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Original article

# COVID-19 – Impact of the lockdown on the weight variation among the Lebanese population



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## ARTICLE INFO

### Article history:

Received 2 November 2021

Received in revised form 12 January 2022

Accepted 14 January 2022

Available online 14 February 2022

### Keywords:

COVID-19

Lockdown

Weight fluctuation

Diet

Physical activity

Alcohol

Smoking

## ABSTRACT

The aim of this study is to assess lifestyle changes along with weight fluctuations during the COVID-19 lockdown in Lebanon. This cross-sectional study was conducted using a web-survey disseminated through social media platforms to a large sample of the Lebanese population between May 25th and June 8th, 2020, during the lockdown in Lebanon. Behavioral changes and weight variation during the confinement were assessed. Two thousand one hundred sixty-one participants (64.9% female) aged 18 to 78 years old were included in this study. On average, no net weight variation was reported by the participants. 59.3% of the smokers changed their smoking habits, 40.7% of the drinkers reported a decrease in alcohol consumption, 43.5% of the participants exercised less than one time weekly and 35.8% changed their diet. Increased frequency of physical activity, following a diet during lockdown, decreased weight dissatisfaction ( $P < 0.0001$  for the three variables) were retained as significant factors associated with weight loss. Planning to engage in physical activity post lockdown was associated with weight gain ( $P = 0.021$ ). In the Lebanese population, no net weight variation was reported during the lockdown. Increasing physical activity and initiating diet were associated with weight loss. Healthcare authorities should be alerted about the importance of these factors during the follow-up of the confined population.

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## 1. Introduction

On December 31st, 2019, in the Chinese Wuhan City, the novel coronavirus SARS-CoV-2 was identified, and the first cases of Coronavirus disease (COVID-19) were reported [1]. On March 11, 2020, the World Health Organization (WHO) declared COVID-19 as a pandemic [1]. At the time of this writing, the reported cases of COVID-19 exceeded 190 million worldwide [2] and the disease is responsible for more than 4.08 million deaths [2]. Lebanon was also included among the affected countries with the first identified case of COVID-19 on February 21st, 2020, [3] and more than 550,000 cases reported at the present time [4].

In an attempt to limit the spread of the disease, many countries, including Lebanon, were put under lockdown with restricted movement, social life, contact and curtailed businesses [5,6]. As

a result, daily habits, social interactions, and workout schedules might have been affected [7,8]. The COVID-19 lockdown led to exceptional psychological and environmental consequences, that strongly influenced lifestyle and dietary choices [5,7,9].

According to the Food and Agriculture Organization (FAO), the pandemic and its consequent lockdown disrupted food chains in both supply and demand across the world [10]. In addition, lockdown was found to increase sedentary behavior, which in turn was correlated with worse food intake habits, particularly sugar-sweetened beverages consumption and snacking [8,11–13]. Boredom related to quarantine was also found to cause limited access to fresh food and more consumption of highly processed foods [14]. Therefore, the disruption of dietary patterns can potentially result in weight fluctuation as it was established in the French Darwin Nutrition study where, in the general population, a gain of 2.5 kg was noted as a result of the lockdown [15]. Similarly, two other Italian studies showed changes in the dietary habits upon lockdown [7,14] where 49% of the population estimated a weight gain in the Di Renzo study. In addition, in Poland, the quarantined population manifested dietary habit changes with a weight gain

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in 29.9% of the population and an increase in snacking frequency [8]. Finally, in a recent meta-analysis, body weight was stated as increased in a significant number of individuals (between 11.1 and 72.4%), although a range of 7.2 to 51.4% of individuals reported weight loss [16].

Physical activity (PA) changes may also contribute to weight fluctuation. Despite the sedentary behavior projected by many studies [7,11], an Italian study showed that the population under lockdown increased the frequency of training in subjects who were previously used to participate in PA [14]. Similarly, a Belgian study showed an increase in PA during the lockdown among the studied population [9].

Because a close relationship exists between the quality of consumed food and PA on one side, and the health of a population on another side [8,17], a change in health habits might affect the immune system, the potential vulnerability to SARS-CoV-2 and the outcome of COVID-19. The ensuing risk is heightened in overweight and obese individuals, and those with chronic diseases, especially cardiovascular diseases (CVDs) [8,9,14].

