

Metabolic Syndrome in Iran

Shila Berenjy

Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences
Universiti Putra Malaysia, Serdang, Malaysia
&
Faculty of Food Sciences and Technology, Varamin branch
Islamic Azad University of Tehran, Iran

Asmah Bt rahmat

Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences
Universiti Putra Malaysia, Serdang, Malaysia

Parichehr Hanachi (Corresponding author)

Biochemistry unit, Biology Department, Faculty of Science
Alzahra University, Tehran-Iran
E-mail: wrc_hanachi@yahoo.com

Lye Munn Sunn

Department of Community Health, Faculty of Medicine and Health Sciences
Universiti Putra Malaysia, Serdang, Malaysia

Zaitun Bt Yassin

Department of Nutrition and Dietetics, Faculty of Medicine and Health Sciences
Universiti Putra Malaysia, Serdang, Malaysia

Farzad Sahebjaamee

Department of cardiology, Kermanshah University of Medical Sciences
Kermanshah, Iran

Abstract

Metabolic Syndrome (MS) also known as syndrome X, the Dysmetabolic Syndrome and Insulin resistance syndrome, refers to a cluster of cardiovascular risk factors including hypertension, glucose intolerance, triglyceridemia and low HDL cholesterol concentrations in blood. This syndrome consists of multiple metabolic risk factors. The significance of MS is that MS and its components seem to be underlying factors for the development of atherosclerotic cardiovascular disease and diabetes type 2. The current article reviews the literature on the prevalence of MS in Iran. According to global statistics, a quarter of the adult population suffers from metabolic syndrome. The prevalence of MS in United States is 24% and 44% of adults over 50 years old suffer from MS. In contrast to this high prevalence of MS in United States of America, its prevalence in some countries such as South Korea is less than 14.2% in men. However, its prevalence in two neighbor country of Iran including Saudi (39.3%) and Turkish (33%) populations is relatively high compared to other countries. We know that 30% of adults in Tehran (Capital city of Iran) suffer from MS and more than 45% of adults older than 20 years old in the Khorasan province (in north east Iran) have MS. This statistics reveal that the prevalence of MS in Iran is even higher than the developed countries and the relation between MS and Coronary Artery disease

suggests that we need to continue research on MS, its components, and the association between MS and Coronary Artery Disease.

Keywords: Metabolic syndrome, Coronary artery disease, Risk factor

1. Introduction

1.1 Definition of Metabolic Syndrome

Metabolic Syndrome (MS) also known as syndrome X, comprises of hypertension, glucose intolerance, high triglycerides, and decreased level of high density lipoproteins (HDL), which are considered risk factors of cardiovascular diseases (Reaven,1988). Additional terms, which define the same clinical entity, include the Deadly Quartet, the Dysmetabolic Syndrome, and Insulin Resistance Syndrome. The above mentioned MS components are known risk factors for development and progression of atherosclerosis, which in turn results in a higher risk for coronary artery diseases. It has also been shown that the MS components are associated with a higher risk for diabetes type 2. Our current knowledge suggests that there is no single cause for MS; however, abdominal obesity and insulin resistance are the most important risk factors for MS. Furthermore, it has been documented that other underlying risk factors such as physical inactivity, aging, hormonal imbalance, and race can increase the risk of MS (Grundy, 2005). These risk factors suggest that there exists an interrelation between combinations of risk factors which may predict the development of MS.

1.2 Diagnostic Criteria for Metabolic Syndrome

The National Cholesterol Education Program (NCEP)-Adult Treatment Panel (ATP), has introduced one of the most widely accepted diagnostic criteria for the diagnosis of MS. This criteria works on some measurements including waist circumference, serum triglyceride (TG), HDL-C, Blood pressure (BP), and fasting blood sugar (FBS). Additionally, and as it is illustrated in Table 1, the American Heart Association/National Heart Lung & Blood Institute (AHA/NHLBI) made some minor modification on the NCEP criteria which is currently considered more in research focusing on MS and its association with Coronary Artery Diseases (CAD) (Grundy SM, 2005). According to the new International Diabetes Federation (IDF), the metabolic syndrome is diagnosed if a person have central obesity plus one pair of any of the “increased level of TG (≥ 150 mg/dL), “decreased level of HDL cholesterol (< 40 mg/dL)”, “increased blood pressure (systolic BP ≥ 130 mm Hg or diastolic BP ≥ 85 mm Hg, or a diagnosed hypertension patient under treatment) “, increased FBS (≥ 100 mg/dL).

