Relationship between marital status and metabolic syndrome using a cohort data in South Korea

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KEYWORDS

Marital status, Metabolic syndrome, Socio-economic position

ABSTRACT

Objectives: This study aimed to identify the relationship between unchanged or changing marital status and metabolic syndrome (MetS) and its components in middle-aged and older Korean.
Methods: The study participants included 51,528 adults 40 years and older from the10-year cohort data of the Korean Genome and Epidemiology Study. Multiple logistic regression analysis was performed. Marital status was categorized as unchanged (single, married, divorced/widowed/separated) or changing (transitioning to marriage or transitioning out of marriage).
Results: The prevalence of MetS was highest in women (47.1%) and men (40.5%) aged 50-59 years. A changing marital status, in single or divorced/widowed/separated men (especially those transitioning from married status) showed a significantly increased risk of MetS and its components, compared with men whose marital status was maintained. Single or divorced/widowed/separated women showed a significantly lower risk of MetS and its components than women who maintained their marital status.
Conclusion: Our study suggests that national public health policies should consider sex-specific findings and prepare interventions and strategies focusing on marital status and sex to prevent MetS and its components.

INTRODUCTION:

Recently, there have been reports on the relationship between marital status and metabolic syndrome (MetS) and its components [1-4]. Sex differences in socioeconomic status and achieving a healthy lifestyle have been found to be important factors in MetS [5,6]. MetS is reportedly related to an increased risk of breast cancer, regardless of overweight or obesity status [7,8]. Among the metabolic components, obesity and overweight status are the major risk factor in MetS [8,9]. Weight gain is reportedly responsible for the induction and propagation of dyslipidemia as a component of MetS, resulting in cardiovascular risk [10]. Poor nutrition is associated with an increasing prevalence of MetS [11]. Physiologically, a close association has been identified between weight gain and impaired glucose metabolism, especially in women [12]. Higher socioeconomic status is reportedly related to being overweight or obesity in men and women, with cardio-metabolic risk factors only in men [13]. Aging, shift work, and physical inactivity are associated with the frequency of MetS [14]. In terms of occupational aspects, a relationship between long work hours, stress, fatigue, and the risk of developing MetS has previously been identified [15]. MetS and its components are considerably

higher in women workers [16].

The outcomes of MetS are reportedly related to severe cognitive decline, according to a 10-year cohort study [17], although the results were inconclusive and insufficient, requiring a systematic review [18]. In particular, sex-specific differences have been reported to be related to MetS [6,19-22]. Regarding family- and sex-specific aspects, parental history of cardiovascular disease is associated with a higher prevalence of MetS in women [23]. Single women had approximately a 20% decrease in abdominal glucose tolerance compared with married women, although the association disappeared after adjustment [3]. Despite extensive research on MetS and its components, few studies have examined the association between changes in marital status and MetS and its components. Therefore, we explored the association between unchanged and changing marital status and MetS and its components by sex. Our analysis was based on 10-year cohort data from the Korean Genome and Epidemiology Study (KoGES) in the context of a dramatically increasing trend in varying marital status types in Korea.

MATERIALS AND METHODS:

Data sources and study participants:

The KoGES is classified into two cohorts (population-based and gene-environmental cohorts). We used data from an urban population-based cohort to evaluate the association between unchanged and changing marital status and the risk of MetS and its components. This is based on cohort data from the KoGES (2004–2013 baseline, 2014–2016 follow-up) conducted by the Korea Centers for Disease Control. They conducted health examinations, human specimens (blood, urine, and DNA) collection, health interviews, and health and lifestyle surveys. We analyzed only the available data of 51,528 participants (males: 17,468, females: 34,060) aged 40 years and older who had completed a health and lifestyle survey and underwent a health examination, including urine, serum, and DNA samples, after excluding unavailable or missing data. Informed consent was obtained from all participants. The KoGES is an ongoing general population-based cohort study of individuals aged 40 years and older. The study seeks to identify genetic and environmental factors and related interactions among the leading diseases in the Korean population using baseline examination data from the Cardiovascular Disease Association Study (CAVAS) cohort, the Health Examinee (HEXA) cohort, and one of the two subprojects of the KoGES. Baseline examination data for the HEXA and CAVAS cohorts included urban and rural community dwellers, respectively. The HEXA cohort study was conducted at 38 community health examination centers and training hospitals in 14 large urban locations from 2004 to 2013. The CAVAS cohort study was performed in 11 rural locations from 2005 to 2011.

