

A STUDY ON WEIGHT CONTROL AND ACTIVITIES OF HEALTH MEMBERS THROUGH THE COVID-19 STAGES

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ABSTRACT

Coronavirus disease 2019 (COVID-19) is a contagious caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Due to COVID-19, the activities and weight control of health members were investigated. Out of 51 participants who completed the general health examination. Crude rate was $68.4\% \pm 2.2$ and standardized rate was $69.5\% \pm 2.3$. For men, diet control (amount of meal: 21.9%, eating out: 7.4%, reducing carbohydrates: 12.5%, and less meat: 13.1%) was higher than increasing exercise as a weight control method. Women preferred exercise the most as a weight control method. Weight was increased during Stage IV of COVID-19. Their skeletal muscle mass (SMM) of most groups decreased slightly through COVID-19 periods regardless of the Stage of COVID-19. PBF increased during the corona period. In Stage IV, the exercise time was shorter than in Stage II, except for running and hiking. Although different from the general public's opinion, they also control their weight by exercising and controlling their meals, but showed that weight gain is accompanied when their activities are limited due to social distancing.

Keywords: COVID-19, health member, skeletal muscle mass, weight.

INTRODUCTION

The SARS-CoV-2-caused COVID-19 pandemic has resulted in a devastating threat to human society in terms of health, economy, and lifestyle (Wood et al., 2020). Staying at home for a prolonged period can lead to disturbing consequences such as weight gain, social isolation (Balanzá-Martínez, 2020). With the current concerns that the pandemic such as recent coronavirus disease (COVID-19) may lead to increases in obesity rates, it's important to develop appropriate and large-scale support options for those aiming to manage their weight. The most important findings of this paper are obesity was an important associated factor for mortality in patients with COVID-19 (Dietz et al., 2020). An increasing body of data suggests that outcomes with Coronavirus Disease 2019 (COVID-19) are worse in those suffering from obesity and that a significant proportion of those needing intensive care suffers from overweight or obesity (Muscogiuri et al., 2020). Bennett et al (2020) investigated the behavior for Health and Wellbeing changes made by members of Slimming World, the UK's largest group-based weight management organization. New members were surveyed regularly over the course of one. The main findings were that both members (59%) and non-members (65%) found it 'very' or 'somewhat' difficult to manage their weight during the COVID-19 situation. Most say their difficulties stemmed from increased snacking, not exercising as much as usual, increased anxiety or stress, and not being able get hold of healthier food.

The worldwide progression in the prevalence of obesity is a marker of the 'evolution' of our lifestyles (the overall quality of our diet and our sedentary habits) that is not always compatible with human health (Blucher, 2019), and many of our living environments have become more

obesogenic. Indeed, the physical demands of many of our jobs have substantially decreased, which has not been accompanied by a compensatory increase in physical activity during our leisure time (Church et al., 2011). Exercise is defined as any movement that makes your muscles work and requires your body to burn calories. There are many types of physical activity, including swimming, running, jogging, walking, and dancing, to name a few. Being active has been shown to have many health benefits, both physically and mentally. However, during the ongoing pandemic, measures taken by governments globally to control the transmission of COVID-19 include 'lock downs' and social distancing (Stockwell et al., 2020; Lee et al., 2020). This has substantially decreased people's daily behaviours, routine and population Stages of physical activity (Tison et al. 2020), which may lead to an unhealthy lifestyle (Piercy et al., 2020).

