

# Presentation of COVID-19 Symptoms in Acute and Post-acute Phases in Elite Athletes: Systematic Review

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**Abstract.** Infection with the COVID-19 Virus affects the health level of athletes. There is still a lack of data regarding to the prevalence of COVID-19 in athletes, so other supporting information is required to predict an impact on their health. This study aimed to report the acute and post-acute presentation of COVID-19 in athletes. This systematic review research was obtained through four databases namely Google Scholar, PUBMED, SCOPUS, and SPORTDiscus. Assessment of article quality conducted with The Joanna Briggs Institute (JBI) Critical Appraisal. Then, nine articles were obtained whose research population was elite athletes. Six articles represented acute infection of COVID-19 and three other articles described post-acute infection of COVID-19 in elite athletes. The data of this study from the presentation of COVID-19 in athletes showed that it does not cause symptoms until the symptoms were mild. Meanwhile, in post-acute COVID-19, in most athletes, persistent symptoms can negatively impact their performance, which affects their recovery time.

Keywords: Athlete · COVID-19 · Symptoms

# 1 Introduction

More than 239.4 million confirmed cases of the 2019 coronavirus illness (COVID-19) were reported worldwide as of October 15 2021 [1]. Coronavirus is a large positive enveloped single-stranded RNA virus that infects humans, and a wide variety of animals [1]. The RNA coronavirus COVID-19 is the seventh member of the subfamily Orthocoronavirinae (subgenus Sarbecovirus) [3].

A wide variety of symptoms are linked to COVID-19 infection, so fellow COVID-19 sufferers may not experience the same symptoms as one another [2]. Studies that have been conducted have found results on the impact of mild symptoms that appear when infected with COVID-19, namely fatigue, fever, cough, and myalgia, as well as several additional symptoms including loss of appetite, chest pain, bitter taste and chills, and abdominal pain [3]. While post-acute symptoms that are commonly encountered are fatigue, dyspnea, headache, anosmia, ageusia, chest pain, and joint pain [4]. The study also classifies the severity of COVID-19 into five symptom levels, namely: (1) no symptoms confirmed by PCR test, (2) mild level characterized by general and self-imposed exhaustion, such as smell or taste malfunction, or moderate signs of the upper respiratory tract, such as a headache, a cough, a sore throat, nausea, myalgia, diarrhea, or vomiting, (3) moderate grade, lasting seven days, with symptoms such as chills, fever, hypoxemia (blood oxygen saturation below 95%), tightness in the chest, pneumonia, and dyspnea while exercising; (4) a serious condition that necessitates hospitalization (such as pulmonary fibrosis, a stroke, or myocarditis) or oxygen treatment (including non-invasive ventilation), and (5) a difficult condition that necessitates invasive ventilation treatment [7, 8].

COVID-19 is not just causing infection, but is also affecting human activities without exception, and this is true even though humans are creatures that have to move and move places to perform daily tasks [5]. An athlete is " an individual, whether young or old, amateur or professional, who regularly participates in sports practice and competes in formal sporting contests," according to the European Society of Cardiology (ESC), and more specifically as a result of a sporting career or competitive event [6]. There is currently no information on the frequency of COVID-19 symptoms among competitive athletes. Medically and research shows that most infections have no symptoms or mild symptoms that can heal on their own without specific medical treatment [7]. There is no danger of pericardial or myocardial involvement, arrhythmias, or SCA (Sudden Cardiac Death) [12].

Since the first day of the pandemic, athletes have been exposed to COVID-19, raising concerns about their health. In addition to delaying training and competition plans, COVID-19 has also adversely affected people's health [13]. Future athletes will need to consider the serious effects of insufficient training and poor performance. In isolation, decreased athletic performance happens within 2–4 weeks [14]. According to Halim, one of the factors for a successful athlete can be seen in the athlete's ability to quickly and effectively determine where to move [8]. Athletes with COVID-19 have a reduced ability to move or exercise, which impacts not only their health, but also their ability to perform actively.

Research has not found that athletes affected by COVID-19 have an uncertain risk of affecting the athlete's physique or mobility. This illness can damage the blood and circulatory systems in addition to the lungs [16]. A professional basketball player, aged 27, who passed away suddenly during practice shortly after recovering from COVID-19 was described in a recent paper [17]. A variable frequency of cardiac involvement has been observed in studies of athletes recovering from COVID-19, despite the absence or mildness of symptoms [18]. Despite the initial appearance of symptoms, Athletes and other low-risk individuals could also have persistent symptoms and aberrant results [19].

