AMERICAN COLLEGE of CARDIOLOGY

Exercise and Athletics in the COVID-19 Pandemic Era

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Expert Analysis

Infection with the novel SARS-Coronavirus-2 (COVID-19) has halted virtually all formal participation in sport and exercise. At long last, public health guidelines have begun releasing timelines for a graded reintroduction of both recreational and competitive athletics. However, questions remain for those individuals with prior COVID-19 exposure/infection regarding the safety of returning to exercise. The World Health Organization reports that most people who contract COVID-19 (>80%), will be asymptomatic or develop mild symptoms.[1] There are many unanswered questions with ever changing data regarding the prevalence of asymptomatic COVID-19 cases in the community, the prevalence of cardiac injury for all exposed to COVID-19, and the associated short- and long-term risks.

Regular moderate exercise has an abundance of beneficial effects beyond the cardiovascular system including mental health and a boost to the immune system. There is general agreement that regular moderate exercise up to 45 minutes a day has beneficial effects on immune defenses. Individuals who are physically fit and regularly exercise to a moderate degree have reduced markers of low-grade inflammation, more robust immune responses to vaccines, enhanced immunosurveillance, and a reduced risk of illness.[2] However, there remains controversy as to whether more exhaustive and prolonged exercise negatively affects the immune system and increases susceptibility to infection.[3] Given that COVID-19 has numerous direct and indirect effects on the heart,[4] questions remain regarding the safety of exercise in those exposed to COVID-19 or who are recovering.

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Mechanisms of COVID-19 induced myocardial injury remain unclear but may be related to cytokine mediated cardiomyopathy, demand ischemia, acute coronary syndrome (which, on initial data, appears rare), or myocarditis from myocyte invasion by the virus. Up to one quarter of hospitalized patients with COVID-19 exhibit significant cardiac manifestations including left ventricular dysfunction and arrhythmias,[5] which exceeds the about 1% prevalence of cardiac involvement in non-COVID-19 acute viral infections.[6] Arrhythmias occur in about 17% of hospitalized patients while heart failure and cardiogenic shock were observed in up to 33% of patients.[7] Early observations indicate that COVID-19 infected patients with hypertension, diabetes, cerebrovascular or cardiovascular disease are more likely to require hospitalization, ICU level care, and die from the infection.[5]

What is the potential cardiac risk of exercise in those with active COVID-19?

One proposed mechanism for COVID-19 myocardial injury is viral induced myocarditis. This non-ischemic inflammatory form of myocardial injury can result in cardiac dysfunction, arrhythmias and even death.[6] Myocarditis is characterized by an early acute phase of viral replication within the myocytes, followed by a sub-acute immune response phase and a chronic phase which can range from complete recovery to fulminant cardiac failure. In the acute phase of disease, exercise can result in accelerated viral replication, a heightened inflammatory response with resultant increased cellular necrosis and a proarrhythmic unstable myocardial substrate.[8] As such, it is generally recommended to avoid exercise training during active infection. Depending on the extent of early necrosis, healed myocarditis can leave foci of myocardial scar, which potentially imparts an increased risk of scar-related reentrant ventricular tachyarrhythmias. This may occur even in the context of full recovery of left ventricular ejection fraction. Return to exercise post myocarditis has to be approached with caution as myocarditis accounts for 7-20% of sudden cardiac deaths (SCD) in young athletes.[9-11] Therefore, those with presumed myocarditis from COVID-19 should also avoid exercise during the acute phase of the disease.

What are the recommendations for returning to exercise and sport after recovering from COVID-19?

The safety and timing of returning to exercise, intense training and/or sport in those with previous cardiac manifestations of COVID-19 is currently unknown. T

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the incidence of cardiac injury in non-hospitalized individuals and the long-term cardiac effects of those exposed to COVID-19. As such, current recommendations are based on expert opinion with the potential for change as more data becomes available in the future.

