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Abdominal obesity and hypertension are correlated with health-related quality of life in Taiwanese adults with metabolic syndrome

Sue-Hsien Chen,[1,2] Shu-Ching Chen,[3] Yo-Ping Lai,[4] Pin-Hsuan Chen,[1] Kun-Yun Yeh [5]

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[1]Community Medicine Research Center, Chang Gung Memorial Hospital, Keelung, Taiwan
[2]School of Nursing, Chang Gung University of Science and Technology, Taoyuan, Taiwan
[3]Department of Medical Research, National Taiwan University Hospital, Taipei, Taiwan
[4]Department of Internal Medicine, National Taiwan University Hospital, Taipei, Taiwan
[5]Division of Hemato-Oncology, Department of Internal Medicine, Chang Gung Memorial Hospital, Keelung & Chang Gung University, College of Medicine, Keelung, Taiwan

Correspondence to
Dr Kun-Yun Yeh; yehtyng@gmail.com

ABSTRACT

Objective Metabolic syndrome (MetS) gains more attention due to high prevalence of obesity, diabetes and hypertension among adults. Although obesity, diabetes and hypertension can certainly compromise health-related quality of life (HRQoL), the correlations of sociodemographic factors, quality of life and MetS remains unclear. This study aims to investigate the association between HRQoL and MetS in an Asian community of the sociodemographic characteristics.

Research design and methods We performed a cross-sectional study by recruiting 2588 Taiwanese patients aged ≥30 years between August 2015 and August 2017. Sociodemographic data and anthropometric variables were obtained from medical records and physical examination. Meanwhile, HRQoL was assessed by 36-Item Short-Form Health Survey questionnaires.

Results The overall prevalence of MetS was 32.8%. Multivariate analysis revealed that age ≥65 years (OR=1.987, p<0.001), body mass index (BMI) ≥24 kg/m^2 (OR=7.958, p<0.001), low educational level (OR=1.429, p=0.014), bad self-perceived health status (OR=1.315, p=0.01), and betel nut usage (OR=1.457, p=0.048) were associated with the development of MetS. For patients with MetS, the physical and mental health domains of HRQoL are negatively correlated with abdominal obesity and hypertension, respectively.

Conclusions Adult MetS in Taiwan was associated with certain sociodemographic factors including older age, high BMI, low educational level, bad self-perceived health status, and betel nut use. Abdominal obesity and hypertension was correlated with HRQoL in patients with MetS.

Significance of this study

What is already known about this subject?

- Metabolic syndrome comprises the clustering of traditional cardiovascular risk factors that are highly associated with increased risk of cardiovascular disease and may trigger physical and mental problems.
- Heterogeneity across geographical regions, study population variability, and different sociodemographic factors affect the prevalence of metabolic syndrome.
- Although obesity, diabetes and hypertension can certainly compromise health-related quality of life, the correlations of sociodemographic factors, quality of life and metabolic syndrome remains unclear.
- The 36-Item Short-Form Health Survey (SF-36) questionnaire is widely used for assessing health-related quality of life.

What are the new findings?

- This study demonstrated no correlation between metabolic syndrome and impaired health-related quality of life among Taiwanese adults aged ≥30 years, using SF-36 questionnaire.
- Old age, high body mass index, low educational level, bad self-perceived health status and betel nut usage are associated with the prevalence of metabolic syndrome.
- For participants with metabolic syndrome, their physical health was correlated with abdominal obesity, and their mental health was correlated with hypertension.

INTRODUCTION

The National Cholesterol Education Program's Adult Treatment Panel III (NCEP-ATP III) defined adults who develop metabolic syndrome (MetS) as those having at least three out of the following five anomalies: abdominal obesity, high triglycerides level, low high-density lipoprotein cholesterol (HDL-C) level, hypertension and hyperglycemia.[1–3] MetS is associated with cardiovascular disease (CVD) and increasingly found in the elderly in developed countries.[1] MetS has a significant impact on morbidity and mortality on CVDs, type 2 diabetes and social-psycho illnesses.[1 4 5] The association between MetS and impaired health-related quality of life (HRQoL) has been reported.[2 6 7]

HRQoL, an individual's overall sense of well-being, is based on subjective physical, social and psychological functioning that are self-reported. It has become an essential outcome variable for healthcare, given for

Significance of this study

How might these results change the focus of research or clinical practice?