A systematic review of acute and post-acute manifestations of COVID-19 in athletes has not yet been conducted, to the best of the investigators' knowledge. Understanding how COVID-19 develops in athletes is critical for efficient screening and observing of potentially high-risk people. This study adds to previous research by screening individuals with approved tools for screening for COVID-19 (ie antigens or antibodies and Polymerase Chain Reaction (PCR)) so that athletes can be known with certainty that athletes are infected with COVID-19. Therefore, this systematic review sought to disclose the acute and post-acute presentation of COVID-19 in athletes.

# 2 Method

This study used a systematic review method based on Preferred Reporting Items of Systematic Reviews (PRISMA).

# 2.1 Search Strategy

Searches were conducted across four databases (Google Scholar, PUBMED, SCOPUS, and SPORTDiscus) for relevant studies. A combination of the terms "Symptoms of COVID-19," "acute phase of COVID-19 in elite athletes," and "post-acute phase in elite athletes" are used in the search approach. Studies published between 2019 and September 30, 2022 were the only ones that could be found.

# 2.2 Eligibility Criteria

The inclusion criteria were as follows: (1) include studies with elite athletes with COVID-19; (2) show data on acute or post-acute COVID-19 symptoms; and (3) possess an observational designs. In addition, articles with discussion topics that are not related to athletes infected with COVID-19 were excluded from the search.

# 2.3 Quality Assessment

Utilizing The Joanna Briggs Institute (JBI), which was chosen based on the design of each study included in the evaluation, evaluate and analyze the methodological quality of each study (i.e. cohort and cross-sectional).

# 2.4 Study Selection

The first stage of this study was looking at the title and abstract, followed by screening up to data extraction and combining the data that met inclusion criteria. The full text was read, evaluated, and graded for inclusion independently by the researcher.

The researcher reviews the data and performs the extraction and compares the consistency of the extracted data. If there is inconsistent data, it becomes a consideration for researchers. Each study included the following information: country, participant characteristics (i.e. age, sex, and level of competition), athlete infection rate, exercise mode, technique for COVID-19 diagnosis and standards for judging illness severity, acute symptom characteristics and post-acute symptom characteristics. Symptom severity levels were extracted according to what was said in the initial study.

### 2.5 Data Extraction

Data was independently gathered from the articles to be reviewed. An overview of each article includes authors, population, observational studies, outcome measures, interpretations, and results in terms of symptoms experienced by athletes with acute and post-acute COVID-19 infections. Can be seen in Table 1.

Author	Participants	Measurement	Interpretation	Result			
		Technique		Acute COVID-19	POST-Acute COVID19		
Aleksandra Milovancev et al. (2021)	16 athletes	PCR	Mild symptoms	Fever $(n = 12)$ Cough $(n = 5)$ Fatigue $(n = 10)$ Muscle aches $(n = 8)$ Chest pain $(n = 1)$ Headache $(n = 5)$ Loss of smell and taste $(n = 10)$ Diarrhea $(n = 3)$ Shortness of breath $(n = 1)$ Weight loss $(n = 1)$			
Jarosław Krzywański et al. (2021)	111 athletes	PCR dan Antibody	Mild symptoms and moderate	Fatigue $(n = 62)$ Loss of smell and taste $(n = 62)$ Headache $(n = 55)$ Muscle aches $(n = 42)$ Sore throat $(n = 22)$ Fever $(n = 21)$ Shortness of breath $(n = 19)$ Chills $(n = 19)$ Gastrointestinal discomfort $(n = 11)$ Conjunctivitis $(n = 10)$ Coughing up blood $(n = 1)$			

Table 1. Characteristic of included studie	Table 1.	Characteristic	of in	cluded	studies
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(continued)

Author	Participants	Measurement	Interpretation	Result				
		Technique		Acute COVID-19	POST-Acute COVID19			
Z. J. Madewell et al. (2020)	452 athletes	PCR dan Antibody	Without symptoms and mild	Loss of smell and taste $(n = 2)$ Shortness of breath $(n = 3)$ Without symptoms $(n = 8)$				
Yorck Olaf Schumacher et al. (2021)	1337 athletes and official	PCR	Without symptoms and mild	Without symptoms $(n = 21)$ Mild symptoms (n = 15)				
Ankit B. Shah et al. (2021)	301 athele	PCR dan Antibody	Without symptoms	Without symptoms (n = 28)				
Emese Csulak et al. (2021)	46 athletes	PCR dan Antibody	Without symptoms and mild	Without symptoms (n = 32) Mild symptoms (n = 14)				
Saurabh Rajpal et al. (2020)	26 athletes	PCR	Without symptoms and mild		Without symptoms (n = 14) Mild symptoms (n = 12)			
Klara Komici et al. (2021)	24 athletes	PCR	Mild symptoms		Loss of smell (n = 17) Muscle aches (n = 16) Fatigue (n = 16) Loss of taste (n = 15) Fever (n = 12) Cough (n = 11) Sore throat (n = 9) Shortness of breath (n = 5) Headache (n = 3) Diarrhea (n = 4) Nausea (n = 1)			
Daniel Brito et al. (2021)	54 athletes	PCR dan Antibody	Without symptoms and mild		Without symptoms (n = $16$ ) Mild symptoms (n = $38$ )s			

