A rapid review of recommendations for mitigating COVID-19 transmission in community sport and recreation facilities

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August 27, 2021

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All authors have agreed to submit this manuscript to SportRxiv in its current form.

Please cite this paper as: Wilson, K. E. S., Evans, Z. C. T., Miller, P. Joseph. & Brown D. M. Y. (2021). A rapid review of recommendations for mitigating COVID-19 transmission in community sport and recreation facilities. Pre-print available from *SportRXiv.*

Keywords: public health, sport, recreation, facility management, occupational health, COVID-19

Abstract

This rapid review was conducted to develop recommendations that can mitigate COVID-19 transmission in community sport and recreation facilities so that the industry that supports physical activity and mental health can return to a degree of normalcy. Three databases (SPORTDiscus, Web of Science, Scopus) and the WHO COVID-19 database were systematically searched for peer-reviewed literature that provided practical implications for the return to community sport and recreation facilities. The search and screening processes yielded 63 articles for full text review. The analysis resulted in 25 recommendations that were categorized in accordance with the National Institute for Occupational Safety and Health's hierarchy of controls framework for addressing occupational hazards: elimination/substitution, engineering controls, administrative controls and personal protective equipment. The results provide recommendations for public health (i.e. mandatory vaccination), architects/engineers (i.e. ventilation) and facility managers (i.e. cleaning) that can be enacted progressively in the event of future public health crises.

A rapid review of recommendations for mitigating COVID-19 transmission in community sport and recreation facilities

In March of 2020, the World Health Organization (WHO) officially declared a global pandemic due to the novel coronavirus (COVID-19) (Timpka, 2020). The disease, which can be transmitted from one person to another via droplets expelled orally, is spread easily in close contact (Hughes et al., 2020) and it has had a more substantial influence on human health and the global economy than any preceding health crises during the previous 100 years (Wackerhage et al., 2020). As of August 2021, there had been over 200 million cases worldwide, over 4 million of which resulted in death; however, there had also been almost 5 billion vaccines administered by August 2021 (World Health Organization, 2021). Despite the vaccination efforts to slow the spread, populations with high levels of COVID-19 vaccine coverage (>85% of the adult population) continue to face resurgences of the variants of concern (i.e. Delta variant) and some suggest that a state of herd immunity is unlikely (Madhi, 2021).

Accordingly, industries will need to continue integrating infection control practices into their regular business practices to safely operate while protecting against the spread of COVID-19 (Kumar et al., 2021). Among the industries that have been most affected by COVID-19-related shutdowns is the sport and recreation industry. When people participate in sport and recreational activities they often experience elevated respiratory activity and, by nature of the activity, may not be able to physically distance themselves. However, because COVID-19's primary method of transmission is through airborne particles, these conditions increase the risk of transmitting viruses that are contracted through aerosol, such as COVID-19 (Bae et al., 2020). As a result, many sport and recreation facilities were required to close or operate under strict COVID-19 guidelines (Vancini et al., 2021).

Restricted access to sport and recreation facilities due to the pandemic (Amini et al., 2021) has corresponded with a decline in population level physical activity, higher levels of sedentary behaviour (Bates et al., 2020; Moore et al., 2020), and a decline in mental health and wellbeing (Daly et al., 2020). Together, the pandemic has been a catalyst for the adoption of unhealthy lifestyles (Hall et al., 2021) that are also associated with a greater risk of severe complications from the COVID-19 virus and that result in hospital admission (Hamer et al. 2020).

Prior to the pandemic, scholars had already identified physical inactivity as a global health concern (Kohl et al., 2012; Hall et al., 2021) and a major economic burden, costing countries billions each year (Ding et al., 2017). Considering the relationship between physical inactivity and severe medical complications from COVID-19, it will be increasingly important for physical activity to be promoted prior to and throughout future pandemics. For this to occur, it is imperative that practitioners within the sport and recreation industry have an array of risk mitigation strategies in place.

