Spousal Concordance of Metabolic Syndrome in 3141 Korean Couples: A Nationwide Survey

HYEON CHANG KIM, MD, PhD [1], DAE RYONG KANG, PhD[1], KUI SON CHOI, PhD[2], CHUNG MO NAM, PhD[1], G NEIL THOMAS, PhD[3], IL SUH, MD, PhD[1]

[1]Department of Preventive Medicine, Yonsei University College of Medicine, Seoul, Korea; [2]Division of Cancer Epidemiology and Control, National Cancer Center Research Institute, Goyang, Korea; [3]Department of Community Medicine, University of Hong Kong, Pokfulam, Hong Kong

Word count: text 2,563, abstract 196; 4 tables

Short title: Thomas et al: METABOLIC SYNDROME SPOUSAL CONCORDANCE

Corresponding author: G Neil Thomas

Department of Community Medicine

The University of Hong Kong

21 Sassoon Road, Pokfulam, Hong Kong

Tel: (852) 2632 3139

Fax: (852) 2632 3139

Email: gneilthomas@yahoo.co.uk

Abstract

PURPOSE: Epidemiologic data from various regions have shown familial correlations of cardiovascular risk factors and the metabolic syndrome (MES), but not spousal concordance that reflects shared environmental factors, which we now describe in a Korean general population.

METHODS: We selected 3141 couples, where both partners had completed a national health examination. MES was determined according to NCEP ATP-III definitions, except for waist circumference where Asian cutoffs were used. Unadjusted and age-adjusted spousal correlations, and spousal concordance, using logistic regression analysis after adjustment for spousal ages, for each MES component were calculated.

RESULTS: There were strong positive spousal correlations for each component of the MES, even after adjustment for age. Significant spousal concordance of MES was also observed. Men whose wives had MES had 1.29 (95%CI, 1.07-1.57) times higher risk of having MES, compared to those whose wives did not. Women whose husbands had MES were also at 1.32 (95%CI, 1.09-1.61) times higher risk of having the MES.

CONCLUSIONS: There was significant spousal concordance of the MES in Koreans, which implies shared environmental factors contribute to the development of the MES. Targeting screening or disease prevention measures of partners of people with the MES may be beneficial.

KEY WORDS: cardiovascular risk factors, environment, lifestyle, metabolic syndrome, spousal concordance

INTRODUCTION

The metabolic syndrome, also known as the insulin resistance syndrome, is defined by a clustering of risk factors for cardiovascular disease. Epidemiologic data from various regions have shown familial correlations of cardiovascular risk factors and metabolic syndrome (1-5). Familial correlation of the metabolic syndrome can be explained by common genetic and environmental factors that predispose to the development of the condition. However, discrimination of the relative contribution of the genetic and environmental components of the correlation is problematic. Both components can contribute to disease independently or in conjunction. As such studies on the spousal concordance of certain diseases as a result of shared lifestyle and socioeconomic environment, but on a unrelated genetic background, allows the investigation of determinants related to non-genetic factors (6,7). Identification of the relative contributions of shared modifiable environmental risk factors may then improve our understanding and thus enable targeting of detrimental lifestyle minimizing the rapid increase in the prevalence of the metabolic syndrome. Thus we studied the spousal concordance of metabolic syndrome and each of its metabolic risk components, using data on 3,141 married couples in Korea.

METHODS

Study population

The Korean National Health and Nutrition Examination Surveys (KNHANES) were conducted in non-institutionalized Korean civilians in 1998 and 2001. The KNHANES consisted of basic household interview, health interview and examination, and 24-hour recall and food frequency questionnaire-based nutrition survey. A stratified multistage probability sampling design was used, with selection made from sampling units based on geographical area, sex, and age groups using household registries. Based on the results from the basic houshold interview, a total of 8,435 families (4,395 in 1998 and 4,040 in 2001) were selected for the health interview and examination, and nutrition survey. Among those families, 19,541 individuals (9,771 in 1998 and 9,770 in 2001) aged ten years or more completed the health examinations. Among them, we identified 4090 couples, who were married at the time of interview. Both spousal members of 3210 couples were fasting for at least eight hours, when their blood samples were obtained. We further excluded 69 couples with pregnant spouses, resulting in the use of 3141 couples for the analyses.

