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Associations between psychological characteristics and indicators of metabolic syndrome among Chinese adults

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Abstract

Current knowledge about the relationship between psychological characteristics and metabolic syndrome components is limited in Asian populations. The purpose of this study is to investigate linkages between physiological markers of metabolic syndrome and life satisfaction, hostility, and depression in Chinese adults. Secondary analyses were conducted using cross-sectional data from parents of randomly selected middle school students participating in a pilot study in Qingdao, China. Among 440 parents who consented to participate (237 women, 203 men), 368 provided valid responses in all three categories of psychological characteristics, and only those subjects were included in these analyses. General linear models and logistic regressions were run separately by gender, controlling for covariates. Among women, life satisfaction was inversely associated with triglyceride levels ($p=0.04$), LDL-C ($p<0.01$), risk of hypertriglyceridemia (OR[0.53], $p<0.01$), HDL-C (OR[0.78], $p=0.03$), and MetS (OR[0.52], $p=0.03$). No associations were found between life satisfaction and any psychological characteristics among men. Among women, hostility was positively associated with triglyceride level ($p=0.04$) and risk of hypertriglyceridemia (OR[2.12], $p<0.05$). Among men, hostility was positively associated with waist circumference ($p=0.04$), waist-hip ratio ($p<0.05$), and fasting plasma insulin ($p<0.01$). Depression was not associated with any physiological measurement in either gender. These findings indicate that relationships exist between certain psychological characteristics and physiological indicators of MetS among Chinese adults, although there may be important differences between genders.

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Conflict of Interest

The authors declare no conflict of interest regarding the publication of this paper.

Keywords

life satisfaction; hostility; depression; metabolic syndrome

Introduction

Stemming from rapid economic growth and modernization, the Chinese population has undergone substantial changes in nutrition and lifestyle, with the unfortunate consequence of an upsurge in rates of metabolic syndrome (MetS). MetS is defined as the existence of central obesity plus two or more additional risk factors, including elevated blood pressure (BP), increased fasting glucose, increased triglycerides (TG), and decreased HDL cholesterol (“IDF Worldwide Definition of the Metabolic Syndrome,” 2005). Previous research has suggested that MetS is associated with an increased risk of cardiovascular disease (CVD), type 2 diabetes (T2DM), and all-cause mortality (Alberti et al., 2009; Ford, 2005; Wilson, D’Agostino, Parise, Sullivan, & Meigs, 2005). A study using data from the China Health and Nutrition Survey in 2009 identified rates of MetS to be 16.2% among men and 20.0% among women (Xi, He, Hu, & Zhou, 2013). The prevalence of this condition makes understanding associations and potential risk factors essential.

Certain psychological characteristics have been identified as possible determinants for developing MetS (Räikkönen, Matthews, & Kuller, 2002). Depression and hostility have been linked to an increased risk of MetS or its individual components, while life satisfaction has been associated with a decreased risk (Gil et al., 2006; Goldbacher & Matthews, 2007; Kinder, Carnethon, Palaniappan, King, & Fortmann, 2004; Laudisio et al., 2009; Räikkönen, Matthews, & Kuller, 2007). The current understanding of these relationships is primarily based on samples from Western nations, and research is lacking among Asian populations. The purpose of this study is to investigate whether associations exist between MetS and life satisfaction, hostility, and depression among Chinese adults.

Methods

Sample Selection and Procedures

Data were retrieved from a cross-sectional pilot study conducted in 2005–2006 among parents of randomly selected 4th and 7th grade students living in Qingdao city of China’s Shandong province (Xie et al., 2010). A total of 440 parents (237 women, 203 men) consented to participate. The present study utilizes data from 368 parents, who provided valid responses for the psychological characteristics questions.

Prior to the data collection, all research staff received training of assessment procedures based on a detailed protocol. Additional information on recruitment, sampling, and data collection methods have been described elsewhere (Xie et al., 2010). All study procedures and survey instruments were approved by both the University of Southern California and Chinese Institutional Review Boards.