Nutritional imbalance is a major challenge for living organisms to achieve systemic homeostasis and maintain normal physiology (Alwarawrah et al., 2018). Excess nutrients are converted and stored in adipose tissue, liver, and muscle during times when nutrients are abundant. By contrast, stored nutrients are metabolized to provide energy and building blocks to maintain vital physiological processes when nutrient availability is low. Obesity was a risk factor for both hospitalization and death, exhibiting a dose-response relationship with increasing body mass index (BMI) category: adjusted risk ratios (aRRs) for hospitalization ranged from 1.07 (95% confidence interval [95% confidence interval (CI) = 1.05–1.09]) for patients with a BMI of 30–34.9 kg/m² to 1.33 (95% CI = 1.30–1.37) for patients with a BMI ≥45 kg/m² compared with those with a BMI of 18.5–24.9 kg/m² (healthy weight); aRRs for death ranged from 1.08 (95% CI = 1.02–1.14) for those with a BMI of 30–34.9 kg/m² to 1.61 (95% CI = 1.47–1.76) for those with a BMI ≥45 kg/m² (Kompaniyets et al., 2021).

In this study, we aimed to assess weight changes during the low Stage II and high Stage IV of the COVID-19 in Korea. We also explored the reason of food characteristics of the participants according to weight gain, as well as the impact of physical exercise during lockdown on social distance control.

METHODOLOGY

Subjects

This data was provided by one of the physical health center (gym) at Yeonje-gu, Busan-city in Republic of Korea. Some of the respondents did not want to disclose their affiliation. Therefore, we respect their opinion and did not give specific places. The study subjects were 51 participants as part of a custom report on 2021. Members are ordinary people who came to exercise. The Stage 2 social distancing of COVID-19 was applied to Busan area from Jul 8, 2021 (Thu) until Jul 14 (Wed). Since raising the country's Crisis Alert Stage to the highest (Stage IV) in August 10, 2021 responses to COVID-19, the Busan government in Korea has decided to extend its current social distancing Stages for 4 more weeks. All physical health center or facilities were shut down in the fourth Stages.

The gym was closed and reopened repeatedly due to COVID-19. Body weight, skeletal muscle mass (SPP), and percentage of body fat (PB) were performed using the In-Body (720) body composition analyzer. This equipment has previously been shown to have high test-pretest reliability and accuracy (Galaño et al. 2010; Gibson et al. 2008).

Obesity index

Body mass index (BMI) is a measure of body fat based on height and weight that applies to adult men and women. It is used to screen for weight categories that may lead to health problems.

Quetlet's index (BMI) = Body weight (kg)/Height (m²)
Röhler index (RI) = Body weight (kg)/Height (cm³) x 10⁷

Statistical analyses

Statistical analysis of data is a key step in every scientific researches. Data were analyzed using the SPSS version 21 (SPSS Inc, Chicago, IL) statistical software package (IBM Corp, 2012). The results were submitted to an ANOVA with an F test.

RESULTS

We examined 51 participants of the physical health center (Gym) at the Busan in Republic of Korea. The characteristics of the groups are shown in Table 1. According to gender, men were 37 (52.9%) and women were 34 (47.1%). Looking at the frequency of weight, the percentage of overweight people was 37.3% and obesity was 17.6%.

Table 1. General characteristics of the members of the physical health center in Busan Province

Categories		Frequency	Rate (%)
Gender	Men	27	52.9
	Women	24	47.1
Weight	Underweight	2	3.9
	Normal weight	21	41.1
	Overweight	19	37.3
	Obesity	9	17.6

Weight control attempt rate according to regions was investigated (Table 2). Crude rate was 68.4%±2.2 and standardized rate was 69.5%±2.3. The members of the physical health center in our area had a higher weight control attempt rate than in Busan and were similar to those in Seoul. If there was not significant differences (p<0.05), crude rate and standardized rate in the health center at Yeonje-gu in Busan were showed higher than more large regions (Busan and Yeonje-gu).

Table 2. Weight control attempt rate according to regions

Region	Number	Crude rate (%)	Crude rate SE	Standardized rate (%)	Standardized rate SE
Seoul*	22,925	68.0	0.3	69.5	0.3
Busan*	14,510	60.6	0.5	64.1	0.5
Yeonje-gu*	909	62.6	1.8	65.7	1.9
This study	51	68.4	2.2	69.5	2.3

*Dada are based on KOSIS (2020).