Data collection

Anthropometric measurements including height, weight, waist circumference and hip girth on individuals wearing light clothing and without shoes were conducted by well-trained examiners. Waist circumference measurements were taken at the end of normal expiration to the nearest 0.1 cm, measuring from the midpoint between the lower borders of the rib cage and the iliac crest. A standard mercury sphygmomanometer was used to measure the blood pressure of each subject in the sitting position after a 10-minute rest period. During the 30 minutes preceding the measurement, subjects were required to refrain from smoking or consuming caffeine. Systolic and diastolic blood pressure was measured at phase I and V Korotkoff sound, respectively. Two readings, each of systolic and diastolic blood pressure were recorded and the average of each measurement was used for data analysis. If the first two measurements differed by more than 5 mmHg, additional readings were obtained. Blood samples were obtained from an antecubital vein into vacutainer tubes containing EDTA in the morning after the overnight fast. Samples were subsequently analyzed at a central, accredited laboratory. Serum glucose, triglycerides, total cholesterol, and high-density lipoprotein (HDL)-cholesterol were measured by an autoanalyzer (Hitachi 747 auto-analyzer, Japan). Current medication status of the participants for hypertension or diabetes was determined by self-administered questionnaire.

Definition of metabolic syndrome

The metabolic syndrome was defined according to the National Cholesterol Education Program Adult Treatment Panel-III (ATP-III), except for abdominal obesity by waist circumference (8). We used a waist circumference cutoff of >90 cm in men and >80 cm in women, according to the report by the International Diabetes Institute / Western Pacific World Health Organization / International Obesity Task Force (9). Hence, in this study, participants having three or more of the five following criteria were defined as having the metabolic syndrome: high blood pressure (≥130/85 mmHg), elevated fasting blood glucose (≥110 mg/dl or 6.05 mmol/l), hypertriglyceridaemia (≥150 mg/dl or 1.65 mmol/l), low HDL-cholesterol (men, <40 mg/dl or 1.05 mmol/l; women, <50 mg/dl or 1.30 mmol/l), and abdominal obesity by waist circumference (men, >90 cm; women, >80 cm). Participants receiving anti-hypertensive or anti-diabetic medications were included in the high blood pressure group and the high fasting blood glucose group, respectively.

Statistical analyses

Descriptive data are shown as mean ± standard deviation. We used Pearson's correlation coefficient to determine the correlation between spouses for the components of metabolic syndrome and other cardiovascular risk factors. As spousal members tend to be close in age, and age contributes to these conditions and thus to spousal correlation, we also estimated correlation coefficients for age-adjusted residuals of each risk factor. Residuals are the differences between the observed and estimated values from age and risk factor analyses. Spousal concordance of metabolic syndrome and each metabolic component was measured, and described using odds ratio and their respective 95% confidence intervals. An odds ratio greater than 1.0 indicates spousal concordance. Unadjusted and age-adjusted odds ratios were estimated by logistic regression models. We calculated the prevalence of metabolic syndrome and each metabolic abnormality by age, and finally we estimated the odds ratio for spousal concordance for metabolic syndrome in different age groups.