# Table 1. (continued)

# 3 Result

Initial research turned up 3,344 articles. After the removal of duplicates to 2,215 articles. Screening of titles and abstracts left 39 articles potentially eligible. The following four factors led to the exclusion of a total of 30 journals: (1) they did not contain interesting results (n = 12), (2) they had the incorrect population (n = 4), (3) they contained conference abstracts (n = 11) or editorials (n = 2), and (4) they may have contained overlap between participants (n = 1). The result were 9 articles as a systematic review. The PRISMA flowchart is shown in Fig. 1.

# 3.1 Characteristic of Study

This systematic review included 9 studies and 2367 infected athletes with an average of 263 participants per study. The included studies were conducted in Serbia (n = 1), Poland (n = 1), Qatar (n = 1), Hungary (n = 1), Italy (n = 1), and the United States (n = 4). All studies included adults and young people. Three studies involved only college or university athletes, and six studies only involved professional or elite athletes. Regarding the diagnosis of COVID-19, four studies used only PCR tests, five studies used PCR and antibody or antigen tests. A total of nine studies were reviewed systematically for disease severity, six of which provided the criteria used to define mild, moderate, and severe disease, while three studies did not provide this information. Nine studies reported infection among athletes after recovery or during a sports competition, and studies reporting infection following the COVID-19 protocol.

# 3.2 Quality Assessment Results

Based on the study's cross-sectional (n = 1) and cohort (n = 8) design, the Joanna Briggs Institute (JBI) Critical Appraisal was used. In a cross-sectional study, exposure was evaluated legitimately and reliably, confounding variables were found, techniques to address unclear variables were defined, and suitable statistical analysis was utilized. Among the cohort study designs, there was one that did not identify confounding factors. However, it informs strategies for dealing with them and having exposure measured validly and reliably. The quality assessment results can be seen in Table 2 and Table 3.

### 3.3 Acute COVID-19 Presentations

The data collected were based on 9 articles, three articles described acute COVID-19 data in detail about the symptoms received in athletes who are acutely infected with COVID-19 [9–11], while the other three only briefly explained the categories received as asymptomatic, mild, and moderate in the affected population of COVID-19 [7, 12, 13].

The results of the study revealed that in general the acute symptoms that occurred in the population included loss of smell and taste (n = 74), fatigue (72), headache (n = 60), muscle aches (n = 50), and fever (n = 33)., shortness of breath (n = 23), sore throat (n = 22), chills (n = 19), gastrointestinal discomfort (n = 11), conjunctivitis (n = 10),



Fig. 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases

cough (n = 5), diarrhea (n = 3), chest pain (n = 1), weight loss (n = 1), and coughing up blood (n = 1). Whereas at the combined event level without symptoms (n = 89), then for a combination of several categories (mild, moderate, severe) (n = 414).

Study $(n = 8)$	1	2	3	4	5	6	7	8	9	10	11	Overall
Jarosław Krzywański <i>et al.</i> (2021)	yes	yes	yes	u	u	N/A	yes	yes	yes	yes	yes	Include
Z. J. Madewell <i>et al.</i> (2020)	yes	yes	yes	yes	yes	N/A	yes	u	u	yes	yes	Include
Yorck Olaf Schumacher <i>et al.</i> (2021)	no	yes	yes	yes	yes	N/A	yes	yes	yes	yes	yes	Include
Ankit B. Shah <i>et al.</i> (2021)	yes	yes	yes	yes	yes	N/A	yes	yes	yes	yes	yes	Include
Emese Csulak <i>et al.</i> (2021)	yes	yes	yes	yes	yes	N/A	yes	yes	yes	yes	yes	Include
Saurabh Rajpal <i>et al.</i> (2020)	yes	yes	yes	yes	yes	N/A	yes	yes	yes	yes	yes	Include
Klara Komici <i>et al.</i> (2021)	yes	yes	yes	yes	yes	N/A	yes	yes	yes	yes	yes	Include
Daniel Brito et al.(2021)	yes	yes	yes	yes	yes	N/A	yes	yes	yes	yes	yes	Include

**Table 2.** Study Quality Assessment using The Joanna Briggs Institute (JBI) Critical Appraisal

 Checklist for cohort studies

1. Were the two groups similar and recruited from the same population?

2. Were the exposures measured similarly to assign people to both exposed and unexposed groups?

3. Was the exposure measured in a valid and reliable way?

4. Were confounding factors identified?

5. Were strategies to deal with confounding factors stated?

6. Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?

