



The role of lifestyle and mental health in the weight change of higher vocational college students in Fuzhou, China during COVID-19

Yimei Li^{*}

Department of Health Management, Fujian Health College, China

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ABSTRACT

Objectives: This study is aimed to explore the influence of higher vocational college students' lifestyle and mental health on weight change in Fuzhou during COVID-19.

Methods: This study adopted the cross-sectional study method and a total of 1426 students (1111 women and 315 men) were recruited from higher vocational college in Fuzhou. The questionnaire mainly included six dimensions: demographic characteristics, anthropometric measurements, dietary habits, physical activity, sleep quality and psychological status.

Results: According to the weight changes, the group was divided into weight loss group, constant weight group and weight gain group. More people in the weight gain group had increased their intake of various foods compared to the other groups ($P < 0.001$), in addition, the number of physical activity decreased and basically unchanged was more, and the number of sedentary time increased and basically unchanged was more in the three groups ($P < 0.001$). The incidence of poor sleep quality (60.3 %, 46.9 %, 57.5 %, $P < 0.001$), depressive symptoms (58.9 %, 47.5 %, 62.0 %, $P < 0.001$) and anxiety symptoms (42.5 %, 35.8 %, 45.3 %, $P = 0.005$) in the weight loss group and the weight gain group were significantly higher than those in the constant weight group. After adjusting for the potential confounders (including age, sex, grade, smoking, drinking, diet, etc.), decreased physical activity, depressive symptoms and anxiety symptoms were independent risk factors for weight gain compared with the constant weight group (OR = 1.643, $P = 0.046$; OR = 1.695, $P < 0.001$; OR = 1.389, $P = 0.020$).

Conclusions: The increased food intake, decreased physical activity, depressive symptoms and anxiety symptoms were positively correlated with weight gain.

1. Introduction

The Corona Virus Disease 2019 (COVID-19) refers to the pneumonia caused by the 2019 novel corona virus infection (Fang et al., 2019; Tingting et al., 2019). The epidemic keep cropping up in the post-pandemic era, and possible outbreaks of different scale at any time, the end of COVID-19 is still a long way off. Various prevention and control measures taken in response to public health emergencies have a profound impact on all aspects of residents' lives, among which higher vocational college students' living habits, including dietary habits, physical activity and sleep quality are particularly affected due to online learning, social distancing, and so on (Sekulic et al., 2022; Cofre et al., 2022; Nobari et al., 2021). Therefore, self-perceived quality of life is a negative evaluation (Lima et al., 2020). In addition, relevant studies have shown that the COVID-19 epidemic will lead to a rise in depression

and anxiety symptoms in the general population (Rodríguez-Larrad et al., 2021) and these effects are often profound and may even peak after an actual pandemic (Ambrosetti et al., 2021), moreover, students are a special group whose mental health is susceptible (Rodríguez-Larrad et al., 2021).

Healthy physical state is the basis of all-round development, and weight is the most frequently used monitoring indicators to evaluate the health condition objectively, which is closely related to human health. There could be many reasons for weight change, among which unhealthy lifestyle of unhealthy diet, lack of physical exercise and sleep deprivation are important influencing factors (Ferrara et al., 2022). In addition, studies have shown that a variety of negative emotional reactions such as anxiety, depression, fear, etc., can also cause weight change (Yazıcı et al., 2022). Thus, it can be seen that the lifestyle and psychological health status of higher vocational students under the

^{*} Address: Department of Health Management, Fujian Health College, 366 Guankou Village, Jingxi Town, Fuzhou 350101, Fujian, China.
E-mail address: 724642494@qq.com.

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COVID-19 epidemic will lead to the change of weight to a certain extent.

To date, there are limited number of studies that have concentrated on the correlation between the lifestyle, mental health and weight change of higher vocational college students under the COVID-19 epidemic. Therefore, the present study is aimed to explore the influence of higher vocational college students' lifestyle and mental health on weight change during COVID-19. Based on existing literature and relevant findings from prior epidemics, we hypothesized that the dietary habits, physical activity, sleep quality and psychological status of higher vocational college students would have negative effects during the epidemic, and analyzed the determinants affecting the weight change of higher vocational college students.