Demographic and anthropometric variables, socioeconomic status, and marital status type:

Age and sex were included as demographic variables; physical exercise, drinking, smoking status, and family medical history as healthy lifestyle factors; educational level and household income as socioeconomic indicators during the health questionnaire interview surveys; and body mass index

(BMI), waist circumference (WC), high-density lipoprotein (HDL) cholesterol, high blood pressure (BP), high blood glucose, and triglycerides (TGs) as anthropometric variables. Educational levels were divided into four groups: elementary school or lower, middle school, high school, and college aor higher. Income levels were classified into four groups by quartile: lowest, middle-low, middle-high, and highest. Smoking status was divided into three groups: non-smokers, ex-smokers, and current smokers. Those who smoked more than five packs during their lifetime were defined as smokers. Ex-smokers were differentiated from current smokers based on their current smoking status. Alcohol intake was divided into three groups: non-drinkers, mild-to-moderate drinkers, and heavy drinkers. Those who drank more than once a month were defined as mild-to-moderate drinkers and those who drank more than three times a day were defined as heavy drinkers. Physical exercise was categorized into two groups: no exercise and regular exercise. Regular exercise refers to exercise performed more than three times per week for more than 20 minutes at a time. As an anthropometric variable, the BMI was calculated using the following formula: weight (kg) / height^2 (m^2). WC was measured at the narrowest point between the lower border of the rib cage and the iliac crest. BP was measured after the participants rested for more than 10 minutes. Systolic and diastolic BP were measured twice on the right arm using an automatic sphygmomanometer or standardized mercury. HDL-cholesterol, high blood glucose, and TG levels were measured using an enzyme method (ADVIA1650, ADVIA1800; Siemens Healthineers, Deerfield, IL, USA). Marital status was divided into two exclusive categories: unchanged (single, married, and divorced/widowed/separated) and changing (to a married or nonmarried state).

Definitions of MetS:

According to the updated National Cholesterol Education Program Adult Treatment Panel III criteria, MetS is defined as the presence of three or more of the following five criteria: (1) a WC of 90 cm or more in men, or 80 cm or more in women, as per the International Obesity Task Force standards for the Asian-Pacific population; (2) BP reading of 130/85 mmHg or higher or the use of antihypertensive medication; (3) a fasting blood glucose level of 100 mg/dL or higher or the use of medication such as insulin or oral agents; (4) a TG level of 150 mg/dL or higher or the use of medication; and (5) an HDL cholesterol level less than 40 mg/dL in men or less than 50 mg/dL in women, or the use of medication.

Statistical analysis:

All data analyses were conducted using the SAS survey procedure ver. 9.2 (SAS Institute Inc.). A one-way analysis of variance was used to identify differences in demographic variables by sex and maintenance or changes in marital status. Multiple logistic regression analysis was used to investigate the odds ratios (ORs) and 95% confidence intervals (CIs) for the risk of MetS and its individual components according to sex, maintenance, or changes in marital status. A two-sided *p*-value of <.05 was considered statistically significant.

RESULTS:

Table 1 shows the general demographic characteristics of the participants according to sex. The participants included 17,468 men (33.9%) and 34,060 women (66.1%). The average ages for men and women were 53 and 51 years, respectively. The prevalence of MetS was highest in women (47.1%) and men (40.5%) aged 50–59 years. Household income and educational levels were higher among men than women. Men smoked much more and had a higher level of alcohol consumption than women, despite the fact men exercised more regularly than women.

Table 1 is here

Table 2 depicts the general characteristics of the study participants according to their unchanged or changing marital status. In both sexes, the divorced/widowed/separated group was older, earned less, and was less educated than the married and single groups. Current smokers were most prevalent among single men and divorced/widowed/separated women. The men in the married group and women in the divorced/widowed/separated group had the largest WC.

Table 2 is here

Table 3 shows the relationship between unchanged or changing marital status and MetS and its components. MetS and its components were significantly more prevalent in single, married, and divorced/widowed/separated women in the unchanged marital status group. Among men, the prevalence of MetS and its components was closely related to the transitional groups of men and women, especially in terms of high BP.