Only one study analyzed the lifestyle of the Lebanese population during the lockdown and found that 32.8% of the population claimed weight gain, with a significant decrease in physical activity engagement [18]. The current study aimed at assessing the dietary and health habit changes along with weight fluctuations as a result of the COVID-19 related lockdown in Lebanon.

## 2. Materials and methods

### 2.1. Study design

This cross-sectional study was conducted using a web-survey (Google Forms®) that was disseminated through social media platforms (WhatsApp®, Facebook® and Instagram®). The questionnaire was anonymous and accessible on any device with Internet connection and was first distributed to a large sample of the Lebanese population between May 25th and June 8th, 2020, hence during the lockdown that started gradually from March 1st and ended on July 1st [19]. The average time interval between the start of the initial lockdown and the collection of survey data (which corresponds to the time for the reported weight change) was  $88.7 \pm 3.3$  days. The study was approved by the Ethics Committee of the Saint-Joseph University (USJ/2020/135).

### 2.2. Questionnaire

The first question was a choice of language (Arabic, French, or English – the three main spoken languages in Lebanon). All participants above 18 were eligible for the study. Following an initial informed consent, the responders had to answer several questions, divided into two sections:

- a socio-demographic section that includes questions inquiring on age, gender, level of education, household income satisfaction and variation, address, confined household size, marital and family status, physical appearance evaluation, smoking and alcohol consumption, comorbidities (diabetes/hypertension/dyslipidemia).
- a section on the behavioral and weight changes during the lockdown that includes questions related to the degree of compliance with confinement measures, initial weight and its variation during the lockdown, weight dissatisfaction, dieting (by asking the participants if they have limited their food intake, which was termed a restrictive diet) and reasons behind it, alcohol and tobacco consumption variation, physical activity frequency and variation, new health habits intentions post-lockdown.

Smoking was categorized as light smoking (< 5 cigarettes/day or ≤ 1 hookah/month), moderate smoking (5 to 25 cigarettes/day or 2 to 8 hookah/month), and heavy smoking (> 25 cigarettes/day or > 8 hookah/month). Alcohol consumption was also categorized as occasional drinking (≤ 1 drink/week), moderate drinking (2 to 15 drinks/week), and heavy drinking (> 15 drink/week).

### 2.3. Sample size determination

The adopted distribution method ensured random responses, and no population parameter could be controlled. Using the following equation (1), the minimal representative sample size corresponds to 384 subjects:

$$n = \frac{tp^2 \times p(1-p) \times N}{tp^2 \times p(1-p) + (N-1) \times y^2} \quad (1)$$

with:

$t_p$ : the sampling confidence interval ( $t_p = 1.96$  for a confidence interval of 0.95).

$p$ : expected proportion of a response from the population fixed at 0.5 by default due to a lack of literature.

$N$ : population size (> 1,000,000).  $y$ : sampling margin of error fixed at 0.05

### 2.4. Statistical analysis

Data are represented as frequencies and percentages with their 95% confidence intervals for categorical variables. Continuous variables were expressed as mean ± standard deviation or as median and its interquartile range following an initial check on normality assumptions using the Shapiro-Wilk test with visual inspection of QQ-plots.

In bivariate analysis, the Spearman correlation coefficient, the Chi square test, the Mann-Whitney U test and the Kruskal-Wallis test were used as appropriate.

A multiple linear regression model was fit to the data using the relative weight variation as a dependent variable and the continuous and categorical variables with a bivariate p-value less than 0.20 as independent factors, following a previous check on the distribution of the dependent variable. The statistical analyses were run using SPSS software (IBM Corp. Released 19, SPSS Statistics for Windows Version 26.0, Armonk, NY). The statistical code and the anonymized dataset are available from the author's institution upon reasonable request.

## 3. Results

### 3.1. Population characteristics

A total of 2161 participants aged between 18 and 78 years old completed the questionnaire, and, following data validation, 2133 responses were retained in the study. The median age was 24 [IQR 22–40] years with a female preponderance (64.9%). Among the participants, 2.4% [95% CI 1.8%–3.1%] were diabetic, 6.7% [5.7%–7.9%] were hypertensive, and 8.1% [7.0%–9.3%] declared having dyslipidemia. Moreover, 28.7% [27.5%–31.4%] were smokers, among them 21.5% were heavy smokers. Alcohol consumption was reported by 31.1% [29.2%–33.1%] of the participants, among them 1.2% were heavy drinkers. The participants' socio-economic status, including level of education, household income satisfaction and variation, marital status, and household size are reported in Table 1.