2. Methods

2.1. Study population

This study adopted the cross-sectional study method and a total of 1426 students (1111 women and 315 men, aged ≥ 18) were recruited from higher vocational College in Fuzhou, who were surveyed through online and paper questionnaires from November 18 to December 5, 2022. Data were collected from October 2022, when China was at the peak of the epidemic, with Fuzhou reported far more confirmed cases than before, and the campus was under closed management. The study was approved by the ethics committee of Fujian Health College, and informed consent was obtained from all participants.

2.2. Measures

According to the weight changes, the group was divided into weight loss group, constant weight group and weight gain group. Structured questionnaire was used to conduct the investigation, with a total of 66 closed-end questions, which mainly included six dimensions: demographic characteristics (age, gender, etc), anthropometric measurements (height, weight, Body mass index (BMI)), dietary habits (the intake of various types of food, dietary regularity), physical activity (physical activity time, sedentary time), sleep quality (sleep quality, sleep duration, etc) and psychological status (depressive symptoms, anxiety symptoms). Demographic characteristics, dietary habits, physical activity and body weight changes were collected from self-reported data, with weight gain defined as weight gain of 2 kg or more; weight loss was defined as weight loss of 2 kg or more. BMI was defined as weight in kilograms divided by square of the height in meters. We used the Pittsburgh Sleep Quality Index (PSQI) to evaluate the sleep quality of the participants, and the cutoff value for defining poor sleep quality is > 5 points (Del Brutto et al., 2021). The Patient Health Questionnaire-9 (PHQ-9) was adopted to screen for depressive symptoms in our study, with the total scores ranging from 0 to 27. The PHQ-9 scale score was divided into five categories: normal (0–4), mild (5–9), moderate (10–14), moderate to severe (15–19), and severe (20–27) (Xiao et al., 2019). The Generalized Anxiety Disorder-7 (GAD-7) was adopted to screen for anxiety symptoms in our study, with the total scores ranging from 0 to 21. The GAD-7 scale score was divided into four categories: normal (0–4), mild (5–9), moderate (10–14), and severe (15–21) (Xu et al., 2021).

2.3. Statistical analysis

The SPSS 25.0 software (IBM, Armonk, NY, USA) was used to perform statistical analysis. Continuous variables were expressed as mean \pm standard deviation or median (P25-P75), and categorical variables were presented as count and percentage. Differences in the baseline characteristics were analyzed by ANOVA test, Kruskal–Wallis test and the chi squared test. Multiple logistic regression analysis was employed to determine whether living habits, psychological health are independently associated with weight change. $P < 0.05$ was considered

statistically significant.

3. Results

3.1. Study population characteristics

According to the weight changes, 1426 students were classified into weight loss group ($n = 292$), weight unchanged group ($n = 734$) and weight gain group ($n = 400$) as shown in Table 1. In the three groups, significant changes were observed in age, sex, grade, height, pre-epidemic weight, post-epidemic weight and BMI (all $P < 0.05$), while there were no significant differences in smoking and drinking (all $P > 0.05$).