In our opinion, the recreational exerciser seeking to resume activity for general physical fitness after COVID-19 who experienced only mild to moderate symptoms, were not hospitalized, and had no concerning cardiac symptoms should be able to resume recreational exercise at moderate intensity (e.g. Physical Activity Guidelines for Americans, US Department of Health and Human Services[12]) once completely recovered. We would emphasize that the individual should start slow and gradually return to their previous levels, while being mindful for any clinical change or new cardiovascular symptoms. This population is not likely to require additional testing unless concerning cardiac symptoms develop upon resumption of activity. However, patients with pre-existing cardiac disease who are potentially at higher risk of complications with COVID-19 (e.g. hypertrophic cardiomyopathy, left ventricular systolic dysfunction, atherosclertic heart disease) may require additional testing and risk assessment prior to a return to regular exercise levels.

For competitive athletes and highly active people with COVID-19 (with or without symptoms), two recently published statements address this issue with recommendations based on expert opinion.[13,14] Both publications provide a framework for evaluating and testing competitive athletes and highly active people who have had documented exposure to COVID-19. Phelan et al[14] present an algorithm (**Figure 1**) with an initial period of rest during the active infection and for a 2-week period after symptom resolution. The potential need for testing is highlighted by the authors and predicated on a low threshold for cardiac evaluation given the significant concern for cardiac involvement in COVID-19 hospitalized patients. In those with demonstrated evidence of myocardial involvement, extensive evaluation including biomarker testing to assess for residual inflammation, echocardiography, stress testing and rhythm monitoring as well as cardiac magnetic resonance imaging may be needed.[15-17] This testing is done 3-6 months after recovery at the time when athletes are considering return to play. Given a lack of clear understanding of the etiology of myocardial injury with COVID-19, [illegible] treating these competitive athletes and highly active people according to the established athlete eligibility guidelines for

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myocarditis.[18,19] Recognizing the limitations of existing data, the conservative timeline proposed is put forth to ensure athlete safety.