RESULTS

Table 1 shows the level of major cardiovascular risk factors and their spousal correlations in 3,141 married Korean couples. All major risk factors were highly correlated between the spouses, even after adjusting for the age of the spouses. According to the ATP-III definition, 565 (18.0%) husbands and 585 (18.6%) wives had the metabolic syndrome. When we used the ATP-III criteria for abdominal obesity (102 cm for men and 88 cm for women), the prevalence of abdominal obesity was 1.7% in men and 15.3% in women. However, when we used modified Asian criteria (90 cm for men and 80 cm for women), the prevalence of abdominal obesity was 23.7% in men and 42.1% in women, and the prevalence of the metabolic syndrome increased to 25.7% and 25.9%, respectively. High blood pressure (48.1%) and serum triglycerides (40.9%) were the most frequent metabolic abnormalities in men, while low serum HDL-cholesterol (54.4%) and abdominal obesity (42.1%) were the most frequent in women (Table 2).

Participants whose marital partner had metabolic syndrome were at increased risk of having the syndrome, when compared with those whose partner did not have the syndrome. If we adjusted for ages of both partners, the spousal odds ratios for the metabolic syndrome were slightly attenuated but still significant. Although the spousal concordance was observed in all the five components of the metabolic syndrome, there was difference in the strength of the concordance between the components. High fasting glucose level showed the strongest spousal concordance. Strength of the spousal concordance in hypertension was markedly attenuated after adjustment for age, whereas the concordances in high triglyceride, low HDL-cholesterol and central obesity did not change even after adjustment for ages of the spousal members (Table 2).

Preliminary analyses of the KNHANES 2001 24-hour recall nutrition survey showed that there was a high level of age-adjusted correlation between the spouses for protein, fat, carbohydrate, fiber and total energy intake ranging from 0.36 to 0.54, p<0.001 for all.

Table 3 shows the prevalence of metabolic syndrome and each risk factor by age. An increasing prevalence of the metabolic syndrome with age was observed in both men and women, but the slope was steeper in women. The prevalence of metabolic syndrome in men did not increase after age 50, while the prevalence in women increased continuously with age. In men, high blood pressure and high fasting blood glucose were positively related with age. However, high triglyceride levels and abdominal obesity in men aged ≥60 years were less frequent than in those aged 40 to 59 years. In women, all the five risk factors positively increased with age. Until age 60 years, high blood pressure, fasting blood glucose, and serum triglycerides were more frequent in men than in women. However after 60 years, the prevalence of these conditions was higher in women (Table 3). When we examined the spousal concordance for the presence of the metabolic syndrome with the metabolic score, namely the number of shared metabolic syndrome components, the age-adjusted odds ratios were significant in the males and females ranging from 1.27 to 2.58, with a significant odds ratio per risk factor of 1.13 (Table 4). Spousal concordance of metabolic syndrome was estimated in different age groups. In men and women aged <40 years or aged 50 to 59 years, spousal correlation for the metabolic syndrome was not significant (Table 5).

DISCUSSION

The present study showed an overall spousal concordance for the metabolic syndrome and each of its components in these 3141 married couples from Korea. When one spouse tested positive for the metabolic syndrome, his or her marital partner showed about a 30% increased risk of also having the metabolic syndrome. These findings suggest that not only genetic factors but also environmental factors may contribute to the development of metabolic syndrome.

Spousal concordance

The positive spousal correlations of cardiovascular risk factors have been reported in earlier studies (10,11). In addition to those findings, we showed strong spousal concordance for the metabolic syndrome and its components. While husband and wife are not genetically related, they do share common environmental factors that may predispose to the development of these conditions. Thus if it is observed that there is a significant spousal concordance for a certain disease, the mechanism is likely to be predominantly mediated by the environmental challenge on a permissive genetic background (6).

