

Relationships among personality traits, metabolic syndrome and metabolic syndrome scores : The Kakegawa cohort study

メタデータ	<p>言語: English</p> <p>出版者:</p> <p>公開日: 2019-05-14</p> <p>キーワード (Ja):</p> <p>キーワード (En): A cross-sectional study, extraversion, the metabolic syndrome, the metabolic syndrome score, neuroticism, personality traits</p> <p>作成者: 山本, 万里</p> <p>メールアドレス:</p> <p>所属:</p>
URL	<p>https://repository.naro.go.jp/records/2544</p>

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Word count for text: 2788;

Word count for abstract: 242;

Tables: 4; Figures: 0;

Supplementary files: 0;

Original article

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Running head: Personality traits and the metabolic syndrome

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1 **Abstract**

2 **Objective:** Metabolic syndrome and the presence of metabolic syndrome components
3 are risk factors for cardiovascular disease (CVD). However, the association between
4 personality traits and metabolic syndrome remains controversial, and few studies have
5 been conducted in East Asian populations.

6 **Methods:** We measured personality traits using the Japanese version of the Eysenck
7 Personality Questionnaire (Revised Short Form) and five metabolic syndrome
8 components—elevated waist circumference, elevated triglycerides, reduced
9 high-density lipoprotein cholesterol, elevated blood pressure, and elevated fasting
10 glucose—in 1,322 participants aged 51.1 ± 12.7 years old from Kakegawa city, Japan.
11 Metabolic syndrome score (MS score) was defined as the number of metabolic
12 syndrome components present, and metabolic syndrome as having an MS score of 3 or
13 higher, in accordance with the American Heart Association/National Heart, Lung, and
14 Blood Institute Scientific Statement.

15 **Results:** Mean (\pm standard deviation) personality scores were higher in participants with
16 (N=241) than without metabolic syndrome (N=1,081): 6.1 ± 3.2 vs. 5.6 ± 3.1 for
17 “extraversion”, 3.0 ± 1.6 vs. 2.8 ± 1.6 for “psychoticism”, 6.7 ± 2.5 vs. 6.1 ± 2.7 for “lie”,
18 respectively (all $P < 0.05$). In multiple regression analyses adjusted for age, sex,
19 education, income, smoking status, alcohol use, and family history of CVD and diabetes
20 mellitus, only “extraversion” was associated with MS score (coefficient=0.12, $P=0.0003$).
21 In multiple logistic regression analysis with the same adjustments, “extraversion” was
22 also positively associated with metabolic syndrome (odds ratio = 1.13, 95% confidence
23 interval = 0.97–1.31; $P=0.1$).

24 **Conclusions:** Higher “extraversion” scores tended to be related to a higher prevalence
25 of metabolic syndrome and higher MS scores.

26 **Keywords:** A cross-sectional study; extraversion; the metabolic syndrome;

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- 1 the metabolic syndrome score; neuroticism; personality traits

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1 **Introduction**

2 Metabolic syndrome involves a number of risk factors for cardiovascular disease (CVD)
3 and type 2 diabetes mellitus (DM), including dysglycemia, elevated blood pressure,
4 elevated triglycerides, reduced high-density lipoprotein cholesterol (HDL-C) levels, and
5 obesity[1]. In a meta-analysis, metabolic syndrome was shown to increase the risk of
6 cardiovascular mortality by two-fold and of all-cause mortality by 1.5-fold[2]. The
7 number of metabolic syndrome components present is also related to coronary artery
8 disease[3–5]. Additionally, it has been reported that metabolic syndrome and the
9 number of components in Japanese individuals are related to cardiovascular and
10 all-cause mortality[6]. In Japan, CVD is the second most common cause of death after
11 malignancy[7]. Therefore, it is important to determine risk factors for metabolic
12 syndrome and the number of components. Several risk factors, including smoking
13 status[8], alcohol use[9], and family histories of DM[10] and CVD[11], have been well
14 investigated as risk factors for metabolic syndrome; psychological factors have also
15 been reported to be related to CVD[12].

