Metabolic syndrome associated with habitual indulgence and dietary behavior in middle-aged health-care professionals

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ABSTRACT

Aims/Introduction: Few studies, especially in Asia, have examined the relevance between metabolic syndrome (MetS), habitual indulgence and dietary behaviors in health-care professionals. The present study evaluates metabolic syndrome rate and its association with habitual indulgence (coffee, tea, alcohol and cigarette smoking) and diet behavior in health-care professionals.

Materials and Methods: Information was collected from 514 health-care professionals (147 men, 367 women) who underwent routine physical examinations at a medical center in central Taiwan.

Results: Mean age was 48 ± 5 years for men and 45 ± 4 years for women. Mean body mass index was 25.2 ± 4.0 kg/m^2 for men and 22.5 ± 3.4 kg/m^2 for women. The age-adjusted MetS rate among subjects was 24.8–11.7% in men and 7.8–5.4% in women, using two different definitions, respectively. The MetS rate among those who occasionally or frequently consumed tea was higher than among those who never consumed tea ($P < 0.05$). Although the proportion of subjects who had MetS differed among those with differing alcohol drinking habits (never, quit and current; $P < 0.05$), a posteriori comparisons showed no significant differences between the two groups. Compared with those who had never smoked, the rate was higher in former smokers and current smokers ($P < 0.001$). No significant association with coffee consumption was found. People with MetS often consumed sweetened beverages ($P < 0.05$), rarely read nutrition labels and seldom consumed dairy products.

Conclusions: Health-care professionals who regularly consume tea, smoke, frequently have sweetened drinks, rarely read nutrition labels or rarely consume dairy products are at higher risk of suffering from MetS. (J Diabetes Invest, doi: 10.1111/j.2040-1124.2010.00055.x, 2010)

KEY WORDS: Health-care professionals, Habitual indulgence, Metabolic syndrome

INTRODUCTION

The prevalence of metabolic syndrome (MetS) worldwide has soared and leads to subsequent cardiovascular diseases[1]. Health-care professionals are not exempt from this trend. Recently, the health status of health-care professionals has drawn great attention, because they are exposed to specific hazards, such as the hospital environment, stress, anxiety and possibly depression[2]. In addition, work stress has been reported to be linked to cardiovascular disease (CVD)[3,4], which, together with some habitual indulgences (coffee or tea consumption, alcohol drinking, smoking), might impose health problems on health-care professionals[5–8]. As a matter of fact, habitual indulgence and inappropriate dietary behavior affects the development of MetS[9–15]. Previous studies have pointed out that coffee, but not tea, consumption might protect against MetS[9]. However, other clinical studies reported that tea consumption might improve or prevent the abnormal components of MetS[10–12]. A study by Djoussé *et al.*[13] noted that alcohol and MetS have a U-shaped association among men and a dose-response association among women. Both excessive daily smoking and a long history of smoking increased the risk of MetS, and quitting only partially improved it[14,15]. None of the aforementioned studies included health-care professionals as study subjects.

Although the health of health-care professionals is a hospital's most valuable asset, identifying their health impairment is often difficult, because professionals might suppress and deny any suggestions of a problem, and impairment might not be an all-or-none phenomenon[16]. Hence, the purpose of the present study was: (i) to examine prevalence rate of MetS on health-care professionals; and (ii) to analyze how MetS is related to coffee, tea, alcohol and smoking, as well as dietary behavior among health-care professionals at a medical center in central Taiwan.

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MATERIALS AND METHODS

Subjects

The study group comprised health-care professionals who were 40 years-of-age and over and were employed at a medical center in central Taiwan. The chosen subjects included health-care professionals such as doctors, nurses, dieticians, pharmacists and clinical technicians from the internal medicine and surgical departments. All of the participants volunteered for physical examinations at the medical center. The present study was approved by the Ethics Committee of the medical center and all subjects gave written informed consent on the day of their physical examination. Originally, 592 persons agreed to participate in the study. Those with incomplete data (n = 78) were excluded from the study, so data from 514 subjects (147 men and 367 women) were collected for statistical analysis.

