The Effect of Menopause on the Metabolic Syndrome Among Korean Women

The Korean National Health and Nutrition Examination Survey, 2001

HEE MAN KIM, MD[1,2]
JONG PARK, MD, PHD[3]
SO YEON RYU, MD, PHD[3]
JONGOH KIM, MD[1]

OBJECTIVE — This study examined the effect of menopausal status on the risk of the metabolic syndrome in Korean women.

RESEARCH DESIGN AND METHODS — Data were obtained from the Korean National Health and Nutrition Examination Survey of 2001. A total of 2,671 women who did not receive hormone replacement therapy (1,893 premenopausal women and 778 postmenopausal women) were included in the analysis. The metabolic syndrome was defined according to the National Cholesterol Education Program Adult Treatment Panel III.

RESULTS — Postmenopausal women had significantly higher mean waist circumference, systolic blood pressure, pulse pressure, total cholesterol, LDL cholesterol, and triglyceride levels than premenopausal women after adjusting for age ($P = 0.018$, $P = 0.001$, $P < 0.0001$, $P < 0.0001$, $P < 0.0001$, and $P = 0.006$, respectively). Among postmenopausal women, the age-adjusted odds ratio was 1.61 (95% CI 1.15–2.25) for abdominal obesity, 1.11 (0.76–1.61) for elevated blood pressure, 1.24 (0.90–1.72) for low HDL cholesterol, 1.28 (0.89–1.83) for high triglycerides, and 1.07 (0.69–1.65) for high fasting glucose compared with premenopausal women. The multivariate-adjusted odds ratio for the metabolic syndrome was 1.60 (95% CI 1.04–2.46) among postmenopausal women compared with premenopausal women.

CONCLUSIONS — Postmenopausal status is associated with an increased risk of the metabolic syndrome independent of normal aging in Korean women.

Diabetes Care 30:701–706, 2007

Stroke and coronary artery disease were major causes of death among Korean women in 2004, second only to malignant diseases (1). Ischemic heart disease is more common in Korean women aged >50 years than in Korean men of the same age-group (2). Menopause appears to increase the risk of cardiovascular disease (CVD) independently of normal aging, and premenopausal women may be protected against CVD compared with men and postmenopausal women of a similar age (3).

The metabolic syndrome is one of the major predisposing factors for CVD, and the population-attributable fraction of the metabolic syndrome has been reported to be 12–17% for CVD in the U.S. (4). The prevalence of the metabolic syndrome increases with age in both men and women. From young (≥20 years) to middle age (<50 years), Korean men tend to have a higher prevalence of the metabolic syndrome than Korean women. However, Korean women have a higher prevalence than Korean men above the age of 50 years (5,6). It has been suggested that menopause is a contributing factor for this change in prevalence (6). A study in the U.S. demonstrated an increased risk of the metabolic syndrome among postmenopausal women (7).

To our knowledge, there have been few studies on the effect of menopause on the development of the metabolic syndrome independent of age, and little information is available on an association between the metabolic syndrome and menopausal status in Korean women. This study examined the difference in the prevalence of the cardiovascular risk factors between postmenopausal and premenopausal women and assessed the effect of menopausal status on the metabolic syndrome in Korean women.

RESEARCH DESIGN AND METHODS

The Korean National Health and Nutrition Examination Survey (KNHANES) was conducted by the Korean Ministry of Health and Welfare in 2001. The participants were noninstitutionalized civilians in the Republic of Korea. The sampling units were households selected through a stratified, multistage, probability-sampling design. The participants completed three parts of a questionnaire, which consisted of a health interview survey, a health behavior survey, and a nutrition survey. A selected sample of participants underwent a health examination survey that included anthropometric measurements, blood pressure measurements, and blood biochemistry tests. Of 12,647 participants aged ≥10 years, 9,770 (77.3%) attended the health examination survey. Participants aged <20 years were excluded from our analysis, leaving 6,015 participants (2,596 men and 3,419 women). Participants who had one or more missing values of the risk factors necessary for a diagnosis of the metabolic syndrome were also excluded. Ultimately, a total of 5,588 (92.9%) participants (2,369 men and 3,219 women) were included to examine the prevalence of the metabolic syndrome.