The National Institute for Occupational Safety and Health's (NIOSH) hierarchy of controls framework for addressing occupational hazards to settings that pose safety risks has been recommended for identifying control mechanisms that reduce risk (Morris & Cannady, 2019). The framework suggests that occupational hazards can be reduced by eliminating or substituting the hazard, improving the built environment through engineering control systems, adjusting how people work through administrative controls and using personal protective equipment (National Institute for Occupational Safety and Health, 2015). These control mechanisms are considered to be progressive, with elimination offering the most protection and personal protective equipment the least. Thus, the purpose of this project was to perform a rapid

review of the extant literature and apply the hierarchy of controls framework to determine the steps that community-organized sport and recreation facilities can take to resume safe operation as we emerge from the COVID-19 pandemic.

Methods

Design

This rapid review was conducted in line with the approaches outlined by the World Health Organization (Khangura et al., 2012; Tricco et al., 2017).

Research Question

The goal of this rapid review was to identify recommendations pertaining to the steps that sport and recreation facilities can take to resume operation as we emerge from COVID-19 with the goal of reducing transmission risk.

Search Strategy

Electronic databases selected to identify relevant studies were chosen through consultation with an academic librarian. Searches were conducted in SPORTDiscus, SCOPUS, Web of Science and the WHO COVID-19 Database. The search strategy was also developed in consultation with an academic librarian. Community organized sport and recreation facilities were broadly defined as any facility (e.g., sport facilities, recreation/community centres, gymnasiums, fitness facilities) that provides opportunities for people to engage in physical activity indoors and/or outdoors. Park settings were not included. The search strategy involved combinations of the following keywords and was translated appropriately for each database: 1) facility OR facilities OR centre OR center OR gym OR stadium OR infrastructure; AND 2) recreation OR sport OR fitness OR exercis* OR “physical activity” OR “physical activities”; AND 3) COVID-19 OR coronavirus OR SARS-COV-2; AND 4) return OR restart OR reboot

OR reopen OR resume OR recommendation (see supplementary materials Appendix A). The reference lists of all articles included at the full-text screening stage were also searched to identify any additional relevant articles. Studies published in English from January 1, 2020 – the day after the World Health Organization was informed about cases of pneumonia that were later identified as COVID-19 (World Health Organization Regional Office of Europe, 2020) – to May 13th, 2021 were included. This was later updated to August 3rd, 2021. Results from the searches of each electronic database were exported into the online review management system Covidence (Veritas Health Innovation, Melbourne, Australia), which removed duplicate records from the database.

Study Selection

Inclusion criteria are detailed in Table 1. As per the guidelines for conducting rapid reviews, the title and abstract for each record were screened by one reviewer. Next, the research team retrieved the full-text articles for all records that met inclusion and exclusion criteria. At the full-text stage, each article was screened by two reviewers to determine whether it should be included, and inconsistent decisions were resolved by a third reviewer. Reasons for exclusion were recorded at the full-text screening stage.

<<INSERT TABLE 1 ABOUT HERE>>

Data Extraction

Relevant data were extracted into a structured data charting form with attributes decided on by the research team. The form captured the following data: author, year of publication, country of origin, purpose, methods, source characteristics, applicable context and practical implications. Three authors (ZE, JM, DB) independently extracted and charted the data from one

third of the articles each and subsequently checked an equivalent number of articles (that were not included in their initial batch) for accuracy and completeness.

Data Synthesis and Analysis

The first author (KW) summarized and reported the key findings that emerged from the charting process. The first author then synthesized the key findings into potential recommendations using an inductive content analysis approach (Kyngäs, 2020). This approach involved applying codes to the key findings to reduce and group data into mutually exclusive concepts (recommendations). Next, three authors (ZE, JM, DB) independently reviewed and revised the coding for the potential recommendations to further reduce and group the data. The research team then independently reviewed the recommendations prior to discussing as a team until consensus was achieved. Finally, the recommendations were categorized into broader themes as per the NIOSH hierarchy of controls framework for addressing occupational hazards.

Results

Selection of Sources

The initial search yielded 7,669 peer-reviewed sources from the databases that were uploaded to the Covidence platform. The platform removed duplicate sources, after which 4,984 remained. The title and abstract were then screened using the inclusion/exclusion criteria and 68 articles remained for full-text screening. Full-text screening resulted in the removal of 32 articles and 35 remained in the selection. The reference lists of these articles were reviewed for additional sources which resulted in three more. The search was performed again in August 2021 and 26 additional sources were identified and included. In total, 63 articles were selected for full review (see Figure 1 for PRISMA flow chart).