Data Collection

Basic demographic data collected from the subjects included sex, age, height, weight, waist circumference, seated systolic and diastolic blood pressure, high-density lipoprotein cholesterol (HDL-C) levels, triglyceride levels, and fasting blood glucose levels. All subjects had fasted for 8–10 h the night before the examination. On the day of the physical examination, the subjects rested for 15 min after registration, and their blood pressure was measured twice in the right arm with standard mercury sphygmomanometers, with a 30-s interval between measurements. A third measurement was taken when the difference between the previous two measurements was >10 mmHg. The average of two values with the smallest difference was used for analysis. The subject's waist circumference was measured at the midpoint between the edge of the lower ribs and the anterior superior iliac crest. HDL-C and triglycerides were analyzed using biochemical analytical equipment (Hitachi 7600; Tokyo, Japan) in the laboratory of the medical center.

Two definitions were applied in the present study to investigate the rate of MetS. The first definition was the modified National Cholesterol Education Program: Adult Treatment Panel III MetS definition (modified ATPIII-MetS)[17]. According to this definition, at least three of the following criteria must be met for the confirmation of MetS: (i) elevated waist circumference: waist circumference ≥90 cm in men, and ≥80 cm in women; (ii) elevated blood pressure: blood pressure ≥130/85 mmHg or a diagnosis of hypertension, or on antihypertensive drug treatment in a patient with a history of hypertension; (iii) reduced HDL-C: <40 mg/dL (<1.03 mmol/L) in men, and <50 mg/dL (<1.29 mmol/L) in women, or on drug treatment for reduced HDL-C; (iv) elevated triglycerides: triglycerides ≥150 mg/dL (≥1.7 mmol/L), or on drug treatment for elevated triglycerides; and (v) elevated fasting glucose: blood glucose levels ≥100 mg/dL (≥5.6 mmol/L), or a diagnosis of diabetes. The second definition was the International Diabetes Federation definition (IDF-MetS)[18]. The IDF definition is similar to the modified ATPIII definition, but the IDF definition requires abnormal waist circumference as a compulsory item plus any two of the other four components originally listed in the modified ATPIII definition.

The study subjects were given a habitual indulgence frequency questionnaire in order to obtain data regarding the frequency of habitual indulgence including coffee, tea and alcohol consumption, as well as smoking and dietary behavior. Histories of hypertension or diabetes and medication use were collected and statistically analyzed.

Statistical Analysis

All statistical analyses of the present study were carried out using the software package SPSS (version 11.0). The results were expressed by descriptive statistics, including frequency distribution, percentage, mean and standard deviation. The associations and differences among factors related to MetS were assessed by t-test, χ^2-test, multivariate analysis and one-way ANOVA.

RESULTS

Baseline Characteristic Differences

Table 1 shows the number of male and female subjects in the study, mean age, body mass index (BMI), the components of metabolic syndrome, the MetS rates of the study subjects according to modified ATPIII-MetS and IDF-MetS definitions, and a comparison of the differences between men and women. The man : woman ratio in the present study (147:367) was similar to that of the staff at this medical center who were 40 years-of-age and above (234:627). The data shows that men had a significantly higher mean age, mean BMI and values of the five diagnosis criteria for MetS than women.

Metabolic Syndrome Rates

The rate of MetS in men and women was 25.2% (95% confidence interval [CI] 18.2–32.2), 7.6% (95% CI 4.9–10.3), respectively, using modified ATPIII MetS and 12.2% (95% CI