For the analysis of the effect of menopause, 548 of 3,219 women were excluded for the following reasons: missing data on a questionnaire regarding meno-

From the [1]Korean Association of Public Health Doctor, Chungcheongbuk-do, Korea; the [2]Department of Internal Medicine, Chungbuk Hospital, Chungcheongbuk-do, Korea; and the [3]Department of Preventive Medicine, College of Medicine, Chosun University, Gwangju, Korea.

Address correspondence and reprint requests to Jong Park, MD, PhD, Department of Preventive Medicine, College of Medicine, Chosun University, 375 Seoseok-dong, Dong-gu, Gwangju, 501-759, Korea. E-mail: jpark@chosun.ac.kr.

Received for publication 5 July 2006 and accepted in revised form 9 December 2006.

Abbreviations: CVD, cardiovascular disease; HRT, hormone replacement therapy; KNHANES, Korean National Health and Nutrition Examination Survey.

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

DOI: 10.2337/dc06-1400

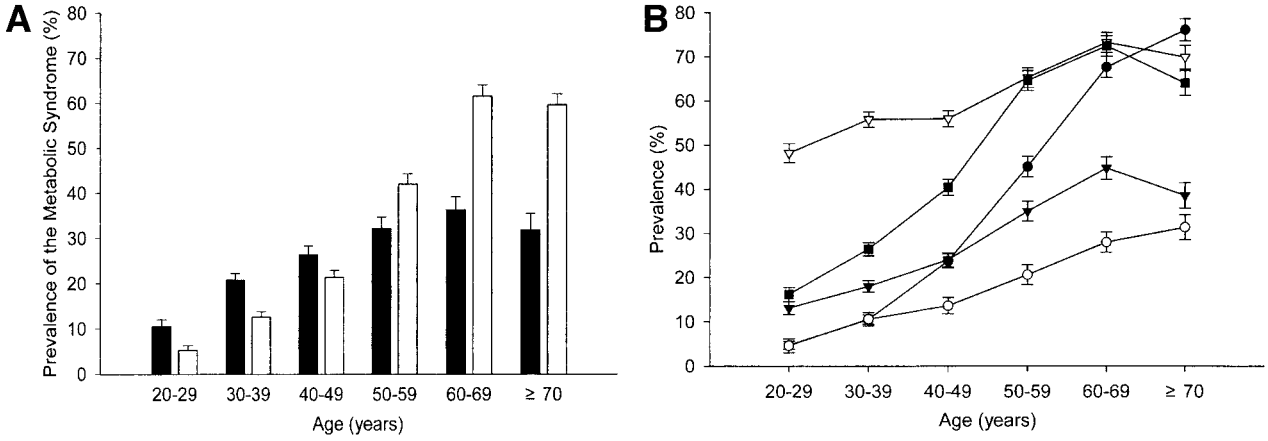

Figure 1—*Age-specific prevalence of the metabolic syndrome in Korean men and women* (n = *2,369 and 3,219, respectively*) (A) *and age-specific prevalence of the components of the metabolic syndrome among Korean women* (n = *3,219) from KNHANES 2001* (B). A: ■, *men;* □, *women*. B: ○, *high fasting glucose;* ●, *elevated blood pressure;* △, *low HDL cholesterol;* ▲, *high triglyceride;* ■, *abdominal obesity*.

pause; menopause duration of <1 year (n = 57); premature menopause induced by surgery, chemotherapy, or radiation (n = 148); and hormone replacement therapy (HRT) for any cause (n = 185). In the end, 2,671 (83.0%) women were considered eligible for the analysis. The sample consisted of 1,893 premenopausal women and 778 postmenopausal women.