7. Were the outcomes measured in a valid and reliable way?

8. Was the follow up time reported and sufficient to be long enough for outcomes to occur?

9. Was follow up complete, and if not, were the reasons to loss to follow up described and explored?

10. Were strategies to address incomplete follow up utilized?

11. Was appropriate statistical analysis used?

Answer: (Yes);(No);(Unclear);(Not/Applicable)

**Table 3.** Study Quality Assessment using The Joanna Briggs Institute (JBI) Critical Appraisal

 Checklist for cross sectional studies

Studies	1	2	3	4	5	6	7	8	Overall
Aleksandra Milovancev	yes	Include							
<i>et al.</i> (2021)									

1. Were the criteria for inclusion in the sample clearly defined?

2. Were the study subjects and the setting described in detail?

3. Was the exposure measured in a valid and reliable way?

4. Were objective, standard criteria used for measurement of the condition?

5. Were confounding factors identified?

6. Were strategies to deal with confounding factors stated?

7. Were the outcomes measured in a valid and reliable way?

8. Was appropriate statistical analysis used?

Answer: (Yes);(No);(Unclear);(Not/Applicable).

#### 3.4 Post-acute COVID-19 Presentations

Three articles describe post-acute symptoms of COVID-19. One study provided detailed information about the various symptoms that occurred [14], while the other two studies only summarized reports into categories (without symptoms and mild) [15, 16].

Symptoms that appeared with a high to low number were loss of smell (n = 17), muscle aches (n = 16), fatigue (n = 16), loss of taste (n = 15), fever (n = 12), cough (n = 11), sore throat (n = 9), shortness of breath (n = 5), headache (n = 3), diarrhea (n = 4), and nausea (n = 1). At the combined event rates of asymptomatic (n = 30) and mild symptoms (n = 159).

### 4 Disscusion

This systematic review's goal was to list COVID-19 acute and post-acute symptoms in top-level or professional athletes. For asymptomatic, mild, moderate, and severe illness, event rates were combined. Although the expanding body of research examined here suggests that acute symptoms are frequently minor or nonexistent in this population.

Headache is one of the most common symptoms in the athletes in this study. As a result, people may become detrained during competitions and training periods, especially during competitions. Detraining syndrome is a decrease in status achieved during training [17]. COVID-19 infection causes changes in psychological factors, mood, loss of appetite, fatigue, psychological disturbances, headaches, loss of appetite, and insomnia in athletes who have abstained from exercising for a considerable time [18].

This study characterized how acute symptoms manifest among elite athletes in a pertinent way. The results showed that only a few of the research subjects tested showed mild or even no symptoms. This is achievable because health services and medical personnel assist athletes, allowing for more accurate detection of asymptomatic conditions. In addition, high levels of physical activity and physical fitness may play a

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role in reducing the likelihood of the severity of COVID-19 symptoms, along with additional elements, including quality and dietary components, which may affect an athlete's immune response.

The study population was a heterogeneous group consisting of various sports athletes with different training intensities. Currently, there are no other detailed studies available at this time that have examined the COVID-19 impacts on the performance of the general athlete population. This is the first study to present acute and post-acute symptoms of COVID-19 in athletes with an approved COVID-19 test measuring tool using antigen or antibody and Polymerase Chain Reaction (PCR). The primary shortcoming of this research is that several articles do not summarize the symptoms athletes receive when infected and only mention mild or moderate or severe categories.

### 5 Conclusion

In conclusion, this systematic analysis offers a thorough description of how COVID-19 manifests in athletes and demonstrates that the majority have minimal or no symptoms while the disease is in its acute stage. While the post-acute phase, most of them experience persistent symptoms that can affect the time to recover which can decrease the athlete's performance.

It can be established that a sizable percentage of COVID-19-infected athletes had post-acute symptoms, namely loss of smell (n = 17). From the frequent findings, there was also muscle pain (n = 16) and fatigue (n = 16) which were persistent symptoms in post-acute COVID-19 athletes. It may be said that compared to athletes who have recovered without symptoms, the percentage of athletes who still struggle with COVID-19 recovery appears to be substantially larger. In professional sports, many athletes who have a minor or asymptomatic infection return to action within 5–10 days. It is still unknown how persistent COVID-19 may affect athletes' health, performance, and its predictors over the course of several weeks to months.

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