

# Prevalence of and associations between metabolic syndrome and the constitutions defined by Korean Eight Constitution Medicine

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## Abstract

Eight Constitution Medicine (ECM) is a Korean constitutional medicine system that classifies people into 8 types: Pulmotonia (PUL), Colonotonia (COL), Renotonia (REN), Vesicotonia (VES), Pancreotonia (PAN), Gastrotonia (GAS), Hepatonia (HEP), and Cholecystonia (CHO). Metabolic syndrome (MS) is a major public health problem worldwide. We assessed the prevalence of and associations between ECM and MS. Cross-sectional convenience sample of 245 adults was used at a medical check-up center in Seoul, South Korea, from 2010 to 2015. Adults were classified into 1 of 8 constitutions by an ECM specialist. MS was diagnosed on the basis of National Cholesterol Education Program Adult Treatment Panel III and Asian Pacific Criteria for abdominal obesity. We also computed the prevalence by percentage and calculated odds ratios (ORs) for MS among 6 constitutions with PUL as the reference.

Among 245 adults, 20 (8.2%) were diagnosed with PUL, 43 (17.6%) with COL, 35 (14.3%) with REN, 4 (1.6%) with VES, 71 (29.0%) with PAN, 0 (0.0%) with GAS, 54 (22.0%) with HEP, and 18 (7.3%) with CHO. The prevalence of MS in the constitutions was significantly different: CHO, 38.9%; HEP, 35.2%; PAN, 18.3%; COL, 11.6%; PUL, 5.0%; REN, 2.9% ( $P = .001$ ). We observed higher ORs for HEP and CHO (OR=13.03, 95% confidence interval [CI]=1.61–105.70; and OR=13.19, 95% CI=1.39–125.46, respectively) than for the other constitutions.

People with HEP and CHO constitutions could be at higher risk for MS. Therefore, ECM-based diagnosis may be useful for preventing and managing MS.

**Abbreviations:** CHO = Cholecystonia, COL = Colonotonia, DBP = diastolic blood pressure, ECM = Eight Constitution Medicine, FBG = fasting blood glucose, GAS = Gastrotonia, HbA1C = hemoglobin A1C, HDL-C = high-density lipoprotein cholesterol, HEP = hepatonia, MS = metabolic syndrome, OR = odds ratios, PAN = Pancreotonia, PUL = Pulmotonia, REN = Renotonia, SBP = systolic blood pressure, VES = Vesicotonia, WC = waist circumference.

**Keywords:** constitutional medicine, Eight Constitution Medicine, Korean medicine, metabolic syndrome

## 1. Introduction

The Eight Constitution Medicine (ECM) typology is a Korean constitutional medical system originally proposed by Dr Do-won

Kuon of South Korea<sup>[1]</sup> and presented in 1965 at the 1st International Congress of Acupuncture in Tokyo, Japan.<sup>[2]</sup> The ECM has its origins in the Sasang typology, the first constitutional theory in Korea, established by Jema Lee, a medical scientist born at the end of the Korean Josun dynasty (1837–1899).<sup>[3]</sup> It classified individuals into Tae-yang, Tae-yeum, So-yang, and So-yeum constitutions based on the strength and weakness of 4 organs: liver, lung, pancreas, and kidney. Drug treatment can be administered on the basis of these 4 constitutions.<sup>[3,4]</sup> ECM is similar to the Sasang typology, as both classifications are made based on the strength and weakness of organs; however, it differs with respect to the number of constitutions, diagnoses, and treatment methods.<sup>[2,5]</sup>

ECM theory classifies humans into 8 types based on their congenital arrangement of organic strengths: Pulmotonia (PUL), Colonotonia (COL), Renotonia (REN), Vesicotonia (VES), Pancreotonia (PAN), Gastrotonia (GAS), Hepatonia (HEP), and Cholecystonia (CHO)<sup>[6]</sup> (Table 1). For example, people with PUL have the weakest liver function, but the strongest lung function. They tend to have a higher likelihood of atopic dermatitis and their bodies are relatively slender.<sup>[5,6]</sup> People with COL have good large intestinal function, but poor gall bladder function. They are also generally slender, but are at high risk of rare illnesses, such as muscle atrophy, if they overeat meat, and tend to have hot tempers.<sup>[5,6]</sup> People with REN have the strongest kidney function, but the weakest pancreatic function.<sup>[5,6]</sup> People

Editor: Daryle Wane.

