Anthropometric and Physiological Parameter Changes in Bodybuilders during the COVID Pandemic

Farnaz Seifi Asgshahr (f.seify@yahoo.com)
Maghsoud Nabilpour
Jerry Mayhow

Research Article

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Abstract

Background

The COVID-19 pandemic infects athletes in different ways. Some ceased their training due to infection. Others reduced training due to closure of sports clubs. Some were able to continiue their training as usual while. The aims of this study were two-fold: (i) test the between-group effect of different levels of training over a 6-week period and (ii) test the within-group changes regarding body composition and fitness levels.

Methods

Thirty-six male bodybuilders (age = 24–33 yrs) with a minimum of two years training experience volunteered to participate. Athletes were categorized as those who were healthy and continued their training program (CTR, n = 12), healthy and ceased their training program (HWT, n = 12), and infected and ceased their training program (INF, n = 12). Participants were measured for maximal muscle strength in a chest press and squat before and after a period of 6-weeks. In addition, skinfolds were used to examine body composition changes over the 6-week period. Pre-pandemic data for anthropometric and physiological parameters of these subjects were available from their club. Before athletes returned to exercise in training groups, cardiovascular symptoms such as chest pain, palpitations, dizziness, syncope, tachycardia, and respiratory symptoms such as cough, sneezing, sore throat, asthma, and bronchial hypersensitivity after infection were assessed and their clinical manifestation reported. Repeated-measures ANOVA wasused to compare pre- and post-parameters, with Tukey post-hoc tests used to assess significance.

Results

Post-test results revealed that bodybuilders who were infected with COVID-19 virus had significantly greater weight and lean body mass losses compared to the other two groups. Also, their 1RM squat and chest press exercises had greater decreased ($p < 0.005$). Clinical manifestations of the virus showed a return to normal ranges following two weeks of training.

Conclusion

Lack of training caused changes in body composition and upper- and lower-body muscle strength of bodybuilders. If cessation of training coincides with the COVID-19 virus, the intensity of these changes were exacerbated. It is recommended that training of those who have recovered from the coronavirus be closely monitored for at least two weeks so that medical actions can be promptly implemented if a clinical incidence occurs.

1. Introduction

COVID-19 disease was declared as a global epidemic on March 11th, 2020, by the World Health Organization (WHO) [1]. Two important activities to lessen the risk of contracting the COVID-19 virus are implementing preventive strategies and having an active lifestyle [2]. Prevention strategies widely accepted around the world include personal protective activities, social distancing, and cleaning up the environment. To protect people from the disease, goverments closed many public places and sports clubs, as well as cancelling sports events. With the closure of sports clubs and gyms, most bodybuilders suffered from under-training or total lack of training. Meanwhile, athletes infected with the COVID-19 virus had to spend time in quarantine with lack of any training. Few studies have evaluated the effect of lack of exercise during the quarantine period [3], leaving questions concerning the time to return to training and intensity of exercise necessary to offset the deleterious effects of the virus. It appears that athletes with minor or moderate level of the disease, after complete recovery with seven to ten days of rest, can return to training. Athletes who require treatment for more than 14 days should be more closely examined by cardiac and respiratory tests before returning to exercise in order to remove the possibility of myocardial infarction and thromboembolic incidents due to the virus [3].

