European Journal of Integrative Medicine 8 (2016) 227–234

Contents lists available at ScienceDirect

European Journal of Integrative Medicine

journal homepage: www.elsevier.com/eujim

Research paper

The association of Sasang constitutional types with metabolic syndrome: A pooled analysis of data from three cohorts

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ARTICLE INFO

Article history:
Received 14 June 2015
Received in revised form 12 November 2015
Accepted 12 November 2015

Keywords:
Metabolic syndrome
Sasang constitutional types
Cohort analysis
Tae-eum
So-eum
So-yang

ABSTRACT

Introduction: Metabolic syndrome (MetS) is a highly prevalent condition, which is considered to be a major risk factor for cardiovascular diseases. Sasang constitutional types (SCTs) are divided into four distinct types which are classified by specific physical, physiological, pharmacological, and psychological characteristics.
Methods: In this study, we performed a pooled analysis to assess the relationship between MetS and SCTs using data from two community-based cohorts and one clinical database of Sasang constitution. The 1421, 1547, and 2279 individuals who participated in the Ansung cohort, Ansan cohort, and Korean Constitutional Multicenter Bank, respectively, were analyzed. The participants were classified into SCTs using the integrated diagnostic model. MetS was defined according to the National Cholesterol Education Program Adult Treatment Panel III.
Results: The prevalence of MetS according to the SCTs in the combined data was 14.1% for the So-eum (SE)-type, 26.7% for the So-yang (SY)-type, and 50.8% for the Tae-eum (TE)-type. In the combined data set, the odds ratios of having MetS was 2.05-fold greater (95% confidence interval [CI], 1.62–2.60; $P < 0.0001$) for the TE-type, and 1.41-fold greater (95% CI, 1.13–1.76; $P = 0.0026$) for the SY-type than the SE-type.
Conclusion: This study found that TE- and SY-types were significantly associated with a risk of MetS.

1. Introduction

Sasang constitutional medicine (SCM) is the distinctive traditional medicine of Korea initiated by a Korean phyician, Lee Je Ma in 19th century. Sasang constitutional types (SCTs) are four distinct classifications based on SCM: Tae-yang (TY), Tae-eum (TE), So-yang (SY), and So-eum (SE). These types have been developed based on the characteristics of physiology and psychology, susceptibility to particular external conditions, and types of weak and strong organ function (Table 1) [1–3].

Acccumulating evidence has shown that different types of the SCTs are associated with certain diseases or pathological conditions. TE-type has been shown to be an independent risk factor for hypertension (HTN) [4], diabetes mellitus (DM) [5], and obstructive sleep apnoea (OSA) [6]. SY-type has been known to be associated with diseases of the urinary system such as renal disease and cystis [7–9]. Also, when metabolic abnormalities are present in SY-type, individuals have a higher incidence of cardiovascular disease (CVD) compared with other Sasang types (TE and SE) even though with the same metabolic abnormality [10]. SE-type has been frequently a dysfunction in food

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http://dx.doi.org/10.1016/j.eujim.2015.11.017
1876-3820/

Table 1
Basic characteristics of the Sasang constitutional types.

Characteristics	Constitutions			
	SE-type	SY-type	TE-type	TY-type
Body shape	Slender	Muscular	Obese	Slender
Temperament	Calm, careful	Hot-tempered	Slow, steady	Progressive
Strong function	Food discharge	Food intake	Anabolism	Catabolism
Weak function	Food intake	Food discharge	Catabolism	Anabolism
Healthy sign	Good digestion	Good bowel movement	Existence of perspiration	Smooth urination
Unhealthy sign	Indigestion	Existence of constipation	Absence of perspiration	Musculoskeletal weakness

Abbreviations: SE-type, So-eum type; SY-type, So-yang type; TE-type, Tae-eum type; TY-type, Tae-yang type.

metabolism, gastroptosis [11,12], and this type has a high prevalence of functional dyspepsia [13].

Metabolic syndrome (MetS) is a highly prevalent condition that is characterized by a cluster of metabolic and cardiovascular abnormalities including abdominal obesity, insulin resistance, dyslipidemia, and HTN [14,15]. It has been considered as a risk factor for morbidity and mortality of CVD and DM, of which individual components required to define MetS-associated with diseases [16].

