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Risk assessment of metabolic syndrome prevalence involving sedentary occupations and socioeconomic status

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ABSTRACT

Objectives To determine whether occupation type, distinguished by socioeconomic status (SES) and sedentary status, is associated with metabolic syndrome (MetS) risk.

Methods We analysed two data sets covering 73 506 individuals. MetS was identified according to the criteria of the modified Adult Treatment Panel III. Eight occupational categories were considered: professionals, technical workers, managers, salespeople, service staff, administrative staff, manual labourers and taxi drivers; occupations were grouped into non-sedentary; sedentary, high-SES; and sedentary, non-high-SES occupations. A multiple logistic regression was used to determine significant risk factors for MetS in three age-stratified subgroups. R software for Windows (V.3.5.1) was used for all statistical analyses.

Results MetS prevalence increased with age. Among participants aged ≤40 years, where MetS prevalence was low at 6.23%, having a non-sedentary occupation reduced MetS risk (OR=0.88, p<0.0295). Among participants aged >60 years, having a sedentary, high-SES occupation significantly increased (OR=1.39, p<0.0247) MetS risk.

Conclusions The influence of occupation type on MetS risk differs among age groups. Non-sedentary occupations and sedentary, high-SES occupations decrease and increase MetS risk, respectively, among younger and older adults, respectively. Authorities should focus on individuals in sedentary, high-SES occupations.

Strengths and limitations of this study

- We are the first to analyse the effects of a sedentary occupation and socioeconomic status (SES) on metabolic syndrome (MetS).
- Two large data sets, covering 64 578 individuals, were employed.
- Occupations were segmented into the following categories: non-sedentary, sedentary and associated with high SES, and sedentary and not associated with high SES.
- A χ^2 test was used for the categorical variables of age (in terms of three age groups) and type of occupation; a multiple logistic regression was used to determine significant factors for MetS risk.
- The study's findings may not be applicable outside Taiwan.

INTRODUCTION

Metabolic syndrome (MetS) is a public health concern in many countries, particularly those in the West. In the USA, 34% of the population has MetS, according to criteria formulated in the National Cholesterol Education Programme Adult Treatment Panel (ATP) III; in particular, US adults older than 60 years of age are more prone to having MetS.[1] The health status of the Taiwanese population was estimated in 2002 using the data of 7566 participants in a nationwide cross-sectional population-based survey: the Taiwanese Survey on Prevalence of Hyperglycemia, Hyperlipidemia, and Hypertension. Hwang *et al*[2] reported that the prevalence of MetS in women increases rapidly after menopause to a level higher than that in their male counterparts; they also noted MetS' high correlations with age and overweight and obesity. MetS is also a public health problem in other Asian countries, and studies on MetS have been conducted in Thailand,[3] Malaysia,[4] South Korea,[5] and Japan[6] as well as Taiwan.[2 7 8]

MetS is highly correlated with overweight and obesity,[2 9] and it comprises a constellation of inter-related metabolic disorders—including hypertension,[10] type 2 diabetes mellitus (T2DM),[11–13] cardiovascular disease (CVD)[13 14] and stroke.[15] In addition, having MetS increases the risk of having diabetes by fivefold.[16] Studies have overwhelmingly indicated that individuals with MetS or a sedentary occupation have an increased risk of T2DM and coronary heart disease and increased mortality due to CVD.[11–14 17] A study also reported that reduced muscular strength is associated with increased risk of CVD and CVD-related mortality.[18]

The causes for MetS should thus be investigated. The risk factors for MetS include ageing, a sedentary lifestyle, long working hours, physical inactivity, a Western diet, sleep duration greater than 7 hours[19] and high occupational stress.[20] Socioeconomic

status (SES) and lifestyle are the possible risk factors for MetS.[21 22] Among these factors, prolonged sitting is notable because it affects people of all ages and is becoming increasingly common because of the rapid automation of the workplace.[23 24] Scholars have recently investigated the relationship of a sedentary occupation with MetS or CVD risk.[9 25–30]

Bakrania *et al*[26] demonstrated that sedentary behaviour affects not only physical but also cognitive health. Leischik *et al*[31] compared the health of 97 firefighters, 55 police officers and 46 sedentary office workers in Germany, and they reported that having a sedentary occupation increased the likelihood of being obese and having MetS in their middle-aged sample . Another study on workers in a petroleum company reported that a sedentary lifestyle—specifically, being sedentary for 10 hours/day with two-thirds of those 10 hours spent sitting at work—was significantly associated with cardiometabolic risk factors.[32] An individual having a sedentary occupation is substantially more likely to be obese. Strauß *et al*[9] reported that office workers had a significantly greater abdominal waist circumference (WC) than did firefighters and that 33% of sedentary German office workers had MetS. In a subsequent study, Strauss *et al*[33] evaluated the 10-year cardiovascular risk of 46 office workers in Germany using the Framingham Score and observed that office workers had a higher risk of CVD and MetS.

