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Differential effect on labor force health initiated by the first wave of the COVID-19 in Taiwan

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Abstract

The 2019 coronavirus disease pandemic disrupts synchronized lifestyles and influences an individual's health status. However, Taiwan has limited studies on the impact of the epidemic on the health and lifestyle of its citizens. This study aims to investigate the impact on lifestyle and health status during the first wave of 2019 coronavirus disease in Taiwan. The 2008 to 2021 Taiwan Biobank database was adopted in this study, covering 29,572 participants and was designed into 3 time periods, Episodes 1, 2, and 3. The definition of metabolic syndrome (MetS) is based on the strict ministry of health and welfare. Logistic regression model was used to explore related risk factors. Prevalence rates of MetS were 16.5%, 17.0%, and 18.7% during Episodes 1, 2, and 3, respectively. When compared to the pre-pandemic prevalence of MetS, the odds ratios increased by 1.19 [95% confidence intervals (CIs): 1.02–1.38] during the nationwide Level 3 epidemic alert, particularly, in male aged 45 to 64 years old and females aged under 45 years old by 1.56 (95% CI: 1.14–2.13) and 1.89 (95% CI: 1.22–2.92), respectively. During pandemic, sweeping influences on Taiwanese health status, especially in the labor force, may provide a lesson in health promotion policy at a specific age.

Abbreviations: CI = confidence interval, COVID-19 = 2019 coronavirus disease, HDL = high-density lipoprotein, MET = metabolic equivalent of task, MetS = metabolic syndrome, OR = odds ratios, PAGA = Physical Activity Guidelines for Americans, TWB = Taiwan Biobank.

Keyword: COVID-19, labor force, MetS

1. Introduction

In December 2019, an outbreak of the coronavirus disease 2019 (COVID-19) occurred in the city of Wuhan, China, and spread rapidly around the world. This respiratory disease is elicited by the severe acute respiratory syndrome coronavirus 2.[1] In Taiwan, the Central Epidemic Command Center for Severe Specific Infectious Pneumonia was established on January 20, 2020, and border control was initiated thereafter.[2] The first COVID-19 case was confirmed on January 21 and the Level 1 epidemic alert was implemented, followed by the Level 2 epidemic alert on May 11, 2021 and the Level 3 epidemic alert on May 18, 2021[3] (Table S1, Supplemental Digital Content, http://links.lww.com/MD/N719) to halt the spread of COVID-19.

The COVID-19 incidence rate in the United States was 6683 per 100,000 population,[4] while, in parallel with Level 3 epidemic in Taiwan, a low incidence rate was 61 per 100,000 population.[3] Even though Taiwan government successfully prevented the outbreak at early stage of pandemic, dramatic impact on economy and daily life was observed,[5] but the comprehensive extent of the epidemic on the health status and lifestyle of Taiwanese people has not yet been reported.

The prognosis of COVID-19 patients who are highly correlated with their health status, such as metabolic syndrome (MetS) and diabetes, features a higher case fatality rate.[6–15] MetS often prevails in the middle-aged labor forces,[16,17] caused by inappropriate diet patterns and lack of exercise habits due

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The authors have no conflicts of interest to disclose.

The data that support the findings of this study are available from a third party, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.

This study was performed in accordance with the Declaration of Helsinki, and authorized by the institutional review board of the Tri-Service General Hospital (TSGH-2-107-05-091). Written informed consent was obtained from all subjects before participation in the study.

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to overwhelming business,[18,19] who are major contributors to economic productivity in a country.[20]

Nevertheless, to our best knowledge, exploration in correlation among lifestyle and health status during the first wave of COVID-19 in Taiwan is scarce. Therefore, data from Taiwan Biobank (TWB), a nation-wide health database in Taiwan, was adopted to investigate the impact on lifestyle and health status during the first wave of COVID-19 in Taiwan.

2. Materials and methods

2.1. Study design and population

The TWB is sponsored by the Taiwanese Government. Its purpose is to collect lifestyle and genetic data from Taiwanese people. TWB is a population based dataset, which aims to recruit 200,000 community-based healthy participants aged 20 years without history of cancer before 2024. In addition to blood samples and physical examination, each participant completed a structured questionnaire on personal information and lifestyle factors through face-to-face interviews with a TWB researcher. All participants gave informed consent when joining TWB.

The data was analyzed using results of TWB questionnaire and physical examination from December 2008 to December 2021. A total of 29,572 participants without with MetS were included in the study with satisfaction with both completions of the pre (Initiate) and posttest (Termination) (detail definition of every Episode shown in below and Fig. 1). Episode 1 was set at January 1, 2015 to January 20, 2020 (prior to the outbreak of COVID-19); Episode 2, January 21, 2020 to May 17, 2021 (the government's nationwide Level 1 and Level 2 epidemic alert); Episode 3, May 18, 2021 to December 31, 2021 (post the government's nationwide Level 3 epidemic alert). The research flow is shown in Figure 1.

2.2. Demographic factors

Basic information about subjects contains age, gender, new onset MetS, weight, waistline, systolic blood pressure, diastolic blood pressure, fasting blood glucose, triglycerides, high-density lipoprotein (HDL), marital status, and education level.

2.3. Lifestyle factors

The BMI of the lifestyle data was a continuous variable. Smoking was categorized as yes (including quitting) or no (including quitting > 20 years). Alcohol consumption was defined as yes (including abstinence) or no. Tea consumption was defined as at least once a day, categorized as yes or no. Coffee consumption was defined as at least 3 times a week, categorized as yes or no. Supplement consumption was defined as the presence or absence of vitamins, minerals, or other supplements in the last month, categorized as yes or no. The diet pattern was based on the food intake preferences of the participants in the last month, and a total of 17 questions were used for the factor analysis (Table S2, Supplemental Digital Content, http://links.lww.com/MD/N719). We used principal components analysis to summarize the diet pattern into 3 variables, including meat intake, flavor intake, and dietary fat intake.

The 3 most common exercise types were done by the participants in the past 3 months, and the metabolic equivalent of task (MET) was calculated with reference to the study by Hiraike et al (2021) (Table S3, Supplemental Digital Content, http://links.lww.com/MD/N719). In this study, 2 variables, accumulation of exercise activity and exercise intensity levels, were defined and used to describe the exercise states of each participant using MET and MET/hour, respectively.[21] The accumulation of exercise activity was defined as the sum of MET, which was divided into none, ≤10 MET/week, 10 (>10) to 20 MET/week, and >20 MET/week. The exercise intensity levels were based on the Physical Activity Guidelines for Americans (PAGA). An exercise of <3 MET/hour was defined as light-intensity physical activity; 3 to 5.9 MET/hour, as moderate intensity-physical activity; and ≥6 MET/hour, as vigorous-intensity physical activity.[22] According to PAGA, participants were divided into 3 groups: group 1: no exercise; group 2: without vigorous-intensity physical activity; and group 3: ever with vigorous-intensity physical activity.