### 3.2. Behavioral changes upon lockdown

The behavioral changes during the lockdown period are shown in Table 2. Among the participants, 1311 (61.4%) admitted being

**Table 1**  
Sociodemographic and clinical characteristics of the 2,133 participants included in the study.

Variable	Value	Variable	Value
Age in years (Me [IQR])	24 [22–40]	Household income satisfaction	
Female gender	1380 (64.7%)	Not satisfying	797 (37.4%)
Language		Satisfying	1201 (56.3%)
Arabic	787 (36.8%)	Very Satisfying	133 (6.2%)
French	590 (27.7%)	Household income variation	
English	778 (36.5%)	Ceased	123 (5.8%)
Level of education		Significantly decreased	776 (36.4%)
No diploma	9 (0.4%)	Slightly decreased	596 (27.9%)
Brevet diploma	25 (1.2%)	Remained unchanged	556 (26.1%)
Technical diploma	29 (1.4%)	Increased	77 (3.6%)
General Baccalaureate	323 (15.1%)	Confined household size	
Undergraduate diploma	763 (35.8%)	1 person	55 (2.6%)
Graduate diploma	719 (33.7%)	2 persons	140 (6.6%)
Doctorate diploma	273 (12.8%)	3 persons	287 (13.5%)
Diabetes	51 (2.4%)	4 persons	566 (26.6%)
Hypertension	143 (6.7%)	5 persons	604 (28.3%)
Dyslipidemia	172 (8.1%)	6 persons and more	474 (22.2%)
Marital Status		Family Status	
Married	666 (31.2%)	Alone	77 (3.6%)
In a relationship	222 (10.4%)	Single with children	57 (2.7%)
Single	1250 (58.6%)	Couple with children	505 (23.8%)
Perception of physical appearance		Couple without children	75 (3.5%)
Average	793 (37.2%)	Single with parents	1317 (62.1%)
Beautiful	1268 (59.6%)	Couple with parents and children	76 (3.6%)
Below average	68 (3.2%)	Couple with parents, no children	14 (0.7%)
Smoking <sup>a</sup>		Alcohol consumption <sup>b</sup>	
None	1446 (67.6%)	None	1470 (68.9%)
Light smoker	234 (10.9%)	Occasional drinking	539 (25.3%)
Moderate smoker	249 (11.6%)	Moderate drinking	117 (5.5%)
Heavy smoker	132 (6.2%)	Heavy drinking	8 (0.4%)
Former smoker	77 (3.6%)		

<sup>a</sup> Light smoker (<5 cigarettes/day or ≤1 hookah/month), Moderate smoker (5 to 25 cigarettes/day or 2 to 8 hookah/month), Heavy smoker (>25 cigarettes/day or >8 hookah/month).

<sup>b</sup> Occasional drinking (≤1 drink/week), Moderate drinking (2 to 15 drinks/week), Heavy drinking (>15 drink/week).

totally confined, 742 (34.7%) being partially confined and 83 (3.9%) not being confined.

### 3.3. Smoking habits and alcohol consumption

Smoking habits have changed in 59.3% of the smokers: 51.1% of them reported an increase in their smoking habits while 48.9% declared a decrease in smoking. In addition, among nonsmoker 1.3% had their first cigarette during the confinement. Regarding alcohol consumption, 49.6% of the drinkers changed their drinking habits; 17.9% reported an increase of alcohol consumption while 82.1% declared a decrease of consumption. Among the nondrinkers, 0.6% had their first drink during the lockdown.

### 3.4. Physical activity

Participants, for the most part (43.5%), exercised less than once a week, while the remaining engaged in PA weekly (14.1%), more than once a week (26.9%) and daily (15.6%). Roughly, half the participants (47.8%) reported a decrease of their physical activity frequency upon confinement, 27.2% declared an increase in PA frequency and 25% noted no change.

### 3.5. Dietary changes

Nearly one third (35.8%) of the participants started a restrictive diet (by reducing their caloric intake) during the lockdown, mainly for health reasons (46.8%), less frequently (29.8%) for aesthetic reasons, and even less (9.4%) for financial reasons.