Table 3 is here

Table 4 shows the ORs for MetS and its components according to unchanged or changing marital status, with the consistently married group serving as the reference. In model 1, the risk of MetS was the highest among men in the changing marital status group who transitioned out of a married state (OR 1.94; CI 1.01–3.97). The highest risks, in terms of MetS components, were associated with HDL cholesterol (OR 1.94; CI 1.23–3.24) in the singles group and hypertension (OR 1.41; 1.10–1.90) and TGs (OR 1.34; CI 1.01–1.88) among divorced/widowed/separated women in the unchanged marital status group after adjustment. In model 2, the metabolic component that presented the highest risk was HDL cholesterol (OR 2.01; CI 1.20–3.37) among single women in the unchanged marital status group and hypertension (OR 1.45; CI 1.10–1.90) among divorced/widowed/separated women in the unchanged marital status group after adjustment. TG risk was not significant among divorced/widowed/separated women in the unchanged marital status group after adjustment, even though it was significant in the model. The TG risk (OR 2.38; CI 1.3–4.30) was the highest among men in the changing marital status group who transitioned out of a married state. In model 3, the metabolic component that presented the highest risk was HDL cholesterol (OR 2.00; CI 1.20–3.30) among single women in the unchanged marital status group and hypertension (OR 1.35; CI 1.00–1.80) among divorced/widowed/separated women in the unchanged marital status group after adjustment. The TG risk (OR 2.38; CI 1.30–4.30) was the highest among men in the changing marital status group who transitioned out of a married state.

Table 4 is here

DISCUSSION:

We found a significant increase in the risk of MetS and its components among single and divorced/widowed/separated men in the changing marital status group, based on data from the KoGES 10-year cohort study. We also found an increased risk of MetS and its components among single and divorced/widowed/separated women in the unchanged marital status group in models I, II, and III. The risk of MetS prevalence was the highest among men (transitioning from a married state to single or divorced/widowed/separated) in the changing marital status group. The prevalence of MetS was higher in women aged 50–59 (47.1%) compared with men aged 50–59 (40.5%). The difference in the prevalence of MetS in a recent Korean study [20], which found a higher prevalence of MetS among married versus single individuals, is largely owing to the different age groups, sample participants, and research methods used. The TG and MetS prevalence among single or

divorced/widowed/separated men (transitioning from a married state) in the changing marital status group. We identified a decreased risk of abdominal obesity in men transitioning to a married state in the changing marital status group. A risk of HDL cholesterol was found in single women in the unchanged marital status group, even after adjustment. The results of a Korean study [4], in which more divorced men than married men were identified as having a higher risk of MetS, are partially consistent with our findings despite differences in age groups and study designs. More younger individuals than older individuals (≤ 65) who live and eat alone were found to have a greater risk of MetS [24]. The TG was the highest factor among the metabolic components of our data analysis by model 1–3 after adjustment. TG, which are known to be related to arterial stiffness in the healthy population [25] and self-reported eating speed [26], represent a major component of MetS risk in men (single/widowed/separated) transitioning out of the married state in the changing marital status group. Among the MetS components, HDL cholesterol, which was identified as a significant variable in single women of marital status, was found to increase the risk of MetS. The rate of high BP, the major factor in MetS, was also related to eating speed in both sexes [26] and was found to be the highest among divorced/widowed/separated women in the unchanged marital status group. A decreasing trend in the risk of abdominal obesity, which is also known to be related to eating speed [26], was observed in men (transitioning toward a married state) in the changing marital status group. The prevalence of MetS, risk of abdominal obesity, high blood glucose level, high BP, and TG levels were related to an increasing prevalence of metabolic risk in women in the unchanged marital status group compared with those in the changing marital status group before adjustment. Dietary patterns are also associated with metabolic components and inflammation among middle-aged and older adults [27]. The consumption of various types of cereals, for instance, relates differently to metabolic components despite regional disparities [28] and the nutritional balance of women [19]. This study makes several important contributions to the existing literature. First, it was an initial attempt to explore the relationship between the risk of MetS and its components and unchanged or changing marital status groups based on the 10-year cohort data of the KoGES study. Second, the results are meaningful because they explore trends and causal associations of MetS and its components with unchanged or transitioning marital status. Third, we included various marital status groups based on sex, such as single, married, and divorced/widowed/separated. A limitation of our study is that we could not consider occupational differences and nutrition data for all participants despite previous research on MetS [29]. In addition, we could not investigate the association between offspring and MetS components in women since parity data were not available. In conclusion, these initial findings explore the relationship between unchanged or changing marital status and the risk of MetS and its components in a successful follow-up study in Korea. Our study suggests that national public health policies should consider sex-specific findings and prepare interventions and strategies focusing on marital status and sex to prevent MetS and its components. Additional prospective studies should be conducted to further develop these findings and investigate the mechanisms that promote sustainable strategies and management of MetS.