2.4. Definition of MetS

MetS is defined by the criteria of the Ministry of Health and Welfare (Taiwan),[23] and the criteria for MetS in Taiwan require 3 or more of the following: (1) abdominal obesity: waist circumference ≥90 centimeters (cm) in males and ≥80 cm in females[24]; (2) hypertension: systolic blood pressure ≥ 130 mm Hg or diastolic blood pressure ≥ 85 mm Hg; (3) fasting plasma glucose: FPG ≥ 100 mg/dL[25]; (4) triglycerides: TG ≥ 150 mg/dL; (5) HDL-C: HDL-C < 40 mg/dL in males and <50 mg/dL in females.[26]

2.5. Statistical analysis

The descriptive statistical methods were described in the following manner: (1) categorical (nominal) variables: the number of apportionments and ratios; and (2) interval and ratio variables: mean ± standard deviation. Inferential statistical methods for the variable analysis included the Student *t* test and chi-square test to examine the significance of differences, while logistic regression was used to estimate odds ratios (OR) and 95% confidence interval (CI). This study considered a *P* value of <.05 as significant for all analyses. All analyses were performed using R 3.5.2.

3. Results

3.1. Demographic and lifestyle data of participants

A total of 29,572 participants were recruited, divided into 3 groups: 20,863 in Episode 1, 7491 in Episode 2, and 1218 in Episode 3. The prevalence of MetS was 16.5% in Episode 1, 17.0% in Episode 2, and 18.7% in Episode 3. Factors, follow-years, age, weight, diastolic blood pressure, fasting blood glucose, blood glucose, triglycerides, HDL, marital status, education, tea consumption, coffee consumption, meat intake preferences, favor intake preferences, dietary fat intake preferences, vegetarian consumption, midnight snack consumption, supplement consumption, exercise habits, and state of motion, showed significant differences ($P < .05$) among the 3 groups (Table 1).

3.2. Identification of risk factors for MetS using logistic regression

With adjustment of age, gender, education, and marital status, the risk factors for MetS in the Episode 1 group were follow-years (OR = 1.11, 95% CI: 1.08–1.15), age (OR = 1.03, 95% CI: 1.02–1.03), smoking (OR = 1.20, 95% CI: 1.09–1.33), alcohol consumption (OR = 1.23, 95% CI: 1.09–1.39), flavored food intake (OR = 1.36, 95% CI: 1.22–1.52), and midnight snack consumption (OR = 1.08, 95% CI: 1.00–1.17); the risk factors for MetS in the Episode 2 group were age (OR = 1.03, 95% CI: 1.02–1.03), smoking (OR = 1.34, 95% CI: 1.15–1.57), alcohol consumption (OR = 1.30, 95% CI: 1.07–1.58), frequent flavored food intake (OR = 1.46, 95% CI: 1.21–1.76), and midnight snack consumption (OR = 1.20, 95% CI: 1.06–1.37); the risk factor for MetS in the Episode3 group was age (OR = 1.02, 95% CI: 1.00–1.03), as shown in Table 2. We additionally used

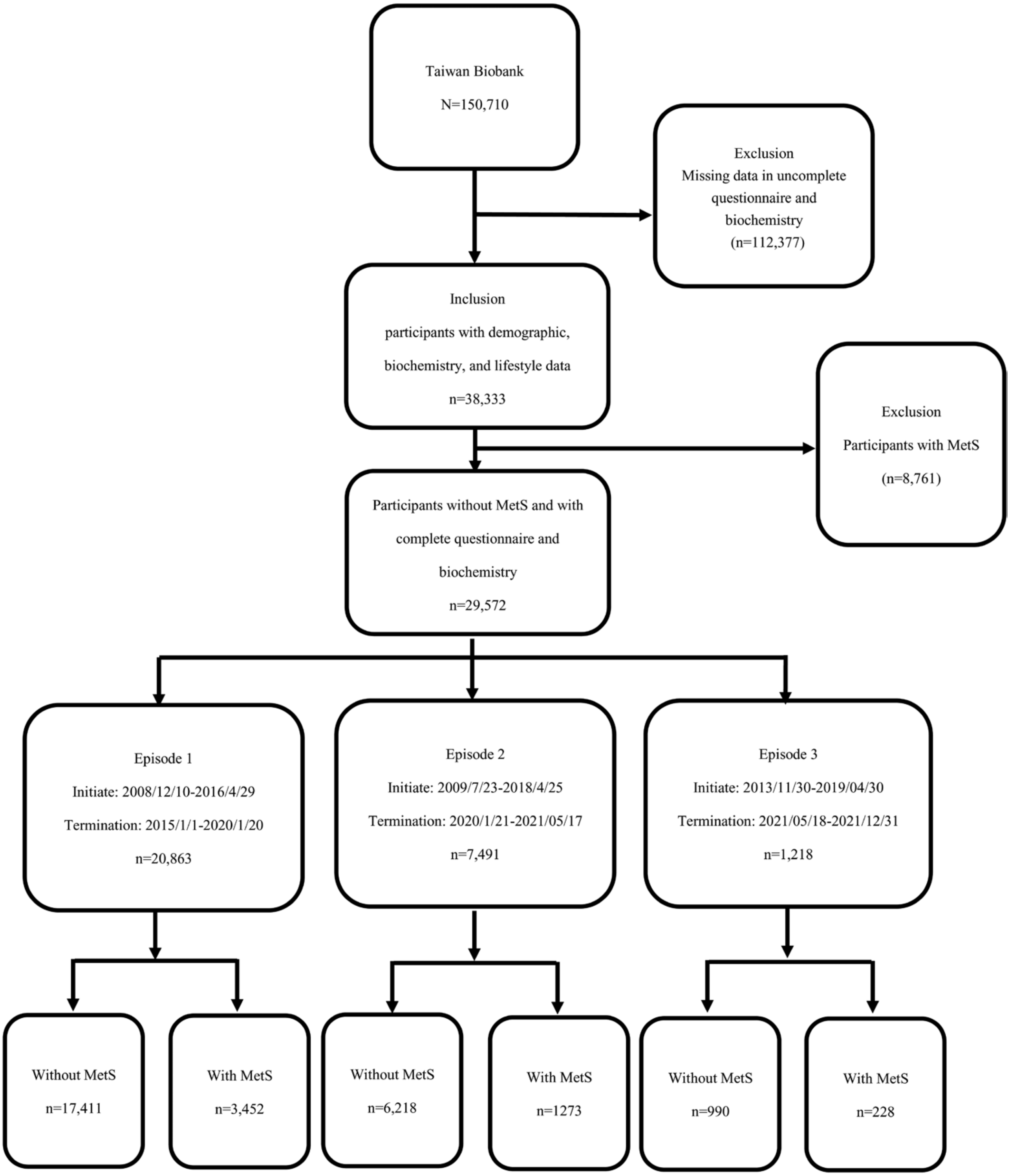

Figure 1. Research flow chart. A total of 150,710 participants were analyzed using data from the TWB database. One lakh twelve thousand three hundred seventy-seven participants without complete pre and posttest data were excluded; 38,333 participants with complete pre and posttest data were included; 8761 pretest MetS patients were excluded. Twenty-nine thousand five hundred seventy-two participants were finally included and divided into 3 groups according to the duration of the epidemic. TWB = Taiwan Biobank.

