Original Article

Metabolic Risk Factors for Prediction Cardiovascular Diseases in a Hospital Setting: A Meta-Analysis

Arinrada Ladla RN[1], Suprawita Saensak PhD[2],
Pramote Tongkrajai PhD[3], Sompong Srisaenpang MD, PhD[4], Kittisak Sawanyawisuth MD, PhD[5]

[1] PhD Student in Health Science, Faculty of Medicine, Mahasarakam University, Mahasarakam, Thailand
[2] Gradutaed Studies Division, Faculty of Medicine, Mahasarakam University, Mahasarakam, Thailand
[3] Gradutaed Studies Division, Faculty of Medicine, Mahasarakam University, Mahasarakam, Thailand
[4] Department of Community Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand
[5] Sleep Apnea Research Group, Research Center in Back, Neck and Other Joint Pain and Human Performance, Research and Training Center for Enhancing Quality of Life of Working Age People, Khon Kaen University, Khon Kaen, Thailand

Cardiovascular diseases are the main cause of death and disability. Metabolic syndrome is a group of several conditions that has been shown to be a major cardiovascular risk factor. A meta-analysis conducted in 2009 found that metabolic syndrome is associated with cardiovascular diseases for 2.35 times. However, the study included various study populations. This study aimed to evaluate and update the cardiovascular risks of metabolic syndrome in hospital setting. Literature searching was performed under the standard of the Cochrane Handbook on nine databases. There were seven studies conducted on risk of cardiovascular diseases by metabolic syndrome. There were 13,216 patients with 3,069 patients (23.22%) diagnosed as metabolic syndrome. Overall relative risk for cardiovascular diseases by presence of metabolic syndrome was 1.88 (1.61, 2.19). Subgroup analysis by study sites and sex were also performed. The relative risks of cardiovascular diseases by metabolic syndrome for Asia, non-Asia, male, and female were 2.19, 1.79, 1.66, and 2.28. In conclusion, patients with metabolic syndrome in hospital setting are at risk for major cardiovascular diseases regardless of continents or sex.

Keywords: Relative risk, Sex, Ethnicity

J Med Assoc Thai 2018; 101 [Suppl. 7]: S143-S148
Website: http://www.jmatonline.com

Cardiovascular diseases are the main cause of death and disability; estimated to be 17.6 million deaths in 2015[1]. The endemic area for incidence of cardiovascular diseases is Europe compared with other regions such as Asia. The mortality rate from cardiovascular diseases in Europe is accounted for 46% of all deaths; coronary artery disease for 20%, stroke for 12% and other vascular diseases for 14%. In addition, it might be sex differences; female sex is at higher risk than male (51% vs. 42% in terms of cardiovascular mortality[2].

Metabolic syndrome is a group of several conditions that has been shown to be a major cardiovascular risk factor[3]. The prevalence of cardiovascular diseases may be high as 34.6% in elderly patients with metabolic syndrome[4,5]. A meta-analysis conducted in 2009 found that metabolic syndrome is associated with cardiovascular diseases for 2.35 times and cardiovascular mortality by 2.40 times[6]. However, the study included various study populations such as general population and those with risks for cardiovascular diseases such as diabetes or hypertension. Patients in hospital setting may have more severe condition than general population and may have higher risk of cardiovascular diseases if metabolic syndrome is presence. The present study aimed to evaluate and update the cardiovascular risks of metabolic syndrome in hospital setting.

Correspondence to:
Sawanyawisuth K. Department of Medicine, Faculty of Medicine, Khon Kaen University, Khon Kaen 40002. Thailand.
Phone: +66-43-363664
E-mail: kittisak@kku.ac.th

Materials and Methods

A systematic review and meta-analysis were followed the Cochrane Handbook and included the Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement[7].