<<INSERT FIGURE 1 ABOUT HERE>>

Source Characteristics

The year of publication, country of origin, purpose, methods, source characteristics, applicable context and practical implications for each study are presented in the supplementary materials (see Appendix B). 26 sources were published in 2020 and 38 in 2021. The country of origin of where the first author resided or research was conducted represented a wide variety of countries including the United States (*n* = 17), United Kingdom (*n* = 9), Brazil (*n* = 5), Italy (*n* = 5), South Korea (*n* = 3), Germany (*n* = 3), Australia (*n* = 2), Hong Kong (*n* = 2), Japan (*n* = 2), Netherlands (*n* = 2), and one (*n* = 1) from 13 other countries. Of the sources, 35 were commentaries or editorials, 19 included empirical evidence, and 9 were reviews (i.e. rapid or systematic reviews). The sources that conducted empirical research used a variety of samples including adults (n = 12), youth (n = 2), commonly touched surfaces (n = 1), sports clubs (n = 1), regions/counties (n = 1), children and adults (n = 1) and one study involved a simulation. The contexts in which the practical implications were applicable included indoor facilities (n = 15), outdoor facilities (n = 4), a combination of indoor and outdoor facilities (n = 25) and broader return to sport recommendations (n = 19).

Recommendations

The analysis resulted in 25 recommendations to help sport and recreation facilities mitigate the spread of infectious diseases between occupants. These recommendations were categorized according to the NIOSH hierarchy of controls for addressing occupational hazards: elimination/substitution, engineering controls, administrative controls and personal protective equipment (National Institute for Occupational Safety and Health, 2015). Elimination and

substitution were grouped together because the current vaccines do not eradicate the virus completely (i.e. elimination) and instead provide a less lethal alternative (i.e. substitution) (Spigarelli, 2020). A summary of findings for each control mechanism is provided below.

Elimination/Substitution

Elimination/substitution pertains to ensuring users who visit sport and recreation facilities that are of low risk for contracting, transmitting or becoming hospitalized due to the virus. One recommendation was identified. Table 2 provides the recommendation and corresponding sources.

Immunization Policy

Facility users must show proof of vaccination(s) upon entry. Vaccination passports and/or immunization policies were identified by four sources (see Table 2). Multiple sources suggested that facilities and organizations should consider mandatory immunization policies to protect participants, staff and potential spectators (e.g. Chu et al., 2021; McElheny et al., 2021; McLaron et al., 2021). DiFiori et al. (2021) also suggested mandating other vaccinations (i.e. influenza) to protect against other types of illnesses. Despite the financial cost, given the nature of physical activity and elevated risk, vaccination could be as important as sport safety equipment (Francis & Francis, 2020).

<<INSERT TABLE 2 ABOUT HERE>>

Engineering Controls

Engineering controls represent strategies for the built environment of sport and recreation facilities that can be altered to mitigate transmission risk. Architects, engineers and facility managers can consider these when designing new or retrofitting existing facilities. Four

recommendations for the built environment were identified. Table 3 provides an overview of these recommendations.

Built Environment

Improve ventilation and air handling procedures. The importance of air quality was identified in 21 sources (see Table 3). Blocken et al., (2021) discussed how sport and recreation facilities generally have large and complex rooms that will require more powerful air handling systems then previous standards. The literature revealed that air quality in these rooms can be improved by incorporating high-intensity air displacement systems, portable air cleaners, high-efficiency particulate absorbing (HEPA) air filtration, ultraviolet-C radiation air disinfectors, and increasing the number of air zones within a facility (Blocken et al., 2021; Blocken et al., 2020; Dominski & Brandt, 2020; Fitzgerald et al., 2021). Moreover, real-time environmental monitoring technology can also help to identify contaminated air and reduce risk for occupants by automating ventilation practices (Blocken et al., 2020; Cortez et al., 2020).