2 variables of exercise (exercise intensity levels and accumulation of exercise activity per week) to conduct cross-table analysis (Table S4, Supplemental Digital Content, http://links.lww.com/MD/N719). In summary, participants with highest level of exercise intensity levels and accumulation of exercise activity had significantly lower risk of MetS (OR = 0.64, 95% CI: 0.53–0.78).

3.3. Identification of male risk factors for MetS using logistic regression

Table S5, Supplemental Digital Content, http://links.lww.com/MD/N719 indicated that the risk factors for MetS in males during the epidemic. With adjustment of age, education, and marital status, the risk factors for MetS in the Episode 1 group were

Table 1

Demographic and lifestyle data of participants.

	Episode1 n = 20,863	Episode2 n = 7491	Episode3 n = 1218	*P*-value
Follow-years	3.81 ± 1.16	5.04 ± 0.59	5.14 ± 0.95	<.001*
Age	54.01 ± 10.38	54.64 ± 10.72	54.22 ± 10.70	<.001*
Gender				.060
Male	6888 (33.0%)	2586 (34.5%)	408 (33.5%)	
Female	13,975(67.0%)	4905 (65.5%)	810 (66.5%)	
New onset metabolic syndrome				.115
No	17,411(83.5%)	6218 (83.0%)	990 (81.3%)	
Yes	3452 (16.5%)	1273 (17.0%)	228 (18.7%)	
Weight	61.11 ± 10.97	62.11 ± 11.73	62.02 ± 11.72	<.001*
BMI	23.59 ± 3.30	23.71 ± 3.47	23.51 ± 3.50	.022*
Waistline	81.93 ± 9.17	82.01 ± 9.67	81.81 ± 9.66	.736
Systolic blood pressure	120.27 ± 17.10	119.79 ± 17.11	120.57 ± 16.89	.079
Diastolic blood pressure	71.92 ± 10.04	72.72 ± 10.15	74.49 ± 10.13	<.001*
Fasting blood glucose	94.01 ± 16.12	94.54 ± 15.20	94.94 ± 14.18	.011*
Triglycerides	103.68 ± 64.72	107.04 ± 70.47	107.11 ± 64.26	<.001*
HDL	56.92 ± 13.32	58.35 ± 13.79	58.19 ± 13.92	<.001*
Marital status				<.001*
Married	16,330(78.3%)	5576 (74.5%)	925 (75.9%)	
Unmarried/widow/divorced	4527 (21.7%)	1921 (25.5%)	293 (24.1%)	
Education				<.001*
≤12	10,318(49.4%)	2970 (39.6%)	467 (38.3%)	
>12	10,545(50.6%)	4521 (60.4%)	751 (61.7%)	
Smoking	4952 (23.7%)	1822 (24.3%)	287 (23.6%)	.567
Alcohol consumption	1928 (9.2%)	704 (9.4%)	107 (8.8%)	.779
Tea consumption	4754 (22.8%)	1576 (21.0%)	271 (22.2%)	.008*
Coffee consumption	8758 (42.0%)	3614 (48.3%)	584 (47.9%)	<.001*
Diet pattern				
Meat intake preferences				<.001*
Q1	4902 (23.6%)	2132 (28.5%)	394 (32.4%)	
Q2	5086 (24.4%)	1965 (26.3%)	308 (25.3%)	
Q3	5272 (25.3%)	1801 (24.1%)	294 (24.2%)	
Q4	5555 (26.7%)	1573 (21.1%)	221 (18.2%)	
Favor intake preferences				<.001*
Q1	5490 (26.4%)	1710 (22.9%)	258 (21.2%)	
Q2	5134 (24.7%)	1925 (25.8%)	285 (23.4%)	
Q3	5194 (25.0%)	1871 (25.0%)	318 (26.1%)	
Q4	4997 (24.0%)	1965 (26.3%)	356 (29.3%)	
Dietary fat intake preferences				<.001*
Q1	4999 (24.0%)	2010 (26.9%)	307 (25.2%)	
Q2	5106 (24.5%)	1842 (24.7%)	326 (26.8%)	
Q3	5257 (25.3%)	1864 (24.9%)	319 (26.2%)	
Q4	5453 (26.2%)	1755 (23.5%)	265 (21.8%)	
Vegetarian consumption	1845 (8.8%)	711 (9.5%)	100 (8.2%)	<.001*
Midnight snack consumption	6797 (32.6%)	2668 (35.6%)	446 (36.6%)	<.001*
Supplement consumption	11,733(55.8%)	4560 (60.9%)	816 (67.1%)	<.001*
Exercise habits	7962 (38.2%)	2732 (36.5%)	440 (36.1%)	.018*
Metabolic equivalent task				.038*
No	12,901(61.8%)	4759 (63.5%)	778 (63.9%)	
≤10 MET/week	1797 (8.6%)	580 (7.7%)	104 (8.5%)	
10–20 MET/week†	2494 (12.0%)	915 (12.2%)	139 (11.4%)	
>20 MET/week	3671 (17.6%)	1237 (16.5%)	197 (16.2%)	
Physical activity intensity‡				.070
Group 1	12,901(61.8%)	4759 (63.5%)	778 (63.9%)	
Group 2	7023 (33.7%)	2420 (32.3%)	384 (31.5%)	
Group 3	939 (4.5%)	312 (4.2%)	56 (4.6%)	

BMI = body mass index, HDL = high-density lipoprotein, MET = metabolic equivalent task.
†10 (>10) to 20 MET/week.
‡According to PAGA, group 1: no exercise; group 2: without vigorous-intensity physical activity; and group 3: with vigorous-intensity physical activity.
* *P*-value < .05.

follow-years (OR = 1.12, 95% CI: 1.06–1.17), age (OR = 1.01, 95% CI: 1.01–1.02), smoking (OR = 1.31, 95% CI: 1.16–1.48), alcohol consumption (OR = 1.32, 95% CI: 1.15–1.51), frequent flavored food intake (OR = 1.50, 95% CI: 1.26–1.80), and midnight snack consumption (OR = 1.16, 95% CI: 1.02–1.31); the risk factors for MetS in the Episode 2 group were age (OR = 1.01, 95% CI: 1.01–1.02), smoking (OR = 1.43, 95% CI: 1.17–1.75), alcohol consumption (OR = 1.32; 95% CI: 1.05–1.66), frequent flavored food intake (OR = 1.70, 95% CI: 1.25–2.31), and midnight snacking consumption (OR = 1.25, 95% CI: 1.02–1.53); the risk factors for MetS in the Episode 3 group were follow-years (OR = 1.32, 95% CI: 1.01–1.72), age (OR = 1.03, 95% CI: 1.01–1.05), alcohol consumption (OR = 1.82, 95% CI: 1.06–3.12), frequent flavored food intake (OR = 2.26, 95% CI: 1.05–4.86),

Table 2

Identification of risk factors for MetS during epidemic alert periods using logistic regression.