- A comprehensive prevention and management program of metabolic syndrome is urgently warranted for controlling the growing obesity trend and its related diseases.
- Integrate public health and primary care is important to accelerating progress in preventing obesity and expanding the role of primary care in the prevention and early treatment of obesity. Additionally, further research and development are needed to expand the role of social networking services in obesity and overweight care.

those with chronic illness.[8] HRQoL can be measured using 36-Item Short-Form Health Survey (SF-36), one of the leading HRQoL measurements that is broadly applied in MetS research.[7 9] The SF-36 survey contains the following 36 items covering functional health status and general health (GH): eight dimensions including physical functioning (PF), role physical (RP), bodily pain (BP), GH, vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH) and two domains including physical component summary (PCS) and mental component summary (MCS). The higher scores, both on eight dimensions and two domains, indicate better functioning.[10] This impaired HRQoL has a negative impact on therapy response and disease control and survival in MetS patients.[11 12]

However, this association was only found in participants with female gender, depression, or high body mass index (BMI) after adjusting for the confounding factors such as sociodemographic variables, medical comorbidities, and obesity.[7 13–15] Impaired HRQoL was associated with high BMI rather than MetS, confirmed by a study on obese participants with a BMI of over 30 kg/m^2.[14] In Korea, abdominal obesity and dyslipidemia were associated with impaired HRQoL.[6 13] Corica *et al*[16] also reported that obesity, hypertension, and diabetes mellitus were the main contributors to poor HRQoL. A correlation has been considered between MetS and poor HRQoL in Japan, whereas this correlation was not found in studies from Taiwan.[17 18] Furthermore, whether MetS is a mere aggregation of metabolic abnormalities or a syndrome representing a clinical entity concerns, the critical investigators[19 20] and the different associations of certain MetS components with HRQoL have been reported among various populations.[7 21] Finally, since heterogeneous geographic area and study population variability influence the estimates of the prevalence of MetS,[22–25] in analyzing the association between MetS and HRQoL, MetS-related risk factors such as sociodemographic background and medical status that could be interrelated with each other should be considered. Nowadays, the association between HRQoL and MetS or MetS components remains debatable. Different patterns of MetS components in various ethnicities could result in different effects on HRQoL of individuals.

Therefore, this study aims to investigate the association between HRQoL and MetS in an Asia community under consideration of the sociodemographic characteristics.

METHODS

Study design

We conducted a cross-sectional study and enrolled residents aged over 30 years who received a health assessment program from August 2015 to August 2017 at Chang Gung Memorial Hospital (CGMH), Keelung, Taiwan. The subjects were excluded from the study if they had already been diagnosed with MetS or had one of the following medical conditions previously: major gastrointestinal disorder; autoimmune disorder; end-stage renal failure; liver cirrhosis; heart failure; diabetes mellitus; uncontrolled blood pressure; recent cardiovascular events; dementia; ongoing infection; active participation in a weight-loss program; pregnancy; and receipt of regular medications that could substantially modulate the metabolism and weight, such as steroids or megestrol acetate. We explained the research study to the participants, including the purpose, procedures, rights, and confidentiality aspects.

They completed physical examinations, laboratory tests, and questionnaires through one-on-one interviews. To assure that they had the required cognitive ability, we asked three fact-based questions including the current year, a simple addition equation, and correct day of the week after the one identified. If any of these three questions were answered incorrectly, the participants' questionnaires were considered ineligible. From a total of 2901 participants recruited, 313 cases (28 women and 285 men) were excluded and 2588 participants (1629 women and 959 men) completed all the required study assessments, yielding a response rate of 89.2%.

Assessment of sociodemographic variables

Sociodemographic data, including age, sex, marital status, level of educational attainment, smoking habits, alcohol, betel nut usage, and any history of obesity, diabetes, hypertension, and CVD, were collected. Participants who were employed in the construction industry including building, bridge, tunnel, railway tracks and road paving were put under the occupation category 'Laborer'. Educational attainment was classified into the following three groups: less than 9 years (junior high school), 9–12 years (senior high school), and more than 12 years (college and above). Marital status was divided into the following two classifications: currently married and currently unmarried (including single, widowed, divorced, or separated). Smoking exposure was considered affirmative if participants were current or former smokers. Alcohol consumption was considered affirmative if participants reported consuming four drinks or more per week. Habits of betel nut usage were considered affirmative if participants indicated any usage during the previous year.