Design or reorganize rooms and corridors to allow for physical distancing. Physical distancing was highlighted in 32 sources (see Table 3) and the literature revealed that general facility spaces should be designed to allow for minimum distances to be maintained between users (1 to 1.5 meters) as they use facilities (e.g. Cortez et al., 2020; Denay et al., 2020; Gentil et al., 2020). The literature also identified that many of the spaces within these facilities were not designed with this intention, so future designs will need to consider strategies that provide enough space for attendees to physically distance and reduce crowding as they occupy and move throughout a facility (Amagasa et al., 2020; Kim & Yang, 2021). Existing facilities may also need to consider altering the layout of equipment to minimize social contacts (Blocken et al. 2020; Chu et al., 2021).

Reduce the number of high-touch surfaces. Nine sources indicated that altering how occupants interact with surfaces can reduce the risk of transmission (see Table 3). Sources suggested that integrating touch-free technology where possible can reduce this risk (e.g. McElheny et al., 2021; Matos et al., 2021; Parker et al., 2020). For example, automatic sensors can be installed on doors, soap/sanitizer dispensers, lighting fixtures, concession areas, garbage bins, water fountains and wherever else possible (DiFiori et al., 2021; Matos et al., 2021; Parker et al., 2020). In addition, foot pedals or robots can play a role activating switches for doorways and amenities (Matos et al., 2021), or doors can be redesigned to reduce the need to touch with hands (Gentil et al., 2020).

Hand washing stations should be installed throughout facilities. With the increased need for occupants to maintain personal hygiene, 27 sources recommended that facilities install hand washing stations throughout (see Table 3). These hand washing stations should have 70% alcohol gel (Cortez et al., 2020) and should be located at the entrance of a facility, high traffic areas, and each activity space, in addition to being accessible to all (e.g. Amagasa et al., 2020; Dominski & Brandt, 2020; Gentil et al., 2020;). Occupants should also be encouraged to use them frequently, including before, after and if needed during an activity (e.g. Blocken et al., 2020; Carmody et al., 2020; Casasco et al., 2020).

<<INSERT TABLE 3>>

Administrative Controls

Administrative controls refer to sport and recreation facility operations and standard practices that can reduce the risk of transmitting infectious diseases within a facility. These recommendations are intended to be progressive and can be enacted to varying degrees, depending on local health conditions. In total, nineteen recommendations were identified and

placed into sub-themes: (1) standard operating procedures; (2) facility capacity and spacing; (3) activities and equipment; and (4) staff. Table 4 provides an overview of these recommendations.

Standard Operating Procedures

Screen everyone who enters the facility for symptoms and general health. To prevent COVID-19 from entering the facility, 27 sources suggested that all occupants should be screened prior to entering the facility (see Table 4). The literature revealed that screening should occur every visit and include a health and symptom questionnaire, and temperature check (e.g. Amagasa et al., 2020; Cortez et al., 2020; Dominski & Brandt, 2020). Those experiencing symptoms, a high temperature, have tested positive, or have encountered someone who has had COVID-19 recently should not be permitted to enter the facility (Blocken et al., 2020; Cortez et al., 2020; Sikka et al., 2020). Four sources also identified COVID-19 testing as a potential component of screening (Chu et al., 2021; Denay et al., 2020; Fitzgerald et al., 2021).

COVID-19 management plans should be developed and integrated into standard operating procedures to manage suspected or confirmed cases, and train staff. 22 sources suggested that standard operating procedures should be updated to reflect the risk of COVID-19 transmission (see Table 4). Multiple sources pointed to case management that outline how the collection of information and contact tracing will commence in the event of a confirmed case within the facility (e.g. Bae et al., 2020; Carmody et al., 2020; Denay et al., 2020; Hughes et al., 2020). Moreover, in the event of a suspected or confirmed case, the case must be medically managed, isolated immediately and contact tracing must commence to reduce further community spread (Castagna et al., 2020; Hughes et al., 2020; Sikka et al., 2020). Facilities may want to enforce the mandatory usage of government contact tracing applications (Hughes et al., 2020; Wackerhage et al., 2020) or use quick response (QR) code mobile phone applications to assist

with contact tracing (Fitzgerald et al., 2021). Emergency action and/or first aid procedures may also need to be altered to protect first responders in the event of an emergency (Hodgson et al., 2021a; Hodgson et al., 2021b; Pena et al. 2021).