Table 1 | Comparisons of baseline characteristics in men and women

Characteristic	Men	Women	*P*-value
n	147	367	
Age (years)	48 ± 5	45 ± 4	<0.001
BMI (kg/m^2)	25.2 ± 4.0	22.5 ± 3.4	<0.001
Waist circumference (cm)	83 ± 8	72 ± 8	<0.001
Systolic BP (mmHg)	127 ± 14	115 ± 15	<0.001
Diastolic BP (mmHg)	82 ± 11	74 ± 10	<0.001
HDL-cholesterol (mg/dL)	50 ± 13	63 ± 17	<0.001
Triglycerides (mg/dL)	158 ± 132	92.4 ± 81	<0.001
Fasting glucose (mg/dL)	102 ± 27	93 ± 18	<0.001
Modified ATPIII-MetS (%)	25.2 (18.2–32.2)	7.6 (4.9–10.3)	<0.001
IDF-MetS (%)	12.2 (6.9–17.5)	5.2 (2.9–7.4)	0.009

Data are means ± SD or % (95% confidence interval). ATPIII, Adult Treatment Panel III; BMI, body mass index; BP, blood pressure; HDL, high-density lipoprotein; IDF, International Diabetes Federation; MetS, metabolic syndrome. P < 0.001, P < 0.01, P < 0.05 were considered statistically significant.

Table 2 | Comparisons of age-adjusted baseline characteristics by gender

Characteristic	Men	Women	*P*-value
n	147	367	
BMI (kg/m²)	25.0 ± 0.3	22.5 ± 0.2	<0.001
Elevated waist circumference (%)	17.1 (11.1–23.1)	14.1 (10.4–17.8)	0.410
Elevated blood pressure (%)	42.2 (34.9–49.5)	22.6 (18.1–27.1)	<0.001
Reduced HDL-cholesterol (%)	23.3 (16.4–30.1)	20.4 (16.1–24.6)	0.489
Elevated triglycerides (%)	34.7 (28.6–40.8)	10.6 (6.8–14.4)	<0.001
Elevated fasting glucose (%)	33.9 (27.6-40.2)	13.1 (9.2–17.0)	<0.001
Modified ATPIII-MetS (%)	24.8 (19.4–30.2)	7.8 (4.4–11.1)	<0.001
IDF-MetS (%)	11.7 (7.4–16.0)	5.4 (2.7–8.1)	<0.05

Data are means ± SE or % (95% confidence interval). Elevated waist circumference: ≥90 cm in men or ≥80 cm in women (for Chinese); elevated blood pressure: systolic/diastolic blood pressure ≥130/85 mmHg or previously diagnosed hypertension; reduced high-density lipoprotein (HDL)-cholesterol: HDL-cholesterol < 40 mg/dL (<1.03 mmol/L) in men and <50 mg/dL (<1.29 mmol/L) in women or specific treatment for this lipid abnormality; elevated triglycerides: triglycerides ≥ 150 mg/dL (≥1.69 mmol/L) or specific treatment for this lipid abnormality; elevated fasting glucose: fasting glucose ≥ 100 mg/dL (≥5.6 mmol/L) or previously diagnosed type 2 diabetes mellitus. ATPIII, Adult Treatment Panel III; BMI, body mass index; IDF, International Diabetes Federation; MetS, metabolic syndrome. $P < 0.001$, $P < 0.01$, $P < 0.05$ were considered statistically significant.

6.9–17.5), 5.2% (95% CI 2.9–7.4), respectively, by IDF-MetS (Table 1). As age differences in men and women were prominent, a further analysis of covariation of age showed that the MetS rate was 24.8% (95% CI 19.4–30.2) by modified APTIII-MetS and 11.7% (95% CI 7.4–16.0) by IDF-MetS in men, and 7.8% (95% CI 4.4–11.1) and 5.4% (95% CI 2.7–8.1), respectively, in women (Table 2). The agreement between the two definitions was higher for women ($k = 0.58$ in men and $k = 0.79$ in women; $P < 0.001$).