Effects that may happen due to lack of training in quarantine are possible changes in anthropometric and physiological parameters of bodybuilders. The reversibility principle states that when regular exercise activity is significantly reduced or stopped, it causes a partial or complete reduction of anatomical, physiological, and functional adaptations dependant on the duration of lack of training [4, 5]. Therefore, determining the intensity of training for returning to exercise is important, especially for strength athletes who usually exercise with nearly maximum loads or to muscular fatigue. Investigations have shown that excessive physical activity may be associated with impaired immune function, inflammation, oxidative stress, and muscle damage [6, 7]. Inflammatory cytokines are involved in altering immune function following strenuous, long-term exercise as well [8, 9]. This situation is clearly seen in the training of resistance athletes. Neutrophil and NK cell function, cytokines, the expression of major histocompatibility complex type II in macrophages, and markers of immune function are reduced from a few hours to several days after long-term endurance activity and intense activity [10]. However, in people with no training, there will be more severe responses in immune system parameters [11]. Yet, for athletes who have not been able to do continuous exercise for some time due to illness, starting exercise is a very important point in returning to functional capacity without any injury. Actually, immune-specific proteins (lysozyme C, neutrophil elastase, Defensin-1, the antimicrobial peptide cathelicidin) are produced in order to regulate the innate immune response (chemotoxic and translocation), and oxylipines are involved in initiating, mediating, and resolving this process. Other proteins, such as amyloid A4, myeloperoxidase, and complements increase during the recovery phase and act in response to the acute inflammatory phase [13]. These disturbances in metabolism, lipid mediators, and proteins that are induced by exercise have a direct effect on immune function and decrease the capacity of immune cells to increase the rate of oxygen consumption after activation. Primary data showed that the metabolic capacity of immune cell decreases during recovery from periods of intense activity, which leads to transient immune dysfunction [14]. However, more research in this field is required to produce a definitive conclusion. Therefore, investigation of clinical manifestations during exercise and also anthropometric and physiological changes in bodybuilders after recovery from COVID-19 can familiarize sports trainers with the condition of those who have recovered from the disease and provide them an appropriate model for regulating exercise programs. It seems that no study has examined this issue in any sport thus far. Therefore, the purpose of the current study was to compare selected anthropometric and physiological parameters in bodybuilders who experienced different training restrictions due to COVID-19.

2. Materials And Methods

The current study is of quasi-experimental pre-test and post-test type. The basic procedures of this study are shown in Table 1.

Table 1
Checklist of specific measures relevant to the study.

Place of practice and test	**Turqan Sports Complex**
Time of exposure to COVID	May to July
Time to return to training in athletes without training	August
Time to return to exercise in coronary patients	May-October
Exercise completion time	October
Data collection	Before the disease on a monthly basis and the final test in October
Time of conflict with COVID	July to August
Duration without practice	August to September
Temperature	21–23 degrees
Humidity	40–50 percent
Sports activities	They had no exercise other than the training protocol

Place Table 1 about here

Sample size determined by G*Power software using a significance level of p = 0.05 and a power of 0.95 indicated that 36 athletes would be required. Bodybuilers from northwestern Iran (age = 24–33 yrs) with two years of training experience volunteered to participate. All participants were in good physical and mental health and had been training voluntarily for at least six months under the supervision of the team's specialists prior to the pandemic. All had performed resistance training on a regular basis with no injuries that prevented them from participating. All participants consumed two grams of protein per kilogram of body weight daily with 50–55% of their diet consisting of carbohydrates. They did not have other daily training activities and got ample sleep during the night

Procedures

All athletes exercised under the surveillance of a coach. Body composition and physiological profiles were examined monthly before the occurance of the virus. Twelve athletes who continued their training during the pandemia were selected as a continuation group (CTR). Twelve athletes (HWT) who could not continue their training due to the closure of clubs and remained without training for six weeks were selected as the second group. The third group (INF) was 12 athletes who were infected with a mild to moderate COVID-19 virus during the pandemic and were without any training for six weeks. The symptoms of infected athletes were fever, headache, cough, anorexia, joint pain, lethargy, sore throat, fatigue, and dizziness, with only the lungs of three athletes infected with the virus. Their PCR test was negative after 15 days, and it was about three weeks after their infection with the virus before they had no cardiac or respiratory symptoms at the time of the study; therefore, these ahletes did not exercise for six weeks. In the assessment before their return to sports activities, according to previous recommendations [4, 16], cardiovascular symptoms such as chest pain, palpitations, dizziness, syncope, tachycardia, and respiratory symptoms such as cough, sneezing, sore throat, asthma, and postviral bronchial hyperreactivity were examined. Participants were asked to perform on an elliptical trainer for 10 minutes. If the condition of participants did not change, and no muscle pain, fever, and gastrointestinal symptoms were noted, they were allowed to engage in light to moderate exercise and a gradual return to full physical activity [3]. All athletes volunteered to participate and signed an informed consent document. Because participants had previously trained, some of their anthropometric and physiological parameters were measured and recorded in their club every month. Therefore, these records were used as pre-test values. Four weeks after recovery and a negative PCR test, their post-test values for all parameters were measured.