Increase the frequency of cleaning rooms, surfaces and equipment. The increased cleaning requirements were identified in 33 sources (see Table 4). Rooms, surfaces and equipment should be evaluated to determine the frequency of cleaning required for each (Hughes et al., 2020; Matos et al., 2021). Many sources pointed to strict cleaning schedules and inspections conducted each day (e.g. Amagasa et al., 2020; Blocken et al., 2020; Mulcahey et al., 2021; Tinaz & Emiroglu, 2020; Wong et al., 2020). Spaces and equipment should be cleaned between each user group to help prevent cross contamination between users (Dominski & Brandt, 2020; Timpka, 2020; Wackerhage et al., 2020). Cleaning and disinfectant products should be readily available on tables, countertops and near equipment to encourage users to assist with cleaning after each use (Cortez et al., 2020; Gentil et al., 2020). In pools and aquatic spaces, the physicochemical indicators should be frequency monitored to ensure chlorine and chemicals are maintained at appropriate levels (Romano-Bertrand et al., 2020; Haddad et al., 2021).

Educational communication strategies should be developed to influence safe user behaviour and reinforce personal hygienic practices. 33 sources recommended that facilities develop educational communication plans to promote safe and hygienic user behaviour (see Table 4). The communication plan can provide users with information regarding health screening procedures, COVID-19 symptoms, facility safety protocols, physical distancing, proper use of personal protective equipment and personal hygiene practices (e.g. Almasri et al., 2020; Gentil et al., 2020; Mulcahey et al., 2021;). The plans should be communicated throughout a facility

(Hughes et al., 2020) and on media platforms to promote safety and encourage users to return to the facility (Tinaz & Emiroglu, 2020). Communication should also be updated whenever new information is available (Parker et al., 2020). Educational communication will help promote safe behaviour and decrease the risk of transmission within facilities (Bae et al., 2020; Francis & Francis, 2020; Robinson et al., 2021a).

Food and concession services should be opened gradually with disposable and individually wrapped items. Six sources provided recommendations for concession services (see Table 4) that included not providing these services (Ramos e Corte et al., 2020), offering them in an individual, pre-packaged manner (Parker et al., 2020), or delivering them directly to seats (Drury et al., 2021). Facility operators will need to progressively consider how to offer food and beverage services in a safe and appropriate manner (Hughes et al., 2020).

Contaminated material should be disposed of in a clinical waste bin. Contaminated equipment was discussed by four sources (see Table 4). Personal protective equipment and materials used to clean should be considered hazardous material and disposed of in a clinical waste bin (Hodgson et al., 2021a; Hodgson et al., 2021b; Pena et al., 2021).

Suppliers should schedule strict delivery times and minimize contact with facility staff. To reduce the number of interactions between facility staff and others, three sources made suggestions towards supplier/delivery scheduling (see Table 4). Deliveries can either take place when the facility is not open (Cortez et al., 2020) or adhere to a strict delivery schedule (Blocken et al., 2020). When accepting deliveries, personal protective equipment should be worn and there should be an immediate sterilization of goods (Blocken et al., 2020; Cortez et al., 2020).

Facility Capacity and Spacing

Facility and room capacity should be reduced. During a pandemic, 17 sources suggested that facility operators should evaluate and reduce their room capacity limits (see Table 4). Piotrowski et al. (2021) recommended that sport facilities should adhere to a limit of 1 person per ten square meters up to a maximum of one hundred fifty people at a time, however other sources suggested that ventilation, the proposed activities (Cortez et al., 2020) and the ability to physically distance (Dominski & Brandt, 2020) can help determine capacity.

Travelling within a facility should be minimized. Nine sources discussed travel within facilities (see Table 4). Users should be encouraged to leave the facility immediately after they've finished their activity (Blocken et al., 2020; Cortez et al., 2020). Facility operators may want to consider one-way traffic flow (DiFiori et al., 2021; Drury et al., 2021) or allowing users to enter and exit through multiple locations to reduce travel within the facility (Parker et al., 2020; Robinson et al., 2021b).