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The authors have no conflicts of interest to disclose.

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How to cite this article: Kim HJ, Jang BH, Kim MJ, Kim KC, Kuon WJ, Kim CK. Prevalence of and associations between metabolic syndrome and the constitutions defined by Korean Eight Constitution Medicine 2020;99:7(e19074).

Received: 29 May 2019 / Received in final form: 29 December 2019 / Accepted: 7 January 2020

<http://dx.doi.org/10.1097/MD.00000000000019074>

**Table 1**  
**Constitutional characteristics and order of organs in Eight Constitutional Medicine.**

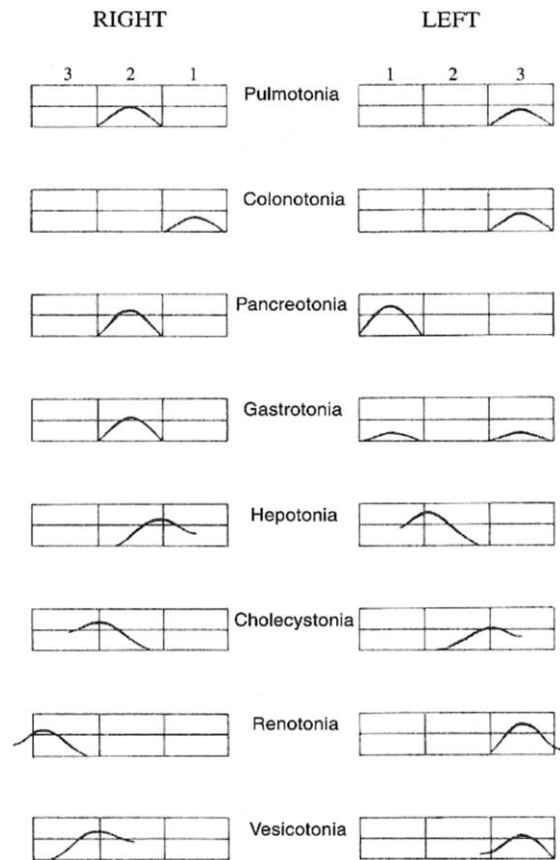
Constitutions	The characteristic of the constitutions Eight different orders of organs
Pulmotonia (PUL)	PUL has a weak liver function and it is better to eat fish than meat Lung > Pancreas > Heart > Kidney > Liver
Colonotonia (COL)	COL is not good eating meat. If they overeat meat, they could tend to have hot tempers and fatigue Large Intestine > Bladder > Stomach > Small Intestine > Gall Bladder
Renotonia (REN)	REN has a meticulous nature and weak digestion function. Kidney > Lung > Liver > Heart > Pancreas
Vesicotonia (VES)	VES has a weak stomach function, so it is better to eat less and to eat warm food. Bladder > Gall Bladder > Small Intestine > Large Intestine > Stomach
Pancreotonia (PAN)	PAN has a quick temper and a strong digestion function. Pancreas > Heart > Liver > Lung > Kidney
Gastrotonia (GAS)	GAS is a very rare constitution and it's good to take something cool and fresh. Stomach > Large Intestine > Small Intestine > Gall Bladder > Bladder
Hepatonia (HEP)	HEP has a weak lung function so it's better to talk less and to sweat a lot. Liver > Kidney > Heart > Pancreas > Lung
Cholecystonia (CHO)	CHO has a weak colon function so it's always better to warm lower abdomen. Gall Bladder > Small Intestine > Stomach > Bladder > Large Intestine

with VES have a weak stomach, but a strong bladder, a small waist, and a balanced upper and lower body.<sup>[5,6]</sup> People with PAN have good pancreatic and digestion functions, but weak kidney function. Their upper bodies are more developed than their lower bodies.<sup>[5,6]</sup> People with GAS have the best gastrointestinal function, but the worst bladder function. This constitution is very rare, with an incidence rate of 1/100,000.<sup>[5,6]</sup> People with HEP have good liver function, but poor lung function. Many people with HEP have a large body size, and sweating is recommended to maintain their health.<sup>[5,6]</sup> People with CHO have strong gallbladder function, but weak colon function. Similar to those with HEP, they tend to experience frequent bowel movements and have a large physique.