3.2. Changes in dietary habits and physical activity

Table 2 shows that compared with the weight loss group and the constant weight group, more people in the weight gain group had increased their intake of various foods, including cereals (36.8 %), soybeans (26.8 %), meat and their products (32.5 %), eggs and their products (26.3 %), milk and their products (30.5 %), vegetables (27.3 %) and fruits (31.5 %) ($P < 0.001$), while more people in the constant weight group (very regular 12.6 %; relatively regular 69.5 %) had a regular diet than the other two groups, and the difference was statistically significant ($P = 0.015$). In the three groups, the number of physical activity decreased and basically unchanged was more (reduce 45.2 % vs 30.5 % vs 43.5 %; basically unchanged 40.8 % vs 59.4 % vs 46.3 %; increase 14.0 % vs 10.1 % vs 10.3 %, $P < 0.001$), and the number of sedentary time increased and basically unchanged was more (reduce 8.9 % vs 5.4 % vs 7.8 %; basically unchanged 37.3 % vs 53.4 % vs 45.5 %; increase 53.8 % vs 41.1 % vs 46.7 %, $P < 0.001$). In addition, the proportion of roommates who exercised gradually increased in the groups of physical activity decreased, physical activity unchanged and physical activity increased (42.0 % vs 60.1 % vs 65.4 %, $P < 0.001$) (Fig. 1).

3.3. Sleep quality and psychological status

In the present study, the incidence of poor sleep quality (60.3 %, 46.9 %, 57.5 %, $P < 0.001$) (Fig. 2a), depressive symptoms (58.9 %, 47.5 %, 62.0 %, $P < 0.001$) (Fig. 2b) and anxiety symptoms (42.5 %, 35.8 %, 45.3 %, $P = 0.005$) (Fig. 2c) in the weight loss group and the

Table 1
Baseline data of higher vocational college students with different weight changes in Fuzhou during COVID-19 ($n = 1426$).

	Weight loss group	Constant weight group	Weight gain group	P-value
No of subjects	292	734	400	
Age (years old)	19.0 (18.0–20.0)	19.0 (18.0–19.0)	19.0 (18.0–20.0)	$<0.001^*$
Male (n (%))	84(28.8 %)	134(18.3 %)	97(24.3 %)	0.001*
Grade				0.001*
Freshman year	169(57.9 %)	486(66.3 %)	216(54.1 %)	
Sophomore year	109(37.3 %)	224(30.6 %)	167(41.9 %)	
Junior year	14(4.8 %)	23(3.1 %)	16(4.0 %)	
Alcohol	39(13.4 %)	78(10.7 %)	55(13.9 %)	0.214
Smoker	13(4.5 %)	19(2.6 %)	14(3.5 %)	0.290
Height (cm)	165.0 (160.0–172.0)	163.0 (159.0–168.0)	164.0 (159.0–170.0)	0.001*
Pre-epidemic weight(kg)	65.0 (55.0–81.8)	54.0 (48.0–68.3)	58.0 (49.0–74.5)	$<0.001^*$
Post-epidemic weight(kg)	60.2 (51.0–77.8)	54.0 (48.0–68.3)	60.0 (52.0–80.0)	$<0.001^*$
BMI (Kg/m ²)	21.1 (18.5–27.0)	20.3 (18.4–23.9)	22.1 (19.7–27.8)	$<0.001^*$

BMI, body mass index. * $P < 0.05$. Differences in the baseline characteristics were analyzed by ANOVA test, Kruskal–Wallis test and the chi squared test.

Table 2

Changes in dietary habits and physical activity of higher vocational college students in Fuzhou during COVID-19 (n = 1426). Comparison between weight loss group, constant weight group and weight gain group.