The use of change rooms should be minimized or altered to allow for physical distancing. Due to the moist environment of locker rooms and prevalence of COVID-19 aerosol transmission, 10 sources recommended reducing the usage of locker and change rooms (see Table 4). The showers in change rooms are an issue because mist can be a possible medium for transmitting infections (Wong et al., 2020). Therefore, change rooms should be primarily used as storage (Romano-Bertrand et al., 2020) and participants should shower (Hughes et al., 2020) or change (Fitzgerald et al., 2021) at home. Change rooms should also have capacity restrictions that reduce the number of people using them at one time (Asif et al., 2020; Ramos e Corte et al., 2020; Timpka, 2020; Wong et al., 2020).

Spectator areas may need to adhere to larger physical distancing radiuses and stricter measures than general facility spaces. Four sources provided guidance for the

management of fans and spectators (see Table 4). Patrons will need to be assigned seats that maintain physical distancing (Hughes et al., 2020) and it is possible that larger distancing radiuses will need to be established to accommodate aerosols travelling further due to shouting and boisterous activity (Parker et al., 2020). Facilities can also consider installing partitions between seats (Murakami et al., in press). While entering and exiting, the flow of traffic will need to be considered to ensure people maintain safe distances apart (Parker et al., 2020). In addition, facility operators may want to consider more targeted screening and rapid testing to reduce transmission risk in spectator areas (Mulcahey et al., 2021).

Activities and Equipment

Adhere to public health guidelines and if possible, engage public health to help assess each activity and space to develop temporary frameworks that promote safety or justifiably cancel a particular activity altogether. The nature of each activity and space is different, a fact that was highlighted by 35 sources that provided recommendations for various activity frameworks (see Table 4). Multiple sources pointed to the risks associated with group activities and suggested that group sizes will need to be reduced to help maintain distancing (e.g. Hughes et al., 2020; Shurlock et al., 2020; Timpka, 2020; Tinaz & Emiroglu, 2020). If possible, the composition of these groups should be maintained for each training session to reduce the chances of larger outbreaks (Ramos e Corte et al., 2020). There is also a lower risk of transmission if participants remain stationery and equipment manipulation is minimized to limit turbulent airflow (Cortez et al., 2020; Gentil et al., 2020). Activities should be assessed, temporarily altered (Asif et al., 2020; Denay et al., 2020; Timpka, 2020) and ranked based on risk to determine how and when certain aspects of activities can be permitted to resume safely (Hughes et al., 2020). If an activity cannot be safely altered, it should be temporarily suspended

until local health conditions improve (Amagasa et al., 2020; Francis & Francis, 2020; Romano-Bertrand et al., 2020; Wackerhage et al., 2020). Traditional customs such as handshakes will need to be discouraged or restricted (Wong et al., 2020). Most importantly, these frameworks should be developed with collaboration between local public health experts, governing bodies, facility operators and other stakeholders involved in the delivery of these services, and adjusted according to local health conditions (Blocken et al., 2020; Carmody et al., 2020; Cortez et al., 2020; Hughes et al., 2020; Robinson et al., 2021b; Romano-Bertrand et al., 2020; Vancini et al., 2021).

Activities should adhere to strict schedules and participants must minimize unnecessary use of facilities. Nine sources provided recommendations for scheduling (see Table 4). Facility operators should consider implementing a time-based reservation system to maintain capacity thresholds (Blocken et al., 2020; Cortez et al., 2020; Hughes et al., 2020; O'Grady & Jordan, 2021). These reservations can be staggered to prevent social contacts (Watson et al. 2021) and allow for cleaning between each user group (Suhs et al. 2021). Users should be encouraged to leave the facility immediately after their activity to reduce contacts between people (Hughes et al., 2020).

Special accommodation must be considered for users who are vulnerable to COVID-19. People with underlying health conditions were identified as particularly vulnerable to COVID-19 by four sources and require additional consideration (see Table 4). Facility operators should consider either delaying the return to activities for vulnerable populations (Amagasa et al., 2020) and/or taking additional safety measures such as further reducing capacity while people who have conditions exercise (Hughes et al., 2020). In addition, enforcing mask

policies for people with underlying medical conditions may not be a safe policy (Shurlock et al., 2020).