Spousal concordance of the metabolic syndrome and each risk factor in our study could be mediated by both "cohabitation effects" and "assortative mating" (1,10). In general, husband and wife share the same or similar household environment, which usually implies the sharing of many aspects of lifestyle. This cohabitation is the most likely mechanism that explains the spousal concordance of the metabolic syndrome, particularly given the high spousal concordance of dietary intake, such as calorie and carbohydrate intake, the latter possibly contributing to the high spousal concordance observed for glycosylated hemoglobin levels. However, spousal concordance can also be explained by assortative mating. People tend to choose a marriage partner who possesses characteristics and lifestyle habits similar to their own. Several previous studies suggested that concordance for several cardiovascular risk factors could be due to positive assortative mating (1,6,10). We could not clearly discriminate the effects of cohabitation and the effects of assortative mating in the development of spousal concordance. However, our findings suggest that non-genetic lifestyle factors significantly contribute to the underlying causes of metabolic syndrome. The findings imply that marital partners of people with the metabolic syndrome could be a potential target population for screening and/or the introduction of disease prevention strategies.

Age effects

In our population, the prevalence of the metabolic syndrome in men did not increase after age 50 years, while the prevalence continuously increased with age in women (Table 3). This finding has already been reported in previous studies in Koreans and in other populations (12-16). Gender differences in the development of the metabolic syndrome after age 50 might be due to the higher prevalence of abdominal obesity and prominent weight gain associated with ageing in women compared with men in Korea. Menopause may be a contributing factor for this abrupt increase in women after age 50. We did not measure the menopausal status, but the abdominal obesity and acute increase of insulin resistance after menopause has been reported previously (17).

When we examined the spousal concordance of the metabolic syndrome by different age groups, we could not observe spousal concordance in men and women aged below 40 years and in those aged 50 to 59 years. It is not clear why these differences by age in the spousal concordance of the metabolic syndrome were observed. In the younger age range it may be the result of the relatively low prevalence of the metabolic syndrome, and probably a shorter duration of marriage and thus less exposure to the common predisposing environmental factors. The non-concordance of the metabolic syndrome in the age 50-59 range could be explained, at least partially, by the menopausal effects in women. Data on menopausal status was obtained only in 2001 survey, and the mean age at menopause was 48.0 years. Compared with the younger age group (40-49 years), the women aged 50-59 years showed markedly increased prevalence of metabolic syndrome (22.3% to 43.9%), whereas the increase of the prevalence was minimal in men (28.2% to 29.5%).

Regional differences

Compared with most Western populations, Koreans have lower cholesterol and body weight levels. However, the prevalence of the metabolic syndrome is still high, and has been estimated at 20 to 30% in Korean adults (13,14,18,19). Among the five components of metabolic syndrome, the prevalence of abdominal obesity has the biggest impact on the difference between Korean and Western populations. There is increasing evidence that Asian people have a lower body mass index and waist circumference than Caucasians, but they have higher percent body fat and different fat distribution (20-22). Thus several studies used various modified criteria for abdominal obesity in Asian people (13,18,20,21,23,24), but we have no clear standard yet. The criteria recommended in the report by the International Diabetes Institute / Western Pacific World Health Organization / International Obesity Task Force have been most widely used (9). When we used the modified Asian criteria instead of original ATP-III criteria, the prevalence of abdominal obesity increased from 1.7% to 23.7% in men and from 15.3% to 42.1% in women. Accordingly, the prevalence of metabolic syndrome also increased from 18.0% to 25.7% in men and from 18.6% to 25.9% in women. These findings are in agreement with most previous studies in Asia (13,15,18,21,23), but the impact of decreasing the abdominal obesity criteria on the prevalence of metabolic syndrome differed by ethnic groups (21). In contrast to the abdominal obesity, frequencies of high triglyceride levels and of low HDL-cholesterol were higher in Korean than in Western populations. However, we do not have enough data to define the normal range of triglycerides and HDL-cholesterol. Many studies suggested that ATP-III criteria, when applied to an Asian population, would underestimate the population at risk (13,18,21,23). Our data support that the original ATP-III criteria might not be applicable to the Korean population. We also observed that the spousal concordance of metabolic syndrome was more prominent when we used modified criteria than when we used original ATP-III criteria (Data are not shown).