Psychological Characteristics

Questionnaires assessing depression, hostility, and life satisfaction were translated into Chinese, back-translated, and pilot tested. Depression was measured by the Center for Epidemiological Studies Depression scale (CES-D), which has high internal consistency in the general population (Cronbach's $\alpha=0.85$) (Radloff, 1977). The CES-D contains 20-items, each scored from 0 to 3. Higher overall scores signify increased symptoms of depression, and a score ≥ 16 indicates an increased risk for clinical depression (Lewinsohn, Seeley, Roberts, & Allen, 1997). For these analyses, both mean CES-D scores and a dichotomized variable (Yes/No for scores ≥ 16) were used. Hostility was measured using one of four scales contained in the Aggression Questionnaire (Buss & Perry, 1992). Mean scores (ranging from 0 to 4) were used in this analysis, with a greater score reflecting a higher level of hostility. Life satisfaction was measured by the Satisfaction with Life scale (SWL), a 5-item questionnaire which assesses global life satisfaction (Diener, Emmons, Larsen, & Griffin, 1985). Higher scores indicate greater satisfaction. Mean scores (ranging 0 to 7) were used in the analyses.

Anthropometric Measurements

Height, waist and hip circumference, skin fold thickness, and weight were measured by trained research staff. BMI was calculated and classified using recommendations from both the World Health Organization (WHO) and the Working Group on Obesity in China (WGO) (WHO Expert Consultation, 2004; Zhou & Cooperative Meta-Analysis Group of the Working Group on Obesity in China, 2002).

Laboratory Assessments and Blood Pressure (BP) Measurement

Blood samples were obtained to measure serum total cholesterol (TC), high-density lipoprotein cholesterol (HDL-C), triglycerides (TG), and plasma glucose and insulin. Low-density lipoprotein cholesterol (LDL-C) concentrations were calculated using the Friedewald equation (Wildman, Gu, Reynolds, Duan, & He, 2004). A standard mercury sphygmomanometer was used to measure seated BP.

Definition of Metabolic Syndrome (MetS)

The present study utilized the consensus definition of MetS for worldwide use as suggested by the International Diabetes Federation (IDF) ("IDF Worldwide Definition of the Metabolic Syndrome," 2005). The diagnostic criteria consists of central obesity (waist circumference ≥ 90 cm for Chinese men, ≥ 80 cm for Chinese women) plus any two of the following: 1) raised TG level (≥ 1.7 mmol/L) or specific treatment for this; 2) reduced HDL (<1.03 mmol/L for men, <1.29 mmol/L for women) or specific treatment for this; 3) raised BP (systolic BP ≥ 130 mmHg or diastolic BP ≥ 85 mmHg) or treatment of previously diagnosed hypertension; 4) raised fasting plasma glucose (≥ 5.6 mmol/L) or previous diagnosis of T2DM.

Other Sociodemographic and Behavioral Measures

Sociodemographic measures include educational attainment, and family income. Behavioral measures consist of questions regarding alcohol use, smoking status, and environmental

tobacco smoke (ETS) exposure. Questionnaire content and development are described elsewhere (Xie et al., 2010).

Data Analysis

Statistical analyses were conducted using Statistical Analysis Software (v.9.4; SAS Institute, Cary, NC). Descriptive statistics were generated for sociodemographic characteristics. General linear models and logistic regressions were used to estimate associations between psychological factors (life satisfaction, hostility, and depression), BMI, central obesity, BP, lipid profile, fasting glucose and insulin, and MetS or its individual components. General linear models and logistic regressions were adjusted for different sets of covariates.

Results

General characteristics of the sample population is summarized in Table 1. Participants' ages ranged from 30–54 years, with the majority obtaining a high school education or above. Far fewer women (2.9%) used tobacco in comparison to men (61.8%, $p<0.01$). For the psychological characteristics, women had higher life satisfaction scores (mean=4.6) than men (mean=4.2, $p=0.02$), but there were no gender differences for hostility or the dichotomized depression variable. Overweight ($p<0.01$), obesity ($p<0.05$, WHO definition; $p<0.01$, WGO definition), MetS ($p<0.01$), and its components all had significant gender differences ($p<0.01$) with the exception of reduced HDL.

Table 2 provides associations between life satisfaction and individual MetS components. Among women, life satisfaction was related to lower LDL-C ($\beta=-0.15$, $SE=0.05$, $p<0.01$) and reduced odds of hypertriglyceridemia (OR[0.53], $p<0.03$) and MetS (OR[0.52], $p=0.03$). Higher life satisfaction was found to be inversely associated with HDL-C (OR[0.78], $p=0.03$). There were no significant relationships between life satisfaction and MetS or its components among men.

