



## Return to play for athletes after COVID-19

Vračanje športnika v proces treniranja po prebolelem covidu-19

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### Abstract

Most athletes with COVID-19 are asymptomatic or mildly symptomatic, but there are now consistent reports that COVID-19 positive athletes may present with persistent and residual symptoms many weeks to months after initial infection. Most often the respiratory system is affected, but COVID-19 can also entail pathological consequences on other organ systems. Athletes are especially at risk for cardiovascular complications but attention must also be paid to other organ systems (neurological, gastrointestinal, musculoskeletal...) when treating an athlete. COVID-19 can cause myocardial damage among athletes that can be due to myocarditis, which is an important cause of sudden cardiac death among them. The following article describes an approach to return to play after COVID-19 for three different athlete groups: elite athletes, child athletes under 15 years old and highly active recreational athletes. We designed four groups according to the course of COVID-19: asymptomatic athletes, athletes with mild symptoms, moderate to severe or prolonged symptoms ( $\geq 14$  days), and with severe disease that requires hospitalization. The content of the article is adjusted to current knowledge, COVID-19 restrictions, capacity and organization of the health system in Slovenia, and is subject to additional adjustments as new evidence becomes available.

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## Izveček

Večina športnikov s covidom-19 nima simptomov ali pa ima blage simptome, a vse več je primerov, ko simptomi vztrajajo še nekaj tednov do mesecev po okužbi. Najpogosteje so prizadeta dihala, vendar so lahko v sklopu sistemskega vnetja prizadeti tudi drugi organski sistemi. Športnika najbolj ogroža prizadetost srčno-žilnega sistema. Pri obravnavi je potrebno poleg srčno-žilnega sistema in dihal upoštevati tudi druge organske sisteme, ki jih lahko covid-19 prizadene (centralni in periferni živčni sistem, prebavila, skeletne mišice ...). Pri športnikih so v posameznih primerih ugotavljali različno stopnjo prizadetosti miokarda, kar je lahko povezano z razvojem miokarditisa, ki je pomemben vzrok za nenadno srčno smrt športnikov. V prispevku predstavljamo vračanje v proces treniranja po prebolelem covidu-19 za tri skupine športnikov: tekmovalni športniki, športniki otroci (do 15 let) in zelo aktivni rekreativni športniki. Razdelili smo jih v štiri skupine glede na potek covid-19: športniki brez simptomov, športniki z blagimi simptomi, športniki s težjimi ali z vztrajajočimi simptomi ( $\geq 14$  dni) in športniki s težjim potekom bolezni, ki zahteva bolnišnično obravnavo. Vsebina prispevka je usklajena s trenutnim znanjem, z omejevalnimi ukrepi, organizacijo zdravstvenega varstva športnikov in zmogljivostmi zdravstvenega sistema v Sloveniji. Treba jo bo prilagajati novimi dognanjem.

## 1 Introduction

In the autumn of 2020, the second wave of the COVID-19 pandemic spread throughout most of the world. In Slovenia, we also experienced a significant increase in the number of infections, confirming almost 180,000 cases by 12 February 2021 (1). Among them were athletes, mostly asymptomatic or mildly symptomatic. However, there are more and more cases of athletes presenting with symptoms (cough, tachycardia, fatigue, dyspnoea), persisting for weeks to months (2). The respiratory system is most commonly affected, but other organ systems can also be part of a systemic inflammatory process. For athletes, the cardiovascular system damage is most threatening as myocarditis is an important cause of sudden cardiac death among them and can appear in athletes with confirmed COVID-19. Most of the data on cardiovascular complications of COVID-19 has been obtained from the elderly with comorbidities, while the data on cardiovascular complications in athletes remain modest (3). In some studies, signs of myocarditis were found in a high proportion of young elite athletes using cardiac magnetic resonance imaging (cardiac MRI) (15%) (4), while in others, such a high prevalence has not been confirmed (0–3%) (5–8). The results of the latest and at the same time the most comprehensive study, which included 789 professional athletes after infection with the SARS-CoV-2 virus, are consistent with the results of the latter studies. None had a severe disease course and 41.8% were asymptomatic. Before returning to training, troponin concentrations and a 12-lead electrocardiogram (ECG) and echocardiography were performed. Abnormalities were found in 3.8% of athletes, with MRI signs of inflammation (myocarditis or pericarditis) in only 0.6%

(8). The symptoms and signs of myocarditis are varied. It is one of the most common causes of sudden cardiac death among young athletes (2–22%) (9,10) and the most common cause of sudden cardiac death among USA military recruits (11). Sudden cardiac death can occur without preceding symptoms or signs. The most typical are chest pain, palpitations, tachycardia, dyspnoea, syncope, lightheadedness (particularly during exertion) and a significant decline in physical performance. Myocarditis can be asymptomatic or with uncharacteristic symptoms of a viral illness, or it can be fulminant with cardiogenic shock (12). Symptoms and signs of myocarditis can also appear in other cardiovascular or respiratory diseases. Therefore, it is important to combine diagnostic methods for both organ systems when determining their cause. With athletes, it is also important to consider other organ systems COVID-19 can affect (the central and peripheral nervous system, gastrointestinal and musculoskeletal systems ...) (13). Due to the risk COVID-19 poses to athletes, numerous authors from Europe and the USA have already made various recommendations for return to play after COVID-19 (2,13–17). The return to play should always be gradual. In case of confirmed infection with SARS-CoV-2, the athlete should rest for at least 10 days with at least seven of those days being asymptomatic before return to play. During the gradual return to play process, the athlete's heart rate, dyspnoea and well-being (fatigue, myalgias, insomnia) should be monitored during and after training. If symptoms appear when training intensity is increased (tachycardia, dyspnoea, disproportionate to exertion, excessive fatigue, poor regeneration after training), the training intensity should

