATP III and IDF. In other words, for the most part, the same individuals will be identified by either definition. This study demonstrates that the differences in diagnostic criteria by IDF and ATP III are small when applied to the Chinese population.

Acknowledgments— This research was supported by the China National Grant on Science and Technology (85-915-01-02).

References

1. Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, Gordon DJ, Krauss RM, Savage PJ, Smith SC Jr, Spertus JA, Costa F: Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute scientific statement. *Circulation* 112:e285–e290, 2005
2. 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) final report.

Table 1—Characteristics of the study population

	Male age-groups (years)				Female age-groups (years)			
	35–44	45–54	55–64	35–64*	35–44	45–54	55–64	35–64*
n	6,052	5,155	3,405	14,612	6,054	4,148	2,158	12,360
Systolic BP (mmHg)	117.7 ± 15.2	122.0 ± 18.1	130.7 ± 21.4	121.9 ± 18.3 [†]	113.0 ± 15.7	123.1 ± 20.4	132.7 ± 22.9	120.6 ± 20.5
Diastolic BP (mmHg)	78.6 ± 11.1	80.4 ± 12.1	83.0 ± 12.4	80.1 ± 11.8 [†]	74.5 ± 10.4	79.3 ± 12.2	81.9 ± 12.4	77.7 ± 11.9
triglycerides (mg/dl)	100.6	107.7	102.5	103.4 [†]	82.6	99.8	109.4	93.5
HDL cholesterol (mg/dl)	56.2 ± 17.2	54.6 ± 16.5	55.0 ± 16.6	55.4 ± 16.9	59.2 ± 16.8	58.5 ± 17.0	56.1 ± 15.7	58.3 ± 16.7 [†]
Glucose (mg/dl)	91.2 ± 21.0	93.7 ± 25.4	95.9 ± 24.9	93.0 ± 23.5 [†]	90.5 ± 19.0	93.1 ± 23.5	95.5 ± 27.8	92.4 ± 22.7
Waist circumference (cm)	80.4 ± 8.8	82.0 ± 9.2	83.4 ± 9.6	81.6 ± 9.2 [†]	74.4 ± 8.2	77.9 ± 8.7	79.1 ± 9.2	76.6 ± 8.8
Prevalence rate (%)								
Raised BP	30.7	40.2	55.7	39.2 [†]	19.1	39.5	56.0	33.8
Raised triglycerides	21.8	26.3	21.7	23.3 [†]	11.4	20.4	25.7	17.5
Raised glucose	25.6	30.1	33.7	28.8 [†]	22.5	27.7	32.7	26.4
Reduced HDL cholesterol	13.9	15.5	14.8	14.6	29.2	32.0	37.2	31.8 [†]
Central obesity	16.0	21.3	27.2	20.2	25.2	41.8	48.6	35.8 [†]
IDF metabolic syndrome	7.0	10.8	14.3	9.8	8.6	19.8	28.3	16.6 [†]
ATP III metabolic syndrome	10.4	15.8	20.7	14.4	10.7	23.4	34.2	20.0 [†]

Data are means ± SD, geometric mean (for triglycerides), or percent. *Age-standardized means and prevalence rates. [†]The value was significantly higher than that for the other sex ($P < 0.05$). BP, blood pressure; raised BP, BP ≥ 130/85 mmHg or on antihypertensive medication; raised triglycerides, triglycerides ≥ 150 mg/dl; raised fasting glucose, fasting glucose ≥ 100 mg/dl or previously diagnosed type 2 diabetes; reduced HDL cholesterol (<40/50 mg/dl), HDL cholesterol <40 mg/dl in men and <50 mg/dl in women; central obesity, waist circumference ≥ 90 cm in men and ≥ 80 cm in women.

- Circulation* 106:3143–3421, 2002
3. 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
 4. Balkau B, Charles MA: Comment on the provisional report from the WHO consultation: European Group for the Study of Insulin Resistance (EGIR). *Diabet Med* 16:442–443, 1999
 5. Alberti KGM, Zimmet P, Shaw J: The metabolic syndrome: a new worldwide definition. *Lancet* 366:1059–1062, 2005
 6. Liu J, Hong Y, D'Agostino RB Sr, Wu Z, Wang W, Sun J, Wilson PW, Kannel WB, Zhao D: Predictive value for the Chinese population of the Framingham CHD risk assessment tool compared with the Chinese Multi-Provincial Cohort Study. *JAMA* 291:2591–2599, 2004
 7. Wu ZS, Yao CH, Zhao D, Wu G, Wang W, Liu J, Zeng Z: A prospective cohort study on cardiovascular disease incidence in 11 provinces of China. I. associations between risk factor level and cardiovascular disease incidence. *Chin J Cardiol* 27:5–8, 1999
 8. Wu ZS, Yao CH, Zhao D, Wu G, Wang W, Liu J, Zeng Z: A prospective cohort study on cardiovascular disease incidence in 11 provinces of China. II. associations between individual risk factor aggregation and cardiovascular disease incidence. *Chin J Cardiol* 29:246–250, 2001
 9. Keil U, Kuulasmaa K: WHO MONICA project: risk factors. *Int J Epidemiol* 18 (Suppl. 1):S46–S55, 1989
 10. Wu Z, Yao C, Zhao D, Wu G, Wang W, Liu J, Zeng Z, Wu Y: Sino-MONICA project: a collaborative study on trends and determinants in cardiovascular diseases in China. Part I: morbidity and mortality monitoring. *Circulation* 103:462–468, 2001
 11. Age specific proportional distribution in the Fifth National Population Census in China [article online]. Available from http://www.moh.gov.cn/news/sub_index.aspx?tp_class=C3. Accessed 5 June 2005
 12. Landis JR, Koch GG: The measurement of observer agreement for categorical data. *Biometrics* 33:159–174, 1977