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Table 1: General characteristics of the subjects according to sex

	Men (*n*=17468)			Women (*n*=34060)		
	Mets	Non-Mets	*P*[a)]	MetS	Non-MetS	*P*[a)]
Age	52.7±8.8	54.8±8.4	<0.001	50.6±7.8	52.4±7.3	<0.001
40-49	1052(29.9)	3931(28.2)		1639(28.0)	11812(41.9)	<0.001
50-59	1426(40.5)	5244(37.6)		2756(47.1)	11855(42.0)	
Over 60	1045(29.7)	4770(34.2)		1460(24.9)	4538(16.1)	
Income			0.08			<0.001
Lowest	879(25.0)	3767(27.0)		2085(35.0)	7785(27.6)	
Middle-low	829(23.6)	3284(23.6)		1363(23.4)	6569(23.3)	
Middle-high	1488(42.3)	5600(40.2)		2018(34.5)	11361(40.3)	
Highest	327(9.2)	1294(9.3)		389(7.1)	2491(8.8)	
Education			<0.001			<0.001
Elementary school or lower	327(9.3)	1180(8.5)		1343(22.9)	3830(13.6)	
Middle school	435(12.3)	1712(12.3)		1228(21.0)	4564(16.2)	
High school	1479(42.1)	5572(40.0)		2443(41.9)	13287(47.1)	
College or higher	1282(36.3)	5480(39.3)		841(14.2)	6524(23.1)	
Smoking			<0.001			0.05
Non-smokers	986(28.4)	4949(35.5)		5672(96.9)	27553(97.7)	
Ex-smokers	1460(41.8)	5635(40.4)		74(1.3)	268(1.0)	
Current-smokers	1077(29.8)	3361(24.1)		108(1.9)	384(1.4)	
Drinking			<0.05			0.10
Non-drinkers	646(17.0)	2719(19.5)		2155(36.8)	10944(38.8)	
Mild to moderate drinkers	2035(61.0)	8437(60.5)		3513(60.0)	16641(59.0)	
Heavy drinkers	842(22.0)	2789(20.0)		187(3.2)	621(2.2)	
Physical exercise			<0.001			<0.001
Regular	2762(78.4)	11061(79.3)		4163(71.1)	20138(71.4)	

Family medical history			<0.001		<0.001
Yes	458(13.0)	1472(10.6)		900(15.4)	3985(14.1)

Data are presented as mean±SE. or N(%).

[a)]Calculated by the Student's t-test or the Chi-square test.

Table 2: General characteristics of the subjects according to marital status transition

	Men					omen				
	Unchanged marital status			Changing marital status		Unchanged marital status			Changing marital status	
	Single	Married	Divorced/Widowed/ Separated	transition to marriage	transition out of marriage	Single	Married	Divorced/Widowed/ Separated	transition to marriage	transition out of marriage
No (%)	243(1.4)	16395(97.2)	229(1.4)	264(43.9)	337(56.1)	625(2.0)	28915(91.8)	1972(6.3)	937(36.8)	1611(63.2)
Age										
40-49	192(79.0)	4539(28.0)	45(19.0)	115(43.9)	92(27.0)	403(64.5)	12099(41.8)	304(15.4)	322(34.4)	323(20.1)
50-59	44(18.1)	6347(39.0)	74(32.0)	86(32.2)	119(35.6)	177(28.3)	12519(43.3)	793(40.2)	403(43.0)	719(44.6)
over 60	7(2.9)	5509(33.0)	110(48.0)	63(23.9)	126(37.4)	45(7.2)	4297(14.9)	875(44.4)	212(22.6)	569(35.3)
Income										
Lowest	103(42.4)	4138(25.3)								
Middle-low	63(25.9)	3864(23.								