However, the association of MetS risk with not only occupation type but also SES must be determined.[22 32 34 35] SES is a concept encompassing salary, social status and education and can be indicated by an individual's occupation.[36] Al-Thani *et al*[34] and Mehrdad *et al*[22] reported that occupation type and seniority in a company, respectively, are not significantly associated with MetS risk. Therefore, this study conducted in Taiwan focused on the relationship of type of occupation with MetS prevalence as well as with the biochemical indexes of related chronic diseases. Specifically, this study focused on sedentary occupations and occupations associated with different SESs.

Finally, although numerous studies have analysed several occupations or SESs in relation to MetS risk,[22 32 34 35] this study is the first to focus on occupations that are sedentary or associated with a high SES . Occupations were segmented into (1) Non-sedentary, (2) Sedentary and associated with high SES (sedentary, high-SES), and (3) Sedentary and not associated with high SES (sedentary, non-high-SES) occupations. We hypothesised that sedentary, high-SES occupations differ from sedentary, non-high-SES occupations in the magnitude of their positive correlation with MetS prevalence and that both types of occupations are associated with increased MetS risk.

METHODS

Definition of a sedentary occupation and SES

According to the US Department of Labour's Dictionary of Occupational Titles, sedentary work is the occasional exertion of 4.54 kilograms of force and/or a frequent exertion of a negligible amount of force. In this definition, 'occasional' and 'frequent' are defined as being present less than a third and a third to two-thirds of the time, respectively. Such force can be used to lift, carry, push, pull or move objects—including the human body. Sedentary work involves sitting most of the time, but it may involve walking or standing for brief periods (https://www.thehortongroup.com/resources/the-strength-test-levels). Thus, a job was defined to be sedentary if walking and standing are required only occasionally, and all other sedentary criteria are met.[37] In this study, we selected taxi drivers, clerical jobs and administrative jobs as representative of sedentary, non-high-SES occupations.

Table 1 Occupations belonging to the professional, technical and managerial categories

Occupations	
Professional-1	Lawyers, teachers, accountants and nurses
Technical-2	Engineers, architects and programmers
Managerial-3	Senior executives of government departments or section chiefs of enterprises

We focused on eight types of workers : professionals, technical workers, managers, salespeople, service staff, administrative staff, manual labourers and taxi drivers. Table 1 presents the occupations in the professional, technical and managerial categories. Jans *et al*[38] reported that occupations in the Netherlands differed with respect to the time a worker spends sitting. We put the occupation categories into three groups: general sedentary-related (Group-I), non-sedentary (Group-II) and sedentary-related and high-SES (Group-III), based on occupational environment and SES of occupations. The arrangement of the eight works is illustrated in table 2.

Definition of MetS

MetS was defined in this study according to guidelines from the Health Promotion Administration of Taiwan's Ministry of Health and Welfare. MetS' prevalence was evaluated using the definitions of the modified ATP III and the MetS criteria for Taiwanese people. Five major factors were used to determine whether a person had MetS: WC, high blood pressure, fasting blood sugar (BS), triglyceride (TG) level and high-density lipoprotein

Table 2 Sedentary versus non-sedentary and high-SES versus non-high-SES occupations

Group number	Type	Categories
Group-I	General sedentary-related	Service-5, clerical and administrative-6 and taxi driver-8
Group-II	Non-sedentary-related	Sales-4 and manual labour-7
Group-III	Sedentary-related and high-SES	Professional-1, technical-2 and managerial-3

SES, socioeconomic status.