Metabolic syndrome								
	Episode 1		Episode 2		Episode 3			
Variable	Crude OR	Adjusted	Crude OR	Adjusted	Crude OR	Adjusted	*P* interaction†	*P* interaction‡
Follow-years	1.11 (1.07–1.14)*	1.11 (1.08–1.15)*	1.06 (0.96–1.17)	1.03 (0.93–1.14)	1.17 (1.00–1.36)*	1.16 (0.99–1.36)		
Age	1.03 (1.03–1.04)*	1.03 (1.02–1.03)*	1.03 (1.03–1.04)*	1.03 (1.02–1.03)*	1.02 (1.00–1.03)*	1.02 (1.00–1.03)*		
Gender							.180	.143
Male	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.		
Female	0.67 (0.62–0.72)*	0.65 (0.61–0.71)*	0.70 (0.62–0.79)*	0.69 (0.61–0.78)*	0.52 (0.39–0.69)*	0.51 (0.38–0.69)*		
Marital status							.895	.820
Married	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.		
Unmarried/ widow/divorced	0.95 (0.87–1.04)	1.05 (0.96–1.15)	0.99 (0.86–1.13)	1.09 (0.95–1.26)	0.95 (0.67–1.33)	1.14 (0.80–1.63)		
Education							.403	.289
≤12	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.		
>12	0.72 (0.67–0.77)*	0.78 (0.72–0.84)*	0.71 (0.63–0.81)*	0.79 (0.70–0.90)*	0.88 (0.66–1.18)	0.91 (0.67–1.25)		
Smoking	1.44 (1.33–1.56)*	1.20 (1.09–1.33)*	1.50 (1.31–1.71)*	1.34 (1.15–1.57)*	1.54 (1.12–2.12)*	1.13 (0.78–1.64)	.839	.784
Alcohol consumption	1.48 (1.32–1.66)*	1.23 (1.09–1.39)*	1.53 (1.27–1.84)*	1.30 (1.07–1.58)*	1.89 (1.21–2.95)*	1.42 (0.89–2.28)	.575	.582
Tea consumption	1.12 (1.03–1.22)*	1.07 (0.98–1.17)	1.10 (0.95–1.27)	1.05 (0.90–1.21)	1.40 (1.00–1.94)*	1.23 (0.88–1.73)	.421	.497
Coffee consumption	0.85 (0.79–0.91)*	0.91 (0.84–0.98)*	0.96 (0.86–1.09)	1.01 (0.90–1.14)	0.89 (0.67–1.19)	0.91 (0.68–1.22)	.208	.316
Diet pattern								
Meat intake preferences							.010*	.021*
Q1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.		
Q2	0.91 (0.82–1.01)	0.91 (0.82–1.01)	0.92 (0.78–1.09)	0.92 (0.77–1.09)	1.38 (0.94–2.03)	1.42 (0.96–2.10)		
Q3	0.93 (0.84–1.03)	0.90 (0.81–1.00)	1.10 (0.93–1.30)	1.06 (0.90–1.26)	1.26 (0.85–1.88)	1.30 (0.87–1.96)		
Q4	0.86 (0.77–0.95)*	0.82 (0.74–0.91)*	1.17 (0.98–1.38)	1.09 (0.92–1.30)	1.31 (0.85–2.00)	1.32 (0.84–2.06)		
Favor intake preferences							.855	.718
Q1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.		
Q2	1.10 (0.99–1.22)	1.13 (1.02–1.26)*	1.19 (1.00–1.42)*	1.24 (1.03–1.48)*	1.12 (0.72–1.75)	1.11 (0.70–1.74)		
Q3	1.07 (0.97–1.19)	1.17 (1.05–1.29)*	1.18 (0.98–1.40)	1.30 (1.09–1.56)*	1.15 (0.74–1.77)	1.19 (0.76–1.85)		
Q4	1.13 (1.02–1.25)*	1.36 (1.22–1.52)*	1.17 (0.98–1.40)	1.46 (1.21–1.76)*	1.42 (0.94–2.15)	1.54 (0.98–2.40)		
Dietary fat intake preferences							.517	.528
Q1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.		
Q2	0.98 (0.88–1.08)	1.03 (0.93–1.14)	0.98 (0.83–1.15)	1.05 (0.89–1.24)	1.06 (0.70–1.59)	1.09 (0.72–1.65)		
Q3	0.92 (0.83–1.02)	1.01 (0.91–1.12)	0.85 (0.72–1.01)	0.94 (0.79–1.12)	1.27 (0.85–1.90)	1.43 (0.95–2.15)		
Q4	0.89 (0.80–0.99)*	1.02 (0.92–1.13)	0.96 (0.81–1.13)	1.10 (0.93–1.31)	1.09 (0.71–1.67)	1.26 (0.81–1.96)		
Vegetarian consumption	1.00 (0.84–1.18)	0.99 (0.84–1.18)	1.01 (0.76–1.35)	0.98 (0.73–1.31)	0.93 (0.43–2.03)	0.95 (0.43–2.08)	.287	.339
Midnight snack consumption	1.00 (0.92–1.08)	1.08 (1.00–1.17)*	1.08 (0.96–1.23)	1.20 (1.06–1.37)*	1.08 (0.81–1.46)	1.11 (0.81–1.50)	.505	.502
Supplement consumption	0.93 (0.86–1.02)	0.90 (0.82–0.98)*	0.72 (0.61–0.84)*	0.76 (0.64–0.89)*	0.88 (0.60–1.29)	0.98 (0.66–1.46)	.031*	.027*
Exercise habits	0.89 (0.83–0.96)*	0.74 (0.68–0.80)*	0.81 (0.71–0.92)*	0.67 (0.58–0.76)*	0.76 (0.56–1.04)	0.65 (0.47–0.90)*	.326	.262
Metabolic equivalent task							.764	.708
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.		
≦10 MET/ week	0.80 (0.69–0.92)*	0.71 (0.62–0.82)*	0.81 (0.64–1.03)	0.73 (0.57–0.93)*	0.72 (0.41–1.26)	0.65 (0.37–1.15)		
10–20 MET/ week§	0.86 (0.76–0.97)*	0.75 (0.66–0.84)*	0.79 (0.65–0.96)*	0.69 (0.56–0.84)*	0.70 (0.43–1.16)	0.60 (0.36–1.00)		
>20 MET/week	0.96 (0.87–1.06)	0.75 (0.68–0.83)*	0.82 (0.69–0.98)*	0.62 (0.52–0.75)*	0.83 (0.55–1.24)	0.68 (0.44–1.04)		
Physical activity intensity‖							.555	.411
Group 1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.		
Group 2	0.90 (0.83–0.97)*	0.75 (0.69–0.81)*	0.81 (0.71–0.93)*	0.67 (0.58–0.77)*	0.73 (0.53–1.02)	0.63 (0.44–0.89)*		
Group 3	0.85 (0.70–1.02)	0.68 (0.56–0.82)*	0.81 (0.59–1.11)	0.67 (0.48–0.92)*	0.97 (0.49–1.91)	0.77 (0.38–1.54)		

Adjusted: adjusted for gender, age, marital status, education.