Table 3 | Association between habitual indulgence (coffee, tea, alcohol and smoking) and metabolic syndrome by International Diabetes Federation definition

	MetS	Never	Occasionally	Frequent	*P*-value
		n (%)	*n* (%)	*n* (%)	
Coffee consumption					
Men	No	26 (89.7)	43 (72.9)	24 (72.7)	0.173
	Yes	3 (10.3)	16 (27.1)	9 (27.3)	
Women	No	60 (96.8)	134 (90.5)	108 (90.0)	0.254
	Yes	2 (3.2)	14 (9.5)	12 (10.0)	
Total	No	86 (94.5)	177 (85.5)	132 (86.3)	0.079
	Yes	5 (5.5)	30 (14.5)	21 (13.7)	
Tea consumption					
Men	No	18 (94.7)	43 (79.6)	34 (63.0)	<0.05
	Yes	1 (5.3)	11 (20.4)	20 (37.0)[N]	
Women	No	54 (98.2)	127 (89.4)	114 (92.7)	0.118
	Yes	1 (1.8)	15 (10.6)	9 (7.3)	
Total	No	72 (97.3)	170 (86.7)	148 (83.6)	<0.05
	Yes	2 (2.7)[OF]	26 (13.3)	29 (16.4)	
		Never	Quit	Current	
		n (%)	*n* (%)	*n* (%)	
Alcohol consumption					
Men	No	88 (77.2)	4 (57.1)	17 (68.0)	0.717
	Yes	26 (22.8)	3 (42.9)	8 (32.0)	
Women	No	314 (92.4)	3 (100.0)	20 (90.9)	0.855
	Yes	26 (7.6)	0 (0.0)	2 (9.1)	
Total	No	402 (88.5)	7 (70.0)	37 (78.7)	<0.05
	Yes	52 (11.5)	3 (30.0)	10 (21.3)	
Cigarette smoking					
Men	No	81 (78.6)	11 (64.7)	16 (64.0)	0.198
	Yes	22 (21.4)	6 (35.3)	9 (36.0)	
Women	No	334 (92.3)	0	1 (100.0)	1.000
	Yes	28 (7.7)	0	0 (0.0)	
Total	No	415 (89.2)	11 (64.7)	17 (65.4)	<0.001
	Yes	50 (10.8)[QC]	6 (35.3)	9 (34.6)	

Never, never happening during a subject's lifetime; Occasionally, happening approximately 1–2 times per week; Frequent, happening 5–6 times per week; Quit, not drinking or smoking for at least 6 months; Currently drinking or smoking, drinking at least 150 cc per time per week for at least 6 months or smoking at least one cigarette per day. The *P*-values were determined using the χ^2-test, Fisher's exact test. [N]$P < 0.05$ for frequent drinking tea versus never drinking tea; [OF]$P < 0.05$ for never drinking tea versus all other groups; [QC]$P < 0.05$ for never smokers versus all other groups. $P < 0.001$, $P < 0.01$, $P < 0.05$ were considered statistically significant.

Association between MetS and Frequency of Coffee, Tea, Alcohol Consumption and Smoking

Table 3 shows no significant association between coffee consumption and MetS among subjects. However, there was a significant correlation between MetS and tea and alcohol consumption, as well as cigarette smoking. The result of multiple comparison analysis showed that (i) the rate of MetS in subjects who occasionally or frequent consumed tea was significantly higher; and (ii) in regard to the items of alcohol consumption, despite significant differences being detected among the three groups, none of any two groups (never drank and quit drinking, never drank and frequently drank, quit drinking and frequently drank) showed significant differences in post-hoc analysis; and (iii) subjects who were former or current smokers had a significantly higher rate of MetS than those who had never smoked. Furthermore, when subjects were analyzed by sex, a higher MetS rate was found only in men who frequently drank tea. In women, the association between MetS and any habitual indulgence was not significant.

Association between MetS Components and Tea, Alcohol Consumption and Smoking

Table 4 shows the association between habitual indulgence and the five MetS components, using multiple comparison analysis. As for tea consumption, the BMI average, serum triglyceride levels and fasting plasma glucose levels were found to be higher ($P < 0.05$) in subjects who frequently drank tea.

With regard to alcohol consumption, subjects who were former and current drinkers were found to have a higher BMI and higher rate of elevated serum triglycerides ($P < 0.001$) than those who had never drank alcohol, whereas, a greater number of incidences of high blood pressure and lower serum HDL-C levels were found in former drinkers than in the other two groups ($P < 0.01$).

