



Five Myths of COVID-19 for the Team Physician

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Introduction

The COVID-19 pandemic has stunned and disrupted the sporting world. Athletes all around the world lost access to their sports due to the cancelation of professional seasons, postponements of major international competitions such as the Olympics, and closures of local sporting facilities [11, 15]. As global stay-at-home orders, enacted to slow the spread of COVID-19, began to be lifted in spring and summer of 2020, athletes gradually began to return to sports, including professional baseball in Taiwan and South Korea, soccer in Germany, and NASCAR in the USA [16, 17, 34]. It is possible that other leagues will

follow suit in the coming months. With an abundance of false or misrepresented information, it can be difficult to sort out myth from fact.

This paper focuses on five myths that may affect a team's return-to-sport protocols and considerations based on the available data. As COVID-19 cases continue to rise nationwide, including among athletes, return-to-play protocols and contingency plans are becoming even more important. Amid a changing landscape in summer 2020, we present information that may be useful to the team physician at any sporting level in crafting recommendations and educating athletes, coaches, and allied team staff about some common misconceptions and risks.

Myth 1: Using Face Masks While Exercising Will Protect Athletes from COVID-19

A primary mode of transmission of SARS-CoV-2, the virus that causes COVID-19, is through respiratory droplets excreted when an infected person coughs, sneezes, or talks. The Centers for Disease Control and Prevention (CDC) has issued guidelines encouraging people to wear face masks or cloth face coverings to prevent viral spread among people in close contact [6]. This is especially relevant due to the prevalence of asymptomatic and presymptomatic carriers, who have been shown to be contagious [2, 23, 48]. Unfortunately, face masks may not be feasible for athletes while training.

The efficacy of various types of face masks in limiting viral spread has yet to be established. In 2015 MacIntyre et al. [28] conducted a randomized controlled trial in health care workers demonstrating that the rate of contracting a respiratory illness was significantly higher in those wearing cloth masks than in those wearing disposable surgical masks (referred to as medical masks in the study). The authors hypothesized that this could be due to moisture retention, reuse of cloth masks, or the

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poor filtration capabilities of cloth masks. In March 2020, the authors issued a commentary relating their 2015 findings to the current pandemic [29]. They reiterated that reusing an unwashed cloth mask may result in less protection from contracting a respiratory illness and mentioned that the cloth masks were made locally and subject to differences in fabric quality. Without the evidence of another clinical trial, the authors offered the pragmatic suggestion of washing a cloth mask at the end of each day [29]. A recent study by Konda et al. [21] looked at the aerosol filtration efficiency of cloth masks and made note of useful design considerations such as using high thread count cotton, combining layers of different fabrics (such as cotton and silk), and optimizing the fit of the mask to the face to achieve the best filtration.

In a 2012 analysis of the 2003 severe acute respiratory syndrome (SARS) pandemic, So et al. [41] summarized other studies that assessed the penetration of microbes through surgical face masks, which is proportional to the flow rate. McCullough et al. [32] assessed microbes at a high flow rate of 85 L/min and a low flow rate of 45 L/min, with the high flow rate having significantly higher penetration [41]. Chen and Willeke [7] determined that a surgical mask had a 25% penetration rate of submicrometer-size aerosols at a flow rate of 5 L/min and a 70% penetration rate at 100 L/min [41]. While exercising, an athlete's flow rate increases drastically, decreasing the effectiveness of surgical masks. Therefore, surgical masks used during periods of exercise may be far less protective in athletic populations. Currently, it is unknown whether the use of cloth or surgical masks by athletes will prevent the spread of the virus.

Further, the World Health Organization (WHO) recognizes that there is limited data supporting the widespread use of face masks by healthy individuals in the community in preventing SARS-CoV-2 transmission, but with growing evidence the WHO amended their guidelines in June 2020 to support the use of face masks in mitigating community spread [49]. When looking at influenza and other respiratory illnesses, data suggests that face masks are effective when worn by infected people [50]. The face mask may prevent person-to-person spread as well as contamination of surfaces. A systematic review and metaanalysis of 172 studies by Chu et al. showed that wearing face masks was protective against coronavirus for both health care workers and the general public [8]. Although the authors insist that further data is needed to determine the efficacy of face masks versus N95 respirators and the extent of possible aerosolization of SARS-CoV-2, they believe there is enough evidence to support the widespread use of face masks [8]. Beyond this, evidence from a natural experiment by Lyu and Wehby [27] showed that the implementation of mask mandates in various states may have averted over 200,000 COVID-19 cases. Still, the paucity of clinical trial data surrounding the effectiveness of face masks raises questions about their use as protective measures for healthy athletes returning to play. This is especially true when considering the negative effects face masks may pose from a respiratory standpoint [50]. Recent updates from the WHO indicate that people should not wear masks while exercising due to respiratory