Instruments

In both pre-and post-training stages, skinfolds were measured using Slim Guide calipers according to the criteria of the International Society for the Advancement of Kinanthropometry. All measurements were performed in the afternoon between 1700 and 1900 hours. Each skinfold was measured twice; if readings were more than one millimeter apart, they were measured a third time. Lean body mass (LBM) was calculated as body weight – (weight x %fat/100). Athletes were advised not to eat bulky food for three hours before the test. Athletes had easy access to water while training.

To estimate maximal muscular strength, participants performed a chest press test for upper body and squat test for lower body [15]. Strength tests were performed with the support of two spotters. For maximum measurement, the athlete was instructed to attempt a minimum of two repetitions. If the athlete was successful, a five-minute rest was given, weight was added, and another attempt was made until the athelete could achieve only one repetition.

The training protocol was based on NASM strength and bodybuilding Training warmup and resistance training protocols are shown in Table 2.

Table 2
Training protocol after recovery.

Warm up					
Sport activity	Sets	Duration	Exercising Notes		
Biking	1	5 minutes	Medium speed, low resistance		
Active isolated stretching: stretch the whole body	2	Ten times	Stretch every part 1 to 2 seconds		
Resistance training					
Exercise	Sets	Repetition	Tempo	Rest	IRM
Barbell shoulder press	3	12	2-1-2	90 sec	60%
Standing barbell curl	2	12	2-0-2	60 sec	60%
Hack squat	3	12	2-0-3	90 sec	60%
Barbell skull crushers	3	12	2-0-2	70 sec	60%
Front lat pulldown	3	12	2-1-2	90 sec	60%
Barbell Bench Press	3	12	2-0-2	90 sec	60%
Lying leg curls	3	12	2-1-2	90 sec	60%
Dumbbell Shrugs	3	12	2-1-2	70 sec	60%
Plank	3	45 sec	——	70 sec	body weight
Sport activity	Sets	Duration	Exercising notes		
Biking	1	3 minutes	Low speed, no resistance		
Static stretching: all active muscles	2	10 seconds	Stretch each part for 10 seconds		

Insert Table 2 about here

Statistics

The Wilk-Shapiro test was used to assess the normality of distribution of the data. Descriptive tests (mean and standard deviation) were used to describe data. Mixed ANOVA tests was also used to compare the groups. The Tukey post hoc test was used for an intergroup comparison was significance at $p < 0.05$ using SPSS version 22 software.

3. Results

One-way analysis of variance was used for intergroup comparison for pre-tests. The results showed there was no significant difference among the three groups in any physiological or anthropometric parameters (Table 3).

Table 3
Pre- and post-means for body composition and strength performances.

Variable	**Pre-Test Mean ± SD**			**Post-Test Mean ± SD**		
	CRT (n = 12)	HWT (n = 12)	INF (n = 12)	CRT (n = 12)	HWT (n = 12)	INF (n = 12)
Weight (kg)	82.41 ± 5.93	80.21 ± 7.38	81.50 ± 6.09	83.28 ± 6.19	78.91 ± 7.45	76.75 ± 5.59
LBM (kg)	73.66 ± 6.40	70.80 ± 7.82	71.61 ± 6.50	74.15 ± 6.42	69.16 ± 8.12	66.61 ± 5.96
%fat	10.90 ± 1.13	11.71 ± 1.20	11.50 ± 1.31	10.62 ± 1.01	11.92 ± 1.28	81.91 ± 6.28
Bench Press (kg)	90.16 ± 7.48	88.58 ± 6.59	87.5 ± 6.28	92.41 ± 7.64	85.66 ± 7.02	81.91 ± 6.28
Squat (kg)	114.50 ± 10.14	112.57 ± 12.78	112.33 ± 11.19	117.50 ± 9.87	108.75 ± 12.80	105.25 ± 11.08

Insert Table 3 about here

One-way analysis of variance on post-test results showed that bodybuilders who had the Covid-19 virus (INF) had more weight and lean body mas loss the other two groups (Table 3). In addition, INF had a greater decrease in one-repetition maxima in squat and chest press than the other groups (Table 4).