Indicators of MetS were not related to depression in either gender (Table 3), but there were significant associations for hostility (Table 4). Among women, hostility was associated with TG level ($\beta=0.15$, $SE=0.07$, $p=0.04$) and increased odds of hypertriglyceridemia (OR[2.12], $p<0.05$). Among men, hostility was related to waist circumference ($\beta=2.25$, $SE=1.08$, $p=0.04$), waist-hip ratio ($\beta=0.01$, $SE=0.01$, $p<0.05$), and fasting plasma insulin ($\beta=1.86$, $SE=0.66$, $p<0.01$).

The final model included potential associations among MetS or its components and all three psychological characteristics. Among women, life satisfaction was inversely associated with TG levels ($\beta=-0.07$, $SE=0.03$, $p=0.04$), LDL-C ($\beta=-0.18$, $SE=0.05$, $p<0.01$), and risk of hypertriglyceridemia (OR[0.50], $p<0.01$), reduced HDL-C (OR[0.78], $p=0.04$), and MetS (OR[0.51], $p=0.03$). An association was also identified between hostility and TG levels ($\beta=0.16$, $SE=0.08$, $p=0.04$). Among men, hostility was associated with fasting plasma insulin ($\beta=2.32$, $SE=0.73$, $p<0.01$).

Discussion

Results indicate that relationships exist between certain psychological factors and MetS in the Chinese population, but the extent varies between genders. Hostility was associated with certain components of MetS for both genders, but the specific MetS component differed. Life satisfaction was correlated with several biomarkers among women only. For both genders, no relationships were identified between depression and MetS components.

Prior studies have reported associations between life satisfaction and general health and longevity. (Diener & Chan, 2011; Lyra, Törmäkangas, Read, Rantanen, & Berg, 2006) Consistent with our results, significant relationships have been found to vary by gender, (Angner, Ray, Saag, & Allison, 2009; Łopuszańska, Szklarska, Lipowicz, Jankowska, & Kozieł, 2013) which may be due to differing concepts of life satisfaction within a culture (Haynes, Feinleib, & Kannel, 1980; Hobfoll, Dunahoo, Ben-Porath, & Monnier, 1994).

Our analyses found hostility was positively related to increased waist circumference, waist-hip ratio, fasting insulin, and risk of hypertriglyceridemia in men, but only to increased TC in women. Other studies have also reported gender differences, with stronger associations between hostility and negative health indicators among men than women (Chida & Steptoe, 2009; Ravaja, Keltikangas-Järvinen, & Keskivaara, 1996).

Findings have been mixed regarding linkages between depression and MetS components. Some prior studies have similarly reported no significant relationships for men or women, (Herva et al., 2006; Hildrum, Mykletun, Midthjell, Ismail, & Dahl, 2009) while others have found associations that vary by gender (Gil et al., 2006; Sekita et al., 2013; Toker, Shirom, & Melamed, 2008; Viinamäki et al., 2009). Different study designs (i.e. longitudinal versus cross-sectional) and populations (i.e. adults of all ages versus exclusively elderly) may explain these discrepancies.

Possible mechanisms to explain the associations between psychological factors and physiological disturbances have been proposed. Negative or stressful events may increase the brain's demand for energy from the body, and exogenous energy provides feelings of relief (Hitze et al., 2010; Peters et al., 2004). It has also been suggested that chronic psychological stress interferes with major biological functions that promote or exacerbate components of MetS (Holvoet, 2008; Hutcheson & Rocic, 2012; O'Donovan, Neylan, Metzler, & Cohen, 2012). Additionally, life satisfaction has been found to increase health promoting behaviors (Grant, Wardle, & Steptoe, 2009; Ko, 2006), which is reflected in improved physiological health.

There are several limitations to consider when interpreting the results of this study. As with all cross-sectional analyses, neither causality nor bidirectional relationships can be determined. Additionally, the accuracy of the psychological assessments used may be limited; self-reported questionnaires can potentially leave out hidden variables, and a single cross-sectional measurement of psychological characteristics do not necessarily reflect a clinical diagnosis. Finally, as CVD risk varies across different Asian ethnicities, (WHO Expert Consultation, 2004) our results are not generalizable beyond Mainland China.

While further investigation is needed to understand the underlying biological mechanisms of these findings, this study may encourage future interventions to consider the inclusion of psychological factors as part of a comprehensive disease management strategy.