difficulties and potential microorganism growth caused by sweat droplets [51]. The American College of Sports Medicine (ACSM) released a statement in August 2020 emphasizing the importance of testing and contact tracing when mask wearing is not feasible (as in high-intensity exercise or close-contact sports) [9].

Previous studies have highlighted the deleterious effects of wearing a face mask during exercise. In 1983, Lerman et al. [22] reported that they found a significant decrease in tidal volume, increased carbon dioxide retention, and difficulty in inspiration correlated to the inspiratory resistance posed by the mask. In 1995, Johnson et al. [19] reported significant exercise impairment at the anaerobic threshold with the use of a respiratory mask during physical activity. Generally, prolonged exercise at a maximal level may not be possible or safe while wearing a face mask. Special considerations should be made for athletes with underlying cardiorespiratory conditions.

Although face masks may not be beneficial for athletes while training, coaches, athletic trainers, and allied health staff should consider wearing face masks during all practices and meetings, and athletes should wear face masks during one-on-one meetings or treatment sessions. This recommendation has been adopted by the National Collegiate Athletic Association (NCAA) for all sidelined players during sporting events and the University of Pittsburgh Medical Center Sports Medicine Playbook, which recommends coaches and staff to be masked at all times [35, 43].

Myth 2: A Physical Distance of 6 ft During Exercise or Sport Is Always Protective for Athletes

Beyond maintaining personal hygiene (e.g., handwashing and avoiding hand to face contact with unwashed hands) and wearing face masks, the CDC recommends practicing physical distancing as a primary preventative measure for COVID-19 [6]. Safe physical distancing is defined as at least 6 ft of separation between people [6] because it is assumed that any excreted viral particles will have reached the floor or evaporated before they contact another person at this distance [4]. Recent data suggests that SARS-CoV-2 does aerosolize and although this is not believed to be a primary mode of transmission as of yet, it is still an important consideration to make when forming physical distance guidelines as athletes and staff return to play in close quarters.

Blocken et al. [4] devised a model to analyze how the recommended physical distance may change when individuals are in motion. In a 2020 preprint, nonpeer reviewed article published on their own website, the authors concluded that the risk of exposure varies greatly whether people are running side by side, inline, or staggered, with people running inline having the greatest risk of contracting airborne droplets. As athletes return to play and begin training together in the team setting, the need for increased distance with running may be taken into consideration. Blocken et al. [4] recommended running

in staggered or side by side arrangements or keeping larger physical distances as speeds increase. Drills where athletes used to run in line with each other may be replaced with side by side running in smaller groups.

Much of the data on aerosolization of SARS-CoV-2 remains preprint and not peer reviewed and cannot yet be regarded as conclusive. Few studies have elucidated the presence of SARS-CoV-2 in aerosol samples from rooms with infected persons, indicating that airborne spread of viral particles is possible [25, 37, 39]. It is unknown whether these aerosolized particles remain infectious. Beyond maintaining physical distancing when possible to mitigate transmission via close contacts, further considerations should be made for indoor sporting activities due to the possibility of increased infection risk when indoors. These may include increased ventilation mechanisms and maximizing open spaces. More data is needed to determine the viability and transmissibility of SARS-CoV-2 when aerosolized in outdoor settings.

Myth 3: Temperature Affects COVID-19 Risk

There were many conflicting hypotheses on whether the transmissibility of COVID-19 would significantly decrease in the Northern Hemisphere summer months and show resurgence in the fall and winter months. Many other viral respiratory illnesses are most transmissible in colder, less humid months. This may be due to a variety of reasons such as easier viral survival in winter air, closer confinement of people indoors, and children being in school during these months [24]. The unfortunate truth is that SARS-CoV-2 is a completely novel coronavirus in humans. Novel viruses do not tend to behave on the same seasonal patterns as old, common viruses. This was seen in the peculiar nature of the 2009 H1N1 influenza pandemic, which had its peaks between April–May and September–October, outside of the regular flu season [24]. Ultimately, direct comparisons of the seasonal epidemiology of COVID-19 to SARS, influenza, and the common cold are impossible. As we approach the fall months, we have seen that COVID-19 transmission did not decrease due to increased temperatures in the USA. Rather, daily incidence of new cases has grown consistently and continues to grow despite warmer temperatures [18].