be reduced and a physician consulted. The return to play process takes 1–2 weeks on average, depending on the sport and possible problems during training intensification. In individual cases, return to play can take three weeks or more (18).

The process of return to play, prepared by members of the Slovenian Sports Medicine Association and the Section for Sports and Exercise Cardiology at the Slovenian Society of Cardiology, is adapted to the restrictive measures against the spread of COVID-19, organization of athlete healthcare and capacity of the healthcare system in Slovenia. It summarizes the knowledge existing to date and is subject to additional adjustments as new evidence becomes available.

## 2 Athlete classification

We divided athletes with proved infection with SARS-CoV-2 into four groups:

1. 1. Asymptomatic athletes with proved infection with SARS-CoV-2.
2. 2. Athletes with mild COVID-19 symptoms (mild fatigue, headache, cough, pharyngitis, coryza, nausea, vomiting, diarrhoea, anosmia/ageusia) which have completely subsided (16).
3. 3. Athletes with moderate to severe COVID-19 symptoms (persistent fever  $\geq 38.0^{\circ}\text{C}$ , chills, severe fatigue, pneumonia, dyspnoea, chest pain, syncope) (16) or persistent symptoms ( $\geq 14$  days) without the need for hospitalization.
4. 4. Athletes with severe COVID-19 who require hospitalization.

Separately we present the management of elite athletes, child athletes under 15 years of age and highly active recreational athletes. It is intended to identify possible damage to the cardiovascular system and respiratory system. For athletes who have never had COVID-19, we propose the same as before – regular pre-participation examinations (PPE).

## 3 Return to play of elite athletes

Elite athletes are athletes who train regularly and participate in national and international competitions.

In the **1<sup>st</sup> group** are asymptomatic athletes with proved infection with SARS-CoV-2. They should self-isolate for 10 days (19). During this period, rest is required with only walking and ordinary activities being allowed; individual training during the self-isolation

period is advised against. As there is currently insufficient scientific basis on the possible effects of SARS-CoV-2 infection on the health of asymptomatic athletes, it is sensible that before return to play, these athletes should undergo a regular PPE, including checking the inflammatory parameters. Return to play should be gradual and at least a week long, depending on the sport and possible problems during training intensification. If any problems appear during the return to play process, a checkup with a specialist in occupational, traffic and sports medicine, subspecialized in sports medicine (in subsequent text: sports medicine specialist) is required. Athletes with previously known respiratory diseases (e.g. asthma) should continue with chronic therapy, modified as needed.

In the **2<sup>nd</sup> group** are athletes with mild COVID-19 symptoms which have completely subsided. They should self-isolate for at least 10 days, starting with the first day of illness (19). They can gradually return to play after they have been asymptomatic for at least seven days and at least 10 days have passed since symptoms started. Return to play should be at least a week long, depending on the sport and possible problems during training intensification. If symptoms do not subside after 14 days or even worsen, the athlete should be managed as group 3 (severe or persistent symptoms). Before return to play, the athletes should be seen by a sports medicine specialist. In addition to a patient history and physical exam directed at the cardiovascular system, an ECG and troponin concentration should be performed. In case of abnormalities or symptoms suggestive of myocarditis (chest pain, palpitations, tachycardia, dyspnoea, syncope), the athlete should be seen by a cardiologist and additional investigations should be performed (echocardiography and, depending on the results, a cardiac MRI and 24-hour Holter monitoring). Finally, if myocarditis is excluded, cardiopulmonary exercise testing (CPET) should be performed. The respiratory system does not need additional investigations. Athletes with previously known respiratory diseases (e.g. asthma) should continue with chronic therapy, modified as needed.

In the **3<sup>rd</sup> group** are athletes with severe or persistent symptoms ( $\geq 14$  days). Before return to play, they should be seen by a sports medicine specialist. In case of persistent respiratory symptoms, a thorough workup is required to exclude thromboembolic events and damage to the respiratory and cardiovascular systems. In addition to patient history and physical exam, a 12-lead ECG, spirometry, chest radiography and blood work (C-reactive protein – CRP, troponin, D-dimer) should