To classify individuals according to the ECM, Dr Kuon proposed 8 pulse patterns of the radial artery.<sup>[5]</sup> Figure 1 shows that the pulse pattern consists of a combination of pulses from the left and right radial arteries. ECM pulse diagnosis is different from traditional pulse diagnosis, in terms of both the location at which it is performed and the method that is used. A previous study reported that ECM pulse diagnosis is reproducible and repeatable depending on the skill of the examining doctor.<sup>[7]</sup> Another study reported that many clinical cases provide accurate and reproducible diagnoses.<sup>[8]</sup>

Treating the ECM constitutions involves performing constitution-based acupuncture and informing patients about beneficial and harmful foods (Table 2).<sup>[9]</sup> In Korea, ECM has been widely studied and is used in many traditional Korean medicine clinics. Constitutional medicine is effective in treating various diseases in the clinic.<sup>[10-14]</sup>

MS is a complex disease that results from interactions among physiological, biochemical, clinical, and metabolic factors; it



**Figure 1.** Pulse pattern according to constitutions in Eight Constitutional Medicine. LEFT = Left hand of the patient, RIGHT = Right hand of the patient. The index finger of the physician, the middle finger of the physician, and the ring finger of the physician. The curved line indicates the first pulse wave increase; the box indicates the pulse strength. The method of checking the 8-constitution pulse is as follows: first, ask the patient to lay down to check the pulses of the patient's right radial artery by using the doctor's left hand, and the patient's radial artery by using the doctor's right hand. When checking at the pulse, the position of the physician's 2nd, 3rd, and 4th finger are placed on the radial artery line that is about 5 cm below the styloid process of the radius. Next, the radial artery is pressed firmly enough so that the pulse can no longer be felt; then the strongest pulse is found by lowering the pressure applied to the artery. At this point, the 3 fingers should be pressed using the same pressure, taking into consideration the inclination of the radius.

directly increases the risks of cardiovascular disease, type 2 diabetes, and even death.<sup>[15,16]</sup> MS is a major public health concern and clinical problem in developing and developed countries.<sup>[17]</sup> Several studies have identified important risk factors that affect MS, such as BMI, aging, and hormonal imbalance.<sup>[18-20]</sup> Other studies indicate that low-density lipoprotein cholesterol (LDL-C) and body mass index (BMI) are more strongly associated with CHO and HEP than the other constitutions, suggesting that certain constitutions may be more at risk of MS.<sup>[21]</sup> A useful method for treating MS is lifestyle change therapy, which combines specific diet recommendations, physical activity, and other behaviors.<sup>[17]</sup> Using ECM to identify congenital factors and to inform lifestyle changes may be an effective strategy for preventing MS.<sup>[9]</sup> The aim of the present study was to examine the prevalence of MS across different constitutions and to document the relationship between ECM

**Table 2**  
**Beneficial and harmful foods according to constitutions in Eight Constitutional Medicine.**

		PUL	COL	REN	VES	PAN	GAS	HEP	CHO	
Beneficial food	Fish	Saltwater fish Shellfish	Saltwater fish Shellfish			All kinds of fish	Saltwater fish Shellfish	Freshwater fish	Freshwater fish	
	Meat			Beef Chicken	Beef Chicken	Beef Pork	Pork Beef	Beef Pork Chicken Milk Dairy products	Beef Pork Milk Dairy products	
		Vegetables	Green vegetables	Green vegetables	Red pepper Ginger Onion	Red pepper Ginger Onion	All kinds of vegetables	Green vegetables	Root vegetables Garlic Mushrooms	Root vegetables Garlic Mushrooms
	Fruits	Banana	Strawberry	Apple	Apple	Persimmon	Persimmon	Persimmon	Pear	Pear
		Strawberry	Pineapple	Orange	Orange	Pear	Pear	Apple	Melon	Melon
		Peach	Grape	Mango	Mango	Melon	Melon	Watermelon	Watermelon	Watermelon
		Cherry	Peach	Tomato	Tomato	Watermelon	Watermelon	Nuts	Nuts	Nuts
		Persimmon melon Quince	Cherry Persimmon Quince			Banana Strawberry	Banana Strawberry			
	Vitamins Etc	E Cocoa		B Acid beverage	A, B, C, D Acid beverage	E	E Cocoa	A, B, C, D Flour Coffee Alkaline beverage	A, B, C, D, E Flour Coffee Alkaline beverage	
	Harmful food	Fish	Freshwater fish	Freshwater fish	All kinds of fish	All kinds of fish			Saltwater fish Shellfish	Saltwater fish Shellfish
Meat		Beef	Beef	Pork	Pork	Chicken	Chicken			
		Pork	Pork							
		Chicken	Chicken							
Vegetable		Milk	Milk							
		Dairy products	Dairy products							
		Red pepper	Root vegetables			Red pepper	Red pepper	Green vegetables	Green vegetables	
		Root vegetables	Garlic			Ginger	Ginger			
Fruits		Garlic	Mushrooms			Onion	Onion			
		Mushrooms								
	Apple	Apple	Persimmon	Persimmon	Apple	Apple	Strawberry	Strawberry		
	Pear	Pear	Melon	Melon	Orange	Orange	Peach	Peach		
	Watermelon	Watermelon	Banana	Banana	Mango	Mango	Cherry	Cherry		
Vitamins Etc			Strawberry	Strawberry	Tomato	Tomato	Persimmon	Persimmon		
	A, B, C, D	A, C, D, E			Grape	Grape	Melon	Melon		
	Flour	Flour	A, D, E	E	Pineapple	Pineapple	Quince	Quince		
	Coffee	Coffee		Cocoa			Grape	Grape		
	Alkaline beverage	Alkaline beverage					Cocoa	Cocoa		