Height was measured using a stadiometer in the upright position, and body weight was measured on a balanced scale (2,6). BMI was calculated using the following formula: BMI = body weight (kg)/height^2 (m). Waist circumference was measured at the midpoint between the bottom of the rib cage and the top of the lateral border of the iliac crest during minimal respiration. Blood pressure was measured using a mercury sphygmomanometer in the sitting position after a 10-min rest period. Two measurements were taken from all the subjects at 5-min intervals, and the average of the two measurements was used. Pulse pressure was defined as the difference between systolic and diastolic blood pressure. Blood samples were collected in the morning after an overnight fast, then centrifuged, refrigerated, and transferred to a national central laboratory in Seoul. Total cholesterol, triglycerides, HDL cholesterol, and plasma fasting glucose levels were measured using an autoanalyzer (Hitachi 747 autoanalyzer; Tokyo, Japan). LDL cholesterol level was calculated using the Friedewald equation if the triglyceride level was <400 mg/dl (8).

According to the National Cholesterol Education Program Adult Treatment Panel III (9), the metabolic syndrome is defined as the presence of three or more of the following risk factors: *1*) abdominal obesity with a waist circumference ≥90 cm for Asian men and ≥80 cm for Asian women according to the World Health Organization (10), *2*) high triglyceride level ≥1.69 mmol/l, *3*) low HDL cholesterol level <1.03 mmol/l for men and 1.29 mmol/l for women, *4*) elevated systolic blood pressure ≥130 mmHg or elevated diastolic blood pressure ≥85 mmHg, and *5*) high fasting glucose level ≥6.1 mmol/l. Subjects who reported taking hypertension or diabetes medications were considered to have elevated blood pressure or high fasting glucose, respectively (11). Menopause is defined as amenorrhea for 12 months following the final menstrual period (12). In our study, a postmenopausal woman was defined as a woman with natural menopause whose current age was ≥1 year than her age of menopause and who did not receive HRT.

Self-reported questionnaires were administered to determine smoking status, alcohol intake, education level, household income, physical exercise level, and family history of medical disease. Smoking status was categorized into nonsmokers, current smokers, and ex-smokers. Alcohol consumption was categorized according to the amount and frequency of alcohol consumed: none, current drinker, risk drinker, and high-risk drinker (2). A risk drinker was a person who consumed ≥60 g of alcohol/day and once or twice per week. A high-risk drinker was a person who consumed ≥60 g of alcohol/day and three or more times per week. A current drinker was a person who drinks less than a risk drinker. Education level was divided into three categories: <9 years, 9–12 years, and >12 years. Household income was divided into quartiles according to the mean household income per month: <1,000,000, 1,000,000–1,499,000, 1,500,000–2,499,000, and ≥2,500,000 won. The exchange rate on 1 January 2001 was 1,259 won to the U.S. dollar. Physical exercise was categorized into three groups according to the frequency of activity for at least 20 min per week: none, 1–2 times per week, and ≥3 times per week. Residential area was categorized according to the Korean administrative district as a large city, a medium or small city, and a rural area (12). A family history of CVD was defined as having at least one parent or sibling diagnosed with hypertension, stroke, or coronary heart disease, and a family history of diabetes was defined as having at least one parent or sibling diagnosed with diabetes.

Statistical analysis

The baseline characteristics of premenopausal and postmenopausal women were compared using an ANCOVA with age as the covariate. Of 2,671 subjects, 195 women (7.3%) on hypertension medications were excluded from the comparison of mean blood pressure, and 60 women (2.2%) on diabetes medications were excluded from the comparison of mean fasting glucose level. The age-adjusted odds ratios (ORs) for risk factors for the metabolic syndrome were calculated by logistic regression with age as a continuous variable. Multivariate logistic regression analysis was used to assess the independent contribution of menopausal status to the presence of the metabolic syndrome with an adjustment for age (a continuous variable), BMI, smoking, alcohol, educa-

Table 1—*Baseline characteristics of premenopausal and postmenopausal women who did not receive hormone replacement therapy*