Both a higher BMI and greater number of abnormal blood pressure levels were found in the current smokers compared with the other two groups ($P < 0.01$). However, a greater number of high serum triglycerides and abnormal fasting plasma glucose levels were found in former and current smokers than in those who had never smoked ($P < 0.001$).

Association between Dietary Behavior and MetS

Subjects with MetS were found to have a significantly lower frequency of 'reading nutrition labels when purchasing food' and 'consuming milk or yogurt daily', but a higher frequency of 'purchasing sweetened beverages when thirsty' ($P < 0.05$, Table 5).

Table 4 | Association between habitual indulgence consumption (coffee, tea, alcohol and smoking) and metabolic syndrome components by International Diabetes Federation definition

	Never	Occasionally	Frequent	*P*-value
	No. cases/total (%)	No. cases/total (%)	No. cases/total (%)	
Coffee consumption				
BMI (means ± SD)	22.8 ± 3.3	23.6 ± 4.0	23.1 ± 3.6	0.126
Elevated waist circumference	13/91 (14.3)	31/207 (15.0)	22/153 (14.4)	0.982
Elevated blood pressure	25/103 (24.3)	68/232 (29.3)	52/175 (29.7)	0.575
Reduced HDL-cholesterol	18/92 (19.6)	55/210 (26.2)	28/157 (17.8)	0.132
Elevated triglycerides	17/103 (16.5)	42/232 (18.1)	27/175 (15.4)	0.771
Elevated fasting glucose	14/103 (13.6)	45/232 (19.4)	42/175 (24.0)	0.107
Tea consumption				
BMI (means ± SD)	22.6 ± 3.2	22.8 ± 3.5	23.9 ± 4.0[ON]	<0.01
Elevated waist circumference	10/74 (13.5)	23/196 (11.7)	28/177 (15.8)	0.517
Elevated blood pressure	21/82 (25.6)	61/218 (28.0)	64/205 (31.2)	0.589
Reduced HDL-cholesterol	15/75 (20.0)	40/198 (20.2)	41/182 (22.5)	0.830
Elevated triglycerides	10/82 (12.2)	34/218 (15.6)	49/205 (23.9)[ON]	<0.05
Elevated fasting glucose	7/82 (8.5)	42/218 (19.3)	51/205 (24.9)[ON]	<0.01
	Never	Quit	Current	
	No. cases/total (%)	No. cases/total (%)	No. cases/total (%)	
Alcohol consumption				
BMI (means ± SD)	22.9 ± 3.6[QC]	26.1 ± 3.5	24.6 ± 4.2	<0.001
Elevated waist circumference	55/402 (13.7)	3/13 (23.1)	17/86 (19.8)	0.253
Elevated blood pressure	115/455 (25.3)	9/15 (60.0)[NC]	31/94 (33.0)	<0.01
Reduced HDL-cholesterol	87/413 (21.2)	8/14 (57.1)[NC]	16/86 (18.6)	<0.01
Elevated triglycerides	67/455 (14.7)[QC]	6/15 (40.0)	25/94 (26.6)	<0.01
Elevated fasting glucose	83/455 (18.2)	5/15 (33.3)	26/94 (27.7)	0.052
Cigarette smoking				
BMI (means ± SD)	23.1 ± 3.8	24.0 ± 2.1	25.5 ± 3.5[N]	<0.01
Elevated waist circumference	66/458 (14.4)	0/16 (0.0)	6/26 (23.1)	0.118
Elevated blood pressure	136/514 (26.5)	8/18 (44.4)	16/29 (55.2)[N]	<0.01
Reduced HDL-cholesterol	94/466 (20.2)	6/17 (35.3)	9/26 (34.6)	0.079
Elevated triglycerides	73/514 (14.2)[qc]	10/18 (55.6)	15/29 (51.7)	<0.001
Elevated fasting glucose	95/514 (18.5)[qc]	8/18 (44.4)	14/29 (48.3)	<0.001

P-values were determined using the χ^2-test. $P < 0.001$, $P < 0.01$, $P < 0.05$ were considered statistically significant.
[ON]Significant difference for frequent drinking tea versus all other groups, [QC]significant difference for never drinkers versus all other groups, [NC]significant difference for past drinkers versus all other groups, [N]significant difference for current smokers versus never smokers, [qc]significant difference for never smokers versus all other groups. BMI, body mass index; HDL, high-density lipoprotein.