Strengths and limitations

The important strengths of our study are its large sample size and its representativeness. We investigated the spousal concordance of the metabolic syndrome in a large general population, which included more than 3,000 married couples from a nationally representative sample. External validity is therefore sufficient to extrapolate the findings to the general Korean population.

A major limitation of this study is that we had no information on the marriage duration or on the sequence of events (for example, when the participants married, whether they already had the disease at the time of marriage, or how long after the marriage they were given the diagnosis). Thus we could not discriminate assortative mating from cohabitation effects in the development of spousal concordance. However, the lack of correlation with the metabolic syndrome in the younger spouses suggests that the cumulative effects of long term cohabitation and subsequent adoption of similar lifestyles may be more important than assortative mating in determining the observed spousal correlations. Further evidence supporting this assumption can be derived from the high correlation between the spouses for intake of dietary components, including total energy intake. Another limitation of this study is its cross-sectional design, suggesting that caution should be used in causal interpretation of these findings. Further studies to establish the presence of metabolic syndrome at the time the marriage and the development of metabolic syndrome during marriage would allow discrimination of these factors. Misclassification bias might be another limitation of this study, but would likely be non-differential rather than differential, and thus would have attenuated the spousal concordance.

CONCLUSIONS

Our study revealed that there is significant spousal concordance for the metabolic syndrome and its components in Korean married couples. The increased risk of same metabolic abnormality within married couples supports the idea that shared environmental factors contribute to the development of the metabolic syndrome. These findings imply that we can reduce the risk of the metabolic syndrome having healthier lifestyles. The findings could also have implications for targeting screening or disease prevention measures at partners of people with the metabolic syndrome. The costs and benefits of screening spouses for metabolic syndrome would need to be considered.

ACKNOWLEDGEMENTS: Thanks are expressed to the members of the Korea Institute for Health and Social Affairs who conducted the national surveys and everyone who contributed to this project. This study was supported, in part, by Yonsei University Research Fund of 2004.

REFERENCES

1. Knuiman MW, Divitini ML, Welborn TA, Bartholomew HC. Familial correlations, cohabitation effects, and heritability for cardiovascular risk factors. Ann Epidemiol. 1996;6:188-194.
2. Brenn T. Adult family members and their resemblance of coronary heart disease risk factors: the Cardiovascular Disease Study in Finnmark. Eur J Epidemiol. 1997;13:623-630.
3. Perusse L, Rice T, Despres JP, Rao DC, Bouchard C. Cross-trait familial resemblance for body fat and blood lipids: familial correlations in the Quebec Family Study. Arterioscler Thromb Vasc Biol. 1997;17:3270-3277.
4. Harrap SB, Stebbing M, Hopper JL, Hoang HN, Giles GG. Familial patterns of covariation for cardiovascular risk factors in adults: The Victorian Family Heart Study. Am J Epidemiol.

2000;152:704-715.

5. Jee SH, Suh I, Won SY, Kim MY. Familial correlation and heritability for cardiovascular risk factors. Yonsei Med J. 2002;43:160-164.

6. Hippisley-Cox J, Coupland C, Pringle M, Crown N, Hammersley V. Married couples' risk of same disease: cross sectional study. BMJ. 2002;325:636.

7. Knuiman MW, Divitini ML, Bartholomew HC. Spouse selection and environmental effects on spouse correlation in lung function measures. Ann Epidemiol. 2005;15:39-43.

8. 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. 2001;285:2486-2497.

9. World Health Organization. The Asia-Pacific perspective: redefining obesity and its treatment: Health Communications, Australia, 2000 [Reference can be found at http://www.idi.org.au/downloads/obesity_report.pdf];1-56.

10. Knuiman MW, Divitini ML, Bartholomew HC, Welborn TA. Spouse correlations in cardiovascular risk factors and the effect of marriage duration. Am J Epidemiol. 1996;143:48-53.

11. Peek MK, Markides KS. Blood pressure concordance in older married Mexican-American couples. J Am Geriatr Soc. 2003;51:1655-1659.