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References

- Alberti KGMM, Eckel RH, Grundy SM, Zimmet PZ, Cleeman JJ, Donato KA, Smith SC. Harmonizing the Metabolic Syndrome A Joint Interim Statement of the International Diabetes Federation Task Force on Epidemiology and Prevention; National Heart, Lung, and Blood Institute; American Heart Association; World Heart Federation; International Atherosclerosis Society; and International Association for the Study of Obesity. *Circulation*. 2009; 120(16):1640–1645. <http://doi.org/10.1161/CIRCULATIONAHA.109.192644>. [PubMed: 19805654]
- Angner E, Ray MN, Saag KG, Allison JJ. Health and Happiness among Older Adults A Community-based Study. *Journal of Health Psychology*. 2009; 14(4):503–512. <http://doi.org/10.1177/1359105309103570>. [PubMed: 19383651]
- Buss AH, Perry M. The Aggression Questionnaire. *Journal of Personality and Social Psychology*. 1992; 63(3):452–459. <http://doi.org/10.1037/0022-3514.63.3.452>. [PubMed: 1403624]
- Chida Y, Steptoe A. The association of anger and hostility with future coronary heart disease: a meta-analytic review of prospective evidence. *Journal of the American College of Cardiology*. 2009; 53(11):936–946. <http://doi.org/10.1016/j.jacc.2008.11.044>. [PubMed: 19281923]
- Diener E, Chan MY. Happy People Live Longer: Subjective Well-Being Contributes to Health and Longevity. *Applied Psychology: Health and Well-Being*. 2011; 3(1):1–43. <http://doi.org/10.1111/j.1758-0854.2010.01045.x>.
- Diener E, Emmons RA, Larsen RJ, Griffin S. The Satisfaction With Life Scale. *Journal of Personality Assessment*. 1985; 49(1):71–75. http://doi.org/10.1207/s15327752jpa4901_13. [PubMed: 16367493]
- Ford ES. Risks for all-cause mortality, cardiovascular disease, and diabetes associated with the metabolic syndrome: a summary of the evidence. *Diabetes Care*. 2005; 28(7):1769–1778. <http://doi.org/10.2337/diacare.28.7.1769>. [PubMed: 15983333]
- Gil K, Radzillowicz P, Zdrojewski T, Pakalska-Korcala A, Chwojnicki K, Piwonski J, Wyrzykowski B. Relationship between the prevalence of depressive symptoms and metabolic syndrome. Results of the SOPKARD Project. *Kardiologia Polska*. 2006; 64(5):464–9. [PubMed: 16752328]
- Goldbacher EM, Matthews KA. Are psychological characteristics related to risk of the metabolic syndrome? A review of the literature. *Annals of Behavioral Medicine*. 2007; 34(3):240–252. <http://doi.org/10.1007/BF02874549>. [PubMed: 18020934]
- Grant N, Wardle J, Steptoe A. The relationship between life satisfaction and health behavior: a cross-cultural analysis of young adults. *International Journal of Behavioral Medicine*. 2009; 16(3):259–268. <http://doi.org/10.1007/s12529-009-9032-x>. [PubMed: 19319695]
- Haynes SG, Feinleib M, Kannel WB. The relationship of psychosocial factors to coronary heart disease in the Framingham Study. III. Eight-year incidence of coronary heart disease. *American Journal of Epidemiology*. 1980; 111(1):37–58. [PubMed: 7352459]
- Herva A, Räsänen P, Miettunen J, Timonen M, Läksy K, Veijola J, Joukamaa M. Co-occurrence of metabolic syndrome with depression and anxiety in young adults: the Northern Finland 1966 Birth Cohort Study. *Psychosomatic Medicine*. 2006; 68(2):213–216. <http://doi.org/10.1097/01.psy.0000203172.02305.ea>. [PubMed: 16554385]