1.3 Risk Factors of Metabolic Syndrome

Similar to most of clinical syndromes, there exist groups of underlying risk factors for the development of MS. These risk factors have a metabolic origin known as MS components (Table 1) and are shown to be the risk factors for CAD. The metabolic risk factors of MS are as following:

- Atherogenic dyslipidemia.
- Elevated serum LDL level.
- Low HDL cholesterol (HDL-C) concentration.
- Elevated blood pressure.
- Elevated plasma glucose.
- Prothrombotic state.
- Proinflammatory state.

According to some research, physical inactivity, aging, hormonal imbalance, and genetic predisposition other underlying conditions associated with MS.(Grundy SM, 2005). Additionally, according to Maki (2004), Lee (2005), Niaura (2000), and Raikonen (2002), biological, behavioral, and social factors may influence MS.

1.4 Prevalence of metabolic syndrome

According to IDF, the global prevalence of MS is about 25% in adult populations (IDF 2008). A 2005 study on the prevalence of MS among the general population in the United States revealed that 24% of participants had MS (McNeill AM. 2004) where Grundy (2005) found 44% of adults over 50 years old suffered from MS. In contrast to this high prevalence of MS in the United States, an age adjusted prevalence statistics on MS in South Korea indicated only 14.2% of men and 17% of women had MS (Hye SP. *et al.* 2004). Similarly, a low prevalence of MS was reported by Boonyavakul (2005) in rural Thai populations where only 18% of the population was diagnosed as having MS. Numerous studies on the prevalence of MS in different countries reported a high prevalence of MS, specifically, 20.7% in the 50-69 year old population, 19.8% in adults over 18

years old, 31.6% in populations over 20 years old, and 24.3% of adults over 18 years old in Ireland (Villagas *et al.* 2003), Greece (Panagiotakos *et al.* 2004), India (Gupta *et al.* 2004), and Canada (Liu *et al.* 1999), respectively. The results of two studies in Saudi (39.3%, Al-Nozha M. 2005) and Turkish (33.4%, Ozsahin AK. 2004) populations illustrated a high prevalence of MS where both countries are neighbors to Iran. All of the above mentioned researchers employed NCEP criteria for the diagnosis of MS, and findings indicate variance in the prevalence of MS for different communities and ethnic groups.

1.5 Prevalence of MS in Iran

Several studies in Iran reported a considerably high prevalence of MS in some regions compared with other countries; however, the prevalence of MS was comparable with the global prevalence in some other areas in Iran. Sarrafzadegan (2008) found 23.3% of adults over 19 years old in three central cities of Iran had MS, while Ghayour Mobarhan (2007) found a much higher prevalence of over 45% of adults 20 years old and older in the Khorasan province suffered from MS. Azizi (2003 & 2004) is among the scholars who conducted several studies on MS in Iran. The statistics from his study in Tehran (2003) showed 30.1% of adults over 20 years old had MS.

We can categorize the literature on MS and its significance, in five categories as follows:

The first category consists of the articles which illustrated the high prevalence of MS globally, regionally, and in Iran (Ford ES, 2002; Azizi F, 2004; Ghayar mobarhan M, 2007). The second category includes the group of articles which emphasized the independent CAD prediction role for MS (Sattar N, 2003; Hunt K, 2004; Lakka HM, 2002; Sadeghi M, 2006; Chen Q, 2008). The next group of literature attempted to show the biomolecular basis of MS components and their atherogenicity (Villena JA, 2004; Ginsberg HN, 2006; Szapary Po, 2004). The effect of dietary factors, as well as physical factors on the risk of MS is beautifully depicted by the fourth category of the literature (Clark SD, 2000; Maki K, 2004; Haffner SM, 2007). Laaksonen (2002), and Lee (2005) are among the researchers whose work proved that life style factors (e.g., physical activity, smoking habit, etc.) have an impact on the risk of having MS. These studies are listed in our fifth category of literature. Finally, numerous studies have suggested the need to explore the matter in different populations and as a multivariable model (Ford Es, 2005; Ghayour M, 2007; Azizi F, 2004; Sadeghi M, 2006).