	Premenopause	Postmenopause	ANCOVA* (*P* value)
n	1,893	778	
Age (years)	35.4 ± 8.1	65.1 ± 9.3	<0.0001
BMI (kg/m^2)	22.7 ± 3.3	24.2 ± 3.3	0.191
Waist circumference (cm)	75.4 ± 8.8	83.5 ± 9.0	0.018
Systolic blood pressure (mmHg)†	112.0 ± 13.2	131.2 ± 21.4	0.001
Diastolic blood pressure (mmHg)†	71.6 ± 10.0	79.0 ± 11.4	0.609
Pulse pressure (mmHg)†	40.4 ± 8.4	52.3 ± 15.4	<0.0001
Total cholesterol (mmol/l)	4.60 ± 0.82	5.29 ± 0.87	<0.0001
LDL cholesterol (mmol/l)‡	2.76 ± 0.70	3.35 ± 0.79	<0.0001
HDL cholesterol (mmol/l)	1.28 ± 0.27	1.18 ± 0.25	0.289
Triglyceride (mmol/l)	1.23 ± 0.73	1.70 ± 0.84	0.006
Fasting glucose (mmol/l)§	5.2 ± 0.8	5.5 ± 1.0	0.687

Data are means ± SD. *ANCOVA with age as a covariate. †Of 2,671 women, 195 on hypertension medications were excluded from comparison of mean blood pressure. ‡Of 2,671 women, 28 with which LDL cholesterol could not be calculated were excluded. §Of 2,671 women, 60 on diabetes medications were excluded from comparison of mean fasting glucose.

tion level, household income, physical exercise level, residential area, and family history of CVD and diabetes. Data analysis was carried out using SPSS software (version 11; SPSS, Chicago, IL). A *P* value <0.05 was considered significant.

RESULTS — The prevalence of the metabolic syndrome and its risk factors increased with age in both Korean men and women (Fig. 1). Above the age of 50 years, the prevalence of the metabolic syndrome was significantly higher in women than in men ($P < 0.05$). Table 1 shows the baseline characteristics in relation to menopausal status. Postmenopausal women had significantly higher mean waist circumference, systolic blood pressure, pulse pressure, total cholesterol, LDL cholesterol, and triglyceride levels than premenopausal women, adjusted for age ($P = 0.018$, $P = 0.001$, $P < 0.0001$, $P < 0.0001$, $P < 0.0001$, and $P = 0.006$, respectively).

Table 2 displays the prevalence and ORs of the risk factors for the metabolic syndrome in relation to menopausal status. Abdominal obesity, elevated blood pressure, low HDL cholesterol, high triglycerides, and high fasting glucose were significantly associated with postmenopausal status ($P < 0.0001$ for all). However, when these factors were adjusted for age, only abdominal obesity was significantly associated with postmenopausal status (OR 1.61 [95% CI 1.15–2.25]; $P = 0.005$).

Table 3 presents the ORs for the metabolic syndrome after adjusting for menopausal status, BMI, smoking, alcohol consumption, education level, household income, exercise, residential area, and family history of CVD and diabetes. The unadjusted and multivariate-adjusted ORs for the metabolic syndrome in postmenopausal women were 7.50 and 1.60, respectively (95% CI 6.18–9.08 and 1.04–2.46, respectively) compared with premenopausal women. Multivariate analysis revealed that a high BMI and a family history of CVD and diabetes were significantly associated with an increased risk of the metabolic syndrome (OR 1.73 and 1.55, respectively). However, the multivariate model showed that smoking, alcohol intake, education level, household income, physical exercise level, and residential area were not significantly associated with the risk for the metabolic syndrome.