- Hildrum B, Mykletun A, Midthjell K, Ismail K, Dahl AA. No association of depression and anxiety with the metabolic syndrome: the Norwegian HUNT study. *Acta Psychiatrica Scandinavica*. 2009; 120(1):14–22. <http://doi.org/10.1111/j.1600-0447.2008.01315.x>. [PubMed: 19120047]
- Hitze B, Hubold C, van Dyken R, Schlichting K, Lehnert H, Entringer S, Peters A. How the selfish brain organizes its supply and demand. *Frontiers in Neuroenergetics*. 2010; 2 <http://doi.org/10.3389/fnene.2010.00007>.
- Hobfoll SE, Dunahoo CL, Ben-Porath Y, Monnier J. Gender and coping: the dual-axis model of coping. *American Journal of Community Psychology*. 1994; 22(1):49–82. [PubMed: 7942644]
- Holvoet P. Association between circulating oxidized low-density lipoprotein and incidence of the Metabolic Syndrome. *JAMA*. 2008; 299(19):2287. <http://doi.org/10.1001/jama.299.19.2287>. [PubMed: 18492970]
- Hutcheson R, Rocic P. The Metabolic Syndrome, oxidative stress, environment, and cardiovascular disease: the great exploration. *Experimental Diabetes Research*. 2012; 2012:1–13. <http://doi.org/10.1155/2012/271028>.
- IDF Worldwide Definition of the Metabolic Syndrome. 2005. Retrieved January 19, 2015, from <http://www.idf.org/metabolic-syndrome>
- Kinder LS, Carnethon MR, Palaniappan LP, King AC, Fortmann SP. Depression and the metabolic syndrome in young adults: findings from the Third National Health and Nutrition Examination Survey. *Psychosomatic Medicine*. 2004; 66(3):316–322. [PubMed: 15184689]
- Ko GTC. Both obesity and lack of physical activity are associated with a less favorable health-related quality of life in Hong Kong Chinese. *American Journal of Health Promotion*. 2006; 21(1):49–52. <http://doi.org/10.4278/0890-1171-21.1.49>. [PubMed: 16977913]
- Laudisio A, Marzetti E, Pagano F, Pozzi G, Bernabei R, Zuccalà G. Depressive symptoms and metabolic syndrome: selective association in older women. *Journal of Geriatric Psychiatry and Neurology*. 2009; 22(4):215–222. <http://doi.org/10.1177/0891988709335793>. [PubMed: 19423752]
- Lewinsohn PM, Seeley JR, Roberts RE, Allen NB. Center for Epidemiologic Studies Depression Scale (CES-D) as a screening instrument for depression among community-residing older adults. *Psychology and Aging*. 1997; 12(2):277–287. [PubMed: 9189988]
- Łopusza ska M, Szklarska A, Lipowicz A, Jankowska EA, Kozieł S. Life satisfaction and cardiovascular disease risk in Poland. *Archives of Medical Science: AMS*. 2013; 9(4):629–634. <http://doi.org/10.5114/aoms.2013.36909>. [PubMed: 24049521]
- Lyyra TM, Törmäkangas TM, Read S, Rantanen T, Berg S. Satisfaction with present life predicts survival in octogenarians. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*. 2006; 61(6):P319–P326.
- O'Donovan A, Neylan TC, Metzler T, & Cohen BE. Lifetime exposure to traumatic psychological stress is associated with elevated inflammation in the Heart and Soul Study. *Brain, Behavior, and Immunity*. 2012; 26(4):642–649. <http://doi.org/10.1016/j.bbi.2012.02.003>.
- Peters A, Schweiger U, Pellerin L, Hubold C, Oltmanns KM, Conrad M, Fehm HL. The selfish brain: competition for energy resources. *Neuroscience & Biobehavioral Reviews*. 2004; 28(2):143–180. <http://doi.org/10.1016/j.neubiorev.2004.03.002>. [PubMed: 15172762]
- Radloff LS. The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*. 1977; 1(3):385–401. <http://doi.org/10.1177/014662167700100306>.
- Räikkönen K, Matthews KA, Kuller LH. The relationship between psychological risk attributes and the metabolic syndrome in healthy women: antecedent or consequence? *Metabolism: Clinical and Experimental*. 2002; 51(12):1573–1577. <http://doi.org/10.1053/meta.2002.36301>. [PubMed: 12489070]
- Räikkönen K, Matthews KA, Kuller LH. Depressive symptoms and stressful life events predict Metabolic Syndrome among middle-aged women: a comparison of World Health Organization, Adult Treatment Panel III, and International Diabetes Foundation definitions. *Diabetes Care*. 2007; 30(4):872–877. <http://doi.org/10.2337/dc06-1857>. [PubMed: 17392548]
- Ravaja N, Keltikangas-Järvinen L, Keskivaara P. Type A factors as predictors of changes in the metabolic syndrome precursors in adolescents and young adults—a 3-year follow-up study. *Health*