be performed. In case of abnormalities or symptoms suggestive of myocarditis (chest pain, palpitations, tachycardia, dyspnoea, syncope), the athlete should be seen by a cardiologist and additional investigations should be performed (echocardiography and/or cardiac MRI, 24-hour Holter monitoring, CPET). Stepwise management is recommended to avoid maximally straining an already ill athlete. If spirometry reveals obstructive lung disease, further follow-ups by a pulmonologist are required. Investigations to differentiate between de novo asthma and bronchial hyperresponsiveness after an infection are required. Basic tests include the bronchodilator test and exhaled nitric oxide (NO) test to determine inflammation of the airways. Depending on the results of these basic investigations, we decide on further diagnostic tests, such as the bronchoprovocation test. If possible, it is useful to compare the lung function testing results to previous ones. In case of suspicion of involvement of the pulmonary parenchyma, pulmonary vasculature or of thromboembolic complications, the athlete should be seen by a pulmonologist who then decides on further investigations (chest CT to determine both the states of the pulmonary parenchyma and vasculature, diffusing capacity for carbon monoxide – DLCO). If the cause of dyspnoea remains unclear, a CPET can be of help. Return to play depends on the results of these investigations. In case of pathologic findings, appropriate treatment is required according to current recommendations.

If diagnostic investigations fail to show abnormalities, return to play should be more gradual, taking at least 1–2 weeks, depending on the sport and possible problems during training intensification.

In the 4<sup>th</sup> group are athletes who require hospitalization. Before returning to play, in addition to blood work (CRP, troponin, D-dimer), extensive diagnostic procedures should be undertaken by a cardiologist and pulmonologist. The extent of investigations (12-lead ECG, echocardiography and/or cardiac MRI, 24-hour Holter monitoring, spirometry, DLCO, chest radiography, chest CT, CPET) is decided on individually, depending on the investigations already performed during hospitalization and their results. Return to play depends on the results of testing and clinical course. It should always be gradual and take at least 1–2 weeks, depending on the sport and possible problems during training intensification.

Return to play of elite athletes is summarized in [Figure 1](#).

## 4 Return to play of child athletes under 15 years

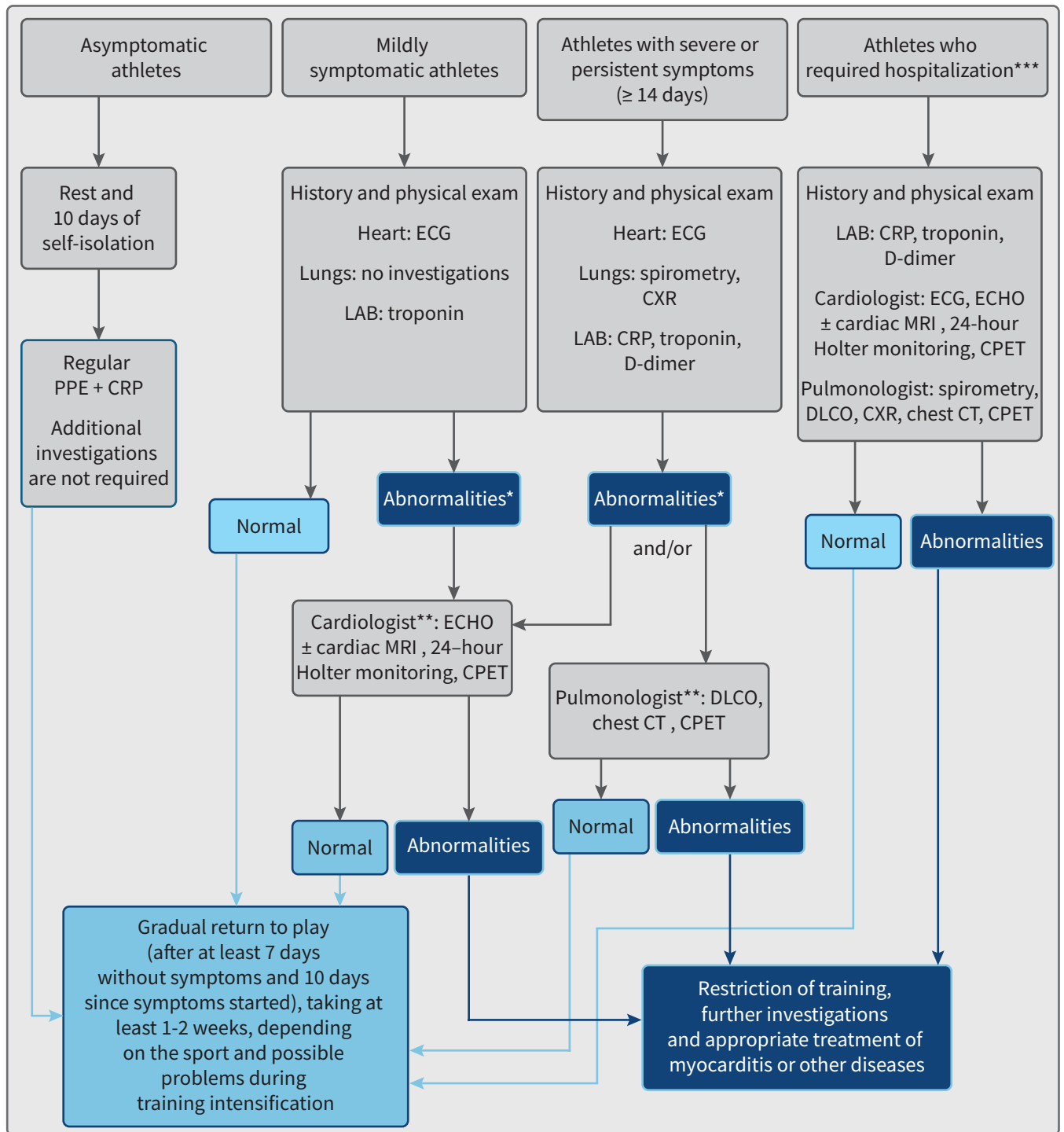
Most children have an asymptomatic or mildly symptomatic COVID-19 course, but in certain cases, multi-system inflammatory syndrome (MIS-C) can develop a few weeks after the infection. The risk of myocarditis in children is low, but myocardial damage can occur as part of MIS-C. Particular care is required in such cases (16). Child athletes aged 15 or more with signs of puberty are managed as adult athletes.