CONCLUSIONS — A higher prevalence of the metabolic syndrome among

Table 2—*Prevalence and age-adjusted ORs of risk factors of the metabolic syndrome among premenopausal and postmenopausal women who did not receive hormone replacement therapy*

				Postmenopause (n = 778)	
	Premenopause (n = 1,893)	Postmenopause (n = 778)	*P* value*	Age-adjusted OR (95% CI)†	*P* value
Risk factors					
Abdominal obesity (≥80 cm)	28.1	67.1	<0.0001	1.61 (1.15–2.25)	0.005
Elevated blood pressure (≥130/85 mmHg)	13.7	63.6	<0.0001	1.11 (0.76–1.61)	0.599
Low HDL cholesterol (<1.29 mmol/l)	54.2	69.8	<0.0001	1.24 (0.90–1.72)	0.190
High triglyceride (≥1.69 mmol/l)	18.9	39.3	<0.0001	1.28 (0.89–1.83)	0.184
High fasting glucose (≥6.1 mmol/l)	9.8	26.0	<0.0001	1.07 (0.69–1.65)	0.775
Number of risk factors					
One or more	70.4	96.3	<0.0001	2.79 (1.67–4.64)	<0.0001
Two or more	35.1	81.0	<0.0001	1.35 (0.96–1.91)	0.087
Three or more	13.8	54.6	<0.0001	1.51 (1.04–2.19)	0.030
Four or more	4.4	27.4	<0.0001	2.20 (1.33–3.65)	0.002

Data are prevalence (%). *χ^2 test. †Logistic regression adjusted for age (continuous variable).

Table 3—*Unadjusted and adjusted ORs for the metabolic syndrome in Korean women*

		Metabolic syndrome			
	n (%)	Unadjusted OR (95% CI)	*P* value	Adjusted OR* (95% CI)	*P* value
Menopause					
Premenopause	1,893 (13.8)	1		1	
Postmenopause on no HRT	778 (54.6)	7.50 (6.18–9.08)	<0.0001	1.60 (1.04–2.46)	0.032
BMI (kg/m^2)					
<18.5	168 (3.6)	0.21 (0.09–0.47)	<0.0001	0.19 (0.08–0.47)	<0.0001
≥18.5 and <25	1,798 (15.2)	1		1	
≥25 and <30	625 (55.7)	6.99 (5.70–8.57)	<0.0001	6.26 (4.90–7.99)	<0.0001
>30	80 (73.8)	15.63 (9.34–26.14)	<0.0001	19.08 (10.57–34.45)	<0.0001
Smoking					
Nonsmoker	2,510 (24.9)	1		1	
Current smoker	128 (37.5)	1.81 (1.25–2.61)	0.002	0.99 (0.61–1.62)	0.966
Ex-smoker	33 (39.4)	1.96 (0.97–3.96)	0.062	1.51 (0.55–4.08)	0.423
Alcohol					
None	1,873 (28.7)	1.84 (1.48–2.29)	<0.0001	0.99 (0.75–1.32)	0.966
Current drinker	702 (17.9)	1		1	
Risk drinker	62 (22.6)	1.33 (0.71–2.49)	0.368	1.64 (0.76–3.52)	0.207
High-risk drinker	30 (26.7)	1.66 (0.72–3.82)	0.231	0.68 (0.24–1.96)	0.480
Education level (year)					
<9	1,034 (47.7)	12.26 (8.82–17.05)	<0.0001	1.51 (0.97–2.37)	0.071
9–12	999 (14.9)	2.36 (1.66–3.35)	<0.0001	1.21 (0.81–1.81)	0.362
≥13	636 (6.9)	1		1	
Household income†					
<1,000	329 (49.8)	5.14 (3.70–7.15)	<0.0001	0.94 (0.61–1.47)	0.943
1,000–1,499	638 (31.3)	2.36 (1.75–3.19)	<0.0001	1.19 (0.81–1.74)	0.386
1,500–2,499	1,103 (19.8)	1.28 (0.95–1.70)	0.101	1.03 (0.72–1.48)	0.873
≥2,500	457 (16.2)	1		1	
Exercise (times/week)					
No	2,050 (27.0)	1.27 (0.97–1.66)	0.083	1.21 (0.87–1.68)	0.248
1–2	234 (17.5)	1.33 (0.87–2.04)	0.185	1.00 (0.60–1.66)	0.993
≥3	382 (23.6)	1		1	
Residential area					
Large city	1,246 (23.8)	1		1	
Medium/small city	876 (20.2)	0.82 (0.66–1.02)	0.075	0.77 (0.58–1.02)	0.067
Rural area	647 (39.9)	2.22 (1.80–2.73)	<0.0001	1.22 (0.92–1.61)	0.161
Family history of CVD	384 (27.9)	1.14 (0.89–1.44)	0.299	1.73 (1.26–2.38)	0.001
Family history of diabetes	267 (25.5)	0.99 (0.74–1.32)	0.921	1.55 (1.07–2.27)	0.022