In the general population, prevalence of MetS has been reported to be approximately 22% in both men and women [17]. There is an increasing trend in prevalence of MetS worldwide [18,19], and this increase has been social and economic burdens. In Korea, prevalence of MetS has increased rapidly from 24.9% in 1998 to 31.3% in 2007, which is possibly due to the change of lifestyle with high calorie diet and physical inactivity [20,21].

Studies have investigated an association between MetS with SCTs, but these have been based only on reports, thus findings are limited regarding how to identify which specific types may be associated with individual metabolic components [10,22–24]. Previous studies have reported an association between MetS with SCTs based on a general population cohort of using a clinical database, but have not combined them. Thus, the previous study findings were likely to be limiated by cohort size leading to an unidentified associaiton, overestimated association for a clinical cohort, or underestimation for a population-based cohort. A pooled-analysis of population-based and clinic-based cohorts has nevere been performed to assess a relationship between MetS and SCTs. We in this analysis, combined cohort data from different sources of two community-based cohorts and the large clinical database of Sasang constitution in Korea and determined an association of MetS with specific SCTs, expecting an accurate investigation.

2. Materials and methods

2.1. Study population

We conducted a pooled-analysis using multi-center data from three sites. This included, two independent population-based cohort studies embedded in the Korean Genome Epidemiology Study (KoGES). Ansung cohort (Study 1) is a rural community cohort which started in 2001 with 5018 participants (2239 men and 2779 women). Ansan cohort (Study 2) is an urban community cohort which started in 2001 and consisted of 5020 participants (2523 men and 2497 women). The participants who participated in Study 1 and Study 2 underwent comprehensive health examinations and on-site interviews at Ajou University Hospital and Korea University Ansan hospital, respectively, and had bi-annual follow-up examinations for anthropometric measurments, biochemical analyses, blood pressure measurement, and demographic information. Detailed information on the procedures and the design of the study for each cohort can be found in previous reports [25,26]. Study 3 consisted of data obtained from the Korean Constitutional Multicenter Bank at the Korea Institute of Oriental Medicine (KIOM), which is the biggest national clinical database, including 24 Korean medical clinics [23]. In total, 1421 and 1547 cases from participants enrolled in Study 1 and Study 2 between 2009 and 2011 were used for the analysis, respectively. From Study 3, 2279 cases which were collected between 2006 and 2009 were employed. Since there was only a few TY-types in our sample, only data from participants classified as the TE, SE, and SY constitutions were analysed in this study. All participants signed an informed consent form. The Institutional Review Board at the Korea University Ansan Hospital reviewed and approved this study.

2.2. Definition of metabolic syndrome and anthropometric measurements

MetS was defined, according to the National Cholesterol Education Program Adult Treatment Panel III [14], as when three or more of the following conditions were present: abdominal obesity based on Asia–Pacific criteria (waist circumference $\geq$90 cm for men and $\geq$80 cm for women) [27], hypertriglyceridemia (triglyceride $\geq$150 mg/dl), low high density lipoprotein (HDL) cholesterol (<40 mg/dl for men and <50 mg/dl for women), HTN (systolic/diastolic pressure $\geq$130/85 mmHg and/or the use of antihypertensive drugs), and high fasting glucose ($\geq$110 mg/dl or treatment with antidiabetic drugs). Body mass index (BMI) was calculated by dividing weight in kilograms by height in meters squared (kg/m^2). Waist circumference (cm) was measured at the narrowest point between the lower rib and the iliac crest. BP was measured with a mercury sphygmomanometer in a seated position. Blood samples were collected in the morning after an overnight fast. Blood concentrations of triglyceride (TG), HDL cholesterol, and fasting glucose were measured using an auto analyzer (ADVIA 1650, Siemens, Tarrytown, NY) in the Seoul Clinical Laboratories (Seoul, Korea).

2.3. Classification of SCT

An integrated diagnostic model which has been developed by Do et al. [28] was used to classify the subjects into different SCTs on the basis of the probability values for each type. Four individual quantitative data including facial images, body shape, voice features, and questionnaire information on personality and physiological symptoms are integrated into a single value in the model. Briefly, the facial images of subjects which were taken with a digital camera were appropriately processed to extract variables expressing facial characteristics. For body shape analysis, the following eight items were measured: forehead circumference, neck circumference, axillary circumference, chest circumference, rib circumference, waist circumference, pelvic circumference, hip circumference, height, weight, and body mass index (BMI). For the