Asymptomatic child athletes under 15 years of age with proved infection with SARS-CoV-2 do not need additional investigations apart from regular PPE or we decide on them individually. Unlike elite athletes, child athletes under 15 years do not require additional investigations after mild COVID-19 apart from regular PPE. Return to play should always be gradual, starting at least seven days after symptoms have subsided and at least 10 days since symptoms started. It should take at least a week, depending on the sport and possible problems during training intensification. In case of problems during the return-to-play process, the child athlete should be seen by a paediatrician or sports medicine specialist to determine the cardiovascular risk and need for additional investigations (12-lead ECG, troponin). Depending on the problems and investigations results, they will decide on a possible referral to a cardiologist or pulmonologist. Child athletes under 15 years with severe or persistent symptoms ( $\geq 14$  days) and all who required hospitalization should be seen by a paediatrician or sports medicine specialist after symptoms subside to determine the cardiovascular risk and need for additional investigations (12-lead ECG, troponin). Depending on the problems and investigations results, they will decide on a possible referral to a cardiologist or pulmonologist. Return to play should be gradual and should not start before 10–14 days after all symptoms have subsided. It should take at least 1–2 weeks, depending on the sport and possible problems during training intensification.

Return to play of child athletes under 15 is summarized in [Figure 2](#).

## 5 Return to play of highly active recreational athletes

Highly active recreational athletes are people who are active several times a week or engage in high-intensity exercise.



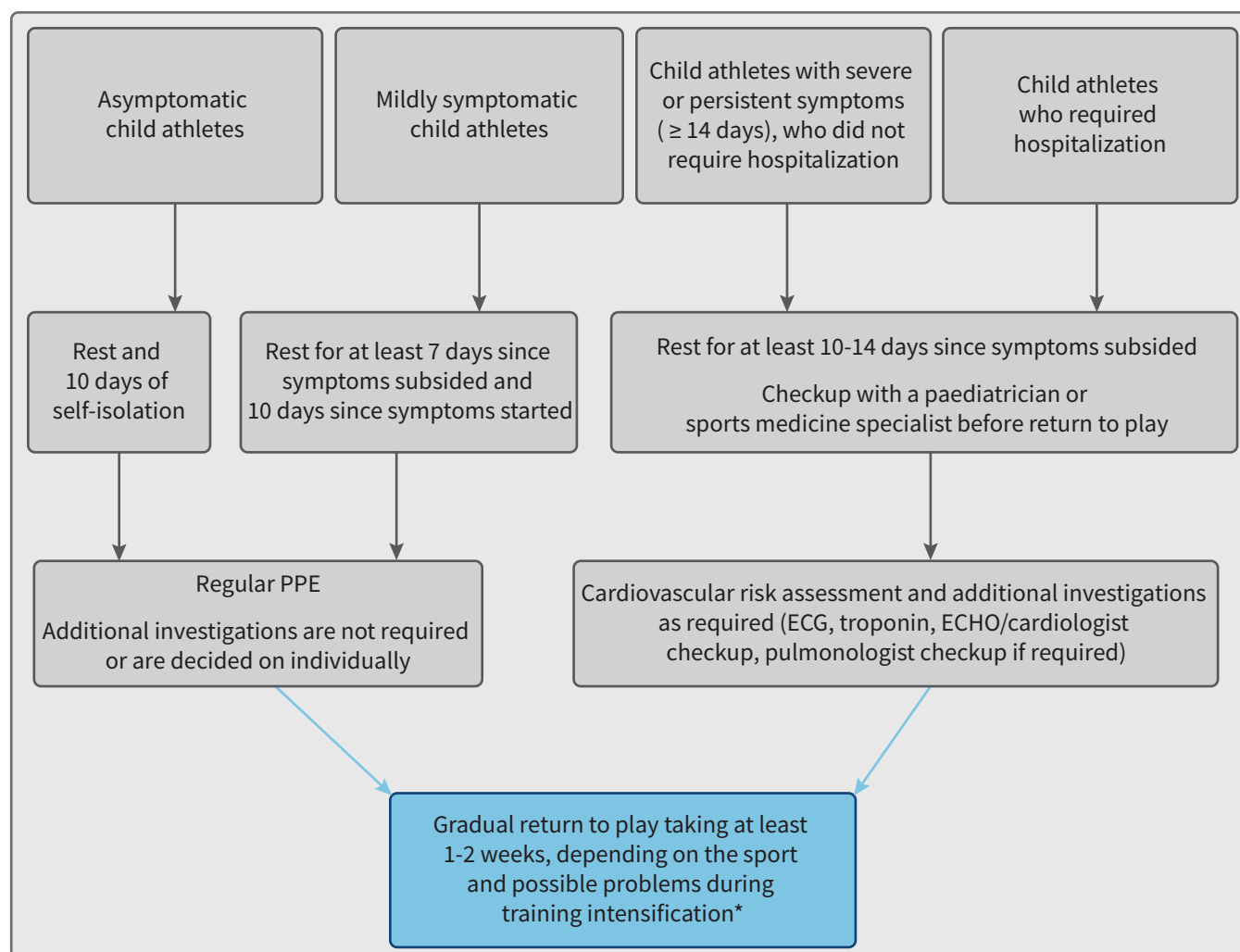
**Figure 1:** Algorithm for return to play of elite athletes after COVID-19.