CHO = Cholecystonia, COL = Colonotonia, GAS = Gastrotonia, HEP = Hepatonia, PAN = Pancreotonia, PUL = Pulmotonia, REN = Renotonia, VES = Vesicotonia.

and MS in individuals who participated in a health screening at our medical institution.

**2. Methods**

**2.1. Design and sample**

This cross-sectional study surveyed a convenience sample of 245 individuals from among 329 people who participated in a health examination at 1 medical check-up center in Seoul, South Korea between 2010 and 2015. Eighty individuals were excluded because they were not diagnosed with an ECM constitution. This

study was granted approval from the university institutional review board of the medical check-up center (2015-09-143).

**2.2. Measures and diagnosis of ECM**

Medical staff performed standard operational procedures and obtained basic measures such as history of exercise, smoking, alcohol intake, body weight, height, waist circumference, blood pressure, and any treatment for previous diseases. Venous blood was collected after fasting for >12 hours.

The National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) guidelines were used to define MS.<sup>[22]</sup>

**Table 3**  
**Age and sex in the 8 constitutions.**

	PUL	COL	REN	VES	HEP	CHO	PAN	P-value
	(n=20)	(n=43)	(n=35)	(n=4)	(n=54)	(n=18)	(n=71)	.258
Age	56.85±10.37	52.07±11.04	52.57±10.48	51.00±9.90	56.33±11.72	57.44±12.53	55.52±10.09	
Sex								
Male	10 (50.0)	12 (27.9)	11 (31.4)	0 (0.0)	22 (40.7)	14 (77.8)	49 (69.0)	<.001
Female	10 (50.0)	31 (72.1)	24 (68.6)	4 (100.0)	32 (59.3)	4 (22.2)	22 (31.0)	

VES was excluded from the chi-squared test of association in order to avoid the violation of assumptions due to no observation with MS; CHO=Cholecystonia, COL=Colonotonia, HEP=Hepatonia, PAN=Pancreotonia, PUL=Pulmotonia, REN=Renotonia, VES=Vesicotonia.

These guidelines require at least 3 of the following 5 criteria for MS: a fasting blood glucose (FBG)  $\geq 100$  mg/dL or taking medication for diabetes mellitus<sup>[22]</sup>; triglycerides (TG)  $\geq 150$  mg/dL<sup>[22]</sup>; high-density lipoprotein cholesterol HDL-C  $\leq 40$  mg/dL for men and 50 mg/dL for women<sup>[22]</sup>; systolic blood pressure (SBP)  $\geq 130$  mmHg and/or diastolic blood pressure (DBP)  $\geq 85$  mmHg, or taking medication for high blood pressure<sup>[22]</sup>; central obesity with waist circumference (WC)  $\geq 90$  cm for men and  $\geq 80$  cm for women.<sup>[23]</sup>

Patients' constitutions were diagnosed using Dr Kuon's 8 pulse patterns of the radial artery, as shown in Fig. 1. The diagnoses were made twice to ensure accuracy and reproducibility.