- Psychology: Official Journal of the Division of Health Psychology, American Psychological Association. 1996; 15(1):18–29.
- Sekita A, Arima H, Ninomiya T, Ohara T, Doi Y, Hirakawa Y, Kiyohara Y. Elevated depressive symptoms in metabolic syndrome in a general population of Japanese men: a cross-sectional study. *BMC Public Health*. 2013; 13(1):862. <http://doi.org/10.1186/1471-2458-13-862>. [PubMed: 24044502]
- Toker S, Shirom A, Melamed S. Depression and the metabolic syndrome: gender-dependent associations. *Depression and Anxiety*. 2008; 25(8):661–669. <http://doi.org/10.1002/da.20379>. [PubMed: 17941099]
- Viinamäki H, Heiskanen T, Lehto SM, Niskanen L, Koivumaa-Honkanen H, Tolmunen T, Hintikka J. Association of depressive symptoms and metabolic syndrome in men. *Acta Psychiatrica Scandinavica*. 2009; 120(1):23–29. <http://doi.org/10.1111/j.1600-0447.2008.01333.x>. [PubMed: 19133875]
- WHO Expert Consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet*. 2004; 363(9403):157–163. [http://doi.org/10.1016/S0140-6736\(03\)15268-3](http://doi.org/10.1016/S0140-6736(03)15268-3). [PubMed: 14726171]
- Wildman RP, Gu D, Reynolds K, Duan X, He J. Appropriate body mass index and waist circumference cutoffs for categorization of overweight and central adiposity among Chinese adults. *The American Journal of Clinical Nutrition*. 2004; 80(5):1129–1136. [PubMed: 15531658]
- Wilson PWF, D'Agostino RB, Parise H, Sullivan L, Meigs JB. Metabolic Syndrome as a Precursor of Cardiovascular Disease and Type 2 Diabetes Mellitus. *Circulation*. 2005; 112(20):3066–3072. <http://doi.org/10.1161/circulationaha.105.539528>. [PubMed: 16275870]
- Xi B, He D, Hu Y, Zhou D. Prevalence of metabolic syndrome and its influencing factors among the Chinese adults: the China Health and Nutrition Survey in 2009. *Preventive Medicine*. 2013; 57(6): 867–71. <http://doi.org/10.1016/j.ypmed.2013.09.023>. [PubMed: 24103567]
- Xie B, Palmer PH, Pang Z, Sun P, Duan H, Johnson CA. Environmental tobacco use and indicators of metabolic syndrome in Chinese adults. *Nicotine & Tobacco Research*. 2010; 12(3):198–206. <http://doi.org/10.1093/ntr/ntp194>. [PubMed: 20056689]
- Zhou BF, Meta-Analysis Group of the Working Group on Obesity in China Cooperative. Predictive values of body mass index and waist circumference for risk factors of certain related diseases in Chinese adults—study on optimal cut-off points of body mass index and waist circumference in Chinese adults. *Biomedical and Environmental Sciences: BES*. 2002; 15(1):83–96. [PubMed: 12046553]

Table 1

General characteristics of the sample population

	Women (n=204)			Men (n=164)			Overall (N=368)		
	mean	SD	n	mean	SD	n	mean	SD	n
Age (in years)	37.71	3.7		39.73	4.2		38.66	4.0	
<hr/>									
Education	n	%	n	%	n	%	n	%	n
Below High School	53	26.6	34	20.9	87	24.3			
High School	72	36.2	60	36.8	132	36.5			
College or Above	74	37.2	69	42.3	143	39.5			
Annual family income	n	%	n	%	n	%	n	%	n
Below 1000 Yuan	16	8.0	9	5.6	25	6.9			
1001–2500 Yuan	24	11.9	20	12.4	44	12.1			
2501–5000 Yuan	14	7.0	8	4.9	22	6.1			
5001–10,000 Yuan	13	6.5	10	6.2	23	6.3			
10,001–15,000 Yuan	17	8.5	17	10.5	34	9.4			
15,001–25,000 Yuan	27	13.4	19	11.7	46	12.7			
25,001–50,000 Yuan	42	20.9	31	19.1	73	20.1			
50,001–75,000 Yuan	27	13.4	29	17.9	56	15.4			
75,001–100,000 Yuan	10	5.0	12	7.4	22	6.1			
100,001–150,000 Yuan	2	1.0	2	1.2	4	1.1			
150,001–200,000 Yuan	5	2.5	3	1.9	8	2.2			
200,001 and above	4	2.0	2	1.2	6	1.7			
Smoking status									
Never smoker	30	17.1	1	0.7	31	10			
ETS	102	58.3	13	9.6	115	37			
Ex-smoker	38	21.7	38	27.9	76	24.4			
Current smoker	5	2.9	84	61.8	89	28.6			
Drinking status									
Never drinker	111	57.2	25	15.2	136	38			
Ex-drinker	0	0.0	21	12.8	21	5.9			