In Korea, at the stage where the number of patients with COVID-19 was small, the frequency of exercise in ports facilities was high (Table 3). There were 39 people doing physical health exercise and 24 people doing walking or running at a low Stage II of COVID-19 control. On the other hand, while the number of COVID-19 patients increased (Stage IV), indoor activities were prohibited, and outdoor activities increased. However, the activity time decreased (data not showed). Most of the activities were weak. In Stage IV, the exercise time was shorter than in Stage II, except for running and hiking (data not showed).

It was found that they walks around rivers in the city center such as the Oncheon River. Climbing was carried out in parallel with walking in the surrounding mountains such as the Baesan Moutain (256.4 m).

Table 3. COVID-19 pandemic Stages and actions related to training of the members of the physical health center in Busan (duplicate allowed)

Rank	May, 2021 (COVID Stage II)	Frequency	August, 2021 (COVID Stage IV)	Frequency
1	Physical health exercise	39	Walking or running	35
2	Walking or running	24	Climbing mountains	30
3	Climbing mountains	18	Out-of-home exercise	18
4	Out-of-home exercise	12	Climbing stairs	12
5	Aerobic	7	Badminton with family	10
6	Domestic exercise	6	Yoga (personal)	6
7	Pilates	5	Bicycle ride	5
8	Yoga (club)	5	Health exercise	2
9	Badminton with family	3	Cooking action	1
10	Swimming	2	Domestic exercise	1

During the COVID-19, women were more active than men as weight control methods (Table 4). For men, diet control (amount of meal: 21.9%, eating out: 7.4%, reducing carbohydrates: 12.5%, and less meat: 13.1%) was higher than increasing exercise as a weight control method. Women preferred exercise the most as a weight control method. There were not showed significance in men and women ($p>0.05$). Since this data were the results of members entering the gym, there might be differences from the results of the common people.

Table 4. How to control your weight during COVID-19? (duplicate allowed)

Method	Men (%)	Women (%)	Total (%)	χ^2
Amount of meal	35 (21.9)	24 (14.1)	59 (17.9)	7.654
Eating out	7 (4.4)	12 (7.1)	19 (5.8)	
Reducing carbohydrates	20 (12.5)	21 (12.4)	41 (12.4)	
Less meat	21 (13.1)	26 (15.3)	47 (14.2)	
Intake vegetabls and fruits	14 (8.8)	23 (13.5)	37 (11.2)	
Exercise	44 (27.5)	50 (29.4)	94 (28.5)	
Diet food	9 (5.6)	8 (4.7)	17 (5.2)	
Taking medicine (herbal medicine, drug)	5 (3.1)	4 (2.4)	9 (2.7)	
Other	5 (3.1)	2 (1.2)	7 (2.1)	
Total	160 (100.0)	170 (100.0)	330 (100.0)	

Characteristics of total weight, skeletal muscle mass (SMM), the percentage of body fat (PBF) are shown on Table 5. Weight was increased during Stage IV of COVID-19. Their skeletal muscle mass (SMM) of most groups decreased slightly through COVID-19 periods regardless of the stage of COVID-19. SMM showed significance in women 20s ($p<0.01$). On the other hand, PBF increased during the corona period.

Table 5. Weight, muscle-fat analysis and change over three months exercise training