*Multivariate-adjusted odds ratio. Age was inserted as a continuous variable. †Unit is thousands won (₩)/month.

women aged >50 years compared with men of the same age has been reported in several Korean studies (6,13–16) with various age-groups of peak prevalence. One Korean study reported an unusual peak prevalence in men of age 40–49 years (13). This study was performed in a medium-sized city in Korea. The subjects were aged ≥40 years and were adjusted to the standard world population of Segi.

To the best of our knowledge, our study is the first to demonstrate the effect of menopause on the metabolic syndrome in Korean women. This finding is consistent with a U.S. study (7) based on the National Health and Nutrition Examination Survey III. However, two small studies have reported no association between the risk of the metabolic syndrome and postmenopausal women. One study of 124 Argentine women reported that postmenopausal women had a 22% higher prevalence of the metabolic syndrome than premenopausal women, but this difference disappeared after an age adjustment (17). A study of 300 Swedish women reported that postmenopausal women not on HRT did not have an increased risk of the metabolic syndrome (18). These two studies appear to be less reliable due to their small sample size, which is in contrast to our study and the U.S. study (6).

Natural menopause is associated with increased central adiposity (19). Abdominal obesity is a cardiovascular risk factor that is independent of overall adiposity (20,21). Middle-aged women gain ~0.55 kg per year, but most studies have not found that BMI increases independent of normal aging (22,23). In our study, the mean BMI of premenopausal and postmenopausal women was similar, but a large waist circumference was significantly associated with postmenopausal status after adjusting for age.

The influence of menopause on blood pressure is difficult to evaluate because menopause coincides with aging (24). Some studies have reported a strong association between blood pressure and

menopause, but other studies have not (24–26). In Korea, middle-aged women (≥50 years) have a higher prevalence of hypertension than age-matched men (2). We found that mean systolic blood pressure and pulse pressure were higher in postmenopausal women than premenopausal women after adjusting for age.

Menopause is associated with an increase in total and LDL cholesterol and triglyceride levels (21,27), while HDL cholesterol level decreases with menopause (28,29). However, not all studies (28,30) agree with this conclusion. In our study, mean HDL cholesterol levels were similar in premenopausal and postmenopausal women.

Oral postmenopausal hormone therapy decreases LDL cholesterol level and increases HDL cholesterol and triglyceride levels (31). A number of studies have shown that women on HRT have a reduced incidence of coronary heart disease and stroke. However, controversy still exists regarding the effect of HRT in preventing CVD in postmenopausal women (32). The Women's Health Initiative study group reported that the overall health benefits did not exceed the risks of using combined estrogen plus progestin in healthy postmenopausal women and conjugated equine estrogen in postmenopausal women (mean age was 63.2 years) who had undergone a hysterectomy (33,34). However, the recent Women's Health Initiative report suggests that conjugated equine estrogen in postmenopausal women aged 50–59 years is associated with a lower risk of coronary heart disease (35). In our study, the small sample of women receiving HRT was excluded on account of its controversial effects. Further research will be needed to determine the effect of HRT on the metabolic syndrome in postmenopausal women.

There were major limitations in our study. Selection bias might have occurred during the exclusion of ineligible women. In addition, our study was cross-sectional. This design limits generalization of our findings to all Korean women. In our study, modifiable health behaviors such as smoking and alcohol intake were not associated with an increased risk of the metabolic syndrome. A Korean study using the data from KNHANES 1998 found a significant association between alcohol and smoking and the risk of the metabolic syndrome in women (6). An association with smoking and alcohol intake might not have been observed due to the improper stratification, the limitations of a self-reported questionnaire, and other confounding factors.