	Women (n=204)		Men (n=164)		Overall (N=368)	
	mean	SD	mean	SD	mean	SD
Current drinker	83	42.8	118	72.0	201	56.2
Weight status						
WHO definition						
Overweight (25 kg/m ² <BMI<30 kg/m ²)	56	27.6	86	52.8	142	38.8
Obesity (BMI 30kg/m ²)	5	2.5	11	6.8	16	4.4
WGOC definition						
Overweight (24kg/m ² <BMI<28kg/m ²)	66	32.5	75	46.0	141	38.5
Obesity (BMI 28kg/m ²)	15	7.4	33	20.3	48	13.1
Metabolic syndrome Components						
Impaired glucose level	3	1.5	13	8.0	16	4.4
High blood pressure	24	11.8	59	36.4	83	22.7
Hypertriglyceridemia	17	8.5	67	41.4	84	23.2
Reduced HDL-C	62	31.0	42	25.9	104	28.7
Central obesity	52	25.6	64	39.0	116	31.6
Psychological characteristics						
CES-D score 16 (dichotomous yes/no)	62	30.4	50	30.5	112	30.4
Depression (Mean score of CES-D)						
	1.5	0.4	1.4	0.3	1.5	0.4
Hostility						
	1.7	0.6	1.8	0.8	1.7	0.7
Life satisfaction						
	4.6	1.4	4.2	1.5	4.4	1.4

Abbreviations: BMI, body mass index; ETS, environmental tobacco smoke; MetS, metabolic syndrome; WGOC, Working Group on Obesity in China; WHO, World Health Organization; CES-D, Center for Epidemiological Studies-Depression scale.

Table 2
Associations of life satisfaction with central obesity and physiological markers by gender

	Women		Men	
	β (SE)	p value	β (SE)	p value
General Linear Models^a				
BMI	-0.22(0.17)	0.21	0.04(0.19)	0.83
Central obesity				
Scapular skin fold thickness	-0.60(0.34)	0.08	0.58(0.42)	0.17
Waist circumference	-0.02(0.45)	0.97	-0.46(0.57)	0.42
Waist-hip ratio	-5E-4(3E-3)	0.87	-3E-3(4E-3)	0.44
Blood pressure				
SBP	-0.41(0.74)	0.57	0.31(0.74)	0.67
DBP	0.01(0.57)	0.99	-0.15(0.60)	0.80
Lipid profile				
TG	-0.07(0.03)	0.04	-0.22(0.24)	0.37
LDL-C	-0.15(0.05)	<0.01	0.05(0.07)	0.52
HDL-C	0.03(0.02)	0.16	0.01(0.02)	0.97
TC	-0.05(0.05)	0.36	5E-3 (0.07)	0.95
Glycemic components				
Fasting glucose	-3E-3(0.04)	0.95	-0.05(0.09)	0.61
Fasting insulin	0.02(0.18)	0.91	0.34(0.33)	0.31
Logistic Regression^b				
	OR	95% CI	OR	95% CI
Metabolic syndrome	0.52	0.29–0.93	0.03	0.73–1.32
Component				
Impaired fasting glucose	1.97	0.61–6.31	0.25	0.74
High blood pressure	0.92	0.64–1.32	0.64	1.20
Hypertriglyceridemia	0.53	0.35–0.81	<0.01	0.88
Reduced HDL-C	0.78	0.62–0.98	0.03	0.85
Central obesity	1.08	0.84–1.38	0.57	1.03

Abbreviations: BMI, Body Mass Index; SBP, systolic blood pressure; DBP, diastolic blood pressure; OR, odds ratio; TC, total cholesterol; TG, triglycerides.

^aCovariates controlled in general linear models: age, education level, income level, alcohol drinking, and active smoking status.

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^d Covariates controlled in logistic regression models: age, education level, income level, and alcohol drinking for men; age, income level, and alcohol drinking for women.