Table 3 MetS criteria

No.	Factors	Abnormal condition
1	Fasting plasma glucose (FPG)	FPG ≥100 mg/dL
2	High-density lipoprotein cholesterol (HDL-C)	Male <40 mg/dL or female <50 mg/dL
3	High blood pressure	SBP ≥130 mm Hg or DBP ≥85 mm Hg
4	Triglyceride (TG)	TG ≥150 mg/dL
5	Waist circumference (WC)	Male ≥90 cm or female ≥80 cm

DBP, diastolic blood pressure; MetS, metabolic syndrome; SBP, systolic blood pressure.

cholesterol (HDL-C) level. High blood pressure was determined in terms of systolic blood pressure (SBP) and diastolic blood pressure (DBP). A Taiwanese person is defined as having MetS if they have three or more of the following five conditions in ATP III: abdominal obesity, high TG, low HDL-C, hypertension and hyperglycaemia; table 3 presents the criteria for defining MetS.

Data resource and data collection

We obtained two data sets from the New Taipei City Government Annual Taxi Health Examination Survey and from the MJ Health Check-Up-Based Population Database (MJPD). The data in the first data set covered the 2012–2016 period and were collected by Far Eastern Memorial Hospital (FEMH) (FEMH is one of the only hospitals that mainly undertakes the annual health check-up of taxi drivers in New Taipei City, and it is also the hospital with the most significant number of services and the largest hospital in New Taipei City). This data set shall be termed 'the FEMH data set' in the remaining portion of the paper. The second MJPD data set was collected from four MJ clinics, which provide periodic health examinations to their members; this data set is accessible to any researcher on request (http://www.mjhrf.org/main/page/release1/en/release01).

The data sets were authorised for use in this study and provided to us by the MJPD Health Research Foundation with FEMH Institutional Review Board approval. The laboratory data of the two databases were obtained from the same biochemical examination apparatus (Hitachi-7600). The two data sets conform to the International Organization for Standardization 15189 guidelines.

Data preprocessing

The data sets were anonymised prior to any processing or analysis. We enrolled 71 212 individuals (41 600 men and 29 612 women) in the MJPD data set after those whose occupation did not fall under our three categories and those with missing data were excluded. We also enrolled 2294 taxi drivers (2182 men and 112 women) from the FEMH database. Thus, the data of 73 506 individuals were subject to analysis.

Because age is a key factor influencing MetS risk, we stratified our sample into ≤40, 40–60, and ≥60-year-old subgroups, which we refer to as the 'younger', 'middle-aged' and 'older' subgroups, respectively. We focused on the effect on MetS risk from occupation—distinguished first by whether the field is sedentary or non-sedentary and second by the occupation's association with SES.

Statistical analysis

Data analysis, including multiple logistic regression with all variables, and data visualisation were conducted in R (V.3.5.1) software. A value of $p<0.05$ indicated a statistically significant difference between two groups. In univariate analysis, a two-sample independent *t* test was used to determine the differences in the mean values of continuous variables between participants with and without

Table 4 MetS characteristics of male participants

	Total		Without (n=31 454)		With (n=12 328)		
Variables	Mean	SD	Mean	SD	Mean	SD	P value
Weight (kg)	72.8	11.3	69.7	9.3	80.9	12.1	<0.001
SBP (mm Hg)	120.6	15	116.8	13	130.3	15.4	<0.001
DBP (mm Hg)	77.4	10.5	74.8	9.2	84	10.6	<0.001
WC (cm)	84.1	8.7	81.2	7.0	91.5	8.3	<0.001
Body fat (%)	24.3	5.5	22.8	4.8	28	5.3	<0.001
FPG (mg/dl)	103.2	18.7	99.5	12.6	112.6	26.8	<0.001
TG (mg/dl)	136.8	103.5	113.6	74.7	196	137.7	<0.001
Cholesterol	197.5	34.2	195.4	33.1	202.8	36.1	<0.001
HDL-C (mg/dl)	52	11.4	54.3	11.3	46	9.3	<0.001
LDL-C (mg/dl)	124.8	32.1	122.9	31.1	129.6	33.9	<0.001
BMI (kg/m^2)	24.8	3.4	23.7	2.7	27.4	3.5	<0.001

BMI, body mass index; DBP, diastolic blood pressure; FPG, fasting plasma glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MetS, metabolic syndrome; SBP, systolic blood pressure; TG, triglyceride ; WC, waist circumference.