### 3.6. Planned behavioral changes after lockdown

Eating healthier upon the end of lockdown was planned by 28.1% of the participants ( $n = 599$ ), while 39.2% ( $n = 836$ ) asserted willingness to follow a strict diet. Of notice, 86.1% of the surveyed people ( $n = 1834$ ) have taken the decision to initiate PA once the lockdown period is over.

The planned behavioral changes after the lockdown period are depicted in [Table 2](#).

### 3.7. Factors significantly affecting weight fluctuation during the lockdown

On average, no net weight variation was reported by the participants. [Table 3](#) summarizes the different factors associated with relative weight variation in the participants. Relative weight gain was weakly correlated with age (Spearman's  $\rho = 0.046$ ,  $P$ -value = 0.044), and moderately correlated with the degree of body weight dissatisfaction (Spearman's  $\rho = 0.307$ ,  $P$ -value < 0.0001). Relative weight variation was influenced by familial status, with the higher weight gain in participants living in couple with their parents and without children (Anova  $P$ -value = 0.008). It was also higher in those dissatisfied with their physical appearance (Anova  $P$ -value = 0.003) and those who are planning to initiate a restrictive diet post lockdown (Anova  $P$ -value < 0.0001). Weight loss was noted in participants who initiated dieting during lockdown (Anova  $P$ -value < 0.0001), increased the frequency of PA (Spearman's  $\rho = -0.251$ ,  $P$ -value < 0.0001), and in diabetic subjects (Anova  $P$ -value = 0.014). Gender, education level, monthly income and its variation during the current economic crisis in Lebanon, the

**Table 2**  
Behavioral changes reported by the study participants during the lockdown period.

Characteristics	Number (%)
Degree of compliance with confinement measures <sup>a</sup>	
Not confined	83 (3.9%)
Partially confined	742 (34.7%)
Totally	1311 (61.4%)
Dieting during confinement	
No diet	1371 (64.2%)
Diet:	765 (35.8%)
For health reasons	358 (16.8%)
For aesthetic reasons	228 (10.7%)
For financial reasons	72 (3.4%)
For other reasons	107 (5.0%)
Weight dissatisfaction	
Very satisfied	345 (16.1%)
Somewhat satisfied	863 (40.4%)
Indifferent	127 (5.9%)
Mostly unsatisfied	493 (23.1%)
Completely unsatisfied	310 (14.5%)
Tobacco consumption variation:	
Started smoking	19 (0.9%)
Increased	183 (8.6%)
Not changed	246 (11.6%)
Decreased	175 (8.3%)
Alcohol consumption variation	
Started drinking	9 (0.4%)
Increased	50 (2.4%)
Not changed	285 (13.5%)
Decreased	230 (10.9%)
Physical activity frequency	
Daily	330 (15.6%)
Several times per week	569 (26.9%)
Weekly	298 (14.1%)
Less than one time per week	922 (43.5%)
Physical activity frequency variation	
Significantly decreased	609 (28.7%)
Slightly decreased	405 (19.1%)
Remained unchanged	529 (25.0%)
Slightly increased	365 (17.2%)
Significantly increased	211 (10.0%)
New health habits intentions post-lockdown	
Eating healthier	599 (28.1%)
Following a strict diet	836 (39.2%)
Engage in PA	1834 (86.1%)

<sup>a</sup> Totally confined (limited displacement for grocery shopping and emergencies), Partially confined (limited displacement for work purposes), Not confined.

number of individuals confined in the household, smoking, drinking, hypertension, and dyslipidemia were not found to be associated with significant relative weight changes.

### 3.8. Multivariate linear regression model with weight variation as a dependent variable

Using a multiple linear regression model, the following factors remained associated with weight variation: frequency of PA, following a diet during lockdown, the degree of weight satisfaction ( $P < 0.0001$  for the 3 variables), and planning PA post lockdown ( $P = 0.021$ ), as depicted in Table 4.

## 4. Discussion

### 4.1. Weight variation

No relative weight variation was found among our study population before and after the lockdown. These results were opposite to those observed in several European countries. A French study reported an average increase of 2.5 kg over 50 days [15], while in a Polish study, 30% of the participants gained on average 3 kg while only 18% lost 2.9 kg over 44 days of lockdown [8]. In addition, 48.6% of Italians stated a perception of weight gain over 36 days [14].