How to cite this article: Ladla A, Saensak S, Tongkrajai P, Srisaenpang S, Sawanyawisuth K. Metabolic risk factors for prediction cardiovascular diseases in a hospital setting: a meta-analysis. J Med Assoc Thai 2018;101;Suppl.7: S143-S148.

Study selection

A systematic review of research studies, focused on the metabolic risk factors whether affected the cardiovascular diseases in elderly. Inclusion criteria's for the article selection were (1) hospital setting, (2) study designs were analytical cross-sectional study, retrospective prospective cohort study, prospective cohort study, case-control study, (3) clinical risk factors focused on metabolic profiles, and (4) outcomes defined as the prediction of CVD. The cardiovascular diseases included stroke, myocardial infarction, evidence of coronary artery disease, or cardiovascular death. The authors included the studies that have been published, not published, and were published between the years 2005 to 2018. The last search date was March 6, 2018, no language restrictions of all studies.

Search strategy

The authors searched the scientific and medical database of metabolic syndrome and association with cardiovascular diseases. The databases of MEDLINE, EMBASE, SCOPUS, Web of Science, Science Direct, Ovid, CINHAL, PsycINFO and the Cochrane Library were search for a combination of relevant words of metabolic syndrome, risk factors, prediction, cardiovascular disease, and/or use MESH terms of metabolic risk factors and/or single of metabolic profile such as blood pressure, waist circumference, impaired fasting glucose, diabetes, hypertension, and increased triglyceride for the prediction of cardiovascular diseases. Hand searched for relevant journal of the trail registers and published abstract and/or full text proceeding from the conferences will be proceed.

Data collection and analysis

Two reviewers were search the literature and critical appraisal in each article independently, and resolved the unclear of the study by consensus. If article had not unidentified the studies through the selection criteria and/or methodology, we consulted an expert opinion. A potential study that met inclusion will be assesses the quality of scientific evidence by GRADE (Grading of Recommendations Assessment, Development and Evaluation). The authors recorded data collection in the data extraction form of the included criteria by used the table of information, details in the tables included general information, study characteristics, participant, intervention, outcomes and note.

Analysis

The authors calculated the results of studies to determine an accuracy by used 95% confidence intervals and considered the results of the information pooling at the study, using random-effects model due to heterogeneity (I^2 >50%).The analysis of the overall results presented by the Forest plot with relative risk (95% confidence interval) for cardiovascular diseases by metabolic syndrome; a graph display to demonstrate the difference between the results of the study; and biases in each study. Subgroup analyses were performed by study site and sex. Both study site and sex may be potential predictors for cardiovascular diseases as mentioned earlier in the introduction[2]. All analyses were computed by using Review Manager version 5.3 Software (The Cochrane Collaboration, 2000)[14].

Results

There were 3,525 articles reported on metabolic syndrome and/or cardiovascular diseases in mentioned databases (Figure 1). Of those, 59 articles included in the review processes; 34 articles were excluded due to unclear study design (10) and no report on cardiovascular outcomes (24). There were 25 potential articles but only 7 articles were included in the analysis due to unable to pooled data in 18 articles. All seven articles were shown in Table 1[8-14]. All studies were conducted in cohort design. There were two articles conducted only in male[12] and female[13] patients. Two articles had high risk of biases; one in long term follow-up[10] and one in adequacy of follow-up[13].

In total, there were 13,216 patients in all seven studies. Of those, 3,069 patients (23.22%) were diagnosed as metabolic syndrome. Overall relative risk for cardiovascular diseases by presence of metabolic syndrome was 1.88 (1.61, 2.19) with the I^2 of 36% (Figure 2).

Two subgroup analyses were performed by study site (Figure 3 and 4) and sex (Figure 3 and 4). There were two studies conducted in Asia (Figure 3) and metabolic syndrome increases risk cardiovascular diseases by 2.19 (1.56, 3.08) with the I^2 of 30%. For non-Asia studies (Figure 4), the relative risk of metabolic syndrome on cardiovascular diseases was 1.79 (1.53, 2.10) with the I^2 of 30%. Male patients with metabolic syndrome also increases risk of cardiovascular diseases by 1.66 times (1.43, 19.3) with the I^2 of 0% (Figure 5). Similarly to male sex, there were five studies included in the analysis. The relative risk of female sex for cardiovascular diseases was highest at 2.28 (1.49, 3.48)

but the I^2 was also highest at 77% (Figure 6).