12. Lee WY, Park JS, Noh SY, Rhee EJ, Kim SW, Zimmet PZ. Prevalence of the metabolic syndrome among 40,698 Korean metropolitan subjects. Diabetes Res Clin Pract. 2004;65:143-149.

13. Kim MH, Kim MK, Choi BY, Shin YJ. Prevalence of the metabolic syndrome and its association with cardiovascular diseases in Korea. J Korean Med Sci. 2004;19:195-201.

14. Park HS, Oh SW, Cho SI, Choi WH, Kim YS. The metabolic syndrome and associated lifestyle factors among South Korean adults. Int J Epidemiol. 2004;33:328-336.

15. Thomas GN, Ho SY, Janus ED, Lam KSL, Hedley AJ, Lam TH, et al. The US National Cholesterol Education Programme Adult Treatment Panel III (NCEP ATP III) prevalence of the metabolic syndrome in a Chinese population: the Hong Kong Cardiovascular Risk Factor Study. Diab Res Clin Prac. 2005;67:251-257.

16. Jaber LA, Brown MB, Hammad A, Zhu Q, Herman WH. The prevalence of the metabolic syndrome among arab americans. Diabetes Care. 2004;27:234-238.

17. Fujimoto WY, Bergstrom RW, Boyko EJ, Chen K, Kahn SE, Leonetti DL, et al. Type 2 diabetes and the metabolic syndrome in Japanese Americans. Diabetes Res Clin Pract. 2000;50 Suppl 2:S73-76.

18. Oh JY, Hong YS, Sung YA, Barrett-Connor E. Prevalence and factor analysis of metabolic syndrome in an urban Korean population. Diabetes Care. 2004;27:2027-2032.

19. Choi KM, Lee J, Kim KB, Kim DR, Kim SK, Shin DH, et al. Factor analysis of the

metabolic syndrome among elderly Koreans-the South-west Seoul Study. Diabet Med. 2003;20:99-104.

20. Deurenberg P, Yap M, van Staveren WA. Body mass index and percent body fat: a meta analysis among different ethnic groups. Int J Obesity. 1998;22:1164-1171.

21. Tan CE, Ma S, Wai D, Chew SK, Tai ES. Can we apply the National Cholesterol Education Program Adult Treatment Panel definition of the metabolic syndrome to Asians? Diabetes Care. 2004;27:1182-1186.

22. Unwin N, Harland J, White M, Bhopal R, Winocour P, Stephenson P, et al. Body mass index, waist circumference, waist-hip ratio, and glucose intolerance in Chinese and Europid adults in Newcastle, UK. J Epidemiol Community Health. 1997;51:160-166.

23. Ramachandran A, Snehalatha C, Satyavani K, Sivasankari S, Vijay V. Metabolic syndrome in urban Asian Indian adults-a population study using modified ATP III criteria. Diabetes Res Clin Pract. 2003;60:199-204.

24. Ko GTC, Chan JCN, Cockram CS, Woo J. Prediction of hypertension, diabetes, dyslipidaemia or albuminuria using simple anthropometric indexes in Hong Kong Chinese. Int J Obesity. 1999;23:1136-1142.

TABLE 1. Cardiovascular risk factors and their spousal correlation in 3141 married couples