2. Discussion

Review of the literature on metabolic syndrome demonstrates that MS is a prevalent syndrome both throughout the world and in Iran (Sarti S, 2006, and Azizi F, 2004). As we discussed before, the noteworthiness of the epidemiologic studies on MS in Iran is that the prevalence of this syndrome is considerably higher in this region than throughout the world. Evidence of this comes from McNeil (2005) who found that 24% of general population in United States suffers from MS. Similarly, Azizi (2004) reported that 30% of adults in Tehran (Capital city of Iran) suffer from MS. These statistics reveal that the prevalence of MS in Iran is even higher than in developed countries.

As a rule, the prevalence of MS is increasing parallel to the trend in overweight and obesity. In general, the prevalence of MS increases with age and its prevalence are considerably different among races and ethnic groups, which supports the probable genetic predisposition. It seems genetic, social, environmental, psychological, and behavioral factors are linked to this clinical syndrome. The results from previous studies strongly emphasize the need for more studies to explain the interrelation between MS components and their association with MS.

A problem, which shows the significance of MS is that patients with MS have a higher risk of developing CVD mortality & morbidity (Isomma B 2001, Qingwe C, 2008). In addition, coronary artery disease is a common cause of death in Iran (Azizi F, 2004). Thus, it is expected that preventive measures such as, early diagnosis and appropriate management of MS can be considered the key to success in our efforts in reducing the risk of future development of coronary artery disease in our society (Chen Q, 2008).

3. Conclusion

In summary, a strong link between MS and coronary artery disease (CAD) has not been well documented (Petra M, 2004). Additionally, only a few studies conducted on the prevalence of MS and its risk factors in the general population in Iran (Zabetian A, 2007) and rare supplemental information is available regarding MS in CAD patients and the determination of risk factors of MS for this high risk group. Review of the literature and our knowledge on MS suggests the need for future study concerning the association between MS and its components with coronary artery disease in Iran.

References

- Al-Nozha M, Al-Khadra A, Arafah MR, *et al.* (2005). Metabolic syndrome in Saudi Arabia. *Saudi Med J. Dec*, 26(12):1918-2.
- Azizi F, Esmailzadeh A, Mirmiran P. (2004). Obesity and cardiovascular disease risk factors in Tehran adults: a population based study. *East Mediterr Health J*, 10:887-97.
- Azizi F, Salehi P, Etemadi A, Zahedi –Asl S. (2003). Prevalence of metabolic syndrome in an urban population: Tehran Lipid and Glucose Study. *Diabetes Res Clin Pract*, 61:29-37.
- Boonyavarakul A, Choosaeng C, Supasyndh O, Panichkul S. (2005). Prevalence of the metabolic syndrome, and its association factors between percentage body fat and body mass index in rural Thai population aged 35 years and older. *J Med Assoc Thai*, Nov, 88 Suppl 3:S121-30.
- Chen Q, Liu Y, Huang w, *et al.* (2008). Relationship between metabolic syndrome and coronary heart disease in an aged group. *Archives of Gerontology and Geriatrics*, 46:107-115.
- Clarke SD. (2000). Polyunsaturated fatty acid regulation of gene transcription: a mechanism to improve energy balance and insulin resistance. *Br J Nutr*, 83 Suppl: S59 - S66.
- Ford ES. (2005). Risks for all cause mortality, cardiovascular disease and diabetes associated with the metabolic syndrome :a summary of the evidence. *Diabetes Care*, 28:1769-78.
- Ford,ES, Giles WH, Dietz WH. (2002). Prevalence of the metabolic syndrome among US adults: finding from the third National Health and Nutrition Examination Survey. *JAMA*, 287:356-9.
- Ghayour-Mobarhan M, Aziminezhad M, Kazemi SM, *et al.* (2007). Comparing different definitions of metabolic syndrome in Iranian population. Abstract. 76th Congress of the European Atherosclerosis Society, June 10-13, Helsinki, Finland, PO 16-448.
- Ginsberg HN. (2006). Review: efficacy and mechanisms of actions in the treatment of diabetic dyslipidemia. *J Clin Endocrinol Metab*, 91(2):383-392.
- Grundy SM, Cleeman J I, Daniels S R, *et al.* (2005). Diagnosis and Management of the Metabolic Syndrome Scientific Statement Executive Summary *Circulation* 2005;112; e285-e290; originally published online Sep 12, 2005; DOI: 10.1161/CIRCULATION.AHA.105.169405.
- Gupta R, Deedwania PC, Gupta A, Rastogi S, Panwar RB, Kothari K. (2004). Prevalence of metabolic syndrome in an Indian urban population. *Int J Cardiol*, Nov; 97(2):257-61
- Haffner SM. (2007). Abdominal adiposity and cardio metabolic risk: Do we have all the answers? *AM J Med*, 120(9 suppl 1): 6-10.
- Hunt KJ, Resendez RG, Williams K, Haffner SM, Stern MP. (2004). National Cholesterol Education Program versus World Health Organization metabolic syndrome in relation to all cause and cardiovascular mortality in the San Antonio Heart Study. *Circulation*, 110:1251-7.
- Hye Soon Park, Sang Woo Oh, Sung-II Cho, Woong Hwan Choi and Young Soel Kim. (2004). The metabolic syndrome and associated lifestyle factors among South Korean adults. *International Journal of Epidemiology*, 33:328–336
- International Diabetes Federation. (2006). The IDF consensus worldwide definition of the metabolic syndrome. Update 2006. [Online] Available: http://www.idf.org/webdata/docs/MetS_def_update2006.pdf. Accessed 28 Dec. 2009.
- International Diabetic Federation. (2006). The IDF consensus worldwide definition of the metabolic syndrome. [Online] Available: http://www.idf.org/webdata/docs/metabolic_syndrome_definon.pdf. Accessed 2 sep 2008.
- Isomma B, Almgren P, Tuomi T, Forsen B, Lahti K, Nissen M, *et al.* (2001). Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care*, 24:683-9.
- Isomma B, Henricsson M, Almgren P, *et al.* (2001). The metabolic syndrome influences the risk of chronic complications in patients with type II diabetes. *Diabetologia*, 44:1148-54.
- Laaksonen, D. E., Lakka, H.M., Salonen, J. T., Niskanen, L. K., Rauramaa, R., & Lakka, T. A. (2002). Low levels of leisure-time physical activity and cardiorespiratory fitness predict development of the Metabolic Syndrome. *Diabetes Care*, 25, 1612–1618.
- Lakka HM, Laaksonen DE, Lakka TA, Niskanen LK, Kumpusalo E, Tuomilehto J, *et al.* (2002). The metabolic