Wang et al. [47] determined that with every 1°C increase in temperature and 1% increase in relative humidity, the effective reproductive number, R , or severity of infectiousness, of SARS-CoV-2 decreased across 100 Chinese cities. They calculated the average R values from January 21 to 23, 2020 (before widespread public health interventions were implemented), across 100 cities with at least 40 cases and compared this with the average daily temperature and relative humidity. The authors concluded that a similar pattern could occur in the Northern Hemisphere during the summer months. According to this data, the increase in temperature and relative humidity will effectively lead to a decrease in COVID-19 transmission. However, the authors noted that it is unlikely that

COVID-19 would disappear in the summer because community-level transmission may already be high and physical distancing will need to remain a priority in prevention [47]. Similarly, Luo et al. [26] concluded that the relationship between humidity and decreased transmission rates must be analyzed in accordance with other public health measures.

Currently, the relative impact of temperature and humidity compared with public health interventions on the transmission of SARS-CoV-2 is unknown, although daily incidence data from the USA would indicate that maintaining vigilant public health interventions is imperative and much more effective at decreasing transmission than any possible protective aspect of warmer temperatures. For this reason, it appears that the protective elements of summer air conditions cannot outweigh the harmful effects of relaxed physical distancing. It is safe to assume at this time that athletes will not be protected from COVID-19 because of warmer training conditions and that the same precautions of mask wearing, physical distancing, and personal hygiene will be important as athletes return to warm, outdoor play.

Myth 4: Athletes Are more Immune to COVID-19 than the General Population

Although many athletes are young and have no serious medical conditions, there is limited data on whether athletes have an increased immunity to COVID-19. Athletes with COVID-19 are typically less likely to develop severe symptoms from the disease, but they have the potential to either be asymptomatic or experience mild symptoms [42]. In addition, it is important to understand associated medical conditions that occur as a result of COVID-19, as these may manifest within the athletic population. Cardiopulmonary sequelae of COVID-19 may include respiratory illness leading to fibrosis and cardiovascular manifestations including arrhythmias, myocarditis, and heart failure [13, 52]. Previous studies have reported central nervous system involvement with symptoms of dizziness, headache, stroke, and seizure [3, 30]. Lastly, inflammatory dysregulation may also be present in athletes with COVID-19 and may affect their ability to return to sport and competition. Therefore, monitoring for symptoms of various sequelae is important when athletes are training during the COVID-19 pandemic.

Previous studies have correlated physical activity and immune system function, suggesting that moderate training may be protective [31]. Walsh et al. [45] demonstrated an increase in both B and T lymphocytes and neutrophils with moderate endurance activities, reducing overall inflammation and infection risk. Other studies have reported a significant change in immune function following training with high levels of exertion and prolonged cardiorespiratory endurance exercise [36]. It has been hypothesized that between 3 and 72 h following strenuous periods of physical activity, there is an “open window” of altered immunity leading to a state of immunosuppression and increased infection risk

[36]. This may be attributed to an induced oxidative state with accelerated neutrophil apoptosis leading to inflammation, muscle damage, and infection [10, 40, 45]. This suppressed immune response in high intensity training may increase the incidence of upper respiratory infections in athletes and could pose a higher risk for COVID-19 [12].

Although athletes are generally considered healthy, subsets of athletes have diagnosed chronic conditions including airway disease, which is prevalent in 20% of all endurance athletes [14]. In addition, there is concern that many athletes may have an undiagnosed medical condition that may predispose them to a more severe presentation of COVID-19. Unfortunately, there is little data on COVID-19 in athletes; therefore, it is important to be cognizant of the symptoms of the disease and its sequelae in order to better monitor for illness [14].

Finally, certain situations may increase the risk of SARS-CoV-2 transmission among athletes. Sport settings where athletes train in groups have close contact, and share equipment may increase exposure to SARS-CoV-2 [14]. Preventative measures including physical distancing, handwashing, sanitization of equipment, and symptom monitoring can help slow transmission and limit exposure during athletic participation.