Discussion

The relative risk of metabolic syndrome for cardiovascular diseases in hospital setting was comparable to the previous meta-analysis which included various study populations (1.88 vs. 2.35)[6]. The lower relative risk in the present study may explain from better healthcare management and awareness of patients resulting in lower overall cardiovascular risk. Even though this study included fewer studies than the previous meta-analysis (7 vs. 87), the results are in the same direction. The 95% confidence interval in this study was not wide (1.61, 2.19) indicating good quality of data.

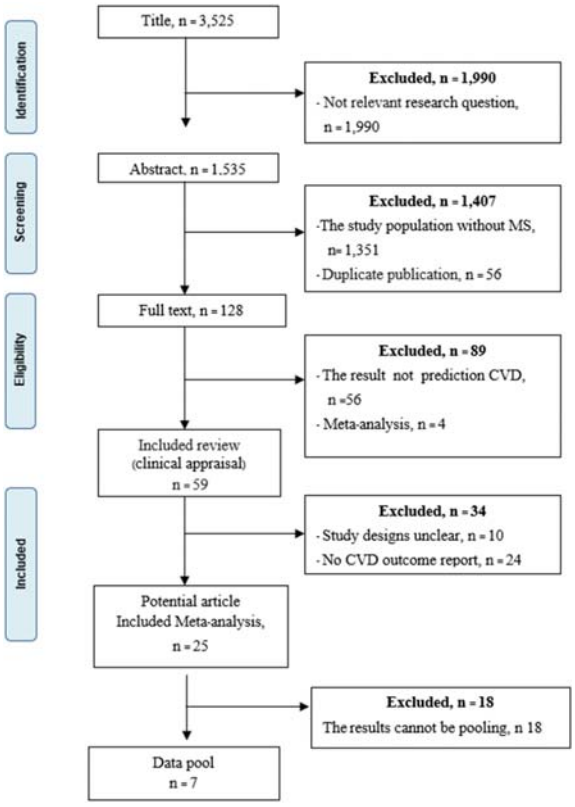

Figure 1. Study flow diagram.

The previous study in Europe showed that European patients were at higher risk for cardiovascular diseases than other ethnicities[2]. In this meta-analysis did not find any differences between Asia and non-Asia analysis. The relative risk was somewhat higher in Asian population though (2.19 vs. 1.79) as shown in Figure 3 and 4. Note that there were only two studies from Asia, while five studies from non-Asia group. The analysis was not performed in European setting per se.

Female patients with metabolic syndrome may have higher risk for cardiovascular diseases than male patients (relative risk 2.28 vs. 1.66) as shown in Figure 5 and 6. However, there are significant heterogeneity in the analysis of female sex (I^2 of 77%). It may be clear that male patients with metabolic syndrome are at risk for cardiovascular diseases. But, further studies may be required for female patients with metabolic syndrome.

There are some limitations in this study. First, NCEP-ATP III definition is the most common definition used in this meta-analysis. Only one study

Table 1. Characteristic of the metabolic syndrome [MS] associated with the risk of cardiovascular diseases

