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The differences of metabolic syndrome in elderly subgroups: A special focus on young-old, old-old and oldest old

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A B S T R A C T

Background: Metabolic syndrome (MetS) is known to be correlated to future diabetes and cardiovascular disease. Due to the aging society, the increasing prevalence of MetS in the elderly is an important health issue. However, there were few studies focusing in this field. We investigated the changes of MetS components in the subgroups of the elderly.

Methods: Subjects aged above 65 years old who underwent routine health checkups in Taiwan (N = 18916) were divided into three groups (young-old: ≧65 and <75, old-old: ≧75 and <85 and oldest-old ≧85). By using multiple logistic regressions, the odds ratio (OR) of subjects with abnormal MetS components to have MetS were evaluated.

Results: For men, the systolic blood pressure (SBP) and high-density lipoprotein cholesterol increased as the age got older. On the contrary, the diastolic blood pressure and triglycerides (TG) decreased. In women, the waist circumference and SBP increased significantly from the young-old to the oldest-old groups. The highest percentage having MetS was 35% in old-old men and 62% in oldest-old women. Finally, subjects with high TG had the highest and BP had the lowest ORs for having MetS in both genders except oldest-old women.

Conclusions: In the elderly, the MetS and its components have different patterns not only in young-, old- and oldest-old groups but also in men and women. Moreover, among the five components, hypertension was always the most prevalent one. Finally, subjects had high TG had the highest ORs to have MetS compared to other components.

1. Introduction

Due to the National Health Insurance, the average life expectancy has been increased recently in Taiwan. At present, it is 76.9 for men and 83.3 years old for women, respectively (Department of Statistics, 2016). Therefore, the health problems of these elderly have become major issues for the health providers and government. This is not unique in Taiwan, there are many other countries and societies facing the same challenges.

Metabolic syndrome (MetS) was first defined by the World Health Organization (WHO) due to the alarming world-wide increase of the cardiovascular diseases (CVD) and diabetes (Alberti & Zimmet, 1998). The purpose for defining this syndrome was in the hope to early detect subjects under higher risks for these two diseases (Kylin, 1923; Vague, 1947). In the same time, it is generally believed that this higher incidence of MetS is related to the simultaneously increased prevalence of obesity. The accumulation of the adiposity in human bodies can cause insulin resistance which is considered to be the core of MetS (Reaven, 1988). After its publication, many organizations modified the WHO-version and published their own definitions. Due to its simplicity and practicability, the most widely used version is suggested by Third Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (NCEP, 2001). Many corner-stone-studies are based on this definition and these studies

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contribute tremendously to our understanding of the CVD and diabetes pathophysiology (Cinti et al., 2005; Lau, Dhillon, Yan, Szmitko, & Verma, 2005; Alberti et al., 2009; Trayhurn & Wood, 2004). Moreover, the importance and accuracy of MetS to predict CVD and diabetes are further consolidated.

It should be noted that the health problems vary with the increasing of age. For example, in subjects younger than 65 years old, cancer is the most important cause of death. But once over 65, CVD, originally is in the third place, replaces cancer and becomes the number one on the top of the list (Sahyoun, Hoyert, & Robinson, 2001). Other than the age, the patterns are also not the same in different genders. In US, men and women have different top 10 causes of death is a very good example. However, it should be noted that CVD has always been a more and more important cause of death when people get older.[1]

Even though the impact of CVD and diabetes has become more and more severe, it is surprising to note that there has been very few studies focusing on the exploring the details of MetS components in the elderly, particularly on the effects of genders. In the present study, we hypothesized that the prevalence of MetS and its components change with age and genders in the elderly. We enrolled 18916 subjects and further classified them into three groups [young-old (≧65 and <75), old-old (≧75 and <85) and oldest-old (≧85 years-old)]. In this cohort, we explored the effects of age and genders on MetS in the elderly (Cohen-Mansfield et al., 2013; Hiramatsu et al., 2012; Nagata et al., 2012).

1.1. Study population

We enrolled subjects aged above 65 years old (included) who underwent routine health checkups at the MJ Health Screening Center in Taiwan. MJ Health Screening Centers are private chain-clinics located throughout Taiwan that provide regular health examinations to their members. All study participants were anonymous, and informed consents were obtained from each individual. Data were provided by MJ Health Screening Center for research purposes only, and the institutional review board of MJ Health Screening Center approved the study protocol. We randomly selected 57,517 records from MJ Health Screening Center's database between 1999 and 2008. We excluded 21,338 subjects who aged less than 65 years old. We excluded another 3347 subjects who visited only once during the sampling period. Subjects with a past history of hypertension, type 2 diabetes, CVD events, or were taking medications known to affect MetS components level were excluded (n = 11,562). In addition, we excluded subjects who had missing data regarding to MetS components, or other general data (n = 2354). Finally, a total of 18,916 subjects were eligible for further analysis. They were further classified as aforementioned three age group, i.e., young-old, old-old and oldest-old.