Variables	Husband (n=3,141)	Wife (n=3,141)	Simple correlation Coefficient	Simple correlation p-value	Age-adjusted residual correlation* Coefficient	Age-adjusted residual correlation* p-value
Mean ± SD						
Age, years	47.9 ± 12.8	44.2 ± 12.2	0.9665	<.0001		
Weight, kg	66.8 ± 10.0	57.6 ± 8.2	0.0740	<.0001	0.0811	<.0001
Height, cm	168.4 ± 6.2	156.3 ± 5.6	0.2721	<.0001	0.1365	<.0001
Body mass index, kg/m^2	23.5 ± 3.0	23.6 ± 3.2	0.0364	0.0414	0.0693	<.0001
Waist circumference, cm	84.3 ± 8.2	78.8 ± 8.9	0.0681	0.0001	0.0610	0.0006
Hip circumference, cm	93.9 ± 6.1	93.8 ± 6.3	0.1030	<.0001	0.1159	<.0001
Waist-hip ratio	0.90 ± 0.06	0.84 ± 0.07	0.2161	<.0001	0.1104	<.0001
Fasting blood glucose, mg/dl	102.0 ± 27.2	99.4 ± 28.1	0.1037	<.0001	0.0822	<.0001
Glycosylated hemoglobin, mg/dl	6.4 ± 9.3	8.1 ± 15.1	0.5524	<.0001	0.5339	<.0001
Systolic blood pressure, mmHg	127.4 ± 18.6	120.8 ± 19.2	0.2431	<.0001	0.1051	<.0001
Diastolic blood pressure, mmHg	81.2 ± 11.6	75.7 ± 11.2	0.1383	<.0001	0.1280	<.0001
Total cholesterol, mg/dl	191.2 ± 36.2	187.8 ± 35.7	0.0657	0.0002	0.0547	0.0022
HDL-cholesterol, mg/dl	46.1 ± 11.8	49.7 ± 11.4	0.1014	<.0001	0.1064	<.0001
LDL-cholesterol, mg/dl	115.5 ± 33.3	115.3 ± 31.5	0.0615	0.0006	0.0560	0.0017
Triglyceride, mg/dl	148.1 ± 74.2	114.8 ± 61.0	0.0960	<.0001	0.0982	<.0001
Number (%)						
Anti-hypertensive medication	178 (5.7%)	212 (6.7%)	$\chi^2 = 4.574$, p=0.0325			
Anti-diabetic medication	86 (2.7%)	86 (2.7%)	$\chi^2 = 1.207$, p=0.2720			

*Residuals were difference between the observed value and the estimated value from age.

TABLE 2. Spousal concordance of metabolic syndrome and its each metabolic risk factor in 3141 married couples

	Husband			Wife		
		Spouse odds ratio* (95% CI)			Spouse odds ratio* (95% CI)	
Outcome	No. (%)	Unadjusted	Age-adjusted**	No. (%)	Unadjusted	Age-adjusted**
Metabolic syndrome	807 (25.7)	1.49 (1.25-1.77)	1.29 (1.07-1.57)	812 (25.9)	1.49 (1.25-1.77)	1.32 (1.09-1.61)
Each metabolic risk factor						
Fasting glucose ≥110 mg/dl	684 (21.8)	2.25 (1.83-2.75)	1.92 (1.55-2.37)	530 (16.9)	2.25 (1.83-2.75)	1.94 (1.57-2.40)
Blood pressure ≥130/80 mmHg	1511 (48.1)	2.03 (1.74-2.38)	1.37 (1.15-1.63)	954 (30.4)	2.03 (1.74-2.38)	1.39 (1.17-1.66)
Triglyceride ≥150mg/dl	1285 (40.9)	1.30 (1.10-1.54)	1.31 (1.10-1.56)	711 (22.6)	1.30 (1.10-1.54)	1.34 (1.12-1.59)
HDL-cholesterol <40 (50) mg/dl	990 (31.5)	1.61 (1.38-1.88)	1.62 (1.39-1.89)	1709 (54.4)	1.61 (1.38-1.88)	1.62 (1.39-1.89)
Waist circumference ≥90 (80) cm	735 (23.4)	1.36 (1.15-1.60)	1.33 (1.11-1.58)	1323 (42.1)	1.36 (1.15-1.60)	1.33 (1.11-1.58)

*Odds ratio of having metabolic syndrome or its component in one spouse whose partner had the same abnormality, compared with those whose partner did not. **Adjusted for age of both partners in bands. HDL, high-density lipoprotein

