Iranian J Publ Health, Vol. 40, No.2, 2011, pp.1-5

Original Article

Association between Homeostasis Model Assessment of Insulin Resistance (HOMA-IR) and Components of Metabolic Syndrome in Young Chinese Men

*X Ying [1], Zh Song [1], Ch Zhao [1], Y Jiang [2]

[1]*International Health Care Center, the Second Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, 310009, China*
[2]*Dept. of Clinical Laboratory, the Second Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou, 310009, China*

(Received 11 Nov 2010; accepted 7 May 2011)

Abstract

Background: To investigate the prevalence of metabolic syndrome (MetS) in young Chinese population and assess the association between HOMA-IR and different components of MetS in young Chinese men.

Methods: Overall 5576 young Chinese subjects (age range [19-44 yr], 3636 men) were enrolled in, who visited our Health Care Center for a related health checkup from March to December 2008. The international diabetes federation (IDF) definition for MetS was used. The SPSS statistical package, version 11.5 was used for the statistical analysis.

Results: The prevalence of MetS was 21.81% in young men and 5.62% in young women. According to suffering from different numbers of MetS components, the male subjects were divided into four groups. Numbers of MetS components were more and HOMA-IR values were significantly higher. In this male population, the quartile of HOMA-IR was higher, values of triglyceride (TG), fasting plasma glucose (FBG), systolic blood pressure(SBP), diastolic blood pressure(DBP) and waist circumference (WC) were all significantly higher, as well as high density lipoprotein cholesterol (HDL-C) value was significantly lower (P= 0.000). In Spearman's correlation analysis, HOMA-IR was positively correlated with TG, FBG, SBP, DBP and WC, and negatively correlated with HDL-C (r= 0.460, 0.464, 0.362, 0.346, 0.586, -0.357, respectively, all P value= 0.000).

Conclusion: The prevalence of MetS in these young Chinese men was obviously high. Insulin resistance played an important role in occurrence and development of MetS. Waist circumference was the best correlation with HOMA-IR among all components of MetS.

Keywords: *Homeostasis model assessment, Insulin resistance, Metabolic syndrome, Young men*

Introduction

The metabolic syndrome (MetS) consists of a cluster of risk factors causing diabetes and cardiovascular disease (CVD) (1-4) which is highly prevalent (5-8) worldwide. Therefore recently, there are many researches in MetS domain; however, although MetS has been referred to as the insulin resistance syndrome (9), there were few studies on relationship between insulin resistance (IR) and components of MetS in young subjects.

This article reports the prevalence of MetS and association between HOMA-IR and components of MetS in a young population. Due to the prevalence of MetS that was obviously higher in this male group than in female group, this article was focused on the correlation analysis of related data in male subjects.

Materials and Methods

Subjects

Finally 5576 young subjects (age range [19-44 yr], 3636 men) who visited our Health Care Center for a related health checkup from March to December 2008 were eligible. The study was approved by the

*Corresponding author: Tel: +86 0571 87783995, Fax: +86 0571 87784672, E-mail: yingxin1977@gmail.com

Ethical Committee of the Second Affiliated Hospital, School of Medicine, Zhejiang University.

Clinical and laboratory data

Venous blood samples were drawn from subjects who had fasted overnight: 1) Fasting insulin (FINS) concentration was measured by the antibody sandwich ELISA method, using DPL IMMULITE automatic immunoanalyzer; 2) Plasma triglyceride (TG) and high density lipoprotein cholesterol (HDL-C) concentrations were measured by the terminal method, using OLYMPUS AU machine; 3) Fasting plasma glucose (FPG) concentration was measured by the hexokinase method, using OLYMPUS AU machine; The interassay coefficients of variation in our laboratory were 8.2% for FINS, 1.2% for TG, 1.8% for HDL-C, 1.3% for FBG. 4) HOMA-IR (10) was calculated according to the following formula: HOMA-IR= [FINS (uIU/ml)×FBG (mmol/L)]/22.5. Weight was measured in kilograms (with light clothing) and height was measured in meters (without shoes). Waist circumference (WC) was measured on standing subjects with a soft tape midway between the lowest rib and the iliac crest. Blood pressure (BP) was taken after at least 5 min of rest. Body mass index (BMI)= Weight (kg)/ (Height (m))^2.