\* Symptoms suggestive of myocarditis (chest pain, palpitations, tachycardia, dyspnoea, syncope, significant decline in physical performance).

\*\* The extent of investigations should be individualized depending on symptoms and the results of previously performed investigations.

\*\*\* The extent of investigations should be individualized depending on investigations performed during hospitalization and their results.

Abbreviations: PPE – pre-participation examination; CRP – C-reactive protein; ECG – 12-lead electrocardiogram; LAB – laboratory blood tests; ECHO – echocardiography; MRI – magnetic resonance imaging; CPET – cardiopulmonary exercise testing; CXR – chest radiography; DLCO – diffusing capacity for carbon monoxide; CT – computed tomography scan.



**Figure 2:** Algorithm for return to play of child athletes under 15 after COVID-19.

Child athletes over 15 years and with signs of puberty are treated as adult athletes.

\* In case of problems during the return-to-play process, the child athlete should be seen by a paediatrician or sports medicine specialist to determine the cardiovascular risk and the need for additional investigations (ECG, troponin) or to refer the child to a cardiologist or pulmonologist.

Abbreviations: PPE – pre-participation examination; ECG – 12-lead echocardiogram; ECHO – echocardiography.

Asymptomatic highly active recreational athletes with proved infection with SARS-CoV-2 and mildly symptomatic highly active recreational athletes do not need additional investigations before returning to play. It should be gradual and start at least seven days after symptoms have subsided and at least 10 days after the first symptoms appeared. It should take at least a week, depending on the sport and possible problems during training intensification. In case of problems during the return-to-play process, a checkup with a family medicine or sports medicine specialist is required, who will decide on additional investigations (12-lead ECG, troponin, chest radiography, spirometry) or a referral to

a cardiologist or pulmonologist. In addition to highly active recreational athletes with severe or persistent symptoms ( $\geq 14$  days) who did not require hospitalization, there are also athletes over 65 years or with known cardiovascular diseases or risk factors in the 3rd group. To decide on return to play, a checkup with a family or sports medicine specialist is sensible once acute symptoms subside. Depending on symptoms, the specialist will decide on additional investigations (e.g. a 12-lead ECG, troponin, CRP, D-dimer, chest radiography, spirometry). If all results are normal, a gradual return to play is required, which should not start before 10–14 days after all symptoms have subsided and should take

at least 1–2 weeks, depending on the sport and possible problems during training intensification. In case of abnormalities, a checkup with a cardiologist or pulmonologist is warranted. In case of pathologic findings, appropriate treatment is required according to current recommendations. Highly active recreational athletes with severe COVID-19 who required hospitalization require, similarly to elite athletes, extensive diagnostic investigations of the cardiovascular and respiratory systems, the extent of which is determined individually based on tests performed during hospitalization and their results before return to play. In case of normal results, a gradual return to play is warranted, but not before 10–14 days after all symptoms have subsided. It should take at least 1–2 weeks, depending on the sport and possible problems during training intensification. In case of abnormalities, appropriate treatment of disease is required.

Return to play of highly active recreational athletes is summarized in [Figure 3](#).

## 6 Problems with assessing myocardial damage in athletes after COVID-19

Currently, a clear definition of clinically significant myocardial damage after COVID-19 in elite athletes does not exist. The data have been mostly obtained from the hospitalized, usually elderly patients with comorbidities with COVID-19 and have not been confirmed to the same extent in younger elite athletes. Myocardial changes, which can be secondary to long-term strenuous physical activity, also present a problem as they overlap with myocardial changes after COVID-19 (16).

Among the limitations of the use of troponin (particularly high-sensitivity troponin) is the lack of reference values for athletes in particular and the well known release of troponin from the myocardium during strenuous physical activity. As exercise-associated troponin release normalizes in 24–48 hours, the athletes should rest for at least 48 hours before troponin concentrations are determined. If elevated troponin concentrations are the only pathologic finding, its concentration should be determined again after another 48 hours of strict rest. Troponin concentrations can be normal despite established myocarditis, so additional investigations can be performed (12-lead ECG, echocardiography and/or cardiac MRI) before return to play (20).