Users should bring their own personal equipment and only be permitted to use their own. 16 sources recommended that facility users should bring their own personal equipment such as water bottles, uniforms, towels, etc. and not be permitted to share (see Table 4). Uniform kits must be cleaned and washed by players themselves between each use (Ramos e Corte et al., 2020) and brought in a separate bag with only the necessary equipment for the activity (O'Grady & Jordan, 2021; Casasco et al., 2020). Any disposable items must be discarded or recycled immediately after use (Casasco et al., 2020; Matos et al., 2021).

Staff Requirements

Basic staff requirements will be heightened with new duties and ensuring absences can be managed if quarantine is necessary. Staff requirements were a concern in eight sources (see Table 4) that highlighted new duties and the ability to manage absences. Regular health and safety evaluations will be required before opening (Parker et al., 2020). Four articles suggested that a COVID-19 supervisor should be appointed for this new, recurring task (Blocken et al., 2020; DiFiori et al., 2021; Hodgson et al., 2021a; Hodgson et al., 2021b). Communication between team members will also be critical to proactively resolve health and safety concerns (Tinaz & Emiroglu, 2020) and ensure staff can quarantine if needed while maintaining operations (Hughes et al., 2020).

Staff should be trained on facility-specific COVID-19 standard operating procedures. The need for staff to be educated about COVID-19 policies was highlighted by eight sources (see Table 4). Since staff can play an integral role in mitigating the risk of infection, facility operators will need to develop a communication plan and continuously educate

staff with the most up to date COVID-19 prevention information possible (Parker et al., 2020; Wackerhage et al., 2020).

Staff whose tasks can be completed at home should work from home to reduce the number of people inside the facility. Four sources suggested that staff who can complete their duties remotely should be encouraged to do so (see Table 4). Doing so will reduce the total number of facility occupants at one time (Cortez et al., 2020; Wong et al., 2020).

Third party personnel and organizations should be considered when developing return to sport protocols. Seven sources suggested that third party personnel should be taken into consideration and help design, educate and enforce COVID-19 protocols (see Table 4). These personnel may include coaches (Francis & Francis, 2020), medical personnel (Mercurio et al., 2020; Ramos e Corte et al., 2020) and officials (Castagna et al., 2020). For example, coaches and medical personnel should be aware of their athletes' vaccination status and assist with providing health status updates (Francis & Francis, 2020). Facilities should also consider regular tenants, such as sport clubs, that regularly rent facility time and may require financial support to continue operations (Feiler et al., 2021).

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Personal Protective Equipment

Personal protective equipment is considered the last line of defence to reduce the risk of transmitting infectious disease. These recommendations are primarily to be enacted when local public health officials deem necessary. Three recommendations were identified, and Table 5 provides a summary of these recommendations.

All facility occupants should be required to wear masks when not participating in physical activity and extra personal protective equipment should be available. The

importance of wearing masks by facility occupants was demonstrated by 42 sources recommending that wearing masks should be mandatory (see Table 5). Multiple sources recommended wearing a mask in any high-risk situation (Mulcahey et al., 2021; Shurlock et al., 2020), particularly when physical distancing cannot be maintained, while users are on the sidelines of activities (Asif et al., 2020; Wong et al., 2020) or on the way to and from the dressing rooms (Romano-Bertrand et al., 2020). One source recommended creating an anonymous reporting system that allows users to report issues of non-compliance (Sikka et al., 2020). Moreover, practitioners, including facility staff, coaches and athletic trainers should be provided additional personal protective equipment that suits their role, such as gloves and goggles (Blocken et al., 2020; Castagna et al., 2020; Cortez et al., 2020; Mercurio et al., 2020; Ramos e Corte et al., 2020).

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Discussion

The present rapid review systematically gathered and reviewed peer-reviewed literature to develop broad recommendations that will help inform the safe return to sport and recreation facilities. After the analysis of 63 articles, 25 recommendations emerged. The recommendations were categorized according to NIOSH's hierarchy of controls for addressing occupational hazards. In addition, within the administrative control category, sub-themes emerged that pertained to standard operating procedures, facility capacity and spacing, activities and equipment, and staff requirements. With the recency of the COVID-19 pandemic, it is likely that additional literature will be produced that will further promote the safe return to these facilities and as a result, the proposed recommendations could be updated in an iterative process. Nevertheless, these 25 recommendations have important implications for the occupational health

and safety of sport and recreation facility users as the industry emerges from the COVID-19 pandemic.