MET = metabolic equivalent task, MetS = metabolic syndrome.

†Curde interaction.

‡Adjusted interaction: adjusted gender, age, marital status, education.

§10 (>10) to 20 MET/week.

‖According to PAGA, group1: no exercise; group 2: without vigorous-intensity physical activity; and group 3: with vigorous-intensity physical activity.

*P-value < .05.

and vegetarian consumption (OR = 3.07, 95% CI: 1.22–7.69), as shown in Table 3.

3.4. Identification of female risk factors for MetS using logistic regression

Table S6, Supplemental Digital Content, http://links.lww.com/MD/N719 indicated that the risk factors for MetS in females during the epidemic. With adjustment of age, education, and marital status, the risk factors for MetS in the Episode 1 group were follow-years (OR = 1.11, 95% CI: 1.06–1.15), age (OR = 1.04, 95% CI: 1.04–1.05), and frequent flavored food intake (OR = 1.30, 95% CI: 1.13–1.50); the risk factors for MetS in the Episode 2 group were age (OR = 1.04, 95% CI: 1.03–1.05), frequent flavored food intake (OR = 1.35, 95% CI: 1.06–1.71), and dietary fat intake (OR = 1.29, 95% CI: 1.03–1.60); the risk factors for MetS in the Episode 3 group were little meat intake (OR = 1.98, 95% CI: 1.14–3.42) and frequent flavored food intake (OR = 1.91, 95% CI: 1.04–3.52), as shown in Table 4.

3.5. Epidemic alert dependent risk factors for MetS

To elucidate the role of age in MetS during epidemic alert, we stratified age into 3 groups, <45, 45 to 64, ≥65, in logistic regression model which focuses on the effect of epidemic alert on MetS. Results showed that the overall risk of MetS was 1.19 times higher in Episode 3 than that in Episode 1 (95% CI: 1.02–1.38). Of note, results of age stratification displayed OR = 1.27 (95% CI: 1.05–1.55) in the 45 to 64 years old labor force. Intriguingly, male in the 45 to 64 years old hit OR up to 1.56 (95% CI: 1.14–2.13), while female <45 years old rose to 1.89 (95% CI: 1.22–2.92). Other vital factors, such as tea consumption (OR = 1.36, 95% CI: 1.01–1.83) or no exercise habit

Table 3

Identification of male risk factors for MetS during epidemic alert periods using logistic regression.

Metabolic syndrome

	Episode 1		Episode 2		Episode 3	
Variable	**Crude OR**	**Adjusted**	**Crude OR**	**Adjusted**	**Crude OR**	**Adjusted**
Follow-years	1.12 (1.06–1.17)*	1.12 (1.06–1.17)*	1.05 (0.89–1.23)	1.05 (0.89–1.24)	1.29 (0.99–1.68)	1.32 (1.01–1.72)*
Age	1.01 (1.01–1.02)*	1.01 (1.01–1.02)*	1.02 (1.01–1.03)*	1.01 (1.01–1.02)*	1.03 (1.01–1.05)*	1.03 (1.01–1.05)*
Marital status						
Married	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Unmarried/widow/divorced	0.97 (0.81–1.16)	1.05 (0.88–1.26)	0.82 (0.63–1.06)	0.89 (0.68–1.16)	0.85 (0.44–1.66)	1.19 (0.59–2.42)
Education						
≤12	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
>12	0.78 (0.69–0.87)*	0.82 (0.73–0.93)*	0.63 (0.52–0.77)*	0.68 (0.55–0.83)*	1.21 (0.75–1.97)	1.47 (0.88–2.44)
Smoking	1.36 (1.20–1.53)*	1.31 (1.16–1.48)*	1.53 (1.26–1.86)*	1.43 (1.17–1.75)*	1.08 (0.69–1.68)	1.09 (0.69–1.73)
Alcohol consumption	1.34 (1.17–1.54)*	1.32 (1.15–1.51)*	1.40 (1.11–1.76)*	1.32 (1.05–1.66)*	1.67 (0.99–2.82)	1.82 (1.06–3.12)*
Tea consumption	1.09 (0.97–1.24)	1.08 (0.96–1.23)	1.20 (0.97–1.47)	1.15 (0.93–1.42)	1.29 (0.80–2.06)	1.24 (0.77–1.99)
Coffee consumption	0.98 (0.87–1.10)	1.01 (0.89–1.13)	0.99 (0.82–1.20)	1.04 (0.85–1.26)	1.02 (0.65–1.58)	1.00 (0.64–1.57)
Diet pattern						
Meat intake preferences						
Q1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Q2	0.96 (0.82–1.12)	0.95 (0.81–1.11)	0.85 (0.66–1.09)	0.83 (0.64–1.07)	1.05 (0.59–1.87)	0.97 (0.55–1.74)
Q3	0.98 (0.84–1.15)	0.95 (0.81–1.12)	1.25 (0.97–1.61)	1.17 (0.91–1.51)	1.27 (0.70–2.31)	1.14 (0.62–2.09)
Q4	0.87 (0.73–1.03)	0.82 (0.69–0.98)*	0.94 (0.70–1.25)	0.87 (0.65–1.17)	1.45 (0.74–2.85)	1.24 (0.61–2.50)
Favor intake preferences						
Q1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Q2	1.34 (1.12–1.61)*	1.37 (1.14–1.64)*	1.38 (1.02–1.88)*	1.44 (1.06–1.96)*	1.46 (0.66–3.21)	1.56 (0.70–3.47)
Q3	1.25 (1.05–1.50)*	1.33 (1.11–1.59)*	1.28 (0.94–1.74)	1.39 (1.02–1.91)*	1.63 (0.76–3.50)	1.93 (0.88–4.23)
Q4	1.32 (1.11–1.56)*	1.50 (1.26–1.80)*	1.43 (1.06–1.92)*	1.70 (1.25–2.31)*	1.61 (0.78–3.31)	2.26 (1.05–4.86)*
Dietary fat intake preferences						
Q1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Q2	0.98 (0.84–1.15)	1.01 (0.86–1.18)	0.92 (0.72–1.18)	0.97 (0.75–1.24)	0.85 (0.48–1.50)	0.82 (0.46–1.46)
Q3	0.88 (0.75–1.04)	0.91 (0.77–1.07)	1.01 (0.78–1.31)	1.08 (0.83–1.40)	0.81 (0.44–1.50)	0.80 (0.43–1.49)
Q4	0.88 (0.75–1.05)	0.92 (0.78–1.09)	0.75 (0.56–1.00)	0.82 (0.61–1.10)	0.77 (0.39–1.53)	0.72 (0.35–1.45)
Vegetarian consumption	1.01 (0.73–1.40)	1.05 (0.76–1.45)	0.50 (0.26–0.94)*	0.49 (0.26–0.92)*	3.14 (1.27–7.79)*	3.07 (1.22–7.69)*
Midnight snack consumption	1.08 (0.96–1.22)	1.16 (1.02–1.31)*	1.14 (0.94–1.39)	1.25 (1.02–1.53)*	0.78 (0.49–1.22)	0.94 (0.58–1.52)
Supplement consumption	0.95 (0.81–1.10)	0.97 (0.83–1.13)	0.66 (0.50–0.86)*	0.69 (0.53–0.91)*	1.16 (0.64–2.11)	1.12 (0.61–2.07)
Exercise habits	0.80 (0.70–0.90)*	0.74 (0.66–0.85)*	0.68 (0.55–0.83)*	0.64 (0.51–0.79)*	0.84 (0.53–1.34)	0.67 (0.41–1.09)
Metabolic equivalent task						
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
≦10 MET/week	0.68 (0.54–0.86)*	0.66 (0.52–0.84)*	0.53 (0.34–0.83)*	0.51 (0.33–0.80)*	0.60 (0.24–1.52)	0.51 (0.20–1.30)
10–20 MET/week†	0.75 (0.62–0.92)*	0.72 (0.59–0.88)*	0.83 (0.61–1.12)	0.81 (0.60–1.11)	0.71 (0.35–1.46)	0.62 (0.30–1.28)
>20 MET/week	0.87 (0.75–1.02)	0.80 (0.68–0.93)*	0.65 (0.50–0.84)*	0.58 (0.44–0.76)*	1.08 (0.60–1.95)	0.81 (0.43–1.51)
Physical activity intensity‡						
Group 1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Group 2	0.81 (0.71–0.93)*	0.76 (0.66–0.87)*	0.69 (0.56–0.86)*	0.64 (0.51–0.80)*	0.85 (0.52–1.41)	0.65 (0.38–1.11)
Group 3	0.73 (0.58–0.92)*	0.71 (0.56–0.89)*	0.62 (0.42–0.94)*	0.61 (0.41–0.92)*	0.80 (0.35–1.85)	0.76 (0.32–1.77)