16 “Neuroticism” and “extraversion” are well-known personality traits[13] that have
17 been shown to have an impact on cardiovascular risk and mortality; “neuroticism” is
18 related to the risk of death from CVD[14], and is associated with the risk of coronary
19 heart disease[15], while “extraversion” is associated with the risk of stroke[15]. However,
20 in several studies, no association was found between personality traits and all-cause
21 mortality[16, 17], or between ischemic heart disease and stroke[18]. “Neuroticism” and
22 “extraversion” are also associated with some metabolic syndrome components. In
23 Japanese individuals, “neuroticism”, “extraversion”, and “psychoticism” are associated
24 with obesity [19], while “extraversion” is positively related to systolic blood pressure[20].
25 Therefore, we assumed that metabolic syndrome is one of the pathways between
26 personality traits and CVD.

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1 Several studies, including a systematic review, investigated the relationship
2 between personality traits and metabolic syndrome[21] in non-East Asian populations.
3 Although the systematic review concluded that there was no clear association between
4 personality traits and metabolic syndrome, some personality traits were found to be
5 related to metabolic syndrome in individual studies[21]. Furthermore, to our knowledge,
6 no such study has focused on East Asian populations. East Asian populations have
7 different lifestyles from their non-East Asian counterparts, so the relationship between
8 personality traits and metabolic syndrome in East Asians needs to be clarified in order to
9 identify risk factors for metabolic syndrome.

10 Therefore, the aims of the present study were to investigate the relationship
11 between personality traits and metabolic syndrome/the number of components in
12 Japanese individuals, and to examine the relationship between personality traits and
13 metabolic syndrome components.

14

15 **Methods**

16 **Participants and procedure**

17 We conducted a cross-sectional study using baseline data from the Kakegawa cohort
18 study, a prospective cohort study in Kakegawa city, Japan that was approved by the
19 ethics review committee of Tohoku University (2009-150). Between June 2009 and
20 October 2011, participants were recruited by a flyer inserted in the local newspaper. The
21 inclusion criteria were age over 30 years and currently living in Kakegawa city. After
22 receiving the flyer, people who were interested in joining the study contacted the authors
23 by post, telephone, fax, or e-mail and made appointments for medical examinations.
24 Next, we sent the respondents an explanation of the study, an informed consent form, a
25 questionnaire, and a urine test kit by post. Informed consent was obtained from all of the
26 participants at the health center after they received an explanation of the study

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1 objectives and methods by trained staff. In total, 1,535 participants were enrolled. Two
2 participants withdrew their consent, and 220 participants had some missing variables,
3 such as basic characteristics, metabolic syndrome components, and scores on the
4 Japanese version of the Eysenck personality questionnaire-revised, short form
5 (EPQ-RS); these participants were excluded, leaving a total of 1,322 participants (831
6 women; mean age \pm standard deviation [SD]=51.1 \pm 12.7 years) for analysis. The study
7 protocol was approved by the institutional review board of Tohoku University.

8 We collected the questionnaires and urine samples, took blood samples, and
9 measured height, weight, waist circumference, and blood pressure during the medical
10 examinations. Blood pressure was measured twice, and the average of the two values
11 was used.

12

13 **Definition of metabolic syndrome**

14 According to the American Heart Association/National Heart, Lung, and Blood Institute
15 (AHA/NHLBI) Scientific Statement[22], metabolic syndrome was defined as the
16 presence of three or more of the following five components: elevated waist
17 circumference (\geq 90 cm for men, \geq 80 cm for women); elevated triglycerides (\geq 150 mg/dL
18 or on drug treatment for elevated triglycerides); reduced HDL-C (<40 mg/dL for men,
19 <50 mg/dL for women or on drug treatment for reduced HDL-C); elevated blood
20 pressure (\geq 130 mmHg systolic blood pressure or \geq 85 mmHg diastolic blood pressure or
21 on antihypertensive drug treatment in a patient with a history of hypertension); and
22 elevated fasting glucose (\geq 100 mg/dL or on drug treatment for elevated glucose). Next,
23 we calculated the metabolic syndrome score (MS score), which was defined as the
24 number of metabolic syndrome components present (range, 0–5).