- syndrome and total and cardiovascular disease mortality in middle aged men. *JAMA*, 288:2709-16.
- Lee W.Y., Jung C.H., Park J.S., Rhee E.J., & Kim S.W. (2005). Effects of smoking, alcohol, exercise, education, and family history on the metabolic syndrome as defined by the A TP III. *Diabetes Research and Clinical Practice*, 67, 70-77.
- MacNeill AM, Rosamond WD, Girman CJ, *et al.* (2004). Prevalence of coronary heart disease and carotid arterial thickening in patients with the metabolic syndrome (the ARIC study). *Am J Cardiol*, 94:1249-54.
- Maki, K. C. (2004). Dietary factors in the prevention of Diabetes Mellitus and Coronary Artery Disease associated with the Metabolic Syndrome. *The American Journal of Cardiology*, 93 (IIA), 12C-17C.
- McNeill AM, Rosamond WD, Girman CJ, *et al.* (2004). Prevalence of coronary heart disease and carotid arterial thickening in patients with the metabolic syndrome(the ARIC study). *Am J Cardiol*, 94:1249-54.
- Ozsahin AK, Gokcel A, Sezgin N. (2004). Prevalence of the metabolic syndrome in a Turkish adult population. *Diabetes Nutr Metab*. Aug; 17(4):230-4.
- Panagiotakos DB, Pitsavos C, Chrysohoou C, *et al.* (2004). Impact of lifestyle habits on the prevalence of the metabolic syndrome among Greek adults from the ATTICA study. *Am Heart J*, 147:106-12.
- Petra M. *et al.* (2004). Prevalence of metabolic syndrome in patients with coronary heart disease, cerebrovascular disease, peripheral arterial disease or abdominal aortic aneurism. *Atherosclerosis*, 173 363-369.
- QingweC, Ying L, Ying Y, *et al.* (2008). Relationship between metabolic syndrome and coronary artery disease. *Archive of Gerontology and Geriatrics*, 46:107-115.
- Reaven GM. Banting Lecture. (1988). Role of insulin resistance in human disease. *Diabetes*, 37: 1595-1607.
- Sadeghi M, Garak-Yaraghi M, *et al.* (2006). Relationship between the metabolic syndrome and coronary artery disease in patients with stable angina. *ARYA J*, 2(1):10-14.
- Sarraffzadegan N, Kelishadi R, Baghaei A, Hussein Sadri G, Malekafzali H, Mohammadifard N, Rabiei K, Bahonar A, Sadeghi M, O'Laugh. (2008). Metabolic syndrome: An emerging public health problem in Iranian Women: Isfahan Healthy Heart Program. *Int J Cardio*, Jan 9.
- Sarti S, Gallagher J. (2006). The metabolic syndrome, Prevalence, CHD risk and treatment. *Journal of diabetes and its complication*, 20:121-132.
- Satar N, Gaw A, Scherbakova O, Ford I, O'Reilly DS, Haffner SM, *et al.* (2003). Metabolic syndrome with and without C-reactive protein as a predictor of coronary heart disease and diabetes in the west of Scotland Coronary Prevention Study. *Circulation*, 108:414-9.
- Simin Liu, Meir J Stampfer, Frank B Hu, Edward Giovannucci, Eric Rimm, JoAnn E Manson, Charles H Hennekens. (1999). Whole-grain consumption and risk of coronary heart disease: results from the Nurses' Health Study1-3, *Am J Clin Nutr*, 70:412-9.
- Szapary PO, Reader DJ. (2004). The triglyceride-high-density lipoprotein axis: an important target of therapy? *AM. Heart J*, 148(2):211-221.
- Villagas R, Uusitupa M, Hermansen K, Riccardi G, *et al.* (2001). Substituting dietary saturated for monounsaturated fat impairs insulin sensitivity in healthy men and women: The KANWU study. *Diabetologia*, 26:3198-9
- Villena JA, Viollet B, Andreelli F, Kahn A, Vaulont S *et al.* (2004). Induced adiposity and adipocyte hypertrophy in mice lacking the AMP-activated protein kinase-alpha2 subunit. *Diabetes*, 53(9):2242-2249.
- Zabetian A, Hadaegh F, Tohidi M, *et al.* (2007). Prevalence of metabolic syndrome by the ATP III, IDF and WHO definition and their association to coronary heart disease in Iranian elderly population. *Iranian Journal of Diabetes and Lipid Disorders*, 7(1(22)):91-101.