Adjusted: adjusted for age, marital status, education.

MET = metabolic equivalent task, MetS = metabolic syndrome.

†10 (more than10) -20 MET/week.

‡According to PAGA, group 1: no exercise; group 2: without vigorous-intensity physical activity; and group 3: with vigorous-intensity physical activity.

**P*-value < .05.

Table 4

Identification of female risk factors for MetS during epidemic alert periods using logistic regression.

Metabolic syndrome						
	Episode 1		Episode 2		Episode 3	
Variable	Crude OR	Adjusted	Crude OR	Adjusted	Crude OR	Adjusted
Follow-years	1.10 (1.06–1.14)*	1.11 (1.06–1.15)*	1.07 (0.94–1.22)	1.00 (0.88–1.14)	1.10 (0.90–1.35)	1.08 (0.88–1.32)
Age	1.05 (1.04–1.05)*	1.04 (1.04–1.05)*	1.04 (1.03–1.05)*	1.04 (1.03–1.05)*	1.01 (0.99–1.03)	1.00 (0.98–1.02)
Marital status						
Married	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Unmarried/widow/divorced	1.04 (0.93–1.15)	1.00 (0.90–1.12)	1.16 (0.98–1.37)	1.14 (0.96–1.35)	1.20 (0.79–1.81)	1.21 (0.80–1.82)
Education						
≤12	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
>12	0.60 (0.54–0.66)*	0.77 (0.69–0.85)*	0.70 (0.60–0.82)*	0.90 (0.77–1.07)	0.64 (0.43–0.93)*	0.64 (0.42–0.97)*
Smoking	0.91 (0.76–1.09)	1.11 (0.92–1.34)	1.02 (0.78–1.34)	1.30 (0.99–1.72)	1.23 (0.67–2.27)	1.17 (0.62–2.21)
Alcohol consumption	0.96 (0.73–1.26)	1.02 (0.78–1.34)	1.21 (0.83–1.77)	1.31 (0.89–1.93)	0.76 (0.22–2.56)	0.67 (0.20–2.28)
Tea consumption	1.01 (0.90–1.14)	1.09 (0.96–1.23)	0.92 (0.75–1.14)	0.97 (0.78–1.19)	1.22 (0.75–1.97)	1.22 (0.75–1.97)
Coffee consumption	0.78 (0.71–0.86)*	0.86 (0.78–0.94)*	0.95 (0.81–1.11)	1.01 (0.86–1.18)	0.80 (0.54–1.18)	0.83 (0.56–1.22)
Diet pattern						
Meat intake preferences						
Q1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Q2	0.93 (0.81–1.07)	0.88 (0.76–1.02)	1.03 (0.82–1.30)	0.99 (0.79–1.25)	1.93 (1.12–3.32)*	1.98 (1.14–3.42)*
Q3	0.98 (0.85–1.12)	0.86 (0.75–0.99)*	1.13 (0.90–1.41)	1.02 (0.81–1.29)	1.56 (0.89–2.72)	1.53 (0.87–2.69)
Q4	0.94 (0.82–1.08)	0.81 (0.70–0.93)*	1.44 (1.16–1.80)*	1.24 (0.99–1.56)	1.62 (0.90–2.90)	1.52 (0.84–2.78)
Favor intake preferences						
Q1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Q2	0.98 (0.87–1.11)	1.05 (0.93–1.19)	1.08 (0.87–1.34)	1.16 (0.93–1.45)	0.92 (0.53–1.61)	0.93 (0.53–1.63)
Q3	0.96 (0.84–1.09)	1.11 (0.97–1.26)	1.10 (0.89–1.37)	1.30 (1.04–1.63)*	0.88 (0.51–1.53)	0.90 (0.52–1.57)
Q4	0.93 (0.82–1.07)	1.30 (1.13–1.50)*	0.95 (0.76–1.20)	1.35 (1.06–1.71)*	1.15 (0.67–1.95)	1.28 (0.72–2.24)
Dietary fat intake preferences						
Q1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Q2	1.01 (0.88–1.16)	1.04 (0.90–1.20)	1.05 (0.84–1.32)	1.10 (0.88–1.38)	1.39 (0.74–2.59)	1.48 (0.79–2.78)
Q3	1.01 (0.89–1.16)	1.08 (0.94–1.24)	0.82 (0.65–1.03)	0.88 (0.70–1.11)	2.16 (1.21–3.85)*	2.35 (1.31–4.22)*
Q4	0.98 (0.86–1.12)	1.10 (0.96–1.26)	1.16 (0.94–1.44)	1.29 (1.03–1.60)*	1.79 (0.98–3.27)	1.91 (1.04–3.52)*
Vegetarian consumption	1.07 (0.88–1.31)	1.02 (0.83–1.26)	1.36 (0.98–1.90)	1.26 (0.90–1.75)	0.70 (0.24–2.03)	0.66 (0.23–1.91)
Midnight snack consumption	0.88 (0.79–0.98)*	1.02 (0.91–1.13)	1.00 (0.85–1.18)	1.15 (0.97–1.36)	1.29 (0.87–1.91)	1.30 (0.87–1.93)
Supplement consumption	0.98 (0.88–1.10)	0.95 (0.85–1.07)	0.80 (0.66–0.98)*	0.79 (0.64–0.96)*	0.84 (0.50–1.41)	0.85 (0.51–1.43)
Exercise habits	0.94 (0.85–1.04)	0.72 (0.65–0.80)*	0.90 (0.76–1.06)	0.68 (0.57–0.81)*	0.67 (0.44–1.02)	0.60 (0.39–0.94)*
Metabolic equivalent task						
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
≦10MET/week	0.88 (0.73–1.04)	0.72 (0.60–0.86)*	1.01 (0.76–1.35)	0.84 (0.63–1.12)	0.80 (0.40–1.63)	0.77 (0.38–1.58)
10–20 MET/week†	0.93 (0.80–1.08)	0.74 (0.64–0.86)*	0.76 (0.59–0.99)*	0.61 (0.46–0.79)*	0.65 (0.32–1.30)	0.57 (0.28–1.16)
>20 MET/week	0.98 (0.86–1.12)	0.71 (0.62–0.81)*	0.94 (0.75–1.18)	0.66 (0.52–0.83)*	0.61 (0.33–1.11)	0.54 (0.29–1.00)
Physical activity intensity‡						
Group 1	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Group 2	0.95 (0.86–1.05)	0.73 (0.66–0.81)*	0.90 (0.76–1.06)	0.67 (0.56–0.80)*	0.66 (0.42–1.02)	0.59 (0.37–0.93)*
Group 3	0.75 (0.55–1.04)	0.64 (0.46–0.89)*	0.90 (0.53–1.51)	0.78 (0.46–1.32)	0.82 (0.24–2.84)	0.77 (0.22–2.69)