Gender (Age)	Measure	Baseline	May	August	<i>F, p</i>
Men (20s)	Total Weight, kg	75.0±2.8	75.2±4.3	75.8±1.3	0.002, NS
	SMM, kg	30.3±2.7	29.5±2.9	28.6±2.8	0.048, NS
	PBF, %	15.0±1.4	14.2±1.3	14.8±1.7	0.347, NS
Women (20s)	Weight	57.8±1.8	58.0±3.0	59.0±1.1	0.586, NS
	SMM	21.0±1.6	20.2±1.5	19.8±1.5	22.412, **
	PBF	29.9±1.6	30.4±1.8	31.0±1.2	0.659, NS
Men (30s)	Weight	78.4±3.4	79.0±2.6	79.6±3.2	0.124, NS
	SMM	34.4±2.8	34.8±4.0	34.4±3.2	1.811, NS
	PBF	14.4±0.6	14.6±1.1	14.7±0.8	0.148, NS
Women (30s)	Weight	58.8±2.4	59.1±1.4	60.0±2.1	0.478, NS
	SMM	23.2±1.3	23.4±1.1	23.2±1.2	0.133, NS
	PBT	31.6±2.1	31.8±1.8	32.2±2.2	0.414, NS
Men (40s)	Weight	76.6±1.5	76.7±2.1	77.3±2.2	0.040, NS
	SMM	31.1±1.8	30.0±1.7	29.7±1.1	0.867, NS
	PBF	11.1±1.3	11.1±1.4	11.0±1.2	0.097, NS
Women (40s)	Weight	59.2±3.1	59.6±2.9	61.0±2.7	0.526, NS
	SMM	23.0±1.6	23.2±1.5	23.0±0.7	0.039, NS
	PBF	32.1±2.0	32.6±0.9	33.2±1.3	0.743, NS
Men (50s)	Weight	74.2±1.3	74.6±2.2	76.2±0.8	0.528, NS
	SMM	30.6±1.8	30.1±2.2	29.3±2.3	0.535, NS
	PBF	19.3±2.7	19.8±3.1	20.4±2.2	0.215, NS
Women (50s)	Weight	59.4±2.1	60.5±1.9	61.8±3.0	0.449, NS
	SMM	22.8±0.5	22.5±1.4	22.4±1.1	0.195, NS
	PBF	33.4±1.1	33.8±0.8	34.4±1.5	0.884, NS

SMM: Skeletal Muscle Mass, PBF: Percentage of body fat. Results are from three experiments and are expressed as mean±SD. NS: Non-significant, $p>0.05$. ** Significant, $p<0.01$.

Figure 1 showed the change of 51 participants of gym members. Men in their 50s gained the most weight (6.7%). On the other hand, women in their 50s gained 3.2% weight.

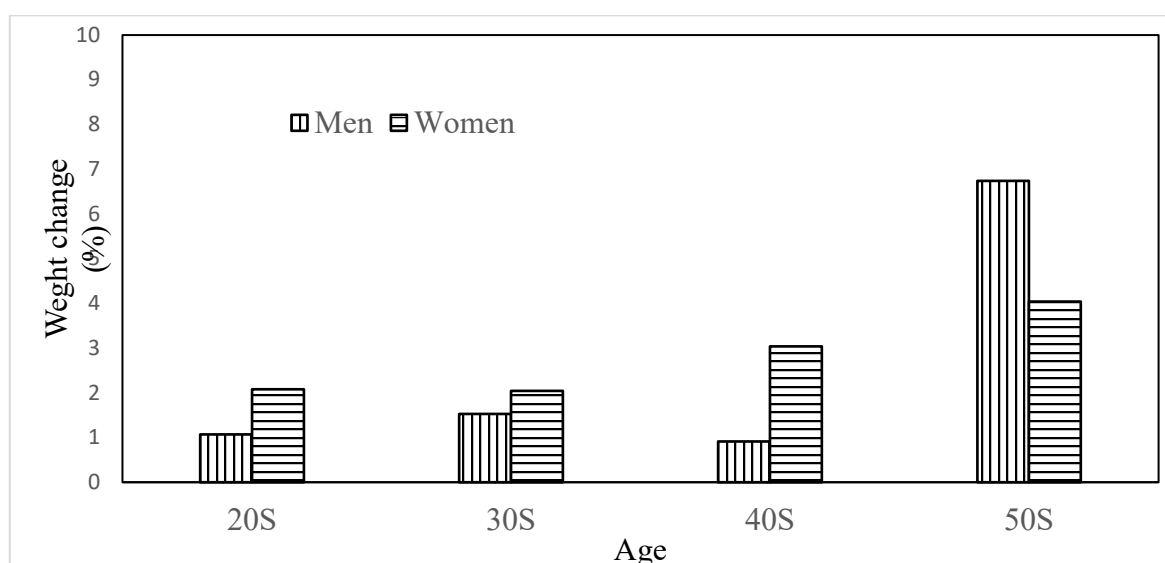


Figure 1. The weight changes of 51 participants (gym members).