Definition of MetS

In the present study, we diagnosed MetS in international diabetes federation (IDF) criteria. The definition of MetS in IDF (11) included: Central obesity: defined as WC≥90 cm for Asian men and ≥80 cm for Asian women. Plus any two of the following four factors:1) Raised TG level: ≥150 mg/ dL (1.7 mmol/L), or specific treatment for this lipid abnormality; 2) Reduced HDL-C< 40 mg/dL (1.03 mmol/ L) in males and < 50mg/ dL (1.29 mmol/L) in females, or specific treatment for this lipid abnormality; 3) Raised BP: systolic BP ≥130 or diastolic BP ≥85 mm Hg, or treatment of previously diagnosed hypertension; 4) Raised FPG≥ 100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes.

Statistical Analysis

The SPSS statistical package, version 11.5 was used for the statistical analysis. P< 0.05 was considered statistically significant. A normal-distribution data were expressed as the mean±standard deviations (SD). Skewed distribution data were expressed as the Median with 25th and 75th percentiles (P_{25}~P_{75}). Chi-Square test was used to compare MetS prevalence between men and women. The Kruskal Wallis test was used to compare the data among different numbers of components of MetS and among different quartiles of the HOMA-IR value. In the Kruskal Wallis test, corrected a value was equal to 0.0083, so P< 0.0083 was considered statistically significant. Associations between HOMA-IR and different components of MetS were determined using Spearman's correlation analysis.

Results

Using the IDF definition, the prevalence of MetS was 21.81% in young men and 5.62% in young women (Table 1). There was significant difference in the comparison with the prevalence of MetS between young men and women (P= 0.000). The prevalence was obviously higher in young men than in young women.

Because the prevalence was obviously higher in men than in women, this study was focused on the correlation analysis in male group. Male subjects were divided into four groups due to different numbers of MetS components (0, 1, 2 and ≥3 components). By the increase of numbers of MetS components, BMI and HOMA-IR values were significantly higher (Both P= 0.000) (Table 2).

In following analysis, the male subjects were divided into another four groups due to different quartiles of HOMA-IR values (Table 3). The quartile of HOMA-IR was higher, values of TG, FBG, SBP, DBP and WC were all significantly higher, and HDL-C value was significantly lower (P = 0.000).

In this male subjects, Spearman's correlation coefficients between HOMA-IR and components of MetS were shown in Table 4. Analysis indicated that HOMA-IR was positively correlated with TG, FBG, SBP, DBP and WC, and negatively correlated with HDL-C (r= 0.460, 0.464, 0.362, 0.346, 0.586, -0.357, respectively, P= 0.000).

Table 1: Prevalence of MetS in this population

	Without MetS	MetS
Male (n=3636)	2843 (78.19%)	793 (21.81%)
Female(n=1940)	1831(94.38%)	109 (5.62%)

Chi-Square test: *P*=0.000 in the comparison of the prevalence of MetS between young Chinese men and women.

Table 2: Comparison with HOMA-IR and BMI among groups including different numbers of components of MetS

	Number of components				
Male(n=3636)	**0**	**1**	**2**	**≥3(3,4,5)**	**P***
	(n=927)	(n=942)	(n=855)	(n=912)	
Age（years）	36(32~40)	38(34~42)	38(35~41)	39(36~42)	0.000
BMI(kg/m^2)	21.88±2.31	23.91±2.49	25.71±2.61	27.18(25.63~39.05)	0.000
HOMA-IR	0.99(0.69~1.40)	1.35(0.95~1.86)	1.87(1.33~2.60)	2.64(1.80~3.89)	0.000

Data are expressed as mean±SD or median (P_{25}–P_{75}).
**P* value: Comparison of HOMA-IR and BMI between one and another number of components of MetS. Corrected a value was equal to 0.0083, so *P*< 0.0083 was considered statistically significant by the Kruskal Wallis test.