Figure 1

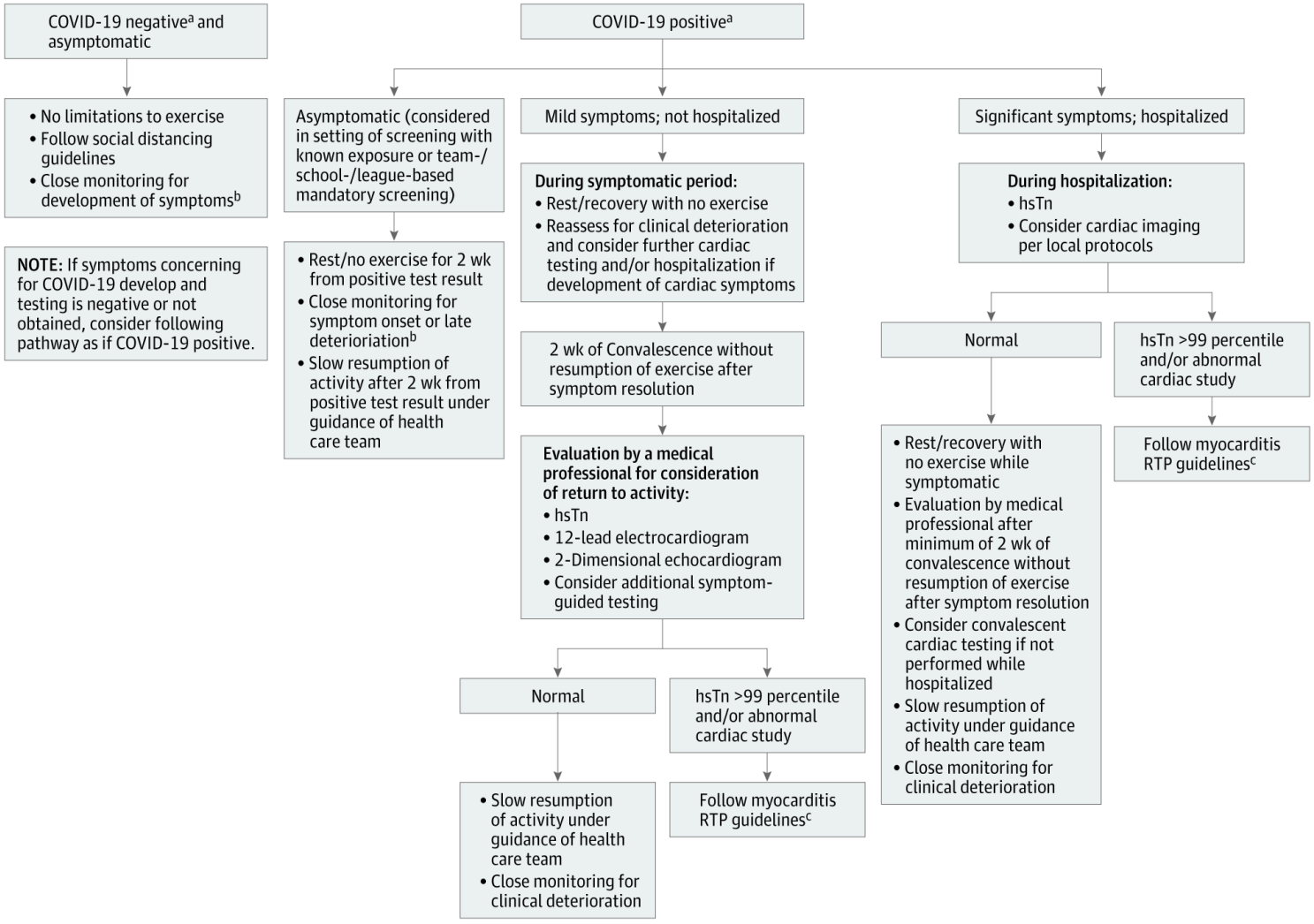

Figure 1: COVID-19 Return-to-Play Algorithm for Competitive Athlete and Highly Active People. COVID-19 indicates coronavirus disease 2019; hsTn, high-sensitivity troponin I; RTP, return to play.

a. Typical testing obtained via a nasopharyngeal swab. All athletes with positive testing should be isolated for 2 weeks regardless of symptoms.
b. If clinical and/or cardiac symptoms develop, follow appropriate clinical pathway.
c. Given lack of clear pathophysiology, we recommend American College of Cardiology/American Heart Association athlete myocarditis guidelines.

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What are some pratical tips for exercise during the COVID-19 pandemic?

In asymptomatic individuals without COVID-19, continued regular exercise is appropriate and important to respect current social distancing guidelines which includes avoiding exercising in groups. Non-peer reviewed re

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recommendation of maintaining 2 meters distance may not be enough when exercising. By simulating the release of saliva particles, they found that if an individual were to sneeze or cough while exercising, those following behind them in the same direction (in the slipstream) would be at risk of exposure. As a result, they recommend maintaining 4-5 meters if walking, 10 meters if running and 20 meters if cycling.[20]

Appropriate hand-hygiene and cleaning of equipment is critical. Athletes should take ownership of that process and expect to clean equipment before and after use. Ideally, athletes would be able to exercise in isolation outdoors or in well ventilated rooms while avoiding touching the eyes, nose and mouth. As some states reduce travel and facility restrictions, gyms are beginning to open. Common sense practices should apply: athletes should bring their own towel, bring their own method of hydration avoiding communal faucets and water fountains/coolers, and avoid areas with high traffic or exposure to sweat.

Conclusion

Advice regarding exercise and athletics in those affected with COVID-19 may evolve quickly as more data are gathered. All individuals should reduce/limit exercise if there is concern for any viral syndrome, with complete cessation if COVID-19 positive. Those who have suffered myocardial injury consistent with possible myocarditis should wait 3-6 months before re-evaluation to adjudicate return to participation in vigorous exercise.

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Keywords: *Sports, COVID-19, Coronavirus, Coronavirus Infections, severe acute respiratory syndrome coronavirus 2, SARS Virus, Myocarditis, Stroke Volume, Shock, Cardiogenic, Cardiovascular Diseases, Expert Testimony, Sweat, Acute Coronary Syndrome, Cicatrix*

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