		131(57.4)	115(43.6)	159(46.9)	241(38.6)	6850(23.7)	1372(69.5	551(58.9)	856(51.9)
		47(20.6)	57(21.6)	82(24.5)	157(25.0)	6900(23.9)	335(17.0)	178(19.1)	362(22.8)
Middle-high	63(25.9)	6820(41.5)	46(20.1)	79(29.9)	80(23.8)	201(32.2)	12400(42.9)	230(11.7)	195(20.6)	353(22.2)

Highest	14(5.8)	1573(9.6)	5(1.9)	13(5.0)	16(4.8)	26(4.2)	2765(9.5)	35(1.8)	13(1.4)	40(3.1)
Education										
Elementary school or lower	9(3.7)	1377(8.4)	46(20.5)	28(10.6)	47(13.5)	16(2.4)	3870(13.4)	666(33.8)	169(18.1)	452(28.0)
Middle school	24(9.5)	1983(12.1)	44(18.8)	46(174.4)	50(15.0)	16(2.6)	4790(16.6)	465(23.6)	183(19.5)	338(21.0)
High school	108(44.9)	6591(40.2)	88(38.4)	105(39.8)	159(47.2)	219(35.1)	13840(47.9)	648(32.9)	389(41.6)	634(39.4)
College or higher	102(41.9)	6444(39.3)	51(22.3)	85(32.2)	81(24.3)	374(59.9)	6415(22.1)	193(9.7)	196(20.9)	187(11.6)
Smoking										
Non-smokers	73(30.0)	5623(34.3)	57(25.3)	76(28.9)	106(31.4)	570(91.2)	28424(98.3)	1839(93.3)	862(92.0)	1532(95.1)
ex-smokers	61(25.0)	6737(41.0)	90(39.3)	82(31.1)	125(37.1)	17(2.6)	202(0.7)	61(3.0)	32(3.5)	29(1.8)
Current smokers	109(45.0)	4035(24.7)	82(35.4)	106(40.0)	106(31.5)	38(6.2)	289(1.0)	72(3.7)	43(4.5)	50(3.1)
Drinking										
Non-drinkers	73(30.0)	5623(34.3)	57(25.3)	49(18.7)	62(18.5)	240(38.5)	11566(40.0)	765(38.8)	360(38.5)	615(38.2)
Mild to moderate drinkers	61(25.0)	6737(41.1)	90(39.3)	160(60.3)	195(58.0)	378(60.5)	17118(59.2)	1183(60.0)	569(59.7)	976(60.6)

Heavy drinkers -	109(45.0)	4035(24.7)	82(35.4)	55(21.0)	80(23.5)	7(1.0)	231(0.8)	24(1.2)	8(0.8)	20(1.2)
Physical exercise										
Regular	189(78.0)	12984(79.2)	178(77.9)	209(79.3)	263(78.1)	443(71.0)	20674(71.5)	1400(71.0)	669(71.5)	1153(71.6)
Family medical history										
Yes	47(19.3)	1800(11.0)	23(10.0)	35(13.3)	25(7.4)	160(25.6)	4192(14.5)	209(10.6)	131(14.0)	196(12.2)
BMI (kg/m^2)	24.1±3.2	24.1±2.6	23.9±2.6	23.6±2.5	24.2±2.9	22.1±3.0	23.3±2.8	23.6±3.0	23.5±3.0	23.6±3.0
WC (cm)	82.2±7.5	84.6±6.8	84.0±7.4	83.6±6.9	84.3±6.7	73.0±7.8	76.9±7.5	78.3±7.9	78.0±7.8	77.8±8.2
Glucose (mg/dL)	101.1±21.2	103.2±19.9	102.2±19.5	106.3±24.5	105.5±24.4	94.1±14.2	96.2±14.7	98.4±16.7	96.9±13.8	98.3±17.0
BP (mmHg)	124.0±12.7	124.2±13.8	125.0±14.5	125.7±15.0	125.4±15.1	114.913.6	118.5±14.2	122.0±14.8	120.1±14.4	119.1±13.5
TG (mg/dL)	140.7±86.0	130.6±9.3	143.0±102.9	139.2±99.5	145.7±104.6	92.6±61.2	97.1±51.1	101.8±49.7	101.9±53.6	101.2±55.6
HDL cholesterol (mg/dL)	50.9±11.5	50.8±11.3	51.2±11.4	50.0±11.9	52.6±13.2	60.1±13.5	58.0±12.2	58.1±12.2	57.4±12.2	58.2±12.2

Data are presented as mean±SE. or N(%)

BMI, body mass index; WC, waist circumference; BP, blood pressure; TG, triglyceride; HDL, high-density lipoprotein; SE, standard error.