### 2.3. Statistical analysis

All data were cleaned and analyzed in SPSS 24.0 (IBM Corp., Armonk, NY).<sup>[24]</sup> Data were missing for >20% of the variables from 4 people; therefore, after ensuring that they did not differ significantly on selected demographic variables from those with no data missing, they were excluded, leaving 245 for further analysis. Missing data for the remaining surveys were handled with multiple imputation. Descriptive statistics were computed to characterize the samples. One-way analyses of variance (ANOVAs) were used to compare blood test results across the constitutions, and a chi-squared test was performed to test associations between constitution types and the prevalence of MS. Finally, odds ratios (OR) for MS were calculated with

logistic regression analysis adjusted by age and sex. All statistical significances were reported at  $P < .05$ , except for the ANOVA results, which used Bonferroni adjustment for comparing blood tests due to a problem with multiple comparisons.

### 3. Results

Table 3 shows the distribution of demographic information and constitutions. Of the 245 patients, 48.2% (n=118) were women; the average age was 54.85 (standard deviation [SD]=10.94). Twenty participants (8.2%) were diagnosed with PUL, 43 (17.6%) with COL, 35 (14.3%) with REN, 4 (1.6%) with VES, 54 (22.0%) with HEP, 18 (7.3%) with CHO, and 71 with PAN (29.0%). The distribution of constitutions was consistent with those of previous studies.<sup>[25]</sup> As previously mentioned, GAS is very rare and only observed in 1/100,000 individuals; there was no case with GAS constitution in the present study.<sup>[6,26]</sup>

Results of one-way ANOVAs revealed several significant differences in the physical measurements associated with each constitution (see Table 4). BMI was significantly different by constitution ( $F[6,238]=15.16, P < .001$ ). The post hoc comparison using Tukey HSD test indicated that HEP and CHO had significantly higher BMI than did PUL, COL, REN, and VES. PAN had significantly higher BMI than did COL, REN, and VES, but lower BMI than CHO (all  $P < .05$ ). Waist circumference was also significantly different among the constitution groups ( $F[6,238]=15.91, P < .001$ ). Similarly, the post hoc comparison

**Table 4**  
**Blood test results (M±SD) in the 8 constitutions.**

	PUL	COL	REN	VES	HEP	CHO	PAN	P-value
	(n=20)	(n=43)	(n=35)	(n=4)	(n=54)	(n=18)	(n=71)	
FBS	95.3±17.8	92.3±17.8	90.6±13.1	80.5±10.7	97.7±16.9	106.4±32.3	98.1±17.4	.023
BMI	21.2±2.0	21.5±2.3	21.2±2.1	17.8±2.5	24.0±2.8	25.4±2.2	23.0±2.4	<.001
WC	79.2±5.1	79.5±8.3	78.4±5.8	71.1±5.8	88.9±8.5	89.7±6.5	84.1±6.4	<.001
SPB	113.5±12.2	111.4±13.7	108.7±11.0	114.3±5.9	118.4±12.8	123.1±12.7	117.2±13.1	<.001
DBP	73.4±8.6	71.9±9.9	68.9±8.1	71.5±6.2	73.6±9.6	78.1±10.8	75.2±8.3	.010
TCHOL	205.0±38.3	191.3±25.3	196.1±33.5	188.3±38.9	199.1±44.7	172.4±24.7	196.6±38.0	.136
TG	121.5±63.7	96.4±76.4	86.3±36.3	63.3±7.5	115.4±55.4	112.4±108.6	108.7±63.7	.219
HDL	54.9±10.1	57.7±9.9	60.5±11.5	66.5±15.6	52.4±12.4	50.6±11.2	56.4±13.1	.008
LDL	125.4±33.3	113.0±22.7	117.9±32.4	105.5±27.8	122.2±37.7	100.6±29.5	116.9±32.6	.201
HbA1C	5.6±0.6	5.5±0.4	5.4±0.3	5.6±0.2	5.6±0.5	5.6±0.7	5.7±0.7	.227
MS* No	19 (95.0)	38 (88.4)	34 (97.1)	4 (100.0)	35 (64.8)	11 (61.1)	58 (81.7)	<.001
Yes	1 (5.0)	5 (11.6)	1 (2.9)	0 (0.0)	19 (35.2)	7 (38.9)	13 (18.3)	

Statistical significance at  $P < .005$  under Bonferroni adjustment is bolded.