However, other studies found similar results to ours; an Italian study reported that 50.7% of its participants reported no weight gain over 31 days [7], and nearly the same number reported an increase (38.8%) or decrease (31.1%) in bodyweight in a Spanish study over 86 days [20]. Finally, our results are close to the recent Lebanese study published by Cheikh Ismail et al. [18] in which the overall weight change of the population during the lockdown is neutral. In that study, weight was maintained in 34.0% of the individuals whereas 32.8% of them claimed weight gain and 28.9% reported weight loss during the pandemic. Both studies presented quite similar number of participants (2507 for the Cheikh Ismail et al. study vs. 2133 in ours) and population characteristics (female preponderance, younger age (more than 50% less than 25 years old) and high educational level (more than 50% with university degree)). However, in our study, we measured the body weight variation as well as the parameters explaining this variation, findings that were not reported in the Cheikh Ismail study. In addition, our study is probably more representative of the Lebanese population since an almost equal proportion of participants completed the survey in each of the 3 languages whereas in the Cheikh Ismail only 6.6% completed it in French [18].

Nevertheless, the large number of participants who were on a restrictive diet (35.8%) might explain the lack of relative weight variation that was found among our population upon lockdown. Moreover, women, who are over represented in our study, tend to under-report their weight [21] which may also explain our finding. Finally, the COVID-19 lockdown as well as the Lebanese economic crisis have increased food insecurity among the Lebanese population from 27% to 39% resulting in an increase in food prices and a decrease in its availability, which might also explain the absence of weight gain in our study [22].

We then looked at the factors that may affect weight variation during the lockdown; frequency of PA, degree of weight satisfaction, dieting during lockdown and planning to initiate PA after lockdown were the factors that were significantly correlated to weight variation in our population. In opposition, age and gender had no effect on weight variation. A greater weight gain was observed with age in one study [8], a finding that was not noted in other ones [14,15]. The absence of greater weight gain with age could be related to the younger age of our population. A study also described that a greater weight gain occurred in men compared to women; this was attributed to the fact that women are more preoccupied by their weight than men [15].

### 4.2. Physical activity

A decrease in physical activity was noted among the participants of our population during the lockdown (47.8%), which is consistent with the results found in previous studies [7,11,14]. This decrease, along with the increase in sedentary behavior, is predictable during confinement because the freedom of movement was heavily limited. However, a Belgium study found opposite results, maybe because, highly active people were overrepresented in that study [9]. The fact that Belgium adopted a “lighter” lockdown in comparison to other countries that opted to a “stricter” lockdown (Lebanon, France, China...) might also explain the difference between the results of these studies [9]. For those who did increase their physical activity during the lockdown in our study, the health benefits of exercising might have been their source of motivation. Frequency of physical activity during lockdown was strongly correlated with weight loss according to our results ( $P$ -value  $< 0.0001$ ). This might reduce cardiometabolic complications and prevent the onset of most chronic diseases such as obesity, hypertension, and diabetes [11] and subsequently reduce the severity of COVID-19 since cardiometabolic diseases increase the severity of the disease [23,24]. Nevertheless, physical activity during lockdown does not prevent



**Table 3**  
Bivariate analysis of independent factors associated with relative weight variation. Only factors with a p-value less than 0.10 are shown.

Factor, categories	Statistic	Value	Test	P-value
Age	CC	0.046	Spearman	0.044
Weight dissatisfaction	CC	0.307	Spearman	<0.0001
Physical activity frequency	CC	0.160	Spearman	<0.0001
Income variation during economic crisis	CC	-0.038	Spearman	0.095
Family status			Anova	0.008
Living alone	m ± sd	0.5% ± 4.1%		
Living with children, no partner	m ± sd	0.2% ± 5.5%		
Living in couple, with children	m ± sd	0% ± 5%		
Living in couple, no children	m ± sd	0.6% ± 6.1%		
Living with parents	m ± sd	-0.2% ± 4.5%		
Living in couple, with children and parents	m ± sd	0.1% ± 4.2%		
Living in couple, with parents, no children	m ± sd	4.6% ± 4.7%		
Diabetes mellitus	m ± sd	0% ± 4.7%	Anova	0.014
No				
Yes	m ± sd	-1.8% ± 6.5%		
Dieting during lockdown			Anova	<0.0001
No	m ± sd	0.8% ± 4.3%		
Yes, esthetic reasons	m ± sd	-1.5% ± 5.2%		
Yes, health reasons	m ± sd	-1.6% ± 4.7%		
Yes, economic reasons	m ± sd	-0.8% ± 4.7%		
Yes, other reasons	m ± sd	-1.9% ± 5.1%		
Physical appearance evaluation			Anova	0.003
Average	m ± sd	-0.3% ± 4.5%		
Beautiful	m ± sd	0% ± 4.8%		
Below average	m ± sd	1.8% ± 4.9%		
Smoking			Anova	0.071
No smoker	m ± sd	0.1% ± 4.4%		
Occasional smoker	m ± sd	-0.5% ± 5.2%		
Moderate smoker	m ± sd	-0.1% ± 5.1%		
Heavy smoker	m ± sd	0.1% ± 6.2%		
Alcohol consumption			Anova	0.094
None	m ± sd	0.1% ± 4.8%		
Occasional	m ± sd	-0.4% ± 4.3%		
Moderate	m ± sd	0% ± 5.3%		
Heavy	m ± sd	-2.1% ± 4%		
Restrictive diet post-lockdown			Anova	<0.0001
No	m ± sd	-0.4% ± 4.2%		
Yes	m ± sd	0.5% ± 5.5%		