Adjusted: adjusted for age, marital status, education.

MET = metabolic equivalent task, MetS = metabolic syndrome.

†10 (more than10) to 20 MET/week.

‡According to PAGA, Group1: no exercise; Group2: without vigorous-intensity physical activity; and Group3: with vigorous-intensity physical activity.

**P*-value < .05.

(OR = 1.25, 95% CI: 1.04–1.51), also exerted negative effect on MetS, as shown in Table 5.

4. Discussion

This study indicated that the prevalence rates of MetS in Taiwan were 16.5% in Episode 1, 17.0% in Episode 2, and 18.7% in Episode 3, suggesting that the epidemic had a significant impact on the national health of Taiwan. Particularly, MetS attacked males aged 45 to 64 years old and females aged under 45 years old by OR = 1.56 (95% CI: 1.14–2.13) and OR = 1.89 (95% CI: 1.22–2.92), respectively. The risk factors for MetS were not exercising, frequent flavored food intake, higher dietary fat intake, and tea consumption during epidemic.

According to a study by R. S. Auriemma[27] in Italy, the prevalence of obesity increased from 37.8% to 51.3% and dyslipidemia increased from 28.4% to 48.6% after the end of the lockdown. In addition, studies by Laura Di Renzo[28] and Cheikh Ismail L[29] also showed that the epidemic would increase the weight of the population and that the increase in weight would increase the chance of getting chronic diseases. In this study, it was found that there was a significant increase in weight and waist circumference during the epidemic, as well as an increase in the prevalence rate of MetS. In Taiwan, although the cases of COVID-19 were sporadic during the first wave of epidemic, a soft lockdown was also implemented, an unexpected and unpalatable constrain, probably leading to abrupt modification of lifestyle, embodiment of illustration shown in the prevalence of MetS increased from 16.5% to 18.72%, which is consistent with the above studies.

This study showed that the lifestyle risk factors for MetS in Episode 3 were lack of exercise, frequent flavored food intake, higher dietary fat intake, and tea consumption. Contradictory to previous research, we found tea consumption was a risk

Table 5

Comparison of impact factors of COVID-19 on MetS among epidemic alert periods using logistic regression model.