	Weight loss group N (%)	Constant weight group N (%)	Weight gain group N (%)	P-value
Cereals				<0.001*
More than before	30(10.3)	86(11.7)	147(36.8)	
As before	162(55.5)	572(77.9)	229(57.3)	
Less than before	100(34.2)	76(10.4)	24(6.0)	
Soybeans				<0.001*
More than before	26(8.2)	56(7.6)	107(26.8)	
As before	173(59.2)	577(78.6)	233(58.3)	
Less than before	95(32.5)	101(13.8)	60(15.0)	
Meat and their products				<0.001*
More than before	34(11.6)	61(8.3)	130(32.5)	
As before	156(53.4)	564(76.8)	226(56.5)	
Less than before	102(34.9)	109(14.9)	44(11.0)	
Eggs and their products				<0.001*
More than before	31(10.6)	67(9.1)	105(26.3)	
As before	177(60.6)	560(76.3)	241(60.3)	
Less than before	84(28.8)	107(14.6)	54(13.5)	
Milk and their products				<0.001*
More than before	40(13.7)	77(10.5)	122(30.5)	
As before	163(55.8)	560(76.3)	219(54.8)	
Less than before	89(30.5)	97(13.2)	59(14.8)	
Vegetables				<0.001*
More than before	46(15.8)	80(10.9)	109(27.3)	
As before	176(60.5)	563(76.7)	240(60.0)	
Less than before	69(23.7)	91(12.4)	51(12.8)	
Fruits				<0.001*
More than before	55(18.8)	99(13.5)	126(31.5)	
As before	150(51.4)	499(68.0)	204(51.0)	
Less than before	87(29.8)	136(18.5)	70(17.5)	
Water				<0.001*
More than before	60(20.5)	98(13.4)	116(29.0)	
As before	166(56.8)	538(73.3)	223(55.8)	
Less than before	66(22.6)	98(13.4)	61(15.3)	
Dietary regularity				0.015*
Very regular	26(8.9)	92(12.6)	44(11.0)	
Relatively regular	188(64.6)	507(69.5)	260(65.2)	
Irregular	77(26.5)	131(17.9)	95(23.8)	
Physical activity				<0.001*
Reduce	132(45.2)	224(30.5)	174(43.5)	
Basically unchanged	119(40.8)	436(59.4)	185(46.3)	
Increase	41(14.0)	74(10.1)	41(10.3)	
Sedentary time				<0.001*
Reduce	26(8.9)	40(5.4)	31(7.8)	
Basically unchanged	109(37.3)	392(53.4)	181(45.5)	
Increase	157(53.8)	302(41.1)	186(46.7)	

* P < 0.05. Chi-square test was adopted.

weight gain group were significantly higher than those in the constant weight group with statistical significance. There has been a progressive decrease in the three groups of the incidence of mild, moderate, moderate to severe and severe depressive symptoms (P < 0.001)(Fig. 2d), as did the incidence of mild, moderate, and severe anxiety symptoms (P = 0.015) (Fig. 2e).

3.4. Logistic regression of influencing factors of weight change

As shown in Fig. 2, the incidence of poor sleep quality (60.3 % vs 46.9 % vs 57.5 %, P < 0.001), depressive symptoms (58.9 % vs 47.5 % vs 62.0 %, P < 0.001) and anxiety symptoms (42.5 % vs 35.8 % vs 45.3 %, P = 0.005) were significantly different among the three groups. Table 3 shows the results of multivariate logistic regression analysis to further study the influencing factors of weight change that decreased physical

activity, depressive symptoms and anxiety symptoms were independent risk factors for weight gain (OR = 1.643, P = 0.046; OR = 1.695, P < 0.001; OR = 1.389, P = 0.020) compared with the constant weight group after adjusting for the potential confounders (including age, sex, grade, smoking, drinking, diet, etc.). In addition, compared with the constant weight group, no significant relationship was observed between the increased sedentary time, poor sleep quality with weight change (P > 0.05).

4. Discussion

During the outbreak of the epidemic, the lifestyle and mental health of higher vocational college students were affected to varying degrees, such as food intake, physical activity and sedentary time had changed significantly, poor sleep quality, depression symptoms and anxiety symptoms increased significantly compared with before the epidemic. Meanwhile, the research results show that increased intake of various food, decreased physical activity, depression symptoms, and anxiety symptoms were closely linked with weight gain.