Table 3: Prevalence of metabolic syndrome its components according to marital status transition

	Unchanged marital status							
	Men				Women			
	Single	Married	Divorced/Widowed/Separated		Single	Married	Divorced/Widowed/Separated	
	N (%)			pa)	N (%)			pa)
Metabolic syndrome	46(18.9)	3308(20.2)	46(20.1)	0.89	64(10.9)	24837(16.7)	454(23.0)	<0.001
Abdominal obesity	31(12.8)	3080(18.8)	43(18.8)	0.06	103(16.5)	8954(31.0)	738(37.4)	<0.001
High glucose	6(2.5)	710(4.3)	8(3.5)	0.30	2(0.3)	374(1.3)	54(2.7)	<0.001
High blood pressure	85(35.0)	6821(41.6)	103(45.0)	0.07	106(17.0)	7209(24.9)	718(36.4)	<0.001
High triglyceride	77(31.7)	4388(26.8)	72(31.4)	0.07	66(10.6)	3291(11.4)	273(13.8)	<0.001
Low HDL cholesterol	22(9.1)	1857(11.3)	21(9.2)	0.3	136(21.9)	6501(22.5)	426(21.6)	0.61
				Changing marital status				

	Men			Women		
	transition marriage	totransition marriage	out of	transition marriage	totransition marriage	out of
	N (%)		*pa)*	N (%)		*pa)*
Metabolic syndrome	56(21.2)	67(19.9)	0.69	170(18.1)	330(20.5)	0.15

Abdominal obesity	41(15.5)	57(16.9)	0.65	314(33.5)	578(35.9)	0.23
High glucose	7(2.7)	12(3.6)	0.53	16(1.7)	21(1.3)	0.41
High blood pressure	97(36.7)	150(44.5)	0.05	243(25.9)	488(30.3)	0.02
High triglyceride	81(30.7)	88(26.1)	0.05	118(12.6)	199(12.4)	0.86
Low HDL cholesterol	24(9.1)	42(12.5)	0.05	202(21.6)	393(24.4)	0.10

Data are presented as N(%).

HDL, high-density lipoprotein.

[a)]Calculated by the Chi-square test.

Table 4: Adjusted odds ratios and 95% confidence intervals for metabolic syndrome and its components across marital status transition

	Unchanged marital status				Changing marital status			
	Single		Widow/Divorce/Separated		Toward married status		Out of married status	
	Men	Women	Men	Women	Men	Women	Men	Women
Metabolic syndrome								
Model 1[a)]	0.40 (0.1-2.1)	1.75 (0.9-3.41)	0.57 (0.2-1.6)	1.17 (0.2-1.6)	0.41 (0.1-1.3)	0.86 (0.1-1.4)	1.94 (0.5-3.7)	1.29 (0.9-1.8)
Model 2[b)]	0.30 (0.1-1.9)	1.70 (0.9-3.33)	0.53 (0.2-1.4)	1.16 (0.2-1.6)	0.41 (0.1-1.2)	0.84 (0.1-1.4)	1.90 (0.5-3.7)	1.30 (0.9-1.8)
Model 3[c)]	0.36 (0.1-1.9)	1.85 (0.93.66)	0.49 (0.2-1.3)	1.07 (0.2-1.5)	0.39 (0.1-1.2)	0.81 (0.1-1.4)	1.80 (0.5-3.5)	1.23 (0.9-1.7)
Abdominal								