Authors, publication year	Study designs	Population	Age range, yr	F/U, yr	De□nitionof MS
Scuteri et al, 2005	Prospective cohort	Cardiovascular Health Study [CHS]	68 to 78	4.1	NCEP-ATPIIIWHO
Hwang et al, 2009	Prospective cohort	Health Promotion Center of the Samsung Medical	20 to 78	8.7	NCEP-ATPIII
Andreadis et al, 2007	Prospective cohort	Hypertensive	46 to 72	2.1	NCEP-ATPIII
Ingelsson et al, 2007	Cohort study	Framingham Offspring Study	47 to 65	7.2	NCEP-ATPIII
Cabrera et al, 2007	Prospective cohort	Elderly women	60 to 84	7	NCEP-ATPIII
Taheuchi et al, 2007	Prospective cohort	Men	48 to 72	2.1	NCEP-ATPIII
Hunt et al, 2007	Cohort	San Antonio Heart Study (SAHS)	25 to 64	4.1	NCEP-ATPIII

F/U = follow-up; NCEP-ATP III = National Cholesterol Education Program–Adult Treatment Panel III; WHO = World Health Organization.

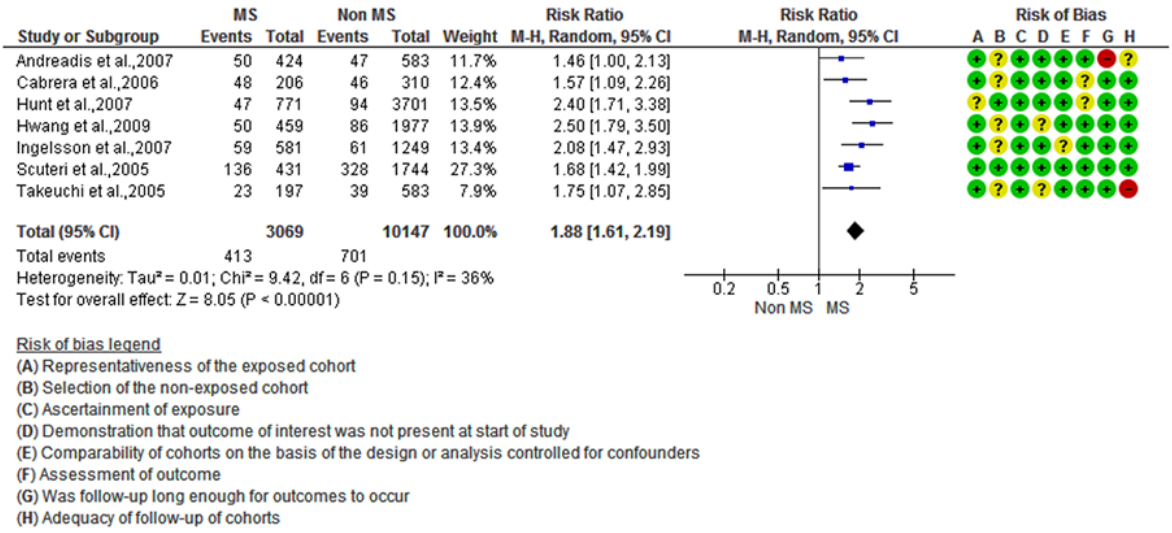

Figure 2. Forest plot of metabolic syndrome on cardio-vascular diseases in seven studies conducted in hospital setting.