25

26 **Questionnaire**

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1 Participants completed a questionnaire regarding their age, sex, income, education,
2 smoking status, alcohol use, personal history, medication history, and family history. We
3 measured personality traits using the EPQ-RS[23]. The EPQ-RS has 48 items to which
4 participants are asked to respond either “Yes” or “No”. The EPQ-RS measures the
5 following four personality traits: “neuroticism”, “extraversion”, “psychoticism”, and “lie”.
6 The score of each personality trait is calculated based on a 12-item scale, and thereby
7 ranges from 0–12. In a previous study, the reliability and validity of the Japanese version
8 of the EPQ-RS were confirmed[23].

9

10 **Statistical analyses**

11 The participants’ characteristics and personality scores were compared between those
12 with and without metabolic syndrome using the Student’s *t*-test for continuous variables
13 and the chi-square test for categorical variables.

14 To examine the relationship between personality and MS scores, we performed
15 logistic regression analyses with changing the dichotomizing threshold of the MS score
16 (1–5 vs. 0, 2–5 vs. 0–1, 3–5 vs. 0–2, and 4–5 vs. 0–3). Then, we used multiple logistic
17 regression analyses considering the MS score subgroup as a dependent variable and
18 the personality score as an independent variable. According to the AHA/NHLBI
19 Scientific Statement, we considered metabolic syndrome as an outcome when the MS
20 score was divided into 3–5 and 0–2[22]. In multiple logistic regression analyses, we
21 adjusted for age (30–39, 40–49, 50–59, 60–69, and ≥70 years old), sex, education
22 (junior high school, high school, junior college/vocational school/university dropout, and
23 college/university or higher), income (≤5.99, 6.00–11.99, and ≥12.00 million JPY/year),
24 smoking status (current, past, and never), alcohol use (current, past, and never), and
25 family history of CVD (present, absent) and DM (present, absent). To examine the effect
26 of each personality score on MS scores, multiple regression analyses were conducted

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1 using each personality score as an independent variable and the MS score as a
2 dependent variable. Moreover, we performed ordinal logistic regression analyses using
3 each personality score as an independent variable and the MS score as a dependent
4 variable on the condition that those with four or five components were in the same group,
5 because the number of those with five components was too small for ordinal logistic
6 regression analyses. In both multiple regression analyses and ordinal logistic regression
7 analyses, we included the same variables described above for adjustment.

8 We also investigated the association of each personality score with metabolic
9 syndrome components. The differences in each personality score were then compared
10 between those with and without metabolic syndrome components using Student's *t*-test.
11 We also performed multiple logistic regression analyses considering each personality
12 score as an independent variable and an individual metabolic syndrome component as
13 a dependent variable after adjusting for the confounders described above. Each
14 personality score was standardized to the z-score in all multivariate analyses.

15 We used the SAS package (version 9.4, SAS Institute Inc., Cary, NC, USA) for
16 all analyses and considered P values <0.05 to be statistically significant.

17

18 **Results**

19 A total of 241 participants (18.2%) had metabolic syndrome. Compared with those
20 without metabolic syndrome, those with metabolic syndrome were older ($P<0.0001$),
21 more likely to be men ($P=0.002$), have a lower level of education ($P<0.0001$), and have
22 a family history of CVD ($P=0.03$) or DM ($P=0.01$). Those with metabolic syndrome had
23 lower "neuroticism" scores ($P=0.06$), higher "extraversion" scores ($P=0.02$), higher
24 "psychoticism" scores ($P=0.049$), and higher "lie" scores ($P=0.0003$) than those without
25 metabolic syndrome (Table 1).