In this study, significantly more people in the weight gain group increased their intake of various foods, such as cereals, soybeans and their products, meat and their products, and eggs and their products, compared with those in constant weight group and weight loss groups. From this, we can see that the epidemic certainly played a part in the nutritional status of higher vocational college students, which in turn leads to the change of weight. Relevant studies have shown that during the epidemic, various measures to control the spread of the virus have greatly changed the living habits of vocational college students, among which the changes of dietary structure and physical activity will lead to weight changes to a certain extent (Sekulic et al., 2022), which is consistent with the conclusions of this study. In addition, due to the lack of free time and motivation, physical activity of students is significantly lower than the recommendations of the World Health Organization, which will increase the risk of obesity, cardiovascular disease, cancer and other chronic diseases (Romero-Blanco et al., 2020), and is even associated with decreased physical and mental health, disease-specific behaviors, and increased risk of all-cause mortality (Nobari et al., 2021), consistent with the conclusion of this study that decreased physical activity is positively correlated with weight gain. Interestingly enough, in this study, people with increased physical activity were more likely to find that their roommates had physical exercise behaviors, suggesting that physical activity behaviors of people around can increase the enthusiasm to exercise and play an important role in the development of a healthy and active lifestyle. However, the results also showed that there was no significant influence of sedentary time on body weight, which probably because students spent a lot of time in classroom and electronic products, and there were already adverse phenomena of insufficient activity and long sedentary time among school students before the epidemic (Li and Li, 2022; Carballo-Fazanes et al., 2020).

The results of this study suggest that the incidence of poor sleep quality is higher than 50 %, but there was no significant correlation between poor sleep quality and weight change after controlling for age, gender, diet and other potential influencing factors. Previous studies have shown that poor sleep quality prevails in college students (Carpi et al., 2022), especially public health emergencies and various control measures will increase the stress, activate the hypothalamic-pituitary-adrenal axis leads to sleep disturbances (Lin et al., 2022), followed by an imbalance in cortisol levels, which leads to weight gain. In addition, the change of biological rhythm and the inhibition of melatonin by the tremendous increase in the use of electronics before bed will aggravate the deterioration of sleep quality (Marelli et al., 2021; Barrea et al., 2020). Nevertheless, this is not entirely consistent with the results of this study, the underlying mechanisms may be that eating behavior acts as the mediator between the sleep quality and body weight change. Poor sleep quality can increase the levels of ghrelin and leptin

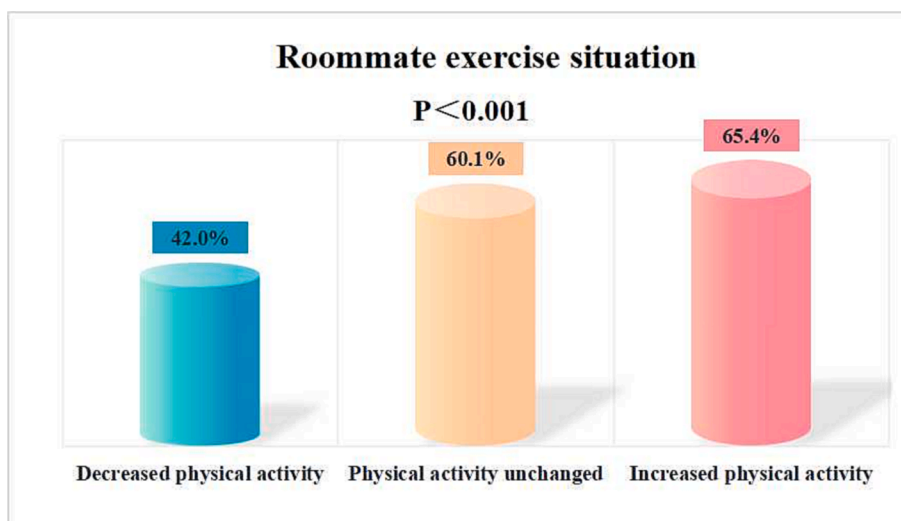


Fig. 1. Physical activity of roommates of all participants in different physical activity groups during COVID-19 (n = 1426): decreased physical activity, 42.00 %; physical activity unchanged, 60.10 %; increased physical activity, 65.40 %; P = 0.000. Chi-square test was adopted.