TABLE 3. Prevalence (%) of metabolic syndrome and its each metabolic risk factor by age

	Husband by age groups						Wife by age groups					
Outcome	<40	40-49	50-59	≥60	Total	p trend	<40	40-49	50-59	≥60	Total	p trend
Number	987	858	633	663	3141		1296	827	585	433	3141	
Metabolic syndrome	19.0	28.2	29.5	28.7	25.7	<.001	9.7	22.3	43.9	56.8	25.9	<.001
Each metabolic risk factor												
Fasting glucose ≥110 mg/dl	13.8	21.5	28.3	27.9	21.8	<.001	9.3	14.8	24.3	33.7	16.9	<.001
Blood pressure ≥130/80 mmHg	33.8	46.4	56.1	64.0	48.1	<.001	9.5	28.9	51.8	66.7	30.4	<.001
Triglyceride ≥150mg/dl	37.4	46.5	43.1	36.8	40.9	0.855	14.0	17.4	35.0	41.6	22.6	<.001
HDL-cholesterol <40 (50) mg/dl	32.6	32.3	28.0	32.3	31.5	0.425	50.2	52.6	58.6	64.7	54.4	<.001
Waist circumference ≥90 (80) cm	17.2	29.4	27.0	21.4	23.4	0.031	24.2	43.9	60.3	67.9	42.1	<.001

HDL, high-density lipoprotein

TABLE 4. Odds ratio for having metabolic syndrome according to the metabolic score of other spouse member

	Husband		Wife	
Metabolic score	Unadjusted odds ratio (95% CI)	Age-adjusted odds ratio (95% CI)*	Unadjusted odds ratio (95% CI)	Age-adjusted odds ratio (95% CI)*
0	1.00	1.00	1.00	1.00
1	1.31 (1.03-1.66)	1.27 (1.00-1.62)	1.73 (1.34-2.23)	1.42 (1.07-1.87)
2	1.53 (1.19-1.96)	1.42 (1.10-1.83)	1.81 (1.39-2.35)	1.37 (1.03-1.81)
3	1.76 (1.34-2.32)	1.56 (1.17-2.07)	2.12 (1.61-2.79)	1.67 (1.24-2.15)
4	2.15 (1.56-2.95)	1.81 (1.28-2.55)	2.39 (1.67-3.42)	1.61 (1.09-2.37)
5	1.92 (1.18-3.12)	1.60 (0.97-2.66)	3.93 (2.21-6.99)	2.58 (1.39-4.78)
Continuous (per 1 risk factor)	1.18 (1.11-1.25)	1.13 (1.06-1.21)	1.22 (1.15-1.30)	1.13 (1.06-1.22)

Metabolic score was defined as the number of presence of metabolic risk factors in NCEP-ATP III criteria.

*Adjusted for age of both partners in bands`

TABLE 5. Spousal concordance of metabolic syndrome in 3141 married couples by age

	Husband			Wife		
Age groups	No. of people	No. (%) with metabolic syndrome	Spousal odds ratio* (95% CI)	No. of people	No. (%) with metabolic syndrome	Spousal odds ratio* (95% CI)
≤39	987	188 (19.1)	0.87 (0.47 to 1.62)	1296	125 (9.7)	1.45 (0.96 to 2.21)
40-49	858	242 (28.2)	1.86 (1.29 to 2.67)	827	184 (22.3)	1.44 (1.01 to 2.05)
50-59	633	187 (29.5)	0.92 (0.64 to 1.32)	585	257 (43.9)	0.90 (0.63 to 1.29)
≥60	663	190 (28.7)	1.47 (1.04 to 2.07)	433	246 (56.8)	1.63 (1.06 to 2.50)

*Odds ratio of having metabolic syndrome in one spouse whose partner had metabolic syndrome, compared with those whose partner did not. The odds ratios were adjusted for age of both partners in bands.