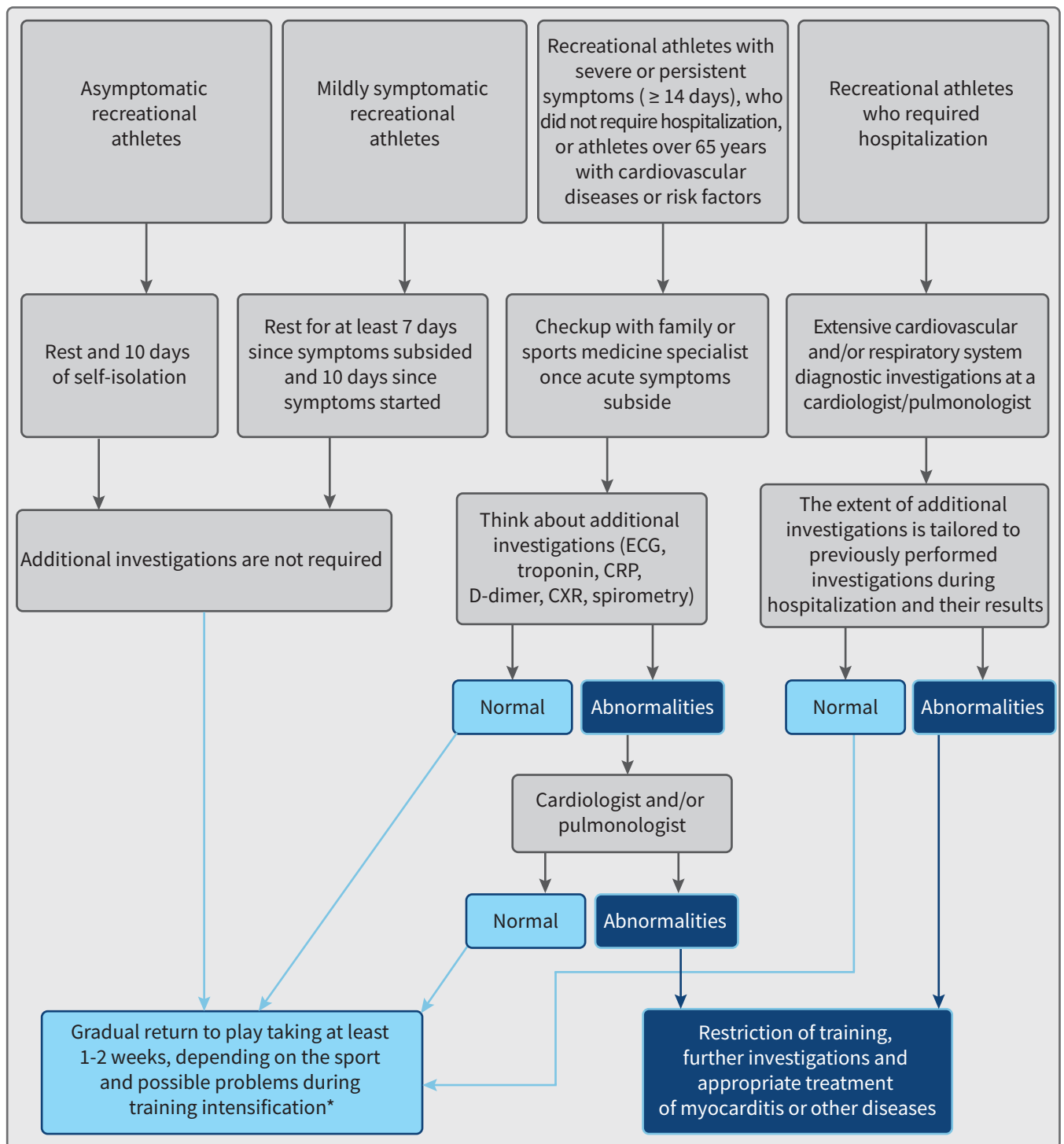
The changes that appear in a 12-lead ECG during

myocarditis or pericarditis are most commonly repolarization abnormalities (changes in the ST segment and/or T waves), ventricular extrasystoles or arrhythmias, bundle branch blocks and atrioventricular (AV) conduction abnormalities. The sensitivity of these abnormalities for the diagnosis of myopericarditis is poor (only 47%) (21). Additionally, repolarization abnormalities are common in athletes (in more than 70%) and may be misinterpreted as a sign of myocarditis. In such cases, comparing the ECG to previous traces can be helpful to observe potential dynamics. An additional problem with determining myocardial damage with a 12-lead ECG is its normalization during myocarditis.

With echocardiography, we can determine the global and segmental ventricular contraction, diastolic function of the left ventricle and pericardial damage. In the acute phase, the left ventricle wall can be regionally thickened due to oedema. In some (particularly endurance athletes), exercise over the years can lead to a significant increase in cardiac chamber volumes and borderline weakened ventricle contraction at rest, mimicking changes seen in mild myocarditis. An additional problem are cases of myocarditis, diagnosed only based on changes observed with a cardiac MRI, while the athletes were asymptomatic and with normal troponin concentrations, 12-lead ECG at rest and echocardiography.