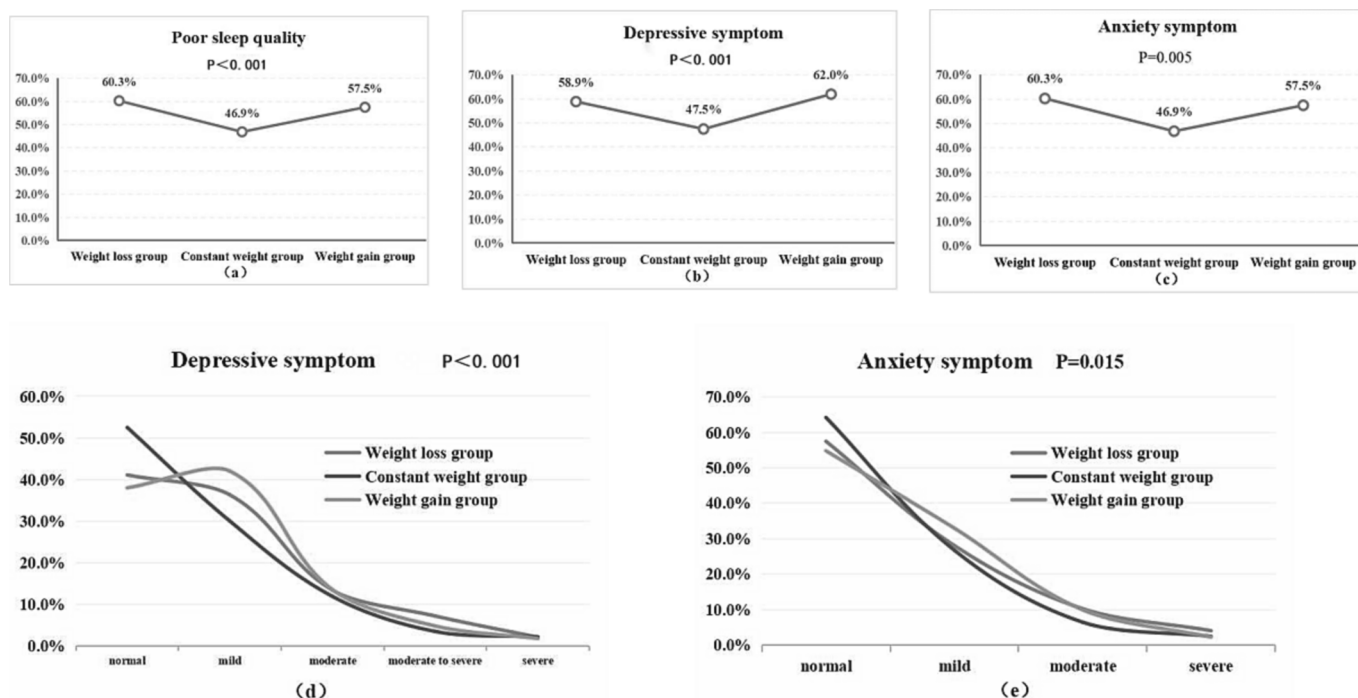


Fig. 2. (a) The incidence of poor sleep quality of higher vocational college students in Fuzhou during COVID-19. (b) The incidence of depressive symptoms of higher vocational college students in Fuzhou during COVID-19. (c) The incidence of anxiety symptoms of higher vocational college students in Fuzhou during COVID-19. (d) The incidence of depressive symptoms with different severity in different weight change groups of higher vocational college students in Fuzhou during COVID-19. (e) The incidence of anxiety symptoms with different severity in different weight change groups of higher vocational college students in Fuzhou during COVID-19. Chi-square test was adopted.

while upping the intake of food especially high-energy food (Du et al., 2021), as a physiological adaptation mechanism of the body. Therefore, no clear associations were observed between poor sleep quality and weight change after adjusting for dietary factors in the study.