26 In the crude model (Table 2), "extraversion" (odds ratio [OR] = 1.18, 95%

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1 confidence interval [CI] = 1.02–1.35; P=0.02), “psychoticism” (OR=1.15, 95%
2 CI=1.00–1.32; P=0.049) and “lie” (OR=1.30, 95% CI=1.13–1.50; P=0.0004) were
3 related to metabolic syndrome. In multiple logistic regression analyses (Table 2),
4 “extraversion” was significantly related to the high MS score subgroup (1–5 vs. 0:
5 OR=1.25, 95% CI=1.09–1.42, P=0.001; 2–5 vs. 0–1: OR=1.19, 95% CI=1.05–1.35,
6 P=0.006; 4–5 vs. 0–3: OR=1.31, 95% CI=1.06–1.62, P=0.01), except when MS scores
7 were divided into 3–5 and 0–2 (OR=1.13, 95% CI=0.97–1.31; P=0.1). “Psychoticism”
8 was only related to the high MS score subgroup when MS scores were divided into 0–1
9 and 2–5 (OR=1.15, 95% CI=1.01–1.31; P=0.03) (Table 2). In multiple regression
10 analyses, “extraversion” was positively related to MS scores (coefficient=0.12, standard
11 error=0.03; P=0.0003) (Table 3). The results of ordinal logistic regression analyses were
12 similar to those of multiple regression analyses (data not shown).

13 “Extraversion” scores were higher in those with metabolic syndrome
14 components (elevated waist circumference: P=0.001; elevated triglycerides: P=0.01;
15 reduced HDL-C: P=0.09; elevated blood pressure: P=0.004; elevated fasting glucose:
16 P=0.002) (Table 4). In multiple logistic regression analyses, “extraversion” was related
17 to elevated waist circumference (OR=1.20, 95% CI=1.06–1.36; P=0.003), elevated
18 triglycerides (OR=1.19, 95% CI=1.02–1.38; P=0.02), elevated blood pressure (OR=1.16,
19 95% CI=1.02–1.33; P=0.02), and elevated fasting glucose (OR=1.20, 95%
20 CI=1.04–1.39; P=0.02). “Lie” was negatively related to elevated waist circumference
21 (OR=0.83, 95% CI=0.72–0.94; P=0.004) (Table 4).

22

23 Discussion

24 “Extraversion” tended to be positively related to metabolic syndrome and was positively
25 related to MS scores. We also found that high “extraversion” scores were related to
26 metabolic syndrome components other than reduced HDL-C. “Neuroticism”,

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1 “psychoticism”, and “lie” were not associated with metabolic syndrome or MS scores. It
2 should be emphasized that no studies have investigated the relationship between
3 personality traits, metabolic syndrome, and MS scores in East Asian populations.

4 Our results were consistent with those of some studies in Japan that
5 investigated the relationship between personality traits as measured by the EPQ-RS
6 and metabolic syndrome components. In a cohort study involving 41,424 participants
7 from Miyagi Prefecture, “extraversion” and “psychoticism” were positively associated
8 with obesity, and “neuroticism” was negatively associated with obesity[19]. In the
9 Ohasama study, morning blood pressure was measured in 999 people from the general
10 population at home for 4 weeks[20]. The results showed that “extraversion” was
11 positively associated with home blood pressure. The populations of our and previous
12 studies were similar in that they were all Japanese and middle-aged and older; therefore,
13 our study was consistent with these previous studies.

14 Previous studies that have investigated the relationship between personality
15 traits and metabolic syndrome in non-Japanese populations have reported results that
16 conflicted with those in the present study; they reported that “neuroticism”, but not
17 “extraversion”, tended to be positively associated with metabolic syndrome. In a study of
18 4,208 men from the Vietnam Experience Study in the U.S.[24], “neuroticism”, as
19 measured by the Minnesota Multiphasic Personality Inventory, was positively
20 associated with metabolic syndrome. However, the population and measurements in
21 that study differed from those in the present study; the Vietnam Experience Study
22 consisted of only male military personnel from the U.S. Vietnam-era Army, and body
23 mass index was used as one of the components of metabolic syndrome instead of waist
24 circumference. Another study involving 2,419 participants from the SardiNIA project in
25 Italy[25] reported that high “neuroticism”, but not “extraversion”, as measured by the
26 Revised NEO Personality Inventory, was associated with metabolic syndrome. They

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1 showed a similar prevalence of metabolic syndrome (19.2%) to our results (18.2%)
2 because the participants were aged over 45 years, which is similar to our population in
3 that all participants were middle-aged or older. Furthermore, the same definition of
4 metabolic syndrome was used in both studies. We assume that the differences in the
5 results between the SardiNIA project and our study were partly due to differences in the
6 personality tests.