Table 1 Characteristics of the 2588 participants according to the presence of metabolic syndrome (MetS)

Variables expressed as number (%) or mean±SD	All (n=2588)	Without MetS (n=1738)	With MetS (n=850)	P*
Gender				0.022
Men	959 (37.1)	617 (35.5)	342 (40.2)	
Women	1629 (62.9)	1121 (64.5)	508 (59.8)	
Age	55.9±12.6	54.8±11.8	59.1±11.2	<0.001
<65 years	1992 (77.0)	1422 (81.8)	570 (67.1)	
≥65 years	596 (23.0)	316 (18.2)	280 (32.9)	
BMI	24.9±12.6	23.6±3.0	27.7±3.6	<0.001
≤24	1139 (44.0)	1014 (58.3)	125 (14.7)	
>24	1449 (56.0)	724 (41.7)	725 (85.3)	
Marital status				0.168
Married	2084 (80.5)	1386 (79.7)	698 (82.1)	
Unmarried†	504 (19.5)	352 (20.3)	152 (17.9)	
Educational attainment (years)				<0.001
≤9 years (junior high school)	1189 (45.9)	714 (41.1)	475 (55.9)	
9–12 years (senior high school)	758 (29.3)	538 (31.0)	220 (25.9)	
>12 years (college and above)	641 (24.8)	486 (27.9)	155 (18.2)	
Self-perceived health status				<0.001
Upper	1272 (49.1)	903 (52.0)	369 (43.4)	
Lower	1316 (50.9)	835 (48.0)	481 (56.6)	
Source of household income				0.002
Self	1532 (59.2)	1070 (61.6)	462 (54.4)	
Relatives	886 (34.2)	561 (32.3)	325 (38.2)	
Government	170 (6.6)	107 (6.2)	63 (7.4)	
Occupation				0.014
Farmer/fisherman/livestock	124 (4.8)	73 (4.2)	51 (6.0)	
Laborer	569 (22.0)	366 (21.1)	203 (23.9)	
Government employee	286 (11.1)	202 (11.6)	84 (9.9)	
Services	1098 (42.4)	767 (44.1)	331 (38.9)	
None‡	511 (19.7)	330 (19.0)	181 (21.3)	
Diet				0.797
Vegetarian	2504 (96.8)	1680 (96.7)	824 (96.9)	
Non-vegetarian	84 (3.2)	58 (3.3)	26 (3.1)	
Smoking				0.024
Yes	652 (25.2)	414 (23.8)	238 (28.0)	
No	1936 (74.8)	1324 (76.2)	612 (72.0)	
Drinking				0.509
Yes	1042 (40.3)	708 (40.7)	334 (39.3)	
No	1546 (59.7)	1030 (59.3)	516 (60.7)	
Betel nut usage				0.007
Yes	191 (7.4)	111 (6.4)	80 (9.4)	
No	2397 (92.6)	1627 (93.6)	770 (90.6)	

*P value was determined using χ^2 test (for gender, BMI, marital status, educational attainment, self-perceived health status, source of household income, occupation, diet, smoking, drinking, and betel nut usage).
†Unmarried included single, divorced, and widowed.
‡None included housewives.
BMI, body mass index; MetS, metabolic syndrome.

Table 2 Health-related quality of life data assessed using 36-Item Short-Form Health Survey (SF-36) among the 2588 participants according to the presence of MetS

Variables expressed as mean±SD	All (n=2588)	Without MetS (n=1738)	With -MetS (n=850)	P*
SF-36 subscales				
PF	89.48±15.73	91.09±14.07	86.18±18.25	<0.001
RP	84.41±32.60	85.44±31.44	82.31±34.78	0.027
BP	81.44±20.94	82.17±20.73	79.94±21.29	0.011
GH	64.87±20.56	65.52±20.07	63.52±21.47	0.023
VT	68.62±20.33	68.33±20.14	69.21±20.73	0.299
SF	92.08±13.18	91.68±13.35	92.88±12.80	0.028
RE	87.80±29.44	88.15±28.83	87.09±30.63	0.393
MH	74.43±17.84	73.72±17.72	75.86±18.00	0.004
PCS	52.66±7.13	53.29±6.80	51.37±7.60	<0.001
MCS	51.43±8.87	50.98±8.79	52.35±8.96	<0.001

*P value was determined using independent Student's t-test.
BP, bodily pain; GH, general health; MCS, mental component summary; MetS, metabolic syndrome; MH, mental health; PCS, physical component summary; PF, physical functioning; RE, role emotional; RP, role physical; SF, social functioning; VT, vitality.