obesity								
Model 1[a)]	0.12 (0.0-0.68 1.4)	(0.31.41)	0.41 (0.1-1.01 1.2)	1.4)	(0.7-0.18 0.8)	(0.0-1.21 1.9)	(0.8-0.69 (0.3-1.6)	1.26 (0.9-1.8)
Model 2[b)]	0.11 (0.0-0.67 1.4)	(0.31.38)	0.42 (0.1-1.00 1.2)	1.4)	(0.7-0.19 0.8)	(0.0-1.19 1.9)	(0.7-0.69 (0.3-1.6)	1.26 (0.9-1.7)
Model 3[c)]	0.11 (0.0-0.70 1.4)	(0.31.44)	0.40 (0.1-0.88 1.2)	1.2)	(0.6-0.18 0.7)	(0.0-1.08 1.7)	(0.7-0.68 (0.3-1.6)	1.15 (0.8-1.6)
High glucose								
Model 1[a)]	0.30 (0.1-0.94 1.9)	6.92)	(0.1-0.55 4.1)	(0.1-1.46 3.2)	(0.7-0.64 4.8)	(0.1-1.62 5.3)	(0.5-1.23 (0.4-4.1)	0.88 (0.3-2.5)
Model 2[b)]	0.30 (0.1-0.76 1.9)	5.70)	(0.1-0.53 4.0)	(0.1-1.36 3.0)	(0.6-0.72 5.4)	(0.1-1.64 5.4)	(0.5-1.21 (0.4-4.1)	0.93 (0.3-2.6)
Model 3[c)]	0.24 (0.1-1.07 2.4)	8.18)	(0.1-0.46 3.5)	(0.1-1.04 2.3)	(0.5-0.69 5.2)	(0.1-1.50 5.0)	(0.5-1.16 (0.3-3.9)	0.75 (0.3-2.1)
High blood pressure								
Model 1[a)]	0.91 (0.3-0.70 2.7)	1.43)	(0.3-1.15 2.4)	(0.6-1.41 1.9)	(1.1-0.56 1.2)	(0.3-0.80 1.3)	(0.5-0.88 (0.5-1.6)	0.85 (0.6-1.2)
Model 2[b)]	0.94 (0.3-0.73 2.8)	1.50)	(0.4-1.20 2.4)	(0.6-1.45 1.9)	(1.1-0.59 1.3)	(0.3-0.81 1.3)	(0.5-0.87 (0.5-1.6)	0.86 (0.6-1.2)
Model 3[c)]	0.89 (0.3-0.72 2.6)	1.48)	(0.3-1.14 2.3)	(0.6-1.35 1.8)	(1.0-0.57 1.2)	(0.3-0.76 1.2)	(0.5-0.82 (0.5-1.5)	0.82 (0.6-1.1)
High triglyceride								
Model 1[a)]	1.80 (0.7-1.28 4.9)	2.27)	(0.7-0.65 1.5)	(0.3-1.34 1.8)	(1.0-0.92 2.0)	(0.4-0.78 1.2)	(0.5-2.39 (1.3-4.2)	1.18 (0.9-1.6)
Model 2[b)]	1.77 (0.7-1.24 4.8)	2.21)	(0.7-0.56 1.3)	(0.2-1.32 1.7)	(1.0-0.86 1.8)	(0.4-0.76 1.2)	(0.5-2.38 (1.3-4.3)	1.18 (0.9-1.6)
Model 3[c)]	1.75 (0.6-1.32 4.8)	2.36)	(0.7-0.57 1.4)	(0.2-1.28 1.7)	(1.0-0.86 1.8)	(0.4-0.76 1.2)	(0.5-2.38 (1.3-4.3)	1.15 (0.9-1.6)
Low HDL cholesterol								
Model 1[a)]	0.96 (0.2-1.94 4.2)	3.2)	(1.2-1.00 2.9)	(0.3-0.88 1.2)	(0.6-0.44 1.9)	(0.1-1.07 1.2)	(0.6-1.03 (0.4-2.4)	0.93 (0.7-1.3)

Model 2[b)]	0.92 (0.2-2.01	(1.2-0.95	(0.3-0.89	(0.7-0.40	(0.1-1.08	(0.7-1.04	0.94	
	4.1)	3.4)	2.7)	1.2)	1.7)	1.7)	(0.4-2.5)	(0.7-1.3)
Model 3[c)]	0.90 (0.2-2.00	(1.2-0.93	(0.3-0.84	(0.6-0.39	(0.1-1.02	(0.7-1.02	0.90	
	4.0)	3.3)	2.7)	1.1)	1.7)	1.6)	(0.4-2.4)	(0.7-1.2)

Adjusted weighted regression analysis. All values are odds ratios with 95% confidence intervals.

[a)]Adjusted for age, BMI, smoking, drinking, physical exercise

[b)]Additionally adjusted for smoking, drinking, physical exercise, family medical history

[c)]Additionally adjusted education for household income, household income for education

Reference: consistently married group