A systematic review before the epidemic found that the prevalence of depression and anxiety among Asian college students was 11 % and 7.04 %, respectively (Ma et al., 2020), and depression and anxiety are highly prevalent mental problems among Chinese students (Chen et al., 2021; Liu et al., 2021). Whereas the results of this study suggest that the incidence of depression and anxiety symptoms is far higher than that before the epidemic, and the depressive and anxiety symptoms were

independent risk factors for weight gain compared with the constant weight group after adjusting for potential influencing factors. There is mounting evidence that the occurrence of public health emergencies causes more people at an increased risk from psychological problems, and that young people are more susceptible because they are more mentally immature, more concerned with the possible consequences of the epidemic and face a more indefinite future (Mautong et al., 2021; Kibbey et al., 2021). In addition, studies have shown that young people who were more active before the epidemic were more likely to develop depression due to changes in lifestyle habits (Amerio et al., 2021). Emotional eating is eating as a way to suppress or soothe negative

Table 3

Correlation analysis of influencing factors of body weight change of higher vocational college students in Fuzhou during COVID-19 (n = 1426).

		Multivariate logistic regression analysis	
		OR (95 %CI)	P-value
Decreased physical activity	constant weight group	—	—
	weight loss group	1.151 (0.717–1.847)	0.560
	weight gain group	1.643 (1.008–2.676)	0.046*
Increased sedentary time	constant weight group	—	—
	weight loss group	1.359 (0.985–1.876)	0.062
	weight gain group	1.097 (0.818–1.470)	0.536
Poor sleep quality	constant weight group	—	—
	weight loss group	1.327 (0.982–1.793)	0.066
	weight gain group	1.277 (0.971–1.678)	0.080
Depressive symptoms	constant weight group	—	—
	weight loss group	1.249 (0.923–1.689)	0.150
	weight gain group	1.695 (1.285–2.237)	<0.001*
Anxiety symptoms	constant weight group	—	—
	weight loss group	1.023 (0.753–1.389)	0.887
	weight gain group	1.389 (1.053–1.831)	0.020*

*P < 0.05. Multiple logistic regression analysis was employed to determine whether living habits, psychological health are independently associated with weight change. Adjusted for age, sex, grade, diet, smoking, and drinking.

emotions which is regarded as a vital way between the onset of depression symptoms, anxiety symptoms and weight gain (Konttinen et al., 2019). Related studies have shown that social barrier and emotional eating mediate the development of depression leading to obesity, which is consistent with the findings of this study that the depressive symptoms were associated with weight gain under isolation measures. In addition, studies have suggested that poor sleep quality may reinforce the link between emotional eating and weight gain (Konttinen, 2020), and decreased physical activity is also associated with an increased risk of depression and anxiety (Carballo-Fazanes et al., 2020); which is consistent with the findings of this study.

It should be noted that our study has several limitations. First, the data of the study were mainly collected through questionnaires, which may have recall errors and information bias. Second, we investigated only one wave of COVID-19 infections and lack other epidemiological data that might add more comprehensive insights. Third, the PHQ-2 and GAD-2 scales used to assess depression and anxiety only preliminary screening, and the questionnaire format did not allow any in-depth investigation. Finally, as this was a cross-sectional study, causal associations between lifestyle, mental health and weight change could not be identified, hence, prospective studies are needed to further explore.

To sum up, this study comprehensively evaluated the correlation between dietary habits, physical activity, sleep quality and psychological status of higher vocational college students and weight change during COVID-19. The results indicated that increased food intake, decreased physical activity, depressive symptoms and anxiety symptoms were positively correlated with weight gain. The object of this study is a group of young people who are critical to the development of society. As poor health behaviors become more evident with increasing autonomy with age, there is a greater need for more important information efforts

to improve health behaviors in young people. In addition, although the public is generally concerned about health issues at the moment, the health awareness during public health events is still weak. Our findings can support evidence-based health policies to respond to emerging outbreaks, as well as guide lifestyles, promote mental health, and improve well-being and overall quality of life during future public health events.

CRediT authorship contribution statement

Yimei Li: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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