Speckle tracking echocardiography plays an important role in determining subtle myocardial changes, and cardiac MRI is even more precise as it can determine both the presence of oedema and myocardial fibrosis.

Cardiac MRI is a useful method to determine the presence of myocarditis in symptomatic athletes (chest pain, impaired physical performance, ventricular arrhythmias) and/or abnormalities, found with e.g. 12-lead ECG or echocardiography with a moderate or high pretest probability of myocarditis. Currently, there is insufficient evidence to support the screening of all athletes with suspected or confirmed COVID-19 for myocarditis with a cardiac MRI, as the specificity of the current criteria for cardiac MRI in diagnosing myocarditis in a healthy and asymptomatic population is not yet known. Cardiac MRI norms for young healthy athletes are also lacking. Therefore, the insufficient measurement standardization in athletes could lead to too many false positive results, leading to unnecessary further diagnostic investigations and training restrictions (16).



**Figure 3:** Algorithm for return to play of highly active recreational athletes after COVID-19.

\* In case of problems during the return-to-play process, the athlete should be seen by a family or sports medicine specialist to determine the need for additional investigations (ECG, troponin, chest radiography, spirometry) or to refer the athlete to a cardiologist or pulmonologist.

Abbreviations: ECG – 12-lead electrocardiogram; CRP – C-reactive protein; CXR – chest radiography; CVD – cardiovascular diseases.



## 7 Conclusion

Return to play should always be individually tailored to the athlete's health, taking into account any comorbidities and type of sport. A multidisciplinary approach and cooperation of all involved (athlete, sports medicine specialist, paediatrician, family medicine specialist, possibly a cardiologist, pulmonologist, coach and other club representatives) is important. In the patient history and physical examination, it is important to consider other organ systems (central and peripheral nervous systems, gastrointestinal and musculoskeletal systems) in addition to the cardiovascular and respiratory systems. Return to play should always be gradual and should not start earlier than seven days

since the last symptoms and at least 10 days since the first symptoms started. It should take at least a week, depending on the sport and possible problems during training intensification. In case of any problems during the return-to-play process, a checkup with a physician is required. The article is adapted to the restrictive measures against the spread of COVID-19, organization of athlete healthcare and capacity of the healthcare system in Slovenia. It is based on the knowledge existing to date and is subject to additional adjustments as new evidence becomes available.

### Conflict of interest

None declared.