Table 1. Diagnosis of MS. National Cholesterol Education program (NCEP)-Adult Treatment Panel III (ATP III) last modified by AHA/NHLBI 2005/update 2008

Measure any 3 of 5 Constitutes Diagnosis of MS	Categorical Cutoff Points
Elevated waist circumference	102 cm (40 inches) in men 88 cm (35 inches) in women
Elevated TG	150 mg/dL (1.7 mmol/L) or Drug treatment for elevated TG
Reduced HDL-C	40 mg/dL (1.03 mmol/L) in men 50 mg/dL (1.3 mmol/L) in women or Drug treatment for reduced HDL-C
Elevated BP	130 mm Hg systolic BP or 85 mm Hg diastolic BP or Drug treatment for hypertension
Elevated fasting glucose	100 mg/dL or Drug treatment for elevated glucose

Table 2. Literature on MS and its significance

Categorized Literature	Main References
Articles illustrated the high prevalence of MS (Global, Regional/Country)	Ford ES (2002); Azizi F(2004); Ghayur Mobarhan M (2007)
Articles illustrated the MS as an independent predictor of CAD	Sattar N (2003); Hunt K (2004); Lakka HM (2002); Sadeghi M (2006); Chen Q (2007)
Articles illustrated the Biomolecular basis of the MS components and their atherogenicity	Villena JA (2004); Ginsberg HN (2006); Szapary PO (2004)
Articles illustrated that life style factors (dietary factors, physical activity, smoking habit) have an impact on the risk of having MS	Laaksonen D (2002), Lee WY (2005); Clark SD (2000); Maki K (2004); Haffner SM (2007)
Literatures suggesting the need to explore the matter in different populations and as an multivariable model	Ford ES (2005); Ghayur Mobarhan M (2007); Aizi F (2004); Sadeghi M (2006)