Table 3: Comparison with components of MetS among different quartiles of HOMA-IR

	HOMA-IR(quartiles)				
Male (n=3636)	Q1(~1.031,n=908)	Q2(1.032~1.590,n=910)	Q3(1.591~2.392,n=909)	Q4(2.393~,n=909)	*P*
Age(years)	38.0(34.0~41.0)	38.0(34.0~42.0)	38.0(34.0~41.0)	38.0(34.0~41.0)	0.631*
HDL-C(mg/dL)	58.0(51.0~68.0)	54.0(47.0~62.0)	52.0(45.0~59.0)	47.0(41.0~54.5)	0.000**
TG(mg/dL)	108.0 (82.0~153.0)	136.0(97.0~197.0)	168.0(125.5~245.0)	220.0(153.5~330.0)	0.000**
FBG(mg/dL)	84.0(79.0~88.0)	87.0(83.0~92.0)	89.0(84.0~95.0)	94.0(88.0~103.5)	0.000**
SBP(mmHg)	118.0(111.0~126.0)	123.0(115.0~133.0)	128.0(118.0~135.0)	132.0(122.5~140.0)	0.000**
DBP(mmHg)	71.0(65.0~79.2)	74.0(68.0~82.0)	78.0(71.0~85.0)	81.0(74.0~88.0)	0.000**
WC(cm)	80.4±7.1	85.7±6.9	89.0(85.0~93.5)	93.0(89.0~98.0)	0.000**

Data are expressed as mean±SD or median (P_{25}–P_{75}).
* *P* value: Comparison of age between one and another quartile of HOMA-IR group.
** *P* value: Comparison of each component of MetS between one and another quartile of HOMA-IR group.
Corrected a value was equal to 0.0083, so *P*< 0.0083 was considered statistically significant by the Kruskal Wallis test.

Table 4: Spearman's correlation analysis between HOMA-IR and components of MetS

Parameter	HOMA-IR (r)	*P*
Age (yr)	0.024	0.140
HDL-C	-0.357	0.000
TG	0.460	0.000
FBG	0.464	0.000
SBP	0.362	0.000
DBP	0.346	0.000
WC	0.586	0.000

r: Spearman's correlation coefficie

Discussion

Our results showed that the prevalence of MetS was 21.81% in young men and 5.62% in young women based on the IDF criteria. The prevalence of MetS was obviously higher in these men than in these women. Results were not consistent with some other studies (12, 13) which show that the prevalence of MetS was much higher in women than in men. This could be due to an association

with different age phases and remains to be further evaluated.

In this study, according to the increase of the numbers of MetS components, both BMI and HOMA-IR values were also significantly increased. Overall, BMI was not considered as a component of MetS in IDF criteria but was associated with MetS in this male population. On the other side, in the American Association of Clinical Endocrinologists (AACE) Criteria (14), BMI is been as one of components of MetS.

Furthermore, the HOMA-IR is a simple and effective index which gauges IR (10). Our results showed that suffering from more numbers of MetS components might cause greater IR. On the other hand, result showed that quartile of HOMA-IR was higher, values of TG, FBG, SBP, DBP and WC were significantly higher and HDL-C value was significantly lower. Therefore, IR was closely correlated with MetS. Joel T. Haas et al. reviewed that recent data pointed to a central role for IR in the pathogenesis of the MetS. It may be related with dis-inhibition of the transcription factor, FoxO1 (15). Hanley AJ et al. (16) reported that HOMA-IR was significantly and independently associated with risk of CVD outcomes in Mexican-American and non-Hispanic white people in the SAHS. Other studies (17, 18) also showed that the children and adolescents with greater IR exhibited more risk factors for CVD.

Further studies showed that HOMA-IR was significantly correlated with each component of MetS in this male population. Previous report (19) also indicated that HOMA-IR was positively associated with WC, BP, TG and FBG, and negatively correlated with HDL-C in Arab Americans. Another study (20) showed that an increased degree of IR is associated with a higher prevalence of disorders in each of the components of the MetS and with a heightened risk of suffering MetS among obese children and adolescents. In this male group, all components of MetS were closely correlated with insulin resistance. The maximum correlation coefficient (r= 0.586) was shown between HOMA-IR and WC. Some study have addressed that WC is a simple tool to exclude IR. The coupling of IR with abdominal obesity suggests a biological link at the fat cell level (21).

The present study has limitations. The subjects were not a general male population. Further studies are required among more general populations. Another limitation is that because the present data were based solely on young men, the extent to which our findings can be generalized to women and other ages of men is unclear.

In conclusion, IR played an important role in occurrence and development of MetS in young male population. Each component of MetS was all correlated with HOMA-IR and WC was best correlation with HOMA-IR among all components, so we need to underscore each component of MetS in particular watch WC, which aims at lowering diabetes and CVD risks.

Ethical Considerations

Ethical issues including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc. have been completely observed by the authors.

Acknowledgements

The authors declare that there is no conflict of interests.