	Metabolic syndrome					
	Crude OR			Adjusted		
	Episode 1	Episode 2	Episode 3	Episode 1	Episode 2	Episode 3
Overall†	Ref.	1.03 (0.96–1.11)	1.16 (1.00–1.35)*	Ref.	1.03 (0.96–1.11)	1.19 (1.02–1.38)*
<45§	Ref.	1.03 (0.86–1.23)	1.29 (0.91–1.82)	Ref.	1.04 (0.87–1.24)	1.33 (0.94–1.89)
45–64§	Ref.	1.02 (0.93–1.12)	1.22 (1.01–1.49)*	Ref.	1.05 (0.96–1.15)	1.27 (1.05–1.55)*
≥65§	Ref.	1.01 (0.87–1.16)	0.94 (0.69–1.29)	Ref.	1.01 (0.88–1.16)	0.95 (0.70–1.30)
Gender						
Male‡	Ref.	1.00 (0.89–1.12)	1.35 (1.07–1.70)*	Ref.	1.01 (0.91–1.14)	1.38 (1.09–1.74)*
<45§	Ref.	0.94 (0.73–1.21)	0.79 (0.45–1.42)	Ref.	0.94 (0.73–1.21)	0.79 (0.45–1.42)
45–64§	Ref.	0.97 (0.83–1.14)	1.56 (1.14–2.13)*	Ref.	0.97 (0.83–1.14)	1.56 (1.14–2.13)*
≥65§	Ref.	1.10 (0.89–1.37)	1.52 (0.98–2.36)	Ref.	1.11 (0.90–1.38)	1.53 (0.98–2.37)
Female‡	Ref.	1.04 (0.95–1.14)	1.04 (0.86–1.27)	Ref.	1.04 (0.95–1.14)	1.05 (0.86–1.29)
<45§	Ref.	1.08 (0.84–1.38)	1.81 (1.17–2.79)*	Ref.	1.11 (0.86–1.42)	1.89 (1.22–2.92)*
45–64§	Ref.	1.04 (0.93–1.17)	1.06 (0.82–1.37)	Ref.	1.09 (0.97–1.23)	1.11 (0.86–1.44)
≥65§	Ref.	0.94 (0.78–1.13)	0.62 (0.39–0.98)*	Ref.	0.95 (0.79–1.15)	0.63 (0.40–0.99)*
Marital status						
Married	Ref.	1.03 (0.95–1.11)	1.16 (0.98–1.38)	Ref.	1.02 (0.94–1.11)	1.17 (0.99–1.39)
Unmarried/widow/divorced	Ref.	1.07 (0.92–1.23)	1.16 (0.85–1.58)	Ref.	1.05 (0.91–1.22)	1.23 (0.90–1.67)
Education						
≤12	Ref.	1.07 (0.96–1.18)	1.07 (0.85–1.35)	Ref.	1.03 (0.93–1.14)	1.02 (0.81–1.29)
>12	Ref.	1.06 (0.97–1.17)	1.31 (1.08–1.59)*	Ref.	1.03 (0.94–1.14)	1.33 (1.09–1.62)*
Smoking						
No	Ref.	1.02 (0.94–1.11)	1.14 (0.96–1.36)	Ref.	1.01 (0.93–1.10)	1.15 (0.96–1.38)
Yes	Ref.	1.06 (0.93–1.21)	1.22 (0.92–1.61)	Ref.	1.09 (0.95–1.24)	1.27 (0.96–1.69)
Alcohol consumption						
No	Ref.	1.03 (0.95–1.11)	1.13 (0.97–1.33)	Ref.	1.03 (0.95–1.11)	1.16 (0.98–1.36)
Yes	Ref.	1.06 (0.86–1.30)	1.45 (0.94–2.23)	Ref.	1.07 (0.86–1.31)	1.45 (0.94–2.25)
Tea consumption						
No	Ref.	1.04 (0.96–1.13)	1.10 (0.93–1.31)	Ref.	1.04 (0.96–1.12)	1.13 (0.95–1.35)
Yes	Ref.	1.02 (0.88–1.18)	1.37 (1.02–1.84)*	Ref.	1.02 (0.88–1.18)	1.36 (1.01–1.83)*
Coffee consumption						
No	Ref.	0.98 (0.89–1.08)	1.15 (0.94–1.40)	Ref.	0.99 (0.90–1.09)	1.18 (0.96–1.44)
Yes	Ref.	1.12 (1.01–1.24)*	1.20 (0.97–1.50)	Ref.	1.08 (0.97–1.20)	1.20 (0.96–1.50)
Diet pattern						
Meat intake preferences						
Q1	Ref.	0.92 (0.80–1.05)	0.89 (0.67–1.17)	Ref.	0.92 (0.80–1.06)	0.93 (0.70–1.24)
Q2	Ref.	0.93 (0.80–1.07)	1.34 (1.01–1.78)*	Ref.	0.93 (0.80–1.08)	1.38 (1.03–1.85)*
Q3	Ref.	1.09 (0.95–1.25)	1.20 (0.89–1.62)	Ref.	1.09 (0.94–1.26)	1.22 (0.90–1.65)
Q4	Ref.	1.25 (1.08–1.45)*	1.35 (0.96–1.89)	Ref.	1.21 (1.05–1.41)*	1.25 (0.89–1.76)
Favor intake preferences						
Q1	Ref.	0.98 (0.84–1.13)	1.05 (0.75–1.48)	Ref.	0.96 (0.83–1.12)	1.05 (0.74–1.48)
Q2	Ref.	1.06 (0.92–1.22)	1.08 (0.79–1.47)	Ref.	1.03 (0.90–1.19)	1.06 (0.77–1.45)
Q3	Ref.	1.07 (0.93–1.23)	1.12 (0.84–1.51)	Ref.	1.07 (0.93–1.23)	1.13 (0.84–1.52)
Q4	Ref.	1.02 (0.89–1.17)	1.33 (1.02–1.72)*	Ref.	1.01 (0.88–1.17)	1.37 (1.05–1.79)*
Dietary fat intake preferences						
Q1	Ref.	1.03 (0.90–1.18)	1.00 (0.73–1.35)	Ref.	1.03 (0.89–1.18)	1.01 (0.74–1.37)
Q2	Ref.	1.03 (0.90–1.19)	1.08 (0.81–1.44)	Ref.	1.05 (0.91–1.21)	1.10 (0.82–1.47)
Q3	Ref.	0.95 (0.83–1.10)	1.38 (1.04–1.82)*	Ref.	0.96 (0.83–1.12)	1.45 (1.09–1.92)*
Q4	Ref.	1.11 (0.96–1.28)	1.22 (0.88–1.67)	Ref.	1.10 (0.95–1.27)	1.24 (0.90–1.71)
Vegetarian consumption						
No	Ref.	1.05 (0.97–1.13)	1.14 (0.97–1.33)	Ref.	1.04 (0.97–1.12)	1.17 (0.99–1.36)
Yes	Ref.	0.92 (0.72–1.16)	1.44 (0.88–2.35)	Ref.	0.91 (0.71–1.16)	1.39 (0.85–2.29)
Midnight snack consumption						
No	Ref.	1.00 (0.92–1.09)	1.13 (0.93–1.36)	Ref.	1.00 (0.91–1.09)	1.15 (0.95–1.39)
Yes	Ref.	1.09 (0.97–1.23)	1.22 (0.96–1.56)	Ref.	1.08 (0.95–1.21)	1.23 (0.96–1.58)
Supplement consumption						
No	Ref.	1.12 (1.00–1.24)*	1.06 (0.82–1.37)	Ref.	1.11 (0.99–1.24)	1.05 (0.81–1.37)
Yes	Ref.	0.98 (0.90–1.08)	1.23 (1.03–1.48)*	Ref.	0.98 (0.89–1.08)	1.27 (1.06–1.53)*
Exercise habits						
No	Ref.	1.06 (0.98–1.16)	1.22 (1.02–1.46)*	Ref.	1.06 (0.97–1.15)	1.25 (1.04–1.51)*
Yes	Ref.	0.97 (0.86–1.09)	1.04 (0.80–1.35)	Ref.	0.95 (0.84–1.07)	1.03 (0.79–1.34)

COVID-19 = 2019 coronavirus disease, MetS = metabolic syndrome.
†Adjusted: adjusted for gender, age, marital status, education.
‡Adjusted: adjusted for age, marital status, education.
§Adjusted: adjusted for marital status, education.
*P-value < .05.

factor for MetS during the lockdown period.[30–33] Tea drinking in Taiwan often serving as sugar-sweetened beverages is probably one of the causes, especially in bubble tea shops, popular and easily accessible.[34] Up to 2017, high density of bubble tea shops, there were an estimated 21,346 bubble tea shops.[35] Consumption of sugar-sweetened beverages was aggravated by convenient delivery platforms, such as Uber-eat. According to statistics, there were about 45,000 delivery workers in Episode 1, 87,000 in Episode 2, and over 100,000 in Episode 3 in Taiwan.[36] Convenient delivery platforms may contribute to the prevalence of MetS.

In Taiwan, this study is the first nationwide scale study to report boost of the prevalence of MetS during lockdown period. In Episode 3, it was found that males aged 45 to 64 years old were 1.56 times more likely to be at significant risk, and females aged under 45 years old were 1.89 times more likely to be at significant risk. The findings of this study indicated that those at high risk were in the main labor force in Taiwan. In the current labor force structure of Taiwan, the labor force participation rate for males aged 45 to 64 years old is 55.7% and for females aged under 45 years old is 64.8% in 2021.[20] Though we found females is a protective factor in MetS, data from stratified by age and gender show opposite results, that is, risky to females aged under 45 years old; while beneficial to females, older than 65 years old. Attitude or reflection towards lifestyle may diverge due to innate character of different stages of age and tempo of life, especially for the labor force and retirement, a distinct comparison. For example, self-indulgent in comfort food intake may compensate for suffering pressure from working, lockdown, and social distance from epidemic, leading to inadvertently and gradually compromise labor force health.

There are some limitations to this study. First, the study was conducted based on the self-reported dietary habits and lack of estimate of the specific frequency dietary content and portion sizes. Second, the participants of this study may have higher health literacy. Lastly, medication information was not available in the database questionnaire thereby reducing estimate of MetS.

5. Conclusion

This is the first nationwide research relating to the impact of COVID-19 on health status in Taiwan. Our results launch an alarm on deteriorating Taiwan labor force health and provide indicators for health promotion policy.

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