7 Few studies have investigated the relationship between personality traits and
8 MS scores in non-Japanese populations[26], and no studies have investigated this
9 relationship in Japanese populations. In a previous study, 15,359 participants were
10 recruited from the fourth wave of The National Longitudinal Study of Adolescent to Adult
11 Health in the U.S. in 2008–2009[26]. Personality traits from the Mini International
12 Personality Item Pool and four metabolic syndrome components (blood pressure, waist
13 circumference, elevated cholesterol, and non-fasting blood glucose) were measured.
14 The researchers defined a metabolic risk index as the sum of the components (range,
15 0–4). The results showed that “neuroticism” was positively associated with metabolic
16 syndrome components other than waist circumference and the metabolic risk index.
17 “Extraversion” was not associated with any of the metabolic syndrome components or
18 the metabolic risk index. One of the reasons for the differences between the results of
19 our and the previous study is that there were differences in the definitions of some
20 components used for analyses. Namely, ≥ 140 mmHg systolic blood pressure or ≥ 90
21 mmHg diastolic blood pressure was considered hypertension in the previous study[26],
22 while in our study, hypertension was considered ≥ 130 mmHg systolic blood pressure or
23 ≥ 85 mmHg diastolic blood pressure or on antihypertensive drug treatment for patients
24 with a history of hypertension.

25 The results of previous studies[24–26] involving non-East Asian populations
26 that investigated the relationship between personality traits, metabolic syndrome, and

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1 MS scores do not support the results of the present study; this is partly because of
2 differences in personality tests or in the definition of metabolic syndrome components,
3 as described above; however, racial differences should also be taken into consideration.
4 No studies have been conducted on the relationship between personality traits and
5 metabolic syndrome in East Asian populations. We demonstrated that “extraversion”
6 tended to be positively related to metabolic syndrome.

7 “Extraversion” may be related to metabolic syndrome through multiple
8 pathophysiological mechanisms. “Extraversion” has been reported to be related to a
9 high level of plasma cortisol[27], and cortisol is associated with metabolic syndrome[28,
10 29]; therefore, the hypothalamic–pituitary–adrenal axis is a possible pathway. However,
11 another study showed that “extraversion” was related to lower cortisol reactivity[30], so
12 this pathway remains controversial. We also speculated that autonomic nervous
13 function could be a possible pathway. “Extraversion” has been reported to be related to
14 increased parasympathetic activity[31], and the vagus nerve has been shown to
15 contribute to metabolic syndrome in rats[32]. Although these pathways may partially
16 explain the relationship between “extraversion” and metabolic syndrome, personality
17 traits can affect one’s health through health behaviors[33] or social relationships[34];
18 therefore, further studies are needed to clarify the mechanisms of the relationship
19 between personality traits and metabolic syndrome.

20 “Lie” scores were positively related to metabolic syndrome and MS scores in
21 the crude model, but the opposite was found in the adjusted model because those who
22 have a high “lie” score were older and more likely to be women; furthermore, the
23 relationship between “lie” and age/sex is stronger than that of other personality
24 traits[23].

25 Our results have at least three implications. First, personality tests, such as the
26 EPQ-RS, are easy, noninvasive, and can be administered without any special

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1 equipment or techniques. This means that we can easily introduce personality tests into
2 clinical practice. It might be possible to use personality tests for screening to identify
3 high-risk populations for metabolic syndrome in East Asian countries such as Japan.
4 Second, identifying individuals with high “extraversion” scores among those who
5 already have metabolic syndrome might be helpful to prevent CVD owing to more
6 frequent and intensive health guidance. Finally, personality traits and metabolic
7 syndrome are known as polygenetic[35, 36]. The relationship observed between
8 personality traits and metabolic syndrome in this study may provide new insight into the
9 identification of susceptibility genes for metabolic syndrome.