In conclusion, there is an association between postmenopausal status and an increased risk of the metabolic syndrome independent of normal aging in Korean women.

Acknowledgments— We thank the Korea Institute of Health and Social Affairs for providing us with the KNHANES 2001 data, as well as Hyejung Jung and Jungja Song (officers working at Gwangju City Hall) for their assistance.

References

1. Vital Statistics Division: *2004 Cause of Death Statistics* [article in Korean]. Daejun, Korea, Korea National Statistical Office, 2005
2. Centers for Disease Control and Prevention: *Health Risk Behavior and Chronic Disease Statistics*. Gwacheon, Gyeonggi-do, Korea, Ministry of Health and Welfare, 2004 (in Korean)
3. Gordon T, Kannel WB, Hjortland MC, McNamara PM: Menopause and coronary heart disease: the Framingham Study. *Ann Intern Med* 89:157–161, 1978
4. Ford ES: Risks for all-cause mortality, cardiovascular disease, and diabetes associated with the metabolic syndrome. *Diabetes Care* 28:1769–1778, 2005
5. Kim MH, Kim MK, Choi BY, Shin YJ: Prevalence of the metabolic syndrome and its association with cardiovascular disease in Korea. *J Korean Med Sci* 19:195–201, 2004
6. 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
7. Park YW. Zhu S, Palaniapan L, Heshka S, Carnethon MR, Heymsfield SB: The metabolic syndrome: prevalence and associated risk factor findings in the US population from the Third National Health and Nutrition Examination Survey, 1998–1994. *Arch Intern med* 163: 427–436, 2003
8. Friedewald WT, Levy RI, Fredrickson DS: Estimation of the concerntration of low-density lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. *Clin Chem* 18:499–502, 1972
9. 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
10. World Health Organization Western Pacific Region, International Association For the Study of Obesity Task Force: *The Asia-Pacific Perspective: Redefining Obesity and Its Treatment*. Sydney, Australia, Health Communications Australia, 2000, p. 15–21
11. Ford ES, Giles WH, Dietz WH: Prevalence of the metabolic syndrome among US adults: findings from the Third National Health and Nutrition Examination Survey. *JAMA* 287:356–359, 2002
12. Soules MR, Sherman S, Parrott E, Rebar R, Santoro N, Utian W, Woods N: Executive summary: Stages of Reproductive Aging Workshop (STRAW). *Fertil Steril* 76: 874–878, 2001
13. Kwon HS, Park YM, Lee HJ, Choi YH, Ko SH, Lee JM Kang SK, Son SY: Prevalence and characteristics of the metabolic syndrome in middle-aged Korean adults. *Korean J Intern Med* 20:310–316, 2005
14. Song J, Kim E, Shin C, Kim SS, Lee HK, Jung M, Jung SC, Jo SA, Jo I: Prevalence of the metabolic syndrome among South Korean adults: the Ansan Study. *Diabet Med* 21:1064–1065, 2004
15. Oh JY, Hong YS, Sung YA, Barrett-Connor E: Prevalence and factor analysis of metabolic syndrome in an urban Korean population. *Diabetes Care* 27:2027–2032, 2004
16. Choi SH, Ahn CW, Cha BS, Chung YS, Lee KW, Lee HC, Huh KB, Kim DJ: The prevalence of the metabolic syndrome in Korean adults: comparison of WHO and NCEP criteria. *Yonsei Med J* 46:198–205, 2005
17. Mesch VR, Boero LE, Siseles NO, Royer M, Prada M, Sayegh F, Schreier L, Bnencia HJ, Berg GA: Metabolic syndrome throughout the menopausal transition: influence of age and menopausal status. *Climacteric* 9:40–48, 2006
18. Wamala S, Lynch J, Horsten M, Mittleman MA, Schenck-Gustafsson K, Orth-Gomer K: Education and the metabolic syndrome in women. *Diabetes Care* 22: 1999–2003, 1999
19. Poehlman ET, Toth MJ, Gardner AW: Changes in energy balance and body composition at menopause: a controlled longitudinal study. *Ann Intern Med* 123: 673–675, 1995
20. Kannel WB, Cupples LA, Ramaswami R, Stokes JD, Kreger BE, Higgins M: Reginal obesity and risk of cardiovascular disease: the Framingham Study. *J Clin Epidemiol* 44:183–190, 1991
21. Rexrode KM, Carey VJ, Hennekens CH, Walters EE, Colditz GA, Stampfer MJ, Willett WC, Manson JE: Abdominal adiposity and coronary heart disease in women. *JAMA* 280:1843–1848, 1998
22. Crawford SL, Casey VA, Avis NE, Mckinlay SM: A longitudinal study of weight and the menopause transition: results from the Messachusetts Women's Health Study. *Menopause* 7:96–104, 2000