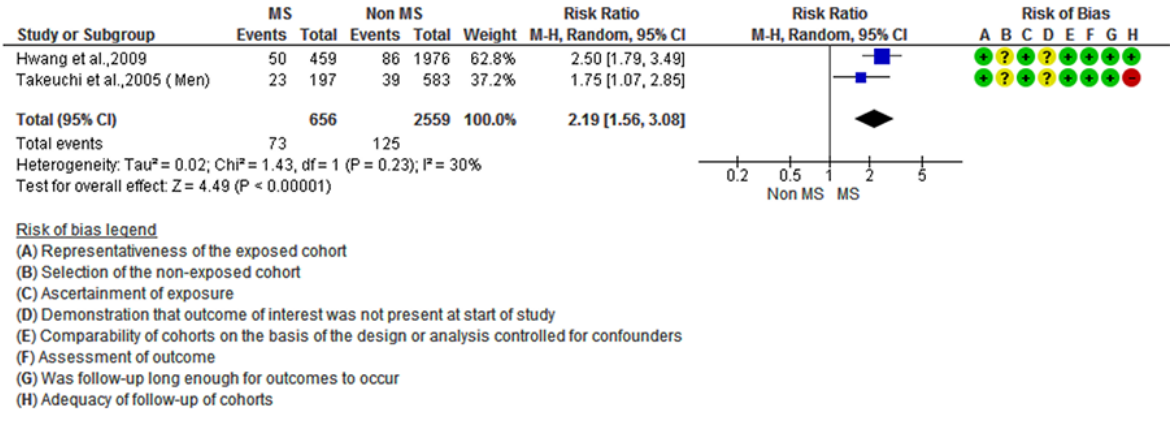

Figure 3. Forest plot of metabolic syndrome on cardiovascular diseases in two studies conducted in Asian hospital setting.

combined the WHO and NCEP-ATP III definition (Table 1). Second, the cardiovascular diseases as an outcome in the present study referred to several major cardiovascular diseases; not specifically to any cardiovascular diseases. Finally, two studies may have high risks for follow-up biases as mentioned in the results.

In conclusion, patients with metabolic syndrome in hospital setting are at risk for major cardiovascular diseases regardless of continents or sex.

What is already known on this topic?

Generally, metabolic syndrome is a major risk factor for cardiovascular diseases.

What this study adds?

Metabolic syndrome is a risk factor for cardiovascular diseases in hospital setting regardless of ethnicity and sex.

Acknowledgements

The authors would like to greatly thank Mr. Dylan Southard for English language editing; grant of Faculty of Medicine, Khon Kaen University, Thailand (Grant Number RG593011); Sleep Apnea Research Group, Research Center in Back, Neck and Other Joint Pain and Human Performance, Research and Training Center for Enhancing Quality of Life of Working Age People, Khon Kaen University for their kind support.

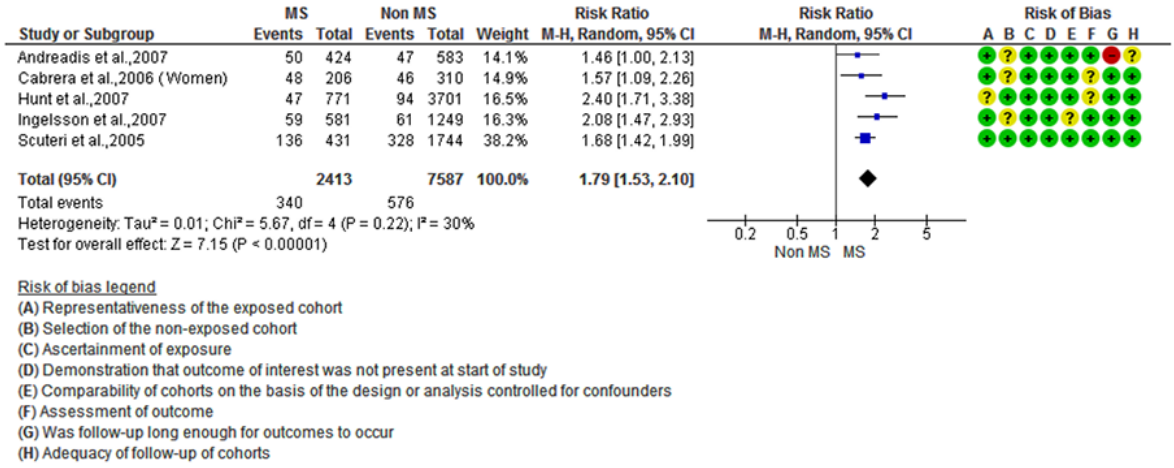

Figure 4. Forest plot of metabolic syndrome on cardiovascular diseases in five studies conducted in non-Asian hospital setting.