10 The strength of this study is that it was the first study to investigate the
11 relationship between personality traits, metabolic syndrome, and MS scores in an East
12 Asian population. In addition, our sample was large with an adequate number of
13 outcomes for analyses. However, this study did have some limitations. First, because
14 this was a cross-sectional study, we could not determine whether personality traits or
15 metabolic syndrome was the cause of the other. Second, even though our study
16 included both sexes and a broad range of age groups, the participants took part in our
17 study voluntarily, meaning that their health awareness could have been higher than the
18 general population; therefore, the generalizability of the results is limited.

19 In conclusion, higher “extraversion” scores were related to higher MS scores
20 and tended to be related to a higher prevalence of metabolic syndrome.

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1 **Acknowledgements**

2 This work was a part of “the Kakegawa cohort study”, which was supported by a
3 research and development grant for projects promoting new policies in agriculture,
4 forestry and fisheries from the Ministry of Agriculture, Forestry and Fisheries, Japan
5 (Grant No.21028, 13406562).

6

7 **Conflict of interest statement**

8 The authors have no competing interests to report.

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Table 1. Characteristics of the participants in the Kakegawa study by metabolic syndrome

	All (n=1,322)	Metabolic syndrome		P
		No (n=1,081)	Yes (n=241)	
Age, years				<0.0001
30–39	323 (24.4)	311 (28.8)	12 (5.0)	
40–49	288 (21.8)	260 (24.1)	28 (11.6)	
50–59	288 (21.8)	225 (20.8)	63 (26.1)	
60–69	334 (25.3)	224 (20.7)	110 (45.6)	
≥70	89 (6.7)	61 (5.6)	28 (11.6)	
Women	831 (62.9)	701 (64.8)	130 (53.9)	0.002
BMI, kg/m ²	22.2 (3.1)	21.6 (2.7)	24.7 (3.3)	<0.0001
Smoking status				0.1
Current	146 (11.0)	114 (10.6)	32 (13.3)	
Past	314 (23.8)	249 (23.0)	65 (27.0)	
Never	862 (65.2)	718 (66.4)	144 (59.8)	
Alcohol use				0.4
Current	806 (61.0)	668 (61.8)	138 (57.3)	
Past	29 (2.2)	22 (2.0)	7 (2.9)	
Never	487 (36.8)	391 (36.2)	96 (39.8)	
Education				<0.0001
Junior high school	100 (7.6)	74 (6.9)	26 (10.8)	
High school	576 (43.6)	448 (41.4)	128 (53.1)	
Junior college, etc. ^a	330 (25.0)	293 (27.1)	37 (15.4)	
College/University or higher	316 (23.9)	266 (24.6)	50 (20.8)	
Income, million JPY/year				0.98
≤5.99	845 (63.9)	690 (63.8)	155 (64.3)	
6.00–11.99	431 (32.6)	353 (32.7)	78 (32.4)	
≥12.00	46 (3.5)	38 (3.5)	8 (3.3)	
Family history of CVD	614 (46.4)	487 (45.1)	127 (52.7)	0.03
Family history of DM	250 (18.9)	191 (17.7)	59 (24.5)	0.01
Metabolic syndrome components ^b				
Elevated waist circumference	521 (39.4)	330 (30.5)	191 (79.3)	<0.0001
Elevated triglycerides	239 (18.1)	64 (5.9)	175 (72.6)	<0.0001
Reduced HDL-C	245 (18.5)	83 (7.7)	162 (67.2)	<0.0001
Elevated blood pressure	500 (37.8)	307 (28.4)	193 (80.1)	<0.0001
Elevated fasting glucose	264 (20.0)	129 (11.9)	135 (56.0)	<0.0001
Personality score				
Neuroticism score	5.4 (3.0)	5.4 (3.0)	5.0 (3.0)	0.06
Extraversion score	5.7 (3.1)	5.6 (3.1)	6.1 (3.2)	0.02
Psychoticism score	2.8 (1.6)	2.8 (1.6)	3.0 (1.6)	0.049
Lie score	6.2 (2.7)	6.1 (2.7)	6.7 (2.5)	0.0003

Data are expressed as means (standard deviation) for continuous variables and n (%) for categorical variables.