CC: correlation coefficient; m ± sd: mean ± standard deviation; ANOVA: analysis of variance.

**Table 4**  
Multiple linear regression model with relative body weight variation as dependent variable. Independent factors with a bivariate P-value <0.20 were included in the model.

Independent factors	Bêta	SE(Bêta)	P-value	95% Confidence Interval
(Constant)	-1.794	0.665	0.007	-3.099 -0.488
Age	0.001	0.012	0.929	-0.022 0.024
Monthly income	-0.181	0.105	0.084	-0.387 0.024
Weight dissatisfaction	0.997	0.083	0.000	0.835 1.160
Smoking	-0.112	0.094	0.233	-0.295 0.072
Alcohol consumption	0.164	0.103	0.112	-0.038 0.365
Physical activity frequency	0.384	0.096	0.000	0.195 0.572
Gender	-0.180	0.219	0.410	-0.609 0.249
Marital status	-0.204	0.161	0.204	-0.519 0.111
Perception of physical appearance	-0.172	0.198	0.387	-0.561 0.217
Diabetes mellitus	-1.066	0.725	0.142	-2.487 0.356
Dieting during lockdown	-0.785	0.098	0.000	-0.977 -0.593
Restrictive diet plans post-lockdown	0.177	0.231	0.444	-0.276 0.630
Physical activity plans post-lockdown	0.733	0.318	0.021	0.109 1.357

Bêta: multivariate coefficient from the multiple regression model; SE: standard error; PA: Physical activity; Model's R<sup>2</sup> = 15%.

long hours of sedentary behavior which is associated with higher energy intake along with physical and mental health issues [23,24].

### 4.3. Dieting

A significant part of our study population was on a restrictive diet during the lockdown (35.9%), which is in line with other studies [14,20,25], existing health conditions being the main trigger (46.8%). In fact, obesity and cardiovascular diseases are well known risk factors for more severe forms of COVID-19 [26,27]. In addition,

a healthy diet reduces inflammation [28] and improves the immune system's ability to fight against viral infections [29,30].

We also found that adopting a restrictive diet was significantly correlated to weight loss (P < 0.0001). Consequently, it is important to promote a healthy diet during the COVID-19 pandemic because proper diet helps in reducing the effects of COVID-19 [13].

### 4.4. Level of weight satisfaction

It was described that, during the COVID-19 pandemic, the risk of developing dysfunctional eating behavior increased due

to the lockdown-induced stress and anxiety [31–33] leading to an increase in body weight [14]. In fact, weight and body image satisfaction are significantly associated [34], and body weight satisfaction is linked to the psychological state of a person, especially in women (64.9% of our population are women) [35]. Hence, an increase in body weight might worsen the stress and anxiety of the confined population resulting in the entrapment in a vicious cycle. Since body weight satisfaction was significantly associated with weight variation among the participants ( $P$  value  $< 0.0001$ ), health care officers should provide psychological and emotional support to the confined individuals in order to break this vicious cycle and put an end to it.

#### 4.5. Behavioral changes after lockdown

We found that most of our population plan to eat healthier (28.1%), begin a restrictive diet (39.2%) and initiate PA after lockdown (86.1%). Similar results were found in the French population where 56% are planning to eat healthier but only 18% want to begin a restrictive diet [15]. In addition, we found that the people planning to initiate PA post-lockdown were among those who gained weight during the confinement ( $P$  value = 0.021). Health care workers should take advantage of this mindset in order to adjust bad and unhealthy lifestyle habits that were initiated during the lockdown even if the long-term consequences of these habits are still unknown.