BMI=Body mass index, CHO=Cholecystonia, COL=Colonotonia, DBP=Diastolic blood pressure, FBS=Fasting blood sugar, HbA1C=Hemoglobina1c, HDL=High-density lipoprotein cholesterol, HEP=Hepatonia, MS=Metabolic syndrome, PAN=Pancreotonia, PUL=Pulmotonia, REN=Renotonia, SBP=Systolic blood pressure, TCHOL=Total cholesterol, TG=Triglycerides, VES=Vesicotonia, WC=Waist circumference.

\* Chi-squared test was run without VES in order to avoid the violation of assumptions.

**Table 5**  
Odds ratios for metabolic syndrome in relation to ECM type.

	Crude			Adjusted <sup>§</sup>		
	OR	95% CI		OR	95% CI	
		Lower	Upper		Lower	Upper
Constitution groups						
PUL	1			1		
COL	0.52	0.19	1.40	3.83	0.41	35.67
REN	0.11*	0.0	0.81	0.80	0.05	13.68
HEP	3.30*	1.65	6.58	13.03*	1.61	105.70
CHO	3.07*	1.12	8.40	13.19*	1.39	125.46
PAN	0.96	0.47	1.95	5.02	0.61	41.64
Age	1.06*	1.02	1.10	1.05*	1.01	1.09
Sex						
Male	1			1		
Female	0.59	0.31	1.13	0.76	0.36	1.63

CHO = Cholecystonia, COL = Colonotonia, ECM = Eight Constitution Medicine, HEP = Hepatonia, OR = Odds ratios, PAN = Pancreotonia, PUL = Pulmotonia, REN = Renotonia, VES = Vesicotonia.

\*  $P < .05$ ; VES was excluded from the analysis due to no observation with metabolic syndrome.

<sup>§</sup> Is adjusted by age, sex.

using Tukey HSD test revealed that HEP and CHO had significantly higher WC than did PUL, COL, REN, and VES. PAN had significantly higher WC than COL, REN, and VES, but lower WC than HEP (all  $P < .05$ ). These results indicate that those with HEP and CHO diagnosis had higher BMI and WC associated with their body type.

Systolic blood pressure (SBP) was significantly different among constitution groups ( $F[6,238] = 4.29$ ,  $P < .001$ ). Follow-up tests using Tukey HSD test indicated that HEP, CHO, and PAN had higher SBP than REN, while CHO had a higher SBP than COL (all  $P < .05$ ). However, there were no significant differences among constitution groups in diastolic blood pressure, total cholesterol (TChol), thyroglobulin (TG), high-density lipoprotein cholesterol (HDL), low-density lipoprotein (LDL), and HbA1c.

The prevalence of MS in the constitutions was significantly different: CHO, 38.9%; HEP, 35.2%; PAN, 18.3%; COL, 11.6%; PUL, 5.0%; REN, 2.9% ( $P < .001$ ). To evaluate whether constitutional diagnosis according to ECM is an independent risk factor for MS, we calculated ORs for MS with a multiple logistic regression analysis. With PUL as the reference, CHO and HEP were at a much higher risk of developing MS than the other constitutions (Table 5). Patients diagnosed with HEP and CHO constitutions were approximately 13 times more likely to have MS than those with PUL constitution. Additionally, older patients were at a higher risk than younger patients.

#### 4. Discussion

The purpose of the present study was to investigate the prevalence of, and association between, MS and ECM constitutions. ECM is a typology system for diagnosing humans into 8 constitution groups according to strengths and weaknesses of organs. It can help us to understand and treat physiological and pathological phenomena based on this classification.<sup>[6]</sup> ECM theory has the advantage of providing a personalized and preventive approach that can provide information about patients' physical and mental characteristics for managing health through changes in lifestyle.<sup>[5]</sup> Previous ECM researchers have demonstrated its clinical effectiveness, showing that ECM can promote health through diet therapy and acupuncture.<sup>[10–14,26,27]</sup>

Our results show that the prevalence of MS was highest in the CHO and HEP constitution groups, followed by PAN, COL,

PUL, and REN. Notably, there were no patients with MS in the VES constitution group. Factors that may have contributed to these results include differences between the groups in WC, HDL-C, BP, and TG. Consistent with previous studies using these measures, we observed similar trends in the data.<sup>[21]</sup>