1.2. Anthropometric measurements and general data

Senior nursing staff obtained subjects' medical history, including information on any current medications, through questionnaire, and complete physical examinations were performed. Waist circumference (WC) was measured horizontally at the level of the natural waist, which was identified as the level at the hollow molding of the trunk when the trunk was laterally concave. Both systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured by nursing staff using standard mercury sphygmomanometers on the right arm of each subject when seated. After the subject had fasted for 10 h, blood samples were drawn from the antecubital vein for biochemical analysis. Plasma was separated from blood within 1 h and stored at −30 °C until analysis for fasting plasma glucose (FPG) and lipid profiles. FPG was measured using a glucose oxidase method (YSI 203 glucose analyzer, Yellow Springs Instruments, Yellow Springs, USA). Total cholesterol and triglycerides (TG) were measured using a dry, multilayer analytical slide method with the Fuji Dri-Chem 3000 analyzer (Fuji Photo Film, Tokyo, Japan). Serum HDL-C concentration were analyzed using an enzymatic cholesterol assay following dextran sulfate precipitation.

1.3. Definition of metabolic syndrome

We used the latest harmonized criteria of MetS in 2009 with some modification which is the decreased WC for Chinese (≧90 for men and 80 cm for women) (Alberti et al., 2009; Weng et al., 2012). The remaining four criteria were the same; i.e. SBP ≧130 mmHg or DBP ≧85 mmHg, TG ≧150 mg/dL, FPG ≧100 mg/dL, HDL ≦40 and 50 mg/dL in men and women or taking related medications. Subjects had to have at least three criteria to be diagnosed as MetS.

1.4. Statistical analysis

All statistical analyses were performed using SPSS 18.0 software (SPSS Inc., Chicago, IL). Data are presented as mean ± standard deviation. All data were tested for normal distribution with Kolmogorov–Smirnov test and for homogeneity of variances with Levene's test. Data were log transformed before analysis if data were not normally distributed. The *t*-test was used to evaluate the differences between the two groups. Analysis of variance was used to compare the three groups. To evaluate the odds ratio of abnormal MetS components to have MetS, logistic regression was performed. Whether normal or abnormal MetS components were regarded as the independent variables and, in the same time, having or not having MetS as the dependent variables. When one of the MetS components was evaluated, other components were

Table 1
Demographic data in different elderly groups.

	Young–old	Old–old	Oldest–old	p value
Male				
n	7654	1963	121	
Age (year)	68.7 ± 2.8	77.9 ± 2.5**	87.0 ± 2.2††	<0.001
WC (cm)	85.1 ± 9.1	84.9 ± 9.6	84.6 ± 10.1	0.484
SBP (mmHg)	135.6 ± 20.3	139.3 ± 20.2**	139.5 ± 22.4	<0.001
DBP (mmHg)	77.3 ± 11.7	75.2 ± 11.9**	73.4 ± 12.9††	<0.001
FPG (mg/dl)	109.8 ± 32.5	110.4 ± 32.1	105.5 ± 17.9	0.247
TC (mg/dl)	199.9 ± 36.4	194.3 ± 35.4**	190.8 ± 35.0††	<0.001
HDL (mg/dl)	49.3 ± 13.9	50.4 ± 14.7*	51.7 ± 16.0†	<0.001
TG (mg/dl)	127.9 ± 70.7	123.1 ± 65.3**	110.9 ± 50.6††	0.001
log TG	2.05 ± 0.21	2.04 ± 0.21**	2 ± 0.19††	<0.001
Female				
n	7523	1574	81	
Age (year)	68.5 ± 2.7	77.8 ± 2.6**	86.8 ± 2.0††	<0.001
WC (cm)	80.1 ± 8.9	82.1 ± 9.6**	83.5 ± 9.1††	<0.001
SBP (mmHg)	139.9 ± 20.8	145.9 ± 21.2**	149.5 ± 19.4††	<0.001
DBP (mmHg)	76.8 ± 11.8	76.2 ± 12.3	76.8 ± 11.5	0.245
FPG (mg/dl)	110.0 ± 33.5	110.1 ± 29.6	109.4 ± 26.7	0.984
TC (mg/dl)	214.2 ± 38.6	210.5 ± 37.0**	212.7 ± 42.4	<0.001
HDL (mg/dl)	57.0 ± 15.1	57.0 ± 15.8	56.8 ± 16.6	0.977
TG (mg/dl)	138.4 ± 69.2	139.6 ± 68.5	143 ± 65.9	0.661
log TG	2.09 ± 0.2	2.1 ± 0.2	2.12 ± 0.18	0.374

WC = waist circumference; BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; FPG = fasting plasma glucose; TC = total cholesterol; HDL = high-density lipoprotein; TG = triglyceride; log TG = log transformed triglyceride.
* p < 0.05 when compared with young–old group.
** p < 0.01 when compared with old–old group.
† p < 0.05 when compared with young–old group.
†† p < 0.01 when compared with old–old group.

[1] http://www.worldlifeexpectancy.com/usa-cause-of-death-by-age-and-gender.