The recommendations identified in this study align with literature that has adopted the NIOSH hierarchy of controls framework to develop strategies for the safe return to non-clinical settings (e.g. Dehghani et al., 2020; Zisook et al., 2020). With the elevated risk of transmitting COVID-19 at sport and recreation facilities (Bae et al., 2020), the framework was appropriate to apply to a sport and recreation context and is a key contribution of this study. The recommendations in this study pertained to eliminating or substituting the virus (through the currently available vaccines), engineering controls, administrative controls and personal protective equipment, acting as risk mitigation strategies. Due to the nature of sport and recreation and the new variants of concern that continue to arise, it is unlikely that risk will be completely eliminated.

The mandatory immunization policy recommendation is the most protective in the hierarchy of controls framework. However, the current available vaccines (as of August 2021) do not provide complete immunity and are less effective at reducing the spread of variants of concern (i.e. Delta) (Harder et al., 2021). Fortunately, the vaccines are effective at reducing the risk of hospitalization (Harder et al., 2021). Therefore, the implementation of an immunization policy will reduce the chance of transmission within sport and recreation facilities, and if transmission occurs, the infected will be less likely to be hospitalized. This will create a safer environment for the return to sport and recreation facilities.

The engineering control recommendations identified in this study highlighted how the built environment can be redesigned to better separate people and pathogens. For example, the current study's recommendation to improve current air handling practices aligns with previous

literature that has found that improvements to ventilation and air quality can minimize the risk of airborne transmission (Megahed & Ghoneim, 2021; Morawska et al., 2020). Like previous epidemics, such as SARS-CoV-1, architects will need to continue improving the built environment (i.e. engineering controls) for occupational health and safety (Pinheiro & Luis, 2020). Together, these recommendations should be considered when designing new sport and recreation facilities or renovating existing facilities to mitigate the risk of transmitting viruses in these settings.

The administrative control recommendations involved altering standard operating procedures to minimize transmission risk. The recommendations in this section also aligned with previous scholarly literature. For example, the need to educate staff, implement reductions to space capacity and promote physical distancing have also been implemented in other workplace settings (Dehghani et al., 2020; Hou et al., 2021; Zisook et al., 2020). Facility operators will also need to collaborate with local public health officials to determine the best course of progressive action based on the local health conditions. More generally, there will need to be a greater emphasis on the promotion of occupational health and safety (Dennerlein et al., 2020) in sport and recreation facilities. Finally, as the last line of defense, facility operators will need to be willing to provide personal protective equipment to their staff and enforce the usage thereof among the general public who enter their facilities when local conditions warrant the most extreme safety measures.

While the present review makes an important contribution to the literature, it is not without limitations. For instance, we did not include literature published before COVID-19 was identified, nor studies that addressed reduction of viral transmission in non-sport and recreational settings. Nevertheless, there has been ample research published since the pandemic was declared,

thus providing significant evidence on which to base our recommendations. Second, our search was restricted to studies published in English, and we therefore may have omitted studies published in other languages that may have had meaningful implications for our recommendations. Third, due to the rapid nature of this review, we did not conduct a risk of bias assessment for the included literature, which may bias our findings. Finally, these recommendations are not exhaustive as more research with implications for reducing transmission in sport and recreational settings is published every day. Moving forward, researchers and practitioners are encouraged to update these recommendations in an iterative manner as new information emerges.

In sum, this rapid review has provided timely practical recommendations to support the safe reopening of the sport and recreation industry. The recommendations identified by this study will provide guidance for practitioners that help the sport and recreation industry return to a degree of normalcy that has not been experienced since the onset of the pandemic. Considering the notion that herd immunity may be unlikely (Madhi, 2021), the progressive return to normalcy for this industry is extremely important, as it will help address the adoption of unhealthy lifestyles and mental health issues that the pandemic has caused.

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