#### 4.6. Changes in legal substances consumption during lockdown

##### 4.6.1. Tobacco

Approximately the same proportion of subjects in our study decreased or increased their smoking habits during lockdown (8.6 and 8.3% respectively). In the literature, conflicting results were found among smokers, with some studies showing an increase in smoking [8] while others didn't [8,14,20]. The increase of tobacco consumption could be explained by the stress and anxiety induced by the confinement [36] and by the fact that smoking is a stress-relief [37,38]. In opposition, the decrease of smoking could be explained by the fear of an increased risk of morbidity and mortality related to COVID-19 [39,40]. Finally, our population is a young one and smoking might be a habit that is done in hiding or outdoors, but during lockdown, this was not possible.

##### 4.6.2. Alcohol

A decrease in alcohol consumption was noted among the drinkers of our study population (40.7%). Results of previous studies are mitigated with one study reporting a decrease in consumption [7] while others observed an increase [6,8]. This decrease might be due to many factors; first, alcoholic consumption disorders and alcoholic liver disease are strongly recognized as risk factors of severe cases of COVID-19 [41]. Second, the WHO warns against the potential risks of increased alcohol consumption during the lockdown, because it might increase the incidence of alcohol use disorders [6]. On another hand, the most vulnerable subjects to an increase of alcohol consumption during the confinement are the subjects with low educational level, that have higher levels of perceived stress or those that already have an alcohol use disorder [6,8]. Our participants are highly educated (82.3% are university students or have a university degree) which might explain the absence of increased alcohol consumption during the lockdown. In addition, only 0.4% ( $n = 8$ ) of our population labels as heavy drinkers that might have an alcohol use disorder which also explains the lack of increased alcohol consumption. Finally, our population is mainly a young one and drinking during lockdown might be difficult because of the bars' and restaurants' closure. Nonetheless, public health officers must provide assistance and support to

individuals at risk of developing drinking problems in order to prevent future alcohol use disorders.

#### 4.7. Limitations

Collected data based on self-reported questionnaire was the principal limitation of our study. In fact, there was no way to confirm how trustworthy the collected information is, leading to possible misreported data. Nevertheless, considering the difficulties of conducting such a study during a lockdown, web-survey was the most used means by many researches to reach the participants. Moreover, the study population did not perfectly represent the Lebanese population with an over-representation of women (64.9% of participants are women) and young people, which is often the case in voluntary survey investigations [7,8]. This potential lack of representativeness must be taken into consideration while analyzing the study results. In addition, we were unable to report changes in body mass index since the participants did not report their height. Finally, data on cooking habits or quality of food products consumed, as well as data on weekly duration of exercise were not recorded by the participants, and this may constitute another limitation of the study.

The strength of the study was the number of participants (more than 2000) that took part in the study in a small country like Lebanon (population of 6.8 million people) when compared to other similar studies. Finally, the period of data collection covered almost the whole period of the lockdown which reinforces the collected information.

In conclusion, the Lebanese population did not experience a net overall weight change during the first COVID-19 wave lockdown of the country. The main factors that were independently associated with weight loss were higher frequency of PA and diet initiation during the lockdown, whereas the one that was associated with weight gain was self-perceived weight dissatisfaction. These results should urge the public health authorities to facilitate the integration of physical activities in everyday life as soon as possible, especially since the study revealed that the population having gained weight intends more to initiate physical activity post-lockdown compared to the rest of the population. On the other hand, working on and improving the mental well being of the population is also imperative. Since the pandemic is far from over, promoting PA, a balanced diet and a robust mental health would strengthen individuals' immunity allowing a better resistance against a potential COVID-19 infection.

#### Funding

None.

#### Disclosure of interest

The authors declare that they have no competing interest.

#### Author contributions statement

MI, KI, ZC have performed the recruitment of participants and data collection, GS has performed the statistical analysis and MHGY has supervised the work. All the authors have participated in the writing of the manuscript and approved the final version of the paper.

#### Data availability statement

The data that support the findings of this study are available upon request from the corresponding author.

## Statement of ethics

The study had the approval of the ethics Committee of the Saint-Joseph University (USJ/2020/135).

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