Table 5 MetS characteristics of female participants

	Total		Without (n=26 478)		With (n=3246)		
Variables	Mean	SD	Mean	SD	Mean	SD	P value
Weight (kg)	55.78	9.35	54.32	7.76	67.7	12.28	<0.001
SBP (mm Hg)	107.49	14.89	105.48	13.15	123.88	17.81	<0.001
DBP (mm Hg)	68.44	10.06	67.32	9.22	77.65	11.76	<0.001
WC (cm)	71.08	7.91	69.71	6.49	82.22	9.52	<0.001
Body fat (%)	29.03	6.75	27.97	5.83	37.76	7.44	<0.001
FPG (mg/dl)	97.02	14.39	95.04	9.38	113.2	29.78	<0.001
TG (mg/dl)	86.99	58.01	78.01	43.4	160.16	97.19	<0.001
CHOL	190.61	32.57	189.36	31.96	200.81	35.56	<0.001
HDL-C (mg/dl)	65.33	14.78	67.12	14.21	50.8	10.78	<0.001
LDL-C (mg/dl)3	109.23	29.83	107.12	28.84	126.33	32.18	<0.001
BMI (kg/m^2)4	22.03	3.48	21.43	2.83	26.93	4.31	<0.001

BMI, body mass index; DBP, diastolic blood pressure; FPG, fasting plasma glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MetS, metabolic syndrome; SBP, systolic blood pressure; TG, triglyceride ; WC, waist circumference.

MetS. An exact χ^2 test was used to determine the differences in categorical variables between groups.

Patient and public involvement

This is a secondhand deidentified data analysis, and it does not need patient and public direct involvement.

RESULTS

Gender, height, weight, WC, blood pressure, TG level, Cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), SBP, DBP and fasting BS were used as covariates; body mass index (BMI) was also computed from data on height and weight.

Descriptive statistics

Among the 73 506 participants, 57 932 did not have MetS and 15 574 had MetS. The MetS prevalence in this study was thus 21.19%. Tables 4 and 5 present the descriptive statistics of physiological parameters, such as weight, SBP and DBP, for the participants with different sex, respectively. Compared with participants with MetS, participants without MetS were healthier; their weight, SBP, WC, TG level and BMI were lower, and their HDL-C level was higher. All physiological parameters were significantly related to MetS risk (p<0.001).

Tables 6 and 7 detail the age-stratified data of male and female participants, respectively. Among men, the MetS prevalence was 23.01%, 32.83% and 35.92% in

Table 6 MetS characteristics of male participants in age-stratified subgroups

	Age ≤40 years (n=21 410)			40 years < age ≤60 years (n=20 565)			Age >60 years (n=1807)		
	Non-MetS	MetS		Non-MetS	MetS		Non-MetS	MetS	
Variables	Mean (SD)	Mean (SD)	P value	Mean (SD)	Mean (SD)	P value	Mean (SD)	Mean (SD)	P value
Weight (kg)	70.8 (9.7)	85.1 (12.5)	<0.001	68.7 (8.5)	78.6 (11.0)	<0.001	64.9 (8.5)	73.5 (9.6)	<0.001
SBP (mm Hg)	115.9 (11.7)	128.9 (14.7)	<0.001	117.1 (13.7)	130.5 (15.6)	<0.001	125.8 (17.2)	139.2 (16.2)	<0.001
DBP (mm Hg)	73.4 (8.6)	82.4 (10.6)	<0.001	76.1 (9.5)	85.0 (10.5)	<0.001	77.8 (10.5)	85.0 (10.0)	<0.001
WC (cm)	80.8 (7.2)	92.6 (8.6)	<0.001	81.6 (6.7)	90.6 (8.1)	<0.001	83.0 (7.4)	91.5 (8.0)	<0.001
Body fat (%)	23.3 (5.0)	29.6 (5.3)	<0.001	22.3 (4.5)	27.0 (5.0)	<0.001	21.3 (4.8)	25.8 (5.4)	<0.001
FPG (mg/dl)	97.8 (9.3)	108.5 (22.8)	<0.001	101.2 (14.7)	114.6 (27.7)	<0.001	103.3 (21.0)	122.0 (37.6)	<0.001
TG (mg/dl)	109.1 (74.0)	198.9 (148.4)	<0.001	120.1 (77.0)	196.0 (132.2)	<0.001	101.1 (47.2)	173.7 (103.5)	<0.001
CHOL	192.1 (32.8)	203.5 (36.2)	<0.001	199.6 (33.0)	203.1 (36.0)	<0.001	192.0 (34.0)	194.6 (35.3)	<0.001
HDL-C (mg/dl)	54.4 (11.2)	45.4 (8.9)	<0.001	54.2 (11.3)	46.3 (9.5)	<0.001	55.3 (11.8)	46.3 (10.5)	<0.001
LDL-C (mg/dl)	120.6 (31.1)	131.9 (33.9)	<0.001	125.8 (30.9)	128.7 (34.0)	<0.001	120.2 (31.3)	122.0 (32.0)	<0.001
BMI (kg/m^2)	23.7 (2.9)	28.2 (3.7)	<0.001	23.7 (2.5)	27.0 (3.2)	<0.001	23.8 (2.8)	26.6 (3.3)	<0.001