Table 3

Associations of depressive symptoms with central obesity and physiological markers by gender

	Women		Men	
	β	p value	β	p value
General Linear Models^a				
BMI	-0.21(0.59)	0.73	-1.38(0.91)	0.13
Central obesity				
Scapular skin fold thickness	-0.40(1.16)	0.73	0.01(2.07)	0.99
Waist circumference	-0.24(1.50)	0.87	-1.70(2.80)	0.54
Waist-hip ratio	0.01(0.01)	0.41	-0.01(0.02)	0.59
Blood pressure				
SBP	0.48(2.48)	0.85	-5.27(3.56)	0.14
DBP	0.30(1.92)	0.87	-1.23(2.87)	0.67
Lipid profile				
TG	-0.08(0.11)	0.48	-1.57(1.14)	0.17
LDL-C	-0.03(0.16)	0.83	-0.26(0.34)	0.45
HDL-C	-0.06(0.08)	0.48	0.01(0.09)	0.90
TC	0.06(0.17)	0.72	-0.23(0.33)	0.48
Glycemic components				
Fasting glucose	0.11(0.15)	0.45	-0.17(0.41)	0.69
Fasting insulin	-0.37(0.61)	0.55	-1.52(1.56)	0.33
Logistic Regression^b				
Metabolic syndrome	OR	95% CI	OR	95% CI
	1.21	0.18–0.86	0.84	0.04–1.05
Component				
Impaired fasting glucose	1.60	0.08–32.46	0.76	0.20–7.29
High blood pressure	1.14	0.29–4.43	0.85	0.09–1.33
Hypertiglyceridemia	0.98	0.24–3.95	0.97	0.42–1.33
Reduced HDL-C	1.43	0.64–3.21	0.38	0.20–2.63
Central obesity	0.49	0.18–1.33	0.16	0.14–1.43

Abbreviations: BMI, Body Mass Index; SBP, systolic blood pressure; DBP, diastolic blood pressure; OR, odds ratio; TC, total cholesterol; TG, triglycerides.

^aCovariates controlled in general linear models: age, education level, income level, alcohol drinking, and active smoking status.

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^d Covariates controlled in logistic regression models: age, education level, income level, and alcohol drinking for men; age, income level, and alcohol drinking for women.

Table 4

Associations of hostility with central obesity and physiological markers by gender

	Women		Men	
	β	p value	β	p value
General Linear Models^a				
BMI	0.18(0.39)	0.64	0.55(0.36)	0.14
Central obesity				
Scapular skin fold thickness	-0.58(0.77)	0.45	1.14(0.80)	0.16
Waist circumference	0.53(1.00)	0.60	2.25(1.08)	0.04
Waist-hip ratio	4E-3(0.01)	0.55	0.01(0.01)	<0.05
Blood pressure				
SBP	0.54(1.64)	0.74	0.22(1.41)	0.88
DBP	-0.01(1.27)	0.99	-0.16(1.12)	0.89
Lipid profile				
TG	0.15(0.07)	0.04	-0.21(0.46)	0.66
LDL-C	-0.10(0.11)	0.33	-0.08(0.14)	0.56
HDL-C	-0.04(0.05)	0.49	-0.02(0.04)	0.54
TC	-0.01(0.11)	0.91	-0.14(0.13)	0.29
Glycemic components				
Fasting glucose	-0.03(0.10)	0.76	0.11(0.17)	0.50
Fasting insulin	-0.03(0.41)	0.94	1.86(0.66)	0.01
Logistic Regression^b				
	OR	95% CI	OR	95% CI
Metabolic syndrome	1.64	0.59–4.58	1.30	0.81–2.09
Component				
Impaired fasting glucose	0.67	0.06–8.23	1.00	0.49–2.00
High blood pressure	1.15	0.51–2.57	0.81	0.51–1.28
Hypertriglyceridemia	2.12	1.00–4.46	1.26	0.82–1.93
Reduced HDL-C	1.04	0.61–1.78	0.93	0.58–1.50
Central obesity	0.84	0.47–1.50	1.51	0.97–2.35

Abbreviations: BMI, Body Mass Index; SBP, systolic blood pressure; DBP, diastolic blood pressure; OR, odds ratio; TC, total cholesterol; TG, triglycerides.

^aCovariates controlled in general linear models: age, education level, income level, alcohol drinking, and active smoking status.

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^d Covariates controlled in logistic regression models: age, education level, income level, and alcohol drinking for men; age, income level, and alcohol drinking for women.