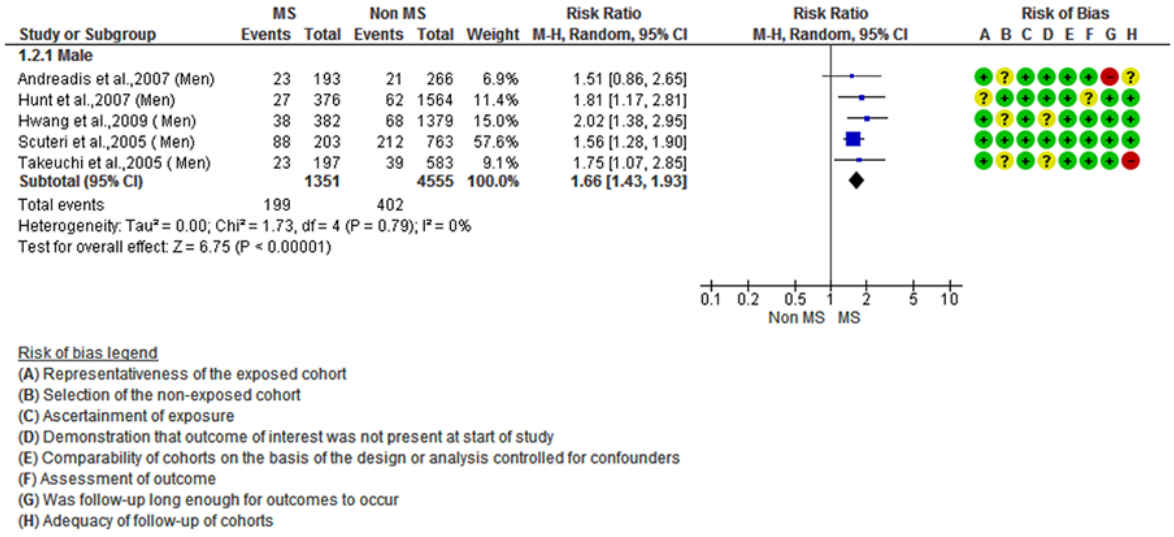

Figure 5. Forest plot of metabolic syndrome on cardiovascular diseases in five studies conducted in hospital setting and male sex.

Potential conflicts of interest

The authors declare no conflict of interest.

References

1. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K, Aboyans V, et al. Global and regional mortality from 235 causes of death for 20 age groups in 1990 and 2010: a systematic analysis for the Global Burden of Disease Study 2010. Lancet 2012;380: 2095-128.
2. Nichols M, Townsend N, Scarborough P, Rayner M. Cardiovascular disease in Europe 2014: epidemiological update. Eur Heart J 2014;35:2929.
3. Carlsson AC, Riserus U, Arnlov J, Borne Y, Leander K, Gigante B, et al. Prediction of cardiovascular disease by abdominal obesity measures is dependent on body weight and sex—results from two community based cohort studies. Nutr Metab Cardiovasc Dis 2014;24:891-9.
4. Kang GD, Guo L, Guo ZR, Hu XS, Wu M, Yang HT. Continuous metabolic syndrome risk score for predicting cardiovascular disease in the Chinese population. Asia Pac J Clin Nutr 2012;21:88-96.
5. Cho NH, Kim JY, Kim SS, Shin C. The relationship