Table 4
Post-Hoc Tukey between three groups

Indicator			Mean difference	P
Weight	Continues training	Healthy with no training	.054	6.36
		No training with COVID-19	.047	6.53*
	No training with COVID-19	Healthy with no training	.998	.166
LMB	Continues training	Healthy with no training	.021	7.99*
		No training with COVID-19	.007	9.24*
	No training with COVID-19	Healthy with no training	.897	1.25
Body fat percentage	Continues training	Healthy with no training	.007	-1.62*
		No training with COVID-19	.000	-2.70*
	No training with COVID-19	Healthy with no training	.087	1.08
Bench Press	Continues training	Healthy with no training	.061	6.750
Bench 1RM		No training with COVID-19	.002	10.50*
	No training with COVID-19	Healthy with no training	.399	3.75
Squat 1RM	Continues training	Healthy with no training	.157	8.75
		No training with COVID-19	.032	12.25*
	No training with COVID-19	Healthy with no training	.731	4.62

The Tukey post hoc test results showed there were significant differences in weight, lean body mass, percentage of fat, and eupper and lower body strength in bodybuilders (CTR) who continued their training compared the bodybuilders (INF) who could not train due to COVID-19 infection. The differences between bodybuilders who lack training (HWT) and those who were able to continue training (CRT) only occurred in lean mass and fat percentage (Table 4).

Table 5 shows that all clinical manifestations on the virus had disappeared from the third week, and the improved bodybuilders continued their training without any symptoms.

Table 5
Some clinical manifestations of athletes recovering from Coronavirus disease during exercise.

Groups	Status	1st week	2nd week	3rd week
Low blood pressure	yes	2	1	0
	no	10	11	12
Delayed soreness	yes	6	1	0
	no	6	11	12
Hypoglycemia	yes	2	0	0
	no	10	12	12
Shortness of breath during exercise	yes	4	1	0
	no	8	11	12
Joint pain	yes	0	0	0
	no	12	12	12
Coughing	yes	3	2	0
	no	9	10	12
Chest pain	yes	2	1	0
	no	10	11	12
Palpitations	yes	1	1	0
	no	11	11	12
Gastrointestinal problems	yes	2	0	0
	no	10	12	12
Syncope	yes	0	0	0
	no	12	12	12
Tachycardia	yes	0	0	0
	no	12	12	12

4. Discussion And Conclusion

The purpose of the current study was to compare selected anthropometric and physiological parameters among bodybuilders who were virus free and continued to train (CRT) verses those who were virus free but ceased to train (HWT) and those who were infected and ceased to train (INF). Results showed that body weights of athletes infected with COVID-19 (INF) and those who ceased to train (HWT) were significantly reduced compared to healthy athletes who continued to exercise (CTR). The reduction was largerly due to significant decreases in LBM of HWT and INF compared to CTR (Table 5). Examining the components of body composition, it was noted that weight reduction was largely due to decreases in LBM in HWT and INF which did not differ significantly from each other. This agreed with Carvalho et al. [17] who showed that during a three-month period of no training, older women lost an average of three kilograms of body weight, which was accompanied by a reduction in function. Loss of weight might be due to infection of COVID-19 since skeletal muscle has one or more combinations of angiotensin-converting enzymes (ACE2) and transmembrane cellular serine protease type 2 (TMRRSS2) receptors that are potential targets of the virus. Second, muscles may be injured because of the increase in inflammatory cytokines [18]. Another possible reason for these changes in body composition could be related to the side effects of treating the disease with corticosteroids such as dexamethasone and betamethasone. Commensurate with the loss of LBM, %fat in bodybuilders who ceased training (ie., HWT and INF) increased significantly compared to those who connected to train (CTR). This could be expected due to the immobility that often accompanies a lack of training.