References

1. Isomaa B, Almgren P, Tuomi T, Forsén B, Lahti K, Nissén M, et al. (2001). Cardiovascular morbidity and mortality associated with the metabolic syndrome. *Diabetes Care*, 24: 683-89.
2. Gupta S, Gupta BM (2006). Metabolic syndrome: diabetes and cardiovascular disease. *Indian Heart J*, 58: 149-52.
3. 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.
4. Ninomiya JK, L'Italien G, Criqui MH,Whyte JL, Gamst A, Chen RS (2004). Associa-

tion of the metabolic syndrome with history of myocardial infarction and stroke in the Third National Health and Nutrition Examination Survey. *Circulation*, 109: 42-6.
5. Earl S. Ford (2005). Prevalence of the metabolic syndrome defined by the international diabetes federation among adults in the U.S. *Diabetes Care*, 28: 2745-49.
6. Earl S. Ford, Wayne H. Giles, William H. Dietz (2002). Prevalence of the metabolic syndrome among US adults: findings from the third national health and nutrition examination survey. *JAMA*, 287: 356-59.
7. Sánchez-Chaparro MA, Calvo-Bonacho E, González-Quintela A, Fernández-Labandera C, Cabrera M, Sáinz JC, et al. (2008). Occupation-related differences in the prevalence of metabolic syndrome. *Diabetes Care*, 31:1884-85.
8. Guize L, Thomas F, Pannier B, Bean K, Jego B, Benetos A (2007). All-cause mortality associated with specific combinations of the metabolic syndrome according to recent definitions. *Diabetes Care*, 30: 2381-87.
9. Stern MP, Haffner SM (1986). Body fat distribution and hyperinsulinemia as risk factors for diabetes and cardiovascular disease. Arteriosclerosis, 6: 123-30.
10. Matthews DR, Hosker JP, Rudenski AS, Naylor BA, Treacher DF, Turner RC (1985). Homeostasis model assessment: insulin resistance and B-cell function from fasting plasma glucose and insulin concentrations in man. *Diabetologia*, 28: 412-19.
11. Alberti KG, Zimmet P, Shaw J, IDF Epidemiology Task Force Consensus Group (2005). The metabolic syndrome - a new worldwide definition. Lancet, 366: 1059-62.
12. He Y, Jiang B, Wang J, Feng K, Chang Q, Fan L, et al. (2006). Prevalence of the metabolic syndrome and its relation to cardiovascular disease in an elderly Chinese population. *J Am Coll Cardiol*, 47: 1588-94.
13. Gu D, Reynolds K, Wu X, Chen J, Duan X, Reynolds RF, et al. (2005). Prevalence of the metabolic syndrome and overweight among adults in China. *Lancet*, 365:1398-405.
14. Grundy SM, Cleeman JI, Daniels SR, Donato KA, Eckel RH, Franklin BA, et al. (2005). Diagnosis and management of the metabolic syndrome: an American Heart Association/National Heart, Lung, and Blood Institute Scientific Statement. *Circulation*, 112: 2735-52.
15. Haas JT, Biddinger SB (2009). Dissecting the role of insulin resistance in the metabolic syndrome *Curr Opin Lipidol*, 20: 206-10.
16. Hanley AJ, Williams K, Stern MP, Haffner SM (2002). Homeostasis model assessment of insulin resistance in relation to the incidence of cardiovascular disease, the San Antonio Heart Study. *Diabetes Care*, 25: 1177-84.
17. Weiss R, Dziura J, Burgert TS, Tamboriane W, Taksall SE, Yeckcel CW, et al. (2004). Obesity and the metabolic syndrome in children and adolescents. *N Engl J Med*, 350: 2362-74.
18. Ferreira AP, Oliveira CE, França NM (2007). Metabolic syndrome and risk factors for cardiovascular disease in obese children: the relationship with insulin resistance (HOMA-IR). *J Pediatr*, 83: 21-6.
19. Jaber LA, Brown MB, Hammad A, Zhu Q, Herman WH (2004). The prevalence of the metabolic syndrome among Arab Americans. *Diabetes Care*, 27:234-8.
20. Juárez-López C, Klünder-Klünder M, Medina-Bravo P, Madrigal-Azcárate A, Mass-Díaz E, Flores-Huerta S (2010). Insulin resistance and its association with the components of the metabolic syndrome among obese children and adolescents. *BMC Public Health*, 2010. 10: 318.
21. Wahrenberg H, Hertel K, Leijonhufvud BM, Persson LG, Toft E, Arner P (2005). Use of waist circumference to predict insulin resistance: retrospective study. *BMJ*, 330: 1363-64.