BMI: body mass index; CVD: cardiovascular disease; DM: diabetes mellitus; HDL-C: high-density lipoprotein cholesterol.

^aJunior college, vocational school, and university dropout.

^bElevated waist circumference: ≥90 cm for men, ≥80 cm for women; elevated triglycerides: ≥150 mg/dL or on drug treatment for elevated triglycerides; reduced HDL-C: <40 mg/dL for men, <50 mg/dL for women or on drug treatment for reduced HDL-C; elevated blood pressure: ≥130 mmHg systolic blood pressure or ≥85 mmHg diastolic blood pressure or on antihypertensive drug treatment in a patient with a history of hypertension; elevated fasting glucose: ≥100 mg/dL or on drug treatment for elevated glucose.

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Table 2. Crude and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the relationship between each personality score and high MS scores (n=1322)

	Crude OR			
	MS score 1–5 vs. 0	MS score 2–5 vs. 0–1	MS score 3–5 vs. 0–2 ^b	MS score 4–5 vs. 0–3
Neuroticism	0.83 (0.74–0.93)†	0.84 (0.75–0.94)†	0.87 (0.76–1.01)	0.85 (0.70–1.04)
Extraversion	1.27 (1.13–1.43)†	1.22 (1.09–1.37)†	1.18 (1.02–1.35)*	1.36 (1.12–1.66)†
Psychoticism	1.05 (0.94–1.18)	1.13 (1.01–1.26)*	1.15 (1.00–1.32)*	1.12 (0.92–1.36)
Lie	1.23 (1.09–1.38)†	1.22 (1.09–1.37)†	1.30 (1.13–1.50)†	1.37 (1.11–1.68)†
	Adjusted OR ^a			
	MS score 1–5 vs. 0	MS score 2–5 vs. 0–1	MS score 3–5 vs. 0–2 ^b	MS score 4–5 vs. 0–3
Neuroticism	0.93 (0.82–1.06)	0.93 (0.82–1.05)	0.99 (0.85–1.15)	0.95 (0.77–1.18)
Extraversion	1.25 (1.09–1.42)*	1.19 (1.05–1.35)*	1.13 (0.97–1.31)	1.31 (1.06–1.62)*
Psychoticism	1.05 (0.93–1.20)	1.15 (1.01–1.31)*	1.14 (0.97–1.34)	1.12 (0.89–1.40)
Lie	0.89 (0.77–1.02)	0.93 (0.82–1.07)	1.01 (0.86–1.19)	1.08 (0.86–1.35)

*P<0.05, †P<0.01

OR: odds ratio per 1 SD increase in personality score; CI: confidence interval; MS score: metabolic syndrome score.

MS score 0: n = 428; MS score 1: n = 393; MS score 2: n = 260; MS score 3: n = 135; MS score 4: n = 79; MS score 5: n = 27.

The dependent variables were the dichotomized categories of the MS score, and the independent variables were each personality score.

^aAdjusted for age, sex, education, income, smoking status, alcohol use, and family history of cardiovascular disease and diabetes mellitus.^bThe definition of the metabolic syndrome.

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Table 3. Results of multiple regression analysis for the relationship between each personality score and MS scores

	Crude		Adjusted ^a	
	Coefficient (SE)	P	Coefficient (SE)	P
Neuroticism	-0.12 (0.04)	0.001	-0.03 (0.03)	0.3
Extraversion	0.16 (0.04)	<0.0001	0.12 (0.03)	0.0003
Psychoticism	0.07 (0.04)	0.046	0.06 (0.03)	0.07
Lie	0.16 (0.04)	<0.0001	-0.03 (0.04)	0.4

SE: standard error; MS score: metabolic syndrome score.

Each personality score was standardized to the z-score.

The dependent variable was MS score and the independent variable was personality score.

^aAdjusted for age, sex, education, income, smoking status, alcohol use, and family history of cardiovascular disease and diabetes mellitus.