The lack of training produced significant reductions in both upper and lower body strengths in HWT and INF compared to CRT (Table 5). Regarding upper body strength, 1RM bench press was reduced by 3.30% in HWT and 6.39% in INF compared an increase of 2.50% in CRT. In lower body strength, 1RM squat was reduced by 3.39% in HWT and 6.30% in INF compared to an increase of 2.62% in CRT. Since there is typically a direct relationship between strength and muscle mass, a major contribution to the decrease in strength can be attributed to the decrease in lean body mass. However, a decrease in neuromuscular coordination cannot be ruled out as a major factor in the decrease in strength. Desser et al. [18] recently reported that one of the systems involved in COVID-19 is the muscular system with a possibility of inflammation and muscle damage due to the virus. In the current study, there were signs of muscle pain in some participants during and after the acute phases of the virus. Muscle pain affects muscle motor neurons and may cause reflex inhibition that could lead to a reduction in muscle strength [19]. In the present study, it was most probably the lack of exercise that was the major reason for the reduction in upper and lower body strengths. This is supported by previous studies that have shown reductions of 4–10% in upper and lower body strengths resulting from 4 to 12 weeks of inactivity [20–22]. Lovell et al. [23] believe the severity of changes during short periods of lack of training may vary depending on initial level of fitness, individual differences in response to lack of training, and age and sex of participants [23]. In fact, even a short period of lack of training in bodybuilding athletes can cause significant changes in physiological and functional capacities [24]. It should also be noted that the decline in physical and mental health of athletes is affected by the limitations and concerns of the quarantine period and the virus itself, especially in areas where the risks of COVID-19 and its consequent death are higher [4]. Even though psychological profiles were not measured in the current participants, it is probable the mental state of those who did not train negatively affected their performmcne. Therefore, it seems prudent to consider the mental state of athletes returning to training following a period of inactivity due to COVID-19.

The findings of this study showed that after complete recovery from COVID-19, participants showed no symptoms of cardiovascular problems. In this regard, Metzl et al. [16] stated that many patients with COVID-19 who have not gone to the hospital were more likely to have no cardiac manifestations and could return to exercise safely. However, before returning to exercise, it is important to make sure that there are no persistent COVID-19-related cardiac complications [3]. In the present study, 33% of the recovered athletes had shortness of breath during exercise in the first week. Recent guidelines recommend ten days or more of rest from onset of symptoms plus an additional seven days after symptoms resolve before returning to activity [25]. Some studies show that recovered patients' arterial oxygen saturation levels during exercise were below 88% [14]. Generally, careful monitoring of respiratory symptoms and a gradual return to activity of recreational athletes suffering from COVID-19 respiratory symptoms are essential. If athletes have a history of underlying lung disease, attention to pulmonary symptoms should be emphasized.

Results of the present study showed that 50% of the recovered athletes had delayed soreness in the first week. In fact, one of the most common musculoskeletal complaints of COVID-19 is myalgia and arthralgia [26]. Myalgia manifests as a symptom in 15% of patients with COVID-19 [26]. Myalgia is usually self-limiting and resolves within a few days to 2 weeks. Like any viral myositis, COVID-19 myalgia care is supportive and includes heat, ice, local analgesia, and/or traction. Intense exercise should be avoided in people with muscle weakness or muscle fatigue. Acetaminophen may also be helpful in controlling pain [3].

Curent results also showed that a small number of recovered bodybuilders experienced gastrointestinal problems during exercising. A study evaluating 116 patients with COVID-19 found that 31.9% experienced gastrointestinal symptoms, of which 22% had nausea and vomiting and 12% had diarrhea [27]. Also, a high percentage of these patients (22%) experienced anorexia. Primary considerations for athletes who have had gastrointestinal manifestations as part of COVID-19 include hydration and availability of energy after returning to exercise after medical treatment [2]. The fluid and calorie intake of athletes should be monitored at all symptomatic stages of the disease, as well as the resolving of symptoms after returning to activity.

Returning to exercise should take into account the type of activity and should occur about two weeks after improving symptoms [16]. Participants in the current study had experienced no symptoms for two weeks and had lack training for four weeks from the infection period until their negative PCR test. Although accurate instructions for returning athletes to sports activities are very limited [18], one study has reported the best time to be more than ten days from the onset of symptoms [29]. However, there is a need for additional research for athletes. The intensity of exercises has operatively been set at about 60% in the first week to reduce the risk of injury due to lack of training and decondition [30, 31].

In summary, absence of training whether due to lack of facilities or viral infection is likely to reduce muscle mass and strength performance in weightlifters. Due to the possible infection of the pulmonary airway, it is recommended that the training of athletes who have recovered from coronavirus be closely monitored for at least two weeks so that medical actions can be promptly implemented if necessary.

Declarations

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All experimental protocol were approved by the) was approved by the Ethics Committee of the University of Mohaghegh Ardabili(IR.UMA.REC.1400.049. written informed consent was obtained from all participants, including agreement of the patients to participate as volunteers and feasibility to leave the study. The authors confirm that all methods were carried out following relevant guidelines and regulations.

Consent for publication

Not applicable

Competing interests

The authors declare no competing financial interests.

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