Assessment of anthropometric variables

Anthropometric data, including blood pressure, weight, height, BMI, and waist circumference (WC), were recorded for each participant. Body height and weight were measured by an automatic height–weight scale to the nearest 0.1 cm and 0.1 kg, respectively. Systolic and diastolic blood pressure was measured twice, after 5 min rest, using validated and calibrated electronic sphygmomanometers. The BMI was calculated from the height and body weight of each participant (weight in kilograms divided by the square of the height in meters, kg/m^2). WC was used to examine central adiposity and measured to the nearest 0.1 cm at the midpoint between the 12th rib and right anterior superior iliac spine, using an unstretched tape meter. All data were collected consistently by the two qualified researchers who had been trained by a certified International Society for the Advancement of Kinanthropometry specialists before this study, in order to collect data in a standardized way.

Diagnostic criteria for MetS

MetS was defined according to the modified NCEP-ATP III as the presence of three or more of the following conditions: (1) hypertension: systolic blood pressure ≥130 mm Hg or diastolic blood pressure ≥85 mm Hg, or the use of antihypertensive agents; (2) hyperglycemia: fasting blood glucose level ≥100 mg/dL; (3) low serum HDL-C: ≤40 mg/dL for men or ≤50 mg/dL for women; (4) hypertriglyceridemia: triglyceride (TG) level ≥150 mg/dL; and (5) abdominal obesity: WC ≥90 cm for men and ≥80 cm for women.[3]

Assessment of HRQoL

HRQoL was measured using the SF-36 questionnaire.[26] The SF-36 scores were summarized using two widely accepted domains, PCS and MCS, based on exploratory factor analysis of the eight SF-36 subscales related to physical health (PF, RP, BP, and GH) and related to mental well-being (VT, SF, RE, and MH). The higher scores with 0–100 range indicated better health.[10]

Expert validation and data collection

A structured questionnaire and direct objective measures were used to collect data, including demographic data, anthropometric data, and HRQoL. We invited six experts, including two cardiologists, one endocrinologist, one family medicine physician, and two senior nursing practitioners, all of whom had practiced for over 10 years, in order to ensure the integrity, suitability, and diction of questionnaires. They conducted a content validity test, in which the content validity index was 0.90. The questionnaires were also analyzed for internal reliability using a Cronbach's α coefficient by 10 senior nurses with more than 3 years of working experience at internal medicine wards. The Cronbach's α coefficient was 0.85, indicating good reliability.

Under the guidance of the study nurses who were specially trained by our seven experts, each participants took approximately 30–35 min to complete and provide their medical records, including details about their current medications. Physical examinations included gathering the data of their body height, body weight, WC, and blood pressure. Blood samples were collected after overnight fasting. The biochemical data included levels of fasting glucose, glycated hemoglobin (HbA1C), TG, total cholesterol, HDL-C, low-density lipoprotein cholesterol (LDL-C), C reactive protein (CRP), and insulin resistance were measured by homeostasis model assessment-insulin resistance using an autoanalyzer (Beckman, USA) in the CGMH central laboratory in Keelung.

Data analysis

All data obtained were analyzed using Statistical Package for Social Sciences software, V.21.0 for Windows. Descriptive statistics were computed using demographic, physiologic/biochemical, and HRQoL data. The Kolmogorov-Smirnov test for normality was conducted, because of the huge sample size. We found that the data were normally distributed, analyzed by the *t*-test. To analyze the association between the prevalence rate of MetS and the variables, including demographic, physiologic/biochemical, and HRQoL data, the independent sample Student's t-test and χ^2 test were used. A logistic regression model was used to perform a multivariate analysis to assess the association between the prevalence rate of MetS and the variables, including demographic characteristics and HRQoL data. A multivariate linear regression model was fit to estimate the association between two domains of HRQoL (PCS and MCS) and sociodemographic variables in the participants with MetS.