BMI, body mass index; DBP, diastolic blood pressure; FPG, fasting plasma glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MetS, metabolic syndrome; SBP, systolic blood pressure; TG, triglyceride ; WC, waist circumference.

Table 7 MetS characteristics of female participants in age-stratified subgroups

	Age ≤40 years (n=15 972)			40 years < age ≤60 years (n=13 172)			Age >60 years (n=580)		
	Non-MetS	MetS		Non-MetS	MetS		Non- MetS	MetS	
Variables	Mean (SD)	Mean (SD)	P value	Mean (SD)	Mean (SD)	P value	Mean (SD)	Mean (SD)	P value
Weight (kg)	54.06	72.86	<0.001	54.69	65.8	<0.001	63.56	64.47	<0.001
SBP (mm Hg)	103.1	120.02	<0.001	108.2	125.09	<0.001	53.5	61.22	<0.001
DBP (mm Hg)	66.3	76.32	<0.001	68.54	78.43	<0.001	118.69	131.14	<0.001
WC (cm)	68.78	84.36	<0.001	70.85	81.28	<0.001	71.42	76.18	<0.001
Body fat (%)	27.51	40.42	<0.001	28.54	36.7	<0.001	73.05	81.2	<0.001
FPG (mg/dl)	93.45	109.35	<0.001	96.89	114.45	<0.001	29.12	35.18	<0.001
TG (mg/dl)	73.05	149.66	<0.001	84.23	165.27	<0.001	91.55	159.6	<0.001
CHOL	183.75	192.51	<0.001	196.28	203.75	<0.001	207.74	212.53	0.1437
HDL-C (mg/dl)	67.05	49.48	<0.001	67.18	51.13	<0.001	67.84	54.21	<0.001
LDL-C (mg/dl)	102.6	123.23	<0.001	112.66	127.47	<0.001	121.36	129.99	0.0047
BMI (kg/m^2)	21.08	28.26	<0.001	21.87	26.39	<0.001	22.49	25.71	<0.001

BMI, body mass index; DBP, diastolic blood pressure; FPG, fasting plasma glucose; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; MetS, metabolic syndrome; SBP, systolic blood pressure; TG, triglyceride ; WC, waist circumference.

the younger, middle-aged and older subgroups, respectively. Among women, the MetS prevalence was 6.23%, 15.68% and 32.07% for the younger, middle-aged and older subgroups, respectively. These findings are consistent with the finding that MetS prevalence increases with age.[1 15] Furthermore, as noted in tables 6 and 7, most factors (such as weight, SBP, DBP and WC) were significantly related (p<0.001) to MetS prevalence in all age-stratified subgroups, which was identical to the findings for the unstratified sample (tables 4 and 5).

χ^2 exact test and multiple logistic regression analysis

We used a χ^2 test to analyse the relationships that categorical variables had with MetS risk; tables 8 and 9 present the findings for the male and female participants, respectively, (key findings are marked in bold). Age and occupation were significantly associated with MetS risk (p<0.001).

The eight occupational categories were significantly associated with MetS risk (p<0.001), among which taxi driving had the highest MetS prevalence rate (33.41% and 60.71% among men and women, respectively). As an aside, the female taxi drivers in our study were underrepresented in this occupation (at only 44 individuals) and had a much higher MetS prevalence than either the average woman or man (28.16% and 10.92%, respectively) in our overall sample. Furthermore, managers and salespeople had the second-highest and third-highest MetS prevalence at 32.52% and 29.53%, respectively. Among female participants, manual labourers and managers had

Table 8 χ^2 test results of differences in categorical variables between ages and between occupations among men

		Non-MetS		MetS		
Variables	Item	n	%	n	%	P value
Age (years)	Age ≤40	16 483	76.99	4927	23.01	
	40< age ≤60	13 813	67.17	6752	32.83	<0.001
	Age >60	1158	64.08	649	35.92	
Occupation	Professional-1	1936	74.18	674	25.82	
	Technical-2	12 603	74.5	4314	25.5	
	Managerial-3	5704	67.48	2749	32.52	
	Sales-4	4516	70.47	1892	29.53	<0.001
	Service-5	1557	71.32	626	28.68	
	Clerical and administrative-6	1558	73.94	549	26.06	
	Manual labor-7	2127	72.79	795	27.21	
	Taxi driver-8	1453	66.59	729	33.41	

MetS, metabolic syndrome.