We observed that body-related factors (BMI and WC) were greatest in the CHO and HEP constitution groups and lowest in REN and VES. A previous study analyzing body shape characteristics for each constitution reported that CHO and HEP constitutions generally include individuals who are tall and heavy; in many cases, these patients were obese.<sup>[28]</sup> According to ECM theory, individuals with VES have the smallest body type. VES is also associated with the weakest gastrointestinal function and poor digestive enzyme activity to supply energy from consumed food compared with other constitutions. These characteristics may explain the observed small body type.<sup>[6,28]</sup>

We also observed that SBP was highest in the CHO and HEP constitution groups, and lowest in VES, PUL, and COL. For DBP, CHO, and PAN constitution groups were the highest, and REN was the lowest. ECM theory has previously suggested that the HEP constitution is associated with high blood pressure.<sup>[6]</sup> In the present study, individuals with CHO also exhibited high blood pressure, which may have been the result of a correlation between BMI and WC. Consistent with this, the REN constitution group had the lowest blood pressure and had the lowest BMI and WC. These results might indicate the importance of considering BMI and WC.

HDL-C was highest in the VES constitution group, and lowest in HEP and CHO. These differences were statistically significant. However, a previous study of serum lipid levels found no significant differences among ECM constitutions for HDL-C and TG.<sup>[21]</sup> It is possible that our results differed from those of the previous study because all of their participants were women, and none were diagnosed with VES and REN constitutions. Therefore, further studies including more participants will provide greater clarity. FBS was also high in the HEP, CHO, and PAN groups. ECM theory suggests that the PAN constitutions are associated with a high prevalence of diabetes, and the results of our study showed a trend in support of this idea with similar associations in PAN.<sup>[6]</sup> However, further research is warranted, because those with HEP and CHO in our sample also had a high prevalence of diabetes.

Results of multiple logistic regression analysis indicated that patients in HEP and CHO were 13 times more likely to be diagnosed with MS than those in PUL. This result is supported by the fact that prevalence of MS in the HEP and CHO groups was significantly higher than that of the other constitutions. Because both HEP and CHO have beneficial constitutions for consuming meats, eating meats may have contributed to a large physique, as shown in previous studies.<sup>[6,28]</sup>

Previous studies have reported that following the suggested diet per ECM improved quality of life and could naturally reduce the likelihood of MS.<sup>[27]</sup> Additionally, age was significantly associated with MS, and patients become more vulnerable as they get older. While the patients in our sample did not much vary in age from the mid-50s, samples with a wider age range are needed to confirm the effect of age on MS.

To our knowledge, this is the first study to examine the association between ECM and MS. Additional strengths of this study include the low amount of missing data, detailed metabolic characterization of the samples, and the use of a balanced sample by sex. However, there are some limitations worth mentioning. First, we used a convenience sample from a hospital in which patients' socioeconomic status was much higher than that of the general population, so the generalizability of the results may be limited. Second, the unequal number of individuals in each constitution group due to the demographic characteristics of our cohort could have impacted the findings. Third, we could not establish causality of such effects due to the use of a cross-sectional design. Future research with larger and diverse samples could extend our results and should evaluate the effectiveness of ECM treatment by comparing groups that do and do not manage MS using diet therapy and acupuncture treatment per each constitution. Additionally, future study should make such diagnosis with 2 doctors and then compute an agreement coefficient such as Kappa in order to further improve accuracy and reproducibility of diagnosis. In our study, the diagnosis of constitutions was made twice by a doctor to ensure accuracy and reproducibility because our study was conducted with 245 people in a single clinic over a period of 5 years. So, it was difficult to use this method this time. Lastly, future studies should also make an attempt to control for any covariates such as a physical activity that might affect an outcome via propensity scoring before the experiment start.

In conclusion, this study shows that the prevalence of MS is differentially associated with the 8 constitutions of ECM, so ECM diagnosis may be a useful method for managing MS. Metabolic syndrome was more prevalent in HEP and CHO, suggesting that the risk of MS is associated with ECM and its dietary recommendations. These findings may emphasize the need to increase attention to ECM and to develop aggressive dietary modifications for patients for those with HEP and CHO constitutions. Innovative management and prevention strategies, if implemented in population subgroups at highest risk, may have a substantial effect on reducing these risks. Our results can inform the design of future ECM studies with larger cohorts, which could improve the early diagnosis and management of MS.

### Author contributions

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