Table 5 | Association between dietary behavior and metabolic syndrome by International Diabetes Federation definition

		MetS-No		MetS-Yes		*P*-value
		n	Mean ± SD	*n*	Mean ± SD	
Reading nutrition labels when purchasing food	Men	105	3.6 ± 1.1	36	3.5 ± 1.2	0.810
	Women	339	4.0 ± 1.0	26	3.7 ± 1.1	0.070
	Total	444	3.9 ± 1.0	62	3.6 ± 1.2	<0.05
Drink milk or yogurt every day	Men	106	2.6 ± 1.1	36	2.3 ± 0.9	0.081
	Women	339	3.0 ± 1.1	26	2.9 ± 1.0	0.681
	Total	445	2.9 ± 1.1	62	2.6 ± 1.0	<0.05
Purchasing sweetened beverages when thirsty	Men	106	1.9 ± 0.8	36	1.9 ± 0.9	0.857
	Women	338	1.9 ± 0.8	26	2.6 ± 1.0	<0.001
	Total	444	1.9 ± 0.8	62	2.2 ± 1.0	<0.05

Likert's 5-point scale for dietary behavior: 5 for 'frequent', 4 for 'often', 3 for 'occasionally', 2 for 'rarely',1 for 'never'.
Statistics by *t*-test. $P < 0.001$, $P < 0.01$, $P < 0.05$ were considered statistically significant.
MetS, metabolic syndrome.

DISCUSSION

In order to understand the difference in MetS rate between health-care professionals and the general population, we researched previous studies[19–21] that dealt with similar age groups and used the same MetS definition (also see Table 6). As a result of comparison, MetS rate and rate of elevated waist circumference (17.1, 14.1% in men and women, respectively) or mean waist circumference (83 cm, 72 cm in men and women, respectively) among our health-care professionals were lower than the general population. An increased waist circumference provides relevant pathophysiological information in the presence of the clinical component of MetS, insofar as it defines the prevalent form of the syndrome resulting from abdominal obesity[22]. MetS rate among the professionals in the present study was lower, probably because of the fact that the degree of abdominal obesity was different. Additionally, team health-care professionals are equipped with abundant medical knowledge. Working, training and learning with other professionals also makes them more sensitive to improving their health and enables them to be better educated about disease prevention.

Table 6 | Information concerning the rate of metabolic syndrome according to the modified Adult Treatment Panel III and International Diabetes Federation definition, as well as waist circumference in middle-aged adults

		Hung *et al.*[19]	Ford *et al.*[20]	Lin *et al.*[21]
Rate of MetS (%)				
Modified ATPIII	Men	23	47.3	35.3
	Women	10.7	33.3	24.2
IDF	Men	18.5	45.5	
	Women	10.1	33.3	
Waist				
Elevated waist (%)	Men	30.9		28.5
	Women	27.7		25.3
Mean waist circumference (cm)	Men		98	86
	Women		90	77

ATPIII, Adult Treatment Panel III; IDF, International Diabetes Federation; MetS, metabolic syndrome.

The association between coffee consumption and MetS or its components was inconsistent[9,23]. With respect to the effect of coffee drinking on metabolic disorder, a dose-response link in coffee consumption with serum total and low-density lipoprotein cholesterol concentrations were greater for unfiltered than filtered coffee[24]. In addition, a meta-analysis of controlled clinical trials identified every cup of coffee consumed, and systolic pressure increased by 0.8 mmHg and diastolic pressure increased by 0.5 mmHg[25]. Furthermore, there has been evidence of an inverse association between coffee consumption and subsequent risk of diabetes[26]. In the present study, there was no association between coffee consumption and MetS or its components, perhaps as a result of the small sample size and no quantitative analysis. More information on this topic obtained from a larger number of subjects and amount coffee consumed or method of preparation is needed.