Table 6 showed the four main delivery food status of 51 respondents in this study. Chicken was the most delivery food with 20.1 times per month. Stir-fried rice cake (Korean: Tteok-bokki) was the second most delivered food six times per month. These delivery foods are not eaten by all health members, but are family foods, but many calories can lead to obesity.

Table 6. Delivery food, calories, and the numbers of use per month in this 51 participants in this study

Delivery food	Unit	100 g (kcal)	Total (kcal)	No. of uses/Month
Chicken	One whole	265	2,000	20.1
Pizza	One cycle	268	3,000	4.4
Stir-fried rice cake	For 1 person	220	1,800	6.5
Pig hocks	For 1 person	240	2,400	2.5

Figure 2 shows the patterns of exercise activities of health members when people collecting is prohibited due to COVID-19. Walking exercise was the most common activity. This is due to the fact that there is an urban river (Oncheon River) around the residential area and a well-established environment for walking. A climbing mountain (hiking) was also a preferred activity because there was a mountain (Mt. Baesan) with hiking trails nearby.

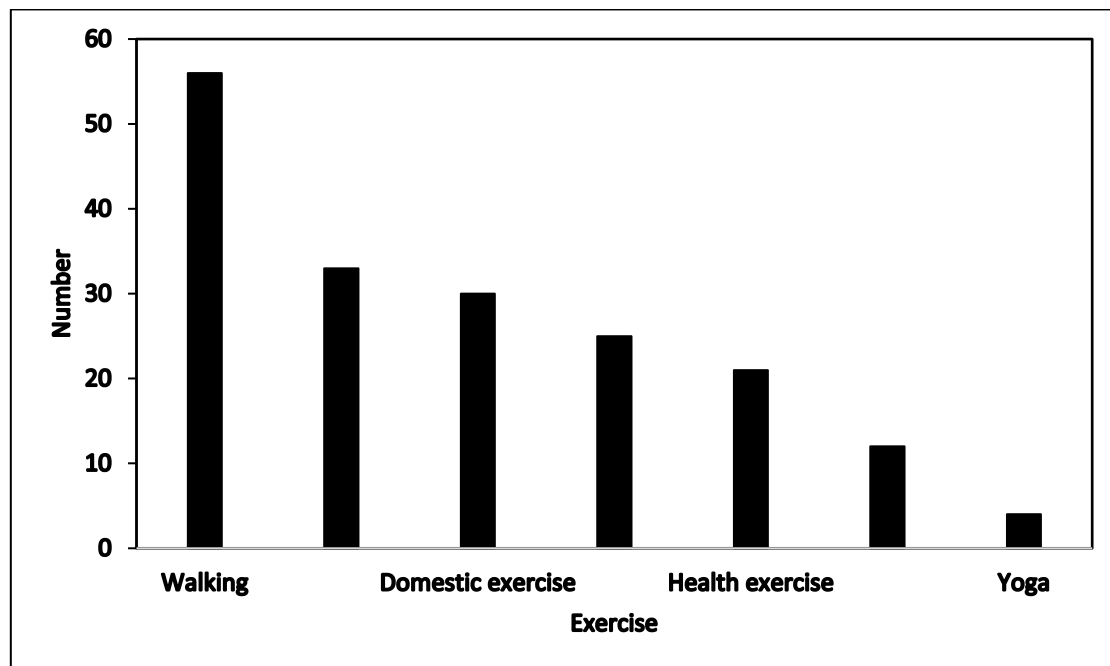


Figure 2. In the event of a ban on gathering due to COVID-19, the pattern of exercise activities of gym members. It allowed duplicate responses to 51 people.