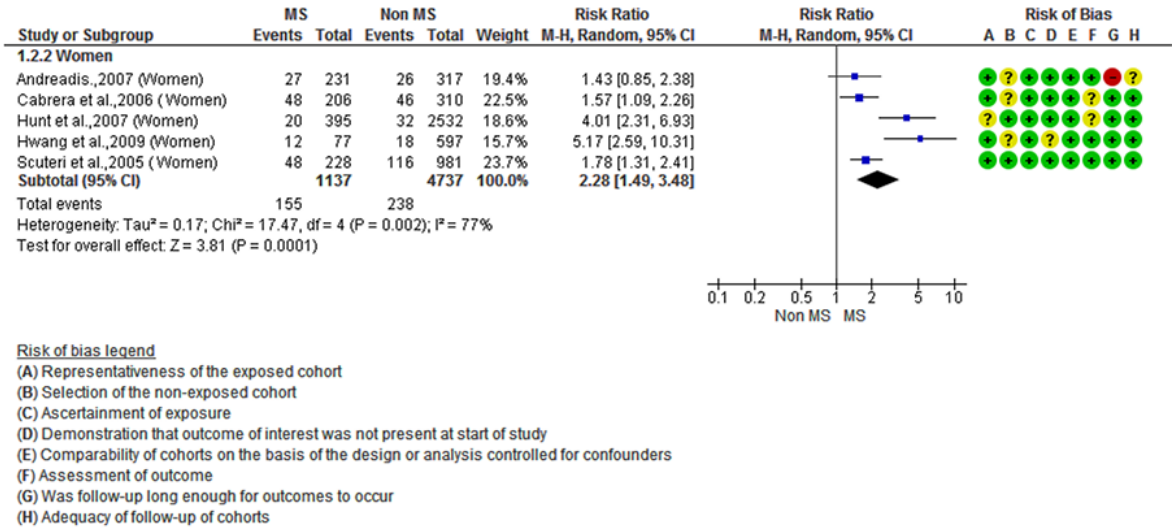

Figure 6. Forest plot of metabolic syndrome on cardiovascular diseases in five studies conducted in hospital setting and female sex.

of metabolic syndrome and constitutional medicine for the prediction of cardiovascular disease. Diabetes Metab Syndr 2013;7:226-32.

6. Mottillo S, Filion KB, Genest J, Joseph L, Pilote L, Poirier P, et al. The metabolic syndrome and cardiovascular risk a systematic review and meta-analysis. J Am Coll Cardiol 2010;56:1113-32.
7. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. J Clin Epidemiol 2009;62:1006-12.
8. Scuteri A, Najjar SS, Morrell CH, Lakatta EG. The metabolic syndrome in older individuals: prevalence and prediction of cardiovascular events: the Cardiovascular Health Study. Diabetes Care 2005;28:882-7.
9. Hwang YC, Jee JH, Oh EY, Choi YH, Lee MS, Kim KW, et al. Metabolic syndrome as a predictor of cardiovascular diseases and type 2 diabetes in Koreans. Int J Cardiol 2009;134:313-21.
10. Andreadis EA, Tsourous GI, Tzavara CK, Georgiopoulos DX, Katsanou PM, Marakomichelakis GE, et al. Metabolic syndrome and incident cardiovascular morbidity and mortality in a Mediterranean hypertensive population. Am J Hypertens 2007;20:558-64.
11. Ingelsson E, Sullivan LM, Murabito JM, Fox CS, Benjamin EJ, Polak JF, et al. Prevalence and prognostic impact of subclinical cardiovascular disease in individuals with the metabolic syndrome and diabetes. Diabetes 2007;56:1718-26.
12. Cabrera MA, Gebara OC, Diament J, Nussbacher A, Rosano G, Wajngarten M. Metabolic syndrome, abdominal obesity, and cardiovascular risk in elderly women. Int J Cardiol 2007;114:224-9.
13. Takeuchi H, Saitoh S, Takagi S, Ohnishi H, Ohhata J, Isobe T, et al. Metabolic syndrome and cardiac disease in Japanese men: applicability of the concept of metabolic syndrome defined by the National Cholesterol Education Program-Adult Treatment Panel III to Japanese men—the Tanno and Sobetsu Study. Hypertens Res 2005;28:203-8.
14. Hunt KJ, Williams K, Hazuda HP, Stern MP, Haffner SM. The metabolic syndrome and the impact of diabetes on coronary heart disease mortality in women and men: the San Antonio Heart Study. Ann Epidemiol 2007;17:870-7.