Previous studies carried out in Japan suggested there is no significant association between tea consumption and MetS[9]. However, the present study yielded a different result. We found that the subjects who drank tea habitually had a higher BMI, and a greater rate of elevated triglycerides and elevated fasting glucose level abnormalities that could be improved through tea consumption, according to past clinical studies[10–12]. In Asia, tea is one of the most widely consumed beverages and is believed by the majority to be beneficial for health. Under the influence of this aspect of Asian culture and with easy access to health-care related information, the subjects of the present study tended to increase tea consumption at times when abnormal metabolism occurred, especially in men who were found to have higher BMI and the percentage having MetS.

In the present study, χ^2-test showed that MetS and alcohol consumption had a marginally significant association ($P = 0.04$) among the three groups. However, a posteriori comparisons indicated no specific differences between any two groups (never drank and quit drinking, never drank and frequently drank, quit drinking and frequently drank). Because MetS and alcohol consumption had only a weak association, it is difficult to have any conclusive results. Further larger studies are needed to define this association in health-care professionals.

Former drinkers had the highest rate of hypertension, lowered HDL-C and triglyceridemia, all of which were probably the result of higher BMI. Previous studies suggested that former drinkers showed a higher rate of being overweight or obese than current drinkers (odds ratio [OR] 1.7, 95% CI 1.1–2.8) and those who had never drank (OR 1.5, 95% CI 1.1–1.9)[27]. The results from the present study suggest that while quitting drinking, one should monitor weight control in order to reduce the risk of developing MetS.

It has been reported that MetS prevalence is higher among current smokers and that quitting showed a very limited improvement on MetS[14,15]. Indeed, it is reported that former and current smoking was associated with increased risk for MetS with odds ratios of 1.77 (95% CI 1.42–2.22, $P < 0.0001$) and 2.38 (95% CI 1.95–2.91, $P < 0.0001$), respectively, when never smoking was used as reference[15]. Thus, to prevent or treat MetS, we need not only encourage smoking cessation, but also concomitantly help former smokers reduce or prevent metabolic abnormalities after smoking cessation.

One of the most interesting findings from the present study was that subjects with MetS were less inclined to read nutrition labels when shopping. Some studies reported that people who read nutrition labels have a lower dietary intake of fat, saturated fatty acids and cholesterol[28,29]; instead, they consume more vegetables and fruits[30]. Data from the present study suggests that the act of reading nutrition labels might have a positive impact on the development of MetS. Studies from France[31], the USA[32] and Iran[33] have shown that dairy consumption reduces the risk of developing MetS. The present study yielded a similar result. Therefore, regular dairy consumption could lower the risk of developing MetS. Because the association between the glycemic index and risk of MetS is positive[34] and sweeteners (with the exception of fructose) have the highest glycemic index of all foods, these reports support our findings that subjects with MetS drank sweetened beverages more frequently than those who did not.

The present study had some limitations. First, our study subjects were all from the same medical center in central Taiwan, and thus not randomly sampled. As a result, it is not applicable to health-care professionals in other medical institutions. Second, our study was designed to show the cross-sectional association between components related to MetS, and hence was unable to further infer any causal relationships among variables. Because our subjects did not want to list their occupations on the habitual indulgence frequency questionnaires, it was not possible to analyze the relationship among variables according to their occupations.

In conclusion, the present study showed that the rate of obesity and of MetS were lower among middle-aged health-care professionals than the general population. Health-care professionals who regularly drink tea, smoke, rarely read nutrition labels, rarely consume dairy products or frequently have sweetened drinks are at a higher risk of suffering from metabolic syndrome. These observations can serve both as a reminder to health-care institutions to pay more attention to the health of health-care professionals and as a reference for programs designed to promote their health. Additional studies are needed to isolate the relationship between MetS and habitual indulgence and dietary behaviors according to professionals' various occupations.

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