23. Poehlman ET, Toth MJ, Ades PA, Rosen CJ: Menopause-associated changes in plasma lipids, insulin-like growth factor I and blood pressure: a longitudinal study. *Eur J Clin Invest* 27:322–326, 1997
24. Gierach GL, Johnson BD, Merz NB, Kelsey SF, Bittner V, Olson MB, Shaw LJ, Mankad S, Pepine CJ, Reis SE, Rogers WJ, Sharaf BL, Sopko G: Hypertension, menopause, and coronary artery disease risk in the Women's Ischemia Syndrome Evaluation (WISE) study. *J Am Coll Cardiol* 47: 50S–58S, 2006
25. Rosenthal T, Oparil S: Hypertension in women. *J Hum Hypertens* 14:691–704, 2000
26. Stassen JA, Ginocchio G, Thijs L, Fagard R: Conventional and ambulatory blood pressure and menopause in a prospective population study. *J Hum Hypertens* 11: 507–514, 1997
27. Schubert CM, Rogers NL, Remsberg KE, Sun SS, Chumlea WC, Demerath EW, Czerwinski SA, Towne B, Siervogel RM: Lipids, lipoproteins, lifestyle, adiposity and fat-free mass during middle age: the Fels Longitudinal Study. *Int J Obes* 30:251–260, 2006
28. Carr MC: The emergence of the metabolic syndrome with menopause. *J Clin Endocrinol Metab* 88:2404–2411, 2003
29. Middleberg RP, Spector TD, Awaminathan R: Genetic and environmental influence on lipids, lipoproteins, and apolipoproteins: effects of menopause. *Arterioscler Thromb Vasc Biol* 22:1142–1147, 2002
30. Ushiroyama T, Sakuma K, Ikeda A, Ueki M: The HDL2/HDL3 ratio in menopause. *Int J Gynaecol Obstet* 88:303–308, 2005
31. Bittner V: Perspectives on dyslipidemia and coronary heart disease in women. *J Am Coll Cardiol* 46:1628–1635, 2005
32. Magliano DJ, Rogers SL, Abramson MJ, Tonkin AM: Hormone therapy and cardiovascular disease: a systemic review and meta-analysis. *BJOG* 113:5–14, 2006
33. The Women's Health Initiative Steering Committee: Effects of conjugated equine estrogen in postmenopausal women with hysterectomy: the Women's Health Initiative randomized controlled trial. *JAMA* 291:1701–1712, 2004
34. Writing Group for the Women's Health Initiative Investigators: Risks and benefits of estrogen plus progestin in healthy postmenopausal women. *JAMA* 288:321–333, 2002
35. Hsia J, Langer RD, Manson JE, Kuller L, Johnson KC, Hendrix SL, Pettinger M, Heckbert SR, Greep N, Crawford S, Eaton CB, Kostis JB, Caralis P, Prentice R, the Women's Health Initiative Investigators: Conjugated equine estrogen and coronary heart disease. *Arch Intern Med* 166:357–365, 2006