Myth 5: Athletes Have a Lower Risk of Injury if they Continue Training During Confinement

The cessation of sporting events and the implementation of physical distancing and self-isolation have forced athletes to rely on home-based training programs that are typically not comparable with the level of training of either practice or competition [20]. Although athletic programs have attempted to implement individualized sport-specific training protocols, previous disuse-based studies have demonstrated detrimental effects following cessation of routine physical activity [10, 44].

Detraining can result in a decrease in muscle strength and endurance. Short periods of unloading may lead to muscle atrophy and loss of flexibility and therefore an increased rate of injury [20]. Prolonged physical inactivity not only decreases the size of both type I (slow twitch) and type II (fast twitch) muscle fibers but also leads to a transition of fast twitch fibers into slow twitch fibers [38, 46]. Previous studies have also reported decreased skeletal muscle capillarization, altered tendon and muscle architecture, and decreased oxidative enzyme activity [10].

Short-term cardiovascular detraining following a reduction in physical activity has also been evaluated in the literature. Studies have demonstrated a reduction in maximal oxygen uptake (VO_2 max), total blood volume, plasma volume, stroke volume, and cardiac output within 4 weeks of cessation of physical activity [33]. In addition, overall cardiac dimensions are decreased following up to 4 weeks of physical inactivity [10]. Respiratory function including maximum ventilatory volume, oxygen pulse, and endurance performance has been shown to decline after deconditioning [33].

Extended periods of rest may result in metabolic changes that can negatively affect an athlete's performance. During periods of prolonged inactivity, there is a higher reliance on carbohydrate as a substrate for muscles at the expense of lipid metabolism [33]. In addition, there is a decrease in both insulin sensitivity and muscle glucose-to-glycogen conversion, which can contribute to suboptimal athletic performance [10]. The negative impact that detraining has on the neuromuscular, cardiovascular, respiratory, and musculoskeletal systems should be considered when developing return-to-sport strategies for athletes when released from home confinement. Sport-specific reconditioning programs allowing adequate recovery of affected physiologic systems is important to injury prevention in athletes returning to practice and competition.

The National Strength and Conditioning Association (NSCA) and Collegiate Strength and Conditioning Coaches Association (CSCCA) previously released training guidelines for a safe transition period following inactivity [5]. These guidelines, known as the 50/30/20/10 rule, allow for a progressive return to activity over the first 4 weeks of reconditioning [5]. The numbers refer to a decrease from 100% effort and equate to 50% of maximum conditioning volume the first week, then 70%, 80%, 90%, and back to 100% in the fifth transition week. These recommendations were crafted in response to the increase in exertional heat illness, exertional rhabdomyolysis, and cardiorespiratory failure in college athletes during periods of transition from inactivity [5]. Adopting this or a similar return-to-training protocol may be a protective measure for all athletes, especially those who had COVID-19 and experienced related cardiopulmonary symptoms.

During periods of confinement, athletes should participate in a variety of activities within their own homes and backyards to counter the effects of deconditioning [1]. Such activities may include running, cycling, resistance training, circuit-based training, plyometrics, and stretching. As social-distancing restrictions are lifted, athletic programs may incorporate both individualized and group rehabilitation protocols to provide athletes with sport-specific training.

As the sporting world finds innovative ways to engage athletes during and after the pandemic, team physicians will play an important role in designing protocols and educating teams on how to stay safe and healthy. The team physician must communicate with the team on why and how protocols will be implemented. The myths chosen here present some areas of concern and confusion, and it is our hope this information may be used by team physicians as evidence is gathered to issue return-to-play protocols.

Compliance with Ethical Standards

Conflict of Interest: Angela Mercurio, BS, and Arianna L. Gianakos, DO, declare that they have no conflict of interest. Mary K. Mulcahey reports being a paid consultant, presenter, or speaker to Arthrex, Inc., and Arthroscopy Association of North America, and a board or committee member at AAOS, ACSM Translational Journal, American Orthopaedic Society for Sports Medicine, Ortho Info, Ruth Jackson Orthopaedic Society, and The Forum. Karen Sutton, MD, reports being

paid a consultant, presenter, or speaker to Johnson and Johnson; an unpaid consultant to ESPN-W and SportsMD; and a board or committee member at AAOS, American Orthopaedic Society for Sports Medicine, Bassett Society, Ruth Jackson Orthopaedic Society, The Forum, US Lacrosse, and World Lacrosse.

Human/Animal Rights: N/A

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Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

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