DISCUSSION

Korean Society for the Study of Obesity surveyed on the current state of weight management and obesity awareness in the era of COVID-19 in Korea. In the survey, they compared the amount of exercise, meal, and video viewing time before the outbreak of COVID-19 (as of January of 2020) and now (as of March of 2021), and asked about weight loss methods and

awareness of obesity disease. As a result of the survey, 6% of all respondents gained 3 kg or more after the outbreak of COVID-19, and this rate was higher in women (51%) than men (42%). By age, they were in their 30s (53%), followed by 40s (50%), 20s (48%), and 50s (36%). The main weight gain factors considered by respondents who gained weight were a decrease in the amount of daily activities (56%), followed by a decrease in exercise (31%) and a change in diet (9%).

COVID-19 has raised awareness of health and diet control (Table 7). Table 7 showed the quarterly keyword changes related to home training in Korea (KOSIS, 2021). Interestingly, Koreans valued society and company rather than home, but daily life and home became important keywords due to COVID-19. The importance of immunity increased, and exercise and weight control were preferred in that way (Table 4). In addition, compared to allowing duplicate responses to 51 people, health members did not have a high frequency of delivery food (Table 6).

Table 7. Quarterly actions related to training (20. 04. 01. ~ 21. 3. 31)

Rank	Q2, 2020	Q3, 2020	Q4, 2020	Q1, 2021
1	Exercise	Exercise	Exercise	Exercise
2	Diet	Diet	Diet	Diet
3	Menu	Menu	Health	House
4	House	House	House	Health
5	Health gym	Health gym	Menu	Body
6	Video	Night	Health club	Corona
7	Pilates	Morning	Day	Menu
8	Morning	Daily routine	Posture	Video
9	Exercise Stargram	Corona	Pilates	Health club
10	Daily routine	Exercise Stargram	Health gym	Day

Korea Consumer Agency, Department of Consumer Information & Education, Big Data Analysis Team, Chungcheongbuk-do, Korea

Exercise can help prevent excess weight gain or help maintain weight loss. When you engage in physical activity, you burn calories. The more intense the activity, the more calories you burn. Examples of home exercises not requiring large spaces or equipment while easily practiced at all times of the day include walking, climbing mountains, out-of-home exercise, stair climbing, yoga, Pilates, and so on.

Huh (2019) investigated the effects of the physical activity and intake of improved food levels on male body compositions. The physical activity and intake of improved food levels were contributed with lost a lot of weight, decrease of SMM and body fat.

Food delivery services are well developed in the Republic of Korea (Kwon et al., 2015). The increase of one person households and the success of applications influence delivery services these days. Comparing the average number of uses per day by food industry, chicken (16712.1 cases), Chinese food (13947.5 cases), pizza (4740.8 cases), and jokbal/bossam meal (1988.1 cases) in Korea on 2014. In the COVID-19 era, the increase in burgers and Korean food was more pronounced than chicken. The main reason for this is the increase in the number of meals at home.

Understanding the effects of exercise on food intake is complicated by limitations of methodology (Titchell, 1988). Regularly performed strenuous exercise decreased the amount of food consumed by male rats, resulting in decreased body weight and fat caused by the caloric cost of exercise and the decreased food intake (Staten, 1991). Since increased sedentary behavior could increase the risk for potential worsening of health conditions, health agencies should look for strategies, including digital remote media training to promote physical activity and subsequently, preventing the increased burden of future comorbidities worsening by a sedentary lifestyle (Dor-Haim et al., 2021). In terms of physical activity, sedentary behavior is like to have decreased the basal metabolic correction factor by 10–50% (Amaro-Gahete et al., 2018). Therefore, performing home-based exercises is a behavioral strategy that is strongly encouraged to alter sedentary compartment (Ricci et al. 2020).

This study investigated the weight control and activities of members due to the opening and closing of the gym. Although different from the general public's opinion, they also control their weight by exercising and controlling their meals, but showed that weight gain is accompanied when their activities are limited due to social distancing.

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