Table 4. Mean and standard deviation (SD) of each personality score by metabolic syndrome components and adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for the relationship between each personality score and metabolic syndrome components

Elevated waist circumference^a				
	Mean (SD) personality score			Adjusted OR^b
	No (n=801)	Yes (n=521)	P	
Neuroticism	5.5 (3.0)	5.2 (3.0)	0.05	0.92 (0.81–1.03)
Extraversion	5.4 (3.1)	6.0 (3.1)	0.001	1.20 (1.06–1.36)†
Psychoticism	2.9 (1.7)	2.8 (1.5)	0.2	1.11 (0.98–1.26)
Lie	6.1 (2.7)	6.3 (2.7)	0.2	0.83 (0.72–0.94)†
Elevated triglycerides^a				
	Mean (SD) personality score			Adjusted OR^b
	No (n=1083)	Yes (n=239)	P	
Neuroticism	5.4 (3.0)	5.1 (3.0)	0.1	0.99 (0.85–1.15)
Extraversion	5.6 (3.1)	6.1 (3.1)	0.01	1.19 (1.02–1.38)*
Psychoticism	2.8 (1.6)	2.9 (1.5)	0.4	0.97 (0.83–1.14)
Lie	6.1 (2.7)	6.6 (2.8)	0.01	1.03 (0.87–1.21)
Reduced HDL-C^a				
	Mean (SD) personality score			Adjusted OR^b
	No (n=1077)	Yes (n=245)	P	
Neuroticism	5.4 (3.0)	5.3 (2.9)	0.5	1.02 (0.88–1.18)
Extraversion	5.6 (3.2)	6.0 (2.9)	0.09	1.06 (0.92–1.23)
Psychoticism	2.8 (1.6)	2.9 (1.6)	0.5	1.14 (0.97–1.32)
Lie	6.0 (2.7)	6.8 (2.5)	<0.0001	1.13 (0.96–1.33)
Elevated blood pressure^a				
	Mean (SD) personality score			Adjusted OR^b
	No (n=822)	Yes (n=500)	P	
Neuroticism	5.6 (3.0)	4.9 (3.1)	<0.0001	0.88 (0.77–1.00)
Extraversion	5.5 (3.1)	6.0 (3.1)	0.004	1.16 (1.02–1.33)*
Psychoticism	2.8 (1.7)	3.0 (1.5)	0.007	1.06 (0.92–1.21)
Lie	6.0 (2.6)	6.5 (2.7)	0.0005	0.98 (0.85–1.13)
Elevated fasting glucose^a				
	Mean (SD) personality score			Adjusted OR^b
	No (n=1058)	Yes (n=264)	P	
Neuroticism	5.4 (3.0)	5.2 (3.2)	0.3	1.07 (0.92–1.24)
Extraversion	5.5 (3.1)	6.2 (3.3)	0.002	1.20 (1.04–1.39)*
Psychoticism	2.8 (1.6)	3.1 (1.6)	0.0008	1.15 (0.98–1.34)
Lie	6.1 (2.7)	6.5 (2.7)	0.0502	0.94 (0.80–1.11)

*P<0.05, †P<0.01

SD: standard deviation; OR: odds ratio per 1 SD increase; CI: confidence interval; HDL-C: high-density lipoprotein cholesterol.

^aElevated waist circumference: ≥90 cm for men, ≥80 cm for women; elevated triglycerides: ≥150 mg/dL or on drug treatment for elevated triglycerides; reduced HDL-C: <40 mg/dL for men, <50 mg/dL for women or on drug treatment for reduced HDL-C; elevated blood pressure: ≥130 mmHg systolic blood pressure or ≥85 mmHg diastolic blood pressure or on antihypertensive drug treatment in a patient with a history of hypertension; elevated fasting glucose: ≥100 mg/dL or on drug treatment for elevated glucose.

^bIn computing adjusted ORs, the dependent variables were metabolic syndrome components (references are those without metabolic syndrome components), and the independent variables were each personality score, with adjustment applied for age, sex, education, income, smoking status, alcohol use, and family history of cardiovascular disease and diabetes mellitus.