RESULTS

Demographic features of MetS

Table 1 shows the different demographic characteristics among participants with and without MetS. Among the participants, the prevalence of MetS was 32.8% (850/2,588), and the average age was 55.9±12.6 years. Most participants were women (62.9%) and married (80.5%). More than half of the participants (54.1%) had graduated from senior high school. The mean BMI was 24.9 kg/m^2 (95% CI 15.0 to 51.0), and there was significant BMI differences between genders with 25.6 kg/m^2 (95% CI 16.8 to 39.4) in men and with 24.3 kg/m^2 (95% CI 15.2 to 40.0) in women. As compared with non-MetS, a greater proportion of participants with MetS were found in the following subgroups: male gender (40.2% vs 35.5%, p=0.022), age ≥65 years (32.9% vs 18.2%, p<0.001), BMI >24 kg/m2 (85.3% vs 41.7%, p<0.001), lower educational level (81.8% vs 72.1% at below college level, p<0.001), lower self-perceived health status (55.6% vs 48.0%, p<0.001), non-self household income (45.6% vs 38.5%, p=0.002), unemployed status (21.3% vs 19.0%, p=0.014), more smoking exposure (28.0% vs 23.8%, p=0.024), and betel nut usage (9.4% vs 6.4%, p=0.007).

MetS clinical features of participants

Participants with MetS demonstrated significantly higher values of body weight (70.3±12.4 kg vs 60.0±10.2 kg), WC (89.0±8.5 cm vs 77.8±7.4 cm), BMI (27.7±3.6 kg/m^2 vs 23.6±3.0 kg/m^2), systolic blood pressure (139.6±16.3 mm Hg vs 125.8±17.1 mm Hg), diastolic blood pressure (82.7±10.7 mm Hg vs 75.9±10.4 mm Hg), fasting glucose levels (118.3±35.8 mg/dL vs 96.2±15.2 mg/dL), HbA1C level (6.3%±1.1% vs 5.6%±0.9%), total cholesterol level (212.5±53.9 mg/dL vs 204.8±36. 8 mg/dL), TG level

Table 3 Logistic regression analysis of risk factors for metabolic syndrome among the 2588 participants in the entire study

Variables	OR	95% CI	P*
Age (ref: <65 years)	1.987	1.555 to 2.539	<0.001*
Gender (ref: female)	0.941	0.720 to 1.229	0.653
BMI (ref: <24 kg/m^2)	7.958	6.394 to 9.905	<0.001*
Educational attainment (ref: college and above)			
≤9 years (junior high school)	1.429	1.076 to 1.879	0.014*
9–12 years (senior high school)	1.234	0.935 to 1.629	0.138
Self-perceived health status (ref: good)	1.315	1.068 to 1.620	0.010*
Source of household income (ref: self)			
Relatives	1.149	0.906 to 1.456	0.251
Government	0.932	0.630 to 1.381	0.726
Occupation (ref: none†)			
Farmer/fisherman/livestock	1.259	0.803 to 1.974	0.316
Laborer	1.494	0.887 to 2.516	0.131
Government employee	1.271	0.787 to 2.054	0.327
Services	1.191	0.765 to 1.856	0.439
Smoking (ref: no)	1.102	0.844 to 1.438	0.474
Betel quid use (ref: no)	1.457	1.003 to 2.118	0.048*
MCS‡	0.988	0.974 to 1.002	0.102
PCS§	1.009	0.998 to 1.021	0.102

*P value <0.05.
†None included housewives.
BMI, body mass index; MCS, mental component summary; PCS, physical component summary.

Table 4 Multivariate associations between physical component summary (PCS) and mental component summary (MCS) among the 850 participants with MetS

Variable	Coefficient	95% CI	P*
PCS			
Sex (ref: female)	0.436	−1.023 to 1.895	0.557
Age (ref: <65 years)	−2.762	−3.913 to 1.611	0.000*
BMI (ref: <24 kg/m^2)	0.162	−1.359 to 1.683	0.835
Self-perceived health status (ref: good)	−4.518	−5.490 to 3.545	0.000*
Educational attainment (ref: college and above)			
≤9 years (junior high school)	−2.036	−3.608 to 0.463	0.011*
9–12 years (senior high school)	−1.387	−2.931 to 0.157	0.078
Source of household income (ref: self)			
Relatives	−0.235	−1.437 to 0.968	0.702
Government	0.411	−1.501 to 2.322	0.673
Occupation (ref: none*)			
Farmer/fisherman/livestock	−2.191	−4.507 to 0.125	0.064
Worker	−0.715	−2.312 to 0.883	0.38
Government employee	−1.336	−3.403 to 0.731	0.205
Services	−0.001	−1.392 to 1.39	0.999
Betel nut use (ref: no)	0.723	−1.142 to 2.587	0.447
Smoking (ref: no)	0.391	−0.993 to 1.774	0.580
Abdominal obesity (ref: no)	−1.734	−3.027 to 0.44	0.009*
Hypertension (ref: no)	−1.46	−2.972 to 0.053	0.059
Impaired glucose tolerance (ref: no)	−0.252	−1.517 to 1.012	0.695
High TG level (ref: no)	−0.476	−1.588 to 0.636	0.401
Low HDL-C level (ref: no)	−0.8	−1.850 to 0.250	0.135
MCS			
Sex (ref: female)	2.509	0.723 to 4.295	0.006*
Age (ref: <65 years)	2.168	0.759 to 3.577	0.003*
BMI (ref: <24 kg/m^2)	−0.145	−2.007 to 1.716	0.878
Self-perceived health status (ref: good)	−4.409	−5.599 to 3.118	0.000*
Educational attainment (ref: college and above)			
<9 years (junior high school)	−2.361	−0.436 to 4.285	0.016*
9–12 years (senior high school)	0.859	−1.031 to 2.749	0.372
Source of household income (ref: self)			
Relatives	−1.979	−3.451 to 0.057	0.008*
Government	−1.362	−3.702 to 0.978	0.254
Occupation (ref: none†)			
Farmer/fisherman/livestock	−1.249	−4.083 to 1.586	0.388
Worker	−1.186	−3.142 to 0.770	0.234
Government employee	−0.237	−2.767 to 2.294	0.854
Services	−0.044	−1.747 to 1.659	0.960
Betel nut use (ref: no)	0.141	−2.141 to 2.424	0.903
Smoking (ref: no)	−2.225	−3.918 to 0.531	0.010*
Abdominal obesity (ref: no)	1.430	−0.154 to 3.014	0.077
Hypertension (ref: no)	−1.988	−0.137 to 3.839	0.035*
Impaired glucose tolerance (ref: no)	−0.330	−1.878 to 1.218	0.676

Continued

Table 4 Continued

Variable	Coefficient	95% CI	P*
High TG level (ref: no)	−1.178	−2.539 to 0.183	0.090
Low HDL-C level (ref: no)	−0.674	−1.959 to 0.611	0.303

*P value <0.05.
†None included housewives.
BMI, body mass index; HDL-C, high-density lipoprotein cholesterol; TG, triglyceride.

(192.8±107.7 mg/dL vs 98.1±35.4 mg/dL), LDL-C level (127.7±30.9 mg/dL vs 120.0±28.6 mg/dL), CRP level (2.9±0.4 mg/dL vs 1.8±0.2 mg/dL), insulin resistance level (11.8±3.7 mU/L vs 6.6±1.5 mU/L) and lower values of HDL-C level (48.62±10. 9 mg/dL vs 60.3±13.1 mg/dL) than those without MetS (all p<0.001). We further compared HRQoL of participants between with and without MetS group (table 2).

QoL-related factors in patients with and without MetS

The participants in the MetS group reported lower scores on PF, RP, BP, GH, and PCS, but higher scores on SF, MH, and MCS. There was no score difference between the two groups in VT and RE. The multivariate analysis using logistic regression model revealed that age ≥65 years (OR=1.987), BMI ≥24 kg/m^2 (OR=7.958), low educational level (OR=1.429), bad self-perceived health status (OR=1.315), and betel nut usage (OR=1.457) were correlated with the development of MetS (table 3).

However, HRQoL, including both PCS and MCS domains, failed to show a contribution to the development of MetS (table 3). This finding suggested that PCS and MCS of participants with MetS should be linked with certain risk factors such as sociodemographic variables. The multivariate analysis revealed that PCS scores of participants with MetS were negatively correlated with age ≥65 years, lower self-perceived health status, lower educational level, and abdominal obesity; MCS scores were positively correlated with male gender and age ≥65 years but negatively correlated with lower self-perceived health status, lower educational level, household income from relatives, smoking exposure, and hypertension (table 4).

DISCUSSION

We examined the relationship between MetS and HRQoL in this study and found that MetS was not significantly related with HRQoL using SF-36 questionnaire after the adjustments of confounding factors among Asia adults. Interestingly, the PCS and MCS of HRQoL in the MetS group were associated with gender, age, self-perceived health status, educational attainment, household income, smoking exposure, abdominal obesity, and hypertension. These observations suggested that sociodemographic variables and MetS components that increased the risk of MetS development are correlated with HRQoL. Accumulative evidence has shown marked association between MetS and the worsening of HRQoL, but a growing body of studies including the current one have failed to show this association (table 5).

This discrepant observation still exists even though participants with the same ethnicity and geographic distribution were studied.[10 14 17 18] The following evidence can explain this discrepancy. First, impaired HRQoL may be attributed to obesity and different patterns of MetS components, not MetS itself, thus representing some degrees of cumulative contributions from the individual components. Tsai's group studied obese participants with a BMI of 30–50 kg/m^2 in a randomized weight reduction trial and found that impaired HRQoL was associated with high BMI rather than MetS since obese participants suffer more psychiatric disorders and may be disadvantaged in education, employment, and healthcare related to MetS.[14 15 27] Two studies from the Korean population found that abdominal obesity and dyslipidemia were associated with impaired HRQoL after adjusting the sociodemographic variables, medical comorbidity, and obesity.[6 13] In accordance with Jahangiry's study,[28] our observation that abdominal obesity and hypertension affected HRQoL in participants with MetS further supports the close association between individual MetS component and HRQoL. Second, various validated tools to quantify the influence of HRQoL were applied. HRQoL can be assessed using generic or disease-specific measurements. Generic measurements can be applied to any health problems by assessing multiple domains of functioning; in contrast, disease-specific measurements are designed to identify specific health problem-related quality of life. Disease-specific measurements tend to be more sensitive than the generic ones.[29] There is no disease-specific quality of life questionnaire for MetS, so generic instruments such as SF-36 questionnaire, which has been the most frequently used questionnaire, offer the only viable option at present.[7] Because those various generic measurements focus on different aspects of quality of life, the inconsistent results were expected to be observed among studies. Furthermore, some ethnicities may be more reserved in reporting physical and mental health complaints even though the study enrolled participants with same ethnicity. It is inherently inevitable to produce measurement errors, especially in the assessment of psychiatric symptoms.[4 6] Lastly, appropriate treatment, convenient medical approach, lifestyle promotion intervention, and effective health-related education improved MetS control and HRQoL scores.[4 7] These studies were not certain about the programs and treatments that the

Table 5 Studies reporting the relation between MetS and health-related quality of life (HRQoL) using SF-36 questionnaire

Author/year	Number	Ethnicity/setting	Design	Comment
Scholtz *et al* 2007[27]	1212	Elder American men and women	Cross-sectional	Insulin resistance is associated with poor HRQoL in physical health but not in mental health.
Tsai *et al* 2008[14]	361	American obese men and women	Randomized control trial	Participants with MetS had lower HRQoL, especially at lower scores in PCS.
Firsman *et al* 2009[28]	1007	Swedish men and women	Cross-sectional	MetS associated with lower score of SF-36 in women.
Huang *et al* 2010[17]	140	Taiwanese men and women	Cross-sectional	MetS not associated with HRQoL.
Liu *et al* 2010[29]	11	Australian men and women	Prospective	Tai Chi and Qigong improved HRQoL of participants with MetS.
Oh *et al* 2010[30]	52	Korean men and women	Randomized control trial	Participants with lifestyle intervention resulted in a greater decrease in MetS than those with no intervention.
Zhang *et al* 2010[10]	1785	American men and women with coronary artery disease	Retrospective	Patients with MetS had lower score of SF-36.
Amiri *et al* 2010[31]	950	Iranian men and women	Cross-sectional	MetS associated with poor HRQoL in women.
Hjellset *et al* 2010[32]	198	Pakistani immigrant women in Norway	Cross-sectional	Women with MetS had lower scores in PCS than women without MetS.
Vetter *et al* 2011[15]	390	American obese men and women with at least one additional criteria for MetS	Cross-sectional	MetS not associated with HRQoL.
Katano *et al* 2012[18]	4480	Japanese men and women	Cross-sectional	MetS associated with poor HRQoL in men and women.
Tziallas *et al* 2012[5]	359	Greek men and women	Cross-sectional	MetS associated with lower scores in PCS and MCS of HRQoL.
Amiri *et al* 2014[33]	630	Iranian women	Cross-sectional	MetS is associated with poor HRQoL in reproductive age but not in postmenopausal women and the association mainly related to physical rather than mental health.
Amiri *et al* 2015[34]	950	Iranian men and women	Cross-sectional	MetS associated with poor PCS in women. Age and smoking are the most important sociodemographic factors affecting the gender-specific association in the MCS.
Jahangiry *et al* 2016[35]	317	Iranian men and women	Cross-sectional	People with MetS experienced lower HRQoL than without MetS. High BP and abdominal obesity are associated with lower HRQoL in participants with MetS.
Donini *et al* 2016[36]	253	Italian men and women	Cross-sectional	MetS not associated with HRQoL.
Hatami *et al* 2016[20]	946	Iranian men and women	Cross-sectional	MetS associated with poor PCS of HRQoL in women but not men.
Amiri *et al* 2018[37]	950	Iranian men and women	Cross-sectional	The association between MetS and HRQoL followed a sex-specific pattern, mainly significant only in women and in the physical aspect.
The current study	2588	Taiwanese men and women	Cross-sectional	MetS not associated with HRQoL. Hypertension and abdominal obesity are associated with lower HRQoL in participants with MetS.

BP, bodily pain; MCS, mental component summary ; MetS, metabolic syndrome; PCS, physical component summary; SF-36, 36-Item Short-Form Health Survey.

participants may have been exposed to previously, potentially through the local medical service or exposure to government media health promotion campaigns. Taken together, it is necessary to conduct further longitudinal studies using MetS-specific questionnaire to confirm this relationship and verify whether this relationship is linear or only a correlation factor.

The current study must be interpreted in the light of certain limitations, namely, cross-sectional studies do not allow causal relationship inferences underlying the observed associations to be drawn and reverse causation may have played a role in our results. Furthermore, the current study only allowed the calculation of summary scales (two domains: PCS and MCS), but it did not allow the calculation of individual subscales (eight dimensions). Thus, the difference between the MetS and non-MetS groups may have been present in the subscales that were not detected. We replaced eight individual subscales to two summary scales and performed multivariate analysis using logistic regression model again. We found that PF (OR=1.389, p=0.039) and MH (OR=1.412, p=0.042) were able to contribute to MetS development independently. Furthermore, it should be more informative if we could compare our results using NCEP-ATP III to the findings according to IDF (International Diabetes Federation) criteria. However, Chen and Pan[30] conducted a study with 2608 adults in Taiwan, who had the completed data for five MetS defining components, and found that the IDF definition failed to identify a portion of people who had more than three MetS component disorder. Chen and Tsai's[31] study also found that NCEP-ATPIII rated greater proportions of subjects with aged 54–91 as having MetS than IDF. Our data showed 29.8% of subjects with more than three MetS component disorder and 23.0% of subjects who are aged over 65 years. Therefore, we preferred using NCEP-ATP III to define MetS in this study. Our results were obtained in the community population who were actively seeking medical counseling and health guidance, thus their external validity in the general population and different settings requires determination. Integrate public health and primary care is important to accelerating progress in preventing obesity. Further research and development are needed to expand the role of social networking services in obesity and overweight care. Finally, we were unable to include the medications that participants took as a covariable since treatment of MetS following evidence-based practice was shown to improve HRQoL in patients with MetS.[9]

CONCLUSIONS

This study showed no correlation between MetS and impaired HRQoL among Taiwanese adults aged ≥30 years, using SF-36 questionnaire. Instead, old age, high BMI, low educational level, bad self-perceived health status and betel nut usage are associated with the prevalence of MetS. For participants with MetS, their physical health was correlated with abdominal obesity, and their mental health was correlated with hypertension. Larger and longitudinal studies that use MetS-specific questionnaire, along with important covariates described previously, are warranted to confirm our observations in this study.

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ORCID iD

Kun-Yun Yeh http://orcid.org/0000-0002-6995-860X

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