## References

1. Dnevno spremljanje okužb s SARS-CoV-2 (COVID-19). Ljubljana: Nacionalni inštitut za javno zdravje; 2021 [cited 2021 Feb 13]. Available from: <https://www.nijz.si/sl/dnevno-spremljanje-okuzb-s-sars-cov-2-covid-19>.
2. Wilson MG, Hull JH, Rogers J, Pollock N, Dodd M, Haines J, et al. Cardiorespiratory considerations for return-to-play in elite athletes after COVID-19 infection: a practical guide for sport and exercise medicine physicians. *Br J Sports Med.* 2020;54(19):1157-61. DOI: [10.1136/bjsports-2020-102710](https://doi.org/10.1136/bjsports-2020-102710) PMID: 32878870
3. Jørstad HT, Piek JJ. COVID-19, sports, and myocardial consequences. *Neth Heart J.* 2020;28(11):563-4. DOI: [10.1007/s12471-020-01499-7](https://doi.org/10.1007/s12471-020-01499-7) PMID: 33030658
4. Rajpal S, Tong MS, Borchers J, Zareba KM, Obarski TP, Simonetti OP, et al. Cardiovascular Magnetic Resonance Findings in Competitive Athletes Recovering From COVID-19 Infection. *JAMA Cardiol.* 2021;6(1):116-8. PMID: 32915194
5. Starekova J, Bluemke DA, Bradham WS, Eckhardt LL, Grist TM, Kuzmirek JE, et al. Evaluation for Myocarditis in Competitive Student Athletes Recovering From Coronavirus Disease 2019 With Cardiac Magnetic Resonance Imaging. *JAMA Cardiol.* 2021:e207444. DOI: [10.1001/jamacardio.2020.7444](https://doi.org/10.1001/jamacardio.2020.7444) PMID: 33443537
6. Clark DE, Parikh A, Dendy JM, Diamond AB, George-Durrett K, Fish FA, et al. COVID-19 Myocardial Pathology Evaluated Through Screening Cardiac Magnetic Resonance (COMPETE CMR). *MedRxiv [Preprint].* 2020. DOI: [10.1101/2020.08.31.20185140](https://doi.org/10.1101/2020.08.31.20185140) PMID: 32908996
7. Małek ŁA, Marczak M, Mitosz-Wieczorek B, Konopka M, Braksator W, Drygas W, et al. Cardiac involvement in consecutive elite athletes recovered from Covid-19: A magnetic resonance study. *J Magn Reson Imaging.* 2021;53(6):1723-9. DOI: [10.1002/jmri.27513](https://doi.org/10.1002/jmri.27513) PMID: 33474768
8. Martinez MW, Tucker AM, Bloom OJ, Green G, DiFiori JP, Solomon G, et al. Prevalence of Inflammatory Heart Disease Among Professional Athletes With Prior COVID-19 Infection Who Received Systematic Return-to-Play Cardiac Screening. *JAMA Cardiol.* 2021:e210565. DOI: [10.1001/jamacardio.2021.0565](https://doi.org/10.1001/jamacardio.2021.0565) PMID: 33662103
9. Cooper LT, Keren A, Sliwa K, Matsumori A, Mensah GA. The global burden of myocarditis: part 1: a systematic literature review for the Global Burden of Diseases, Injuries, and Risk Factors 2010 study. *Glob Heart.* 2014;9(1):121-9. DOI: [10.1016/j.ghheart.2014.01.007](https://doi.org/10.1016/j.ghheart.2014.01.007) PMID: 25432122
10. Maron BJ. Sudden death in young athletes. *N Engl J Med.* 2003;349(11):1064-75. DOI: [10.1056/NEJMra022783](https://doi.org/10.1056/NEJMra022783) PMID: 12968091
11. Rauka NP, Cooper LT. Implications of SARS-CoV-2-Associated Myocarditis in the Medical Evaluation of Athletes. *Sports Health.* 2021;13(2):145-8. DOI: [10.1177/1941738120974747](https://doi.org/10.1177/1941738120974747) PMID: 33201768
12. Halle M, Binzenhöfer L, Mahrholdt H, Schindler MJ, Esefeld K, Tschöpe C. Myocarditis in athletes: A clinical perspective. *Eur J Prev Cardiol.* 2020;2047487320909670. DOI: [10.1177/2047487320909670](https://doi.org/10.1177/2047487320909670) PMID: 32126831
13. Nieß AM, Bloch W, Friedmann-Bette B, Grim C, Halle M, Hirschmüller A, et al. Position stand: return to sport in the current Coronavirus pandemic (SARS-CoV-2/COVID-19). *Dtsch Z Sportmed.* 2020;71(5):1-4. DOI: [10.5960/dzsm.2020.437](https://doi.org/10.5960/dzsm.2020.437)
14. Löllgen H, Bachl N, Papadopoulou T, Shafik A, Holloway G, Vonbank K, et al. Infographic. Clinical recommendations for return to play during the COVID-19 pandemic. *Br J Sports Med.* 2021;55(6):344-6. DOI: [10.1136/bjsports-2020-102985](https://doi.org/10.1136/bjsports-2020-102985) PMID: 32883690
15. Phelan D, Kim JH, Chung EH. A Game Plan for the Resumption of Sport and Exercise After Coronavirus Disease 2019 (COVID-19) Infection. *JAMA Cardiol.* 2020;5(10):1085-6. DOI: [10.1001/jamacardio.2020.2136](https://doi.org/10.1001/jamacardio.2020.2136) PMID: 32402054
16. Kim JH, Levine BD, Phelan D, Emery MS, Martinez MW, Chung EH, et al. Coronavirus Disease 2019 and the Athletic Heart: Emerging Perspectives on Pathology, Risks, and Return to Play. *JAMA Cardiol.* 2021;6(2):219-27. DOI: [10.1001/jamacardio.2020.5890](https://doi.org/10.1001/jamacardio.2020.5890) PMID: 33104154
17. Löllgen H, Bachl N, Papadopoulou T, Shafik A, Holloway G, Vonbank K, et al. Recommendations for return to sport during the SARS-CoV-2 pandemic. *BMJ Open Sport Exerc Med.* 2020;6(1):e000858. DOI: [10.1136/bmjsem-2020-000858](https://doi.org/10.1136/bmjsem-2020-000858)
18. Elliott N, Martin R, Heron N, Elliott J, Grimstead D, Biswas A. Infographic. Graduated return to play guidance following COVID-19 infection. *Br J Sports Med.* 2020;54(19):1174-5. DOI: [10.1136/bjsports-2020-102637](https://doi.org/10.1136/bjsports-2020-102637) PMID: 32571796
19. Navodila za bolnike s COVID-19, ki ne potrebojejo bolnišnične oskrbe. Ljubljana: Nacionalni inštitut za javno zdravje; 2021 [cited 2021 Jan 1]. Available from: [https://www.nijz.si/sites/www.nijz.si/files/uploaded/navodila\\_za\\_osebe\\_s\\_covid-19\\_doma\\_23.4.pdf](https://www.nijz.si/sites/www.nijz.si/files/uploaded/navodila_za_osebe_s_covid-19_doma_23.4.pdf).

20. Phelan D, Kim JH, Chung EH. Return-to-Play Guidelines for Athletes After COVID-19 Infection-Reply. *JAMA Cardiol.* 2020;6(4):479-80. DOI: [10.1001/jamacardio.2020.5351](https://doi.org/10.1001/jamacardio.2020.5351) PMID: 33146679
21. Morgera T, Di Lenarda A, Dreas L, Pinamonti B, Humar F, Bussani R, et al. Electrocardiography of myocarditis revisited: clinical and prognostic significance of electrocardiographic changes. *Am Heart J.* 1992;124(2):455-67. DOI: [10.1016/0002-8703\(92\)90613-Z](https://doi.org/10.1016/0002-8703(92)90613-Z) PMID: 1636589