Table 9 χ^2 test results of differences in categorical variables between ages and between occupations among women

Variables	Item	Non-MetS		MetS		P value
		N	%	n	%	
Age (years)	Age ≤40	14 977	93.77	995	6.23	<0.001
	40< age ≤60	11 107	84.32	2065	15.68	
	Age >60	394	67.93	186	32.07	
Occupation	Professional-1	3410	91.23	328	8.77	<0.001
	Technical-2	2313	91.06	227	8.94	
	Managerial-3	2809	87.59	398	12.41	
	Occupation	4738	89.87	534	10.13	
	Service-5	2655	88.15	357	11.85	
	Clerical and administrative-6	9334	89.81	1059	10.19	
	Manual labor-7	1175	81.03	275	18.97	
	Taxi driver-8	44	39.29	68	60.71	

MetS, metabolic syndrome.

the second-highest and the third-highest MetS prevalence at 18.97% and 12.41%, respectively.

We analysed the associations between the major factors of the three age groups in a multiple logistic regression model in tables 10–12. BMI (%), body weight (kg), body fat percentage (%) and total cholesterol (mg/dL) were seen to be the important risk factors for MetS (p<0.01 or even p<0.001). There are significant differences in gender between the young and middle-aged groups. That is, men run a higher risk of having MetS. However, there is no difference between the male and female genders when age >60 years.

Tables 10–12 present the multiple logistic regression results for the three age-stratified subgroups, respectively. BMI (%), body weight (kg), body fat percentage (%) and total cholesterol (mg/dL) were revealed to be the most significant risk factors for MetS (p<0.01 or p<0.001). Men were significantly more likely to have MetS than women in only the young and middle-aged subgroups.

With regard to the three occupational groups (table 10), in the younger subgroup, individuals with a non-sedentary occupation were less likely to have MetS (OR=0.88, 95% CI 0.78 to 0.99, p=0.0295) than those in other occupations. The three occupational groups did not differ with respect to MetS prevalence in the middle-aged group. In the older subgroup, MetS prevalence was higher among individuals in sedentary, high-SES occupations (OR=1.39, CI 1.04 to 1.85, p=0.0247) than among individuals in other occupations and higher among men than women. Men and women were not significantly different with respect to MetS prevalence.

DISCUSSION

Owen *et al*[24] reported that the average person spends (1) 71% of their daily waking hours in an inactive state and (2) Only 30 min daily on moderate-intensity physical activity on most days of a week. As noted in the literature review in the Introduction

Table 10 Multiple logistic regression results for factors associated with MetS risk among participants aged ≤40 years

Variables	Condition	OR	95% CI	P value
Occupation	Group-I*	1.00		
	Group-II†	0.88	0.78 to 0.99	0.0295
	Group-III‡	1.03	0.95 to 1.12	0.4825
Gender	Male	1.00		
	Female	0.43	0.37 to 0.51	<0.001
Weight (kg)		1.04	1.03 to 1.05	<0.001
BMI		1.26	1.22 to 1.29	<0.001
Body fat percentage (%)		1.07	1.06 to 1.08	<0.001
LDL-C (mg/dl)		1.00	1.00 to 1.01	0.0012
Total cholesterol (mg/dl)		1.00	1.00 to 1.00	0.0406

*Group-I: general sedentary-related occupations.
†Group-II: non sedentary-related occupations.
‡Group-III: sedentary-related occupations with high socioeconomic status.
BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; MetS, metabolic syndrome.

Table 11 Multiple logistic regression results for factors associated with MetS risk among participants aged 40–60 years

Variables	Condition	OR	95% CI	P value
Occupation	Group-I	1.00		
	Group-II	1.01	0.93 to 1.10	0.817
	Group-III	0.98	0.91 to 1.05	0.5618
Gender	Male	1.00		
	Female	0.46	0.4 to 0.52	<0.001
Weight (kg)		1.03	1.02 to 1.03	<0.001
BMI		1.30	1.27 to 1.33	<0.001
Body fat percentage (%)		1.07	1.06 to 1.08	<0.001
LDL-C (mg/dl)		1.00	1.00 to 1.00	0.2922
Total cholesterol (mg/dl)		1.00	1.00 to 1.00	<0.001

BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; MetS, metabolic syndrome.

section, leading a sedentary lifestyle significantly increases the risk of MetS.[24 39 40] A sedentary lifestyle also increases the risk of obesity,[9] poor cardiometabolic health[17 32] and poor cognitive health.[26] An increasing number of researchers have begun to investigate the correlation between a sedentary occupation and MetS or CVD risk.[9 25–27 29 30]

However, most MetS risk factors have centred on a lack of physical activity rather than on a sedentary occupation.[41 42] Studies have also demonstrated that lifestyle and SES are significant risk factors for MetS[21 22] and CVD.[21 43 44] However, Kim *et al*[45] argued that a causal relationship between SES and MetS and CVD risk, as indicated by the Framingham Risk Score, cannot be inferred from the current body of cross-sectional evidence. Furthermore, scholars have yet to investigate the role of occupation in MetS risk, let alone in a fine-grained manner with occupation further distinguished by level of physical activity and association with SES. In particular, MetS risk is likely to differ between those working in typically sedentary, white-collar occupations (such as doctors, professors, managers and engineers) and those working in sedentary blue-collar occupations (such as administrative staff, service staff and taxi drivers).

Our findings indicate that age and occupation are significant MetS risk factors among men and women (tables 8 and 9, respectively). Managers and taxi drivers, regardless of gender, were more likely to have MetS than those in other occupations. Notably, salesmen, despite having a relatively physically active job, had the third-highest (and still high) MetS prevalence rate. The reasons for this finding should be investigated in future research. Furthermore, MetS prevalence was low among women younger than 60 years (tables 8 and 9) but high (at 32.07%, similar to that of their male counterparts) among women older than 60 years. This is attributable to a decrease in oestrogen levels after menopause.[46]

Due to the age group influencing the highest prevalence of MetS, this study compared the three occupation categories under different age groups. In table 10, we found the non-sedentary occupation group had less chance of having MetS. In table 11, there is no difference among the three occupational groups which implies occupational effects might not

Table 12 Multiple logistic regression results for factors associated with MetS risk among participants aged >60 years

Variables	Condition	OR	95% CI	P value
Occupation	Group-I	1.00		
	Group-II	1.16	0.89 to 1.53	0.2708
	Group-III	1.39	1.04 to 1.85	0.0247
Gender	Male	1.00		
	Female	0.99	0.65 to 1.5	0.9657
Weight (kg)		1.06	1.04 to 1.08	<0.001
BMI		1.10	1.03 to 1.18	0.0059
Body fat percentage (%)		1.08	1.05 to 1.11	<0.001
LDL-C (mg/dl)		1.00	0.99 to 1	0.1646
Total cholesterol (mg/dl)		1.00	1.00 to 1.01	0.19

BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; MetS, metabolic syndrome.

be the key factor for MetS. However, high-SES-associated occupations of the older age group are at a higher risk of MetS than general sedentary and non-sedentary occupations shown in table 12. Hence, the people who belong this sedentary and high-SES occupations should avoid prolonged sitting all day long. In addition, there is no difference between men and women because MetS was more prevalent among postmenopausal female.[46]

Individuals in a non-sedentary occupation were less likely to have MetS (table 10). The three occupational groups did not differ with respect to MetS prevalence (table 11), which implies that occupation is not a key factor for MetS. However, among participants in the older subgroup, having a sedentary, high-SES occupation was associated with a higher risk of MetS (table 12). Thus, individuals in sedentary, high-SES occupations should avoid prolonged sitting.[46]

CONCLUSIONS

Although prolonged sitting is a seemingly novel risk factor for health outcomes across all ages, its association must be determined under occupational conditions.[32] Our findings indicate that age and occupation type are risk factors for MetS. We found that lawyers, teachers, accountants, doctors, nurses, engineers, managers and taxi drivers constitute high-risk groups for MetS. For individuals 40 years old, having a non-sedentary occupation lowers the risk of MetS. For individuals >60 years old, having a sedentary, high-SES occupation significantly increases the risk of MetS. Government authorities should focus on sedentary, high-SES workers by tailoring health promotion programmes—involving, for example, aerobic exercise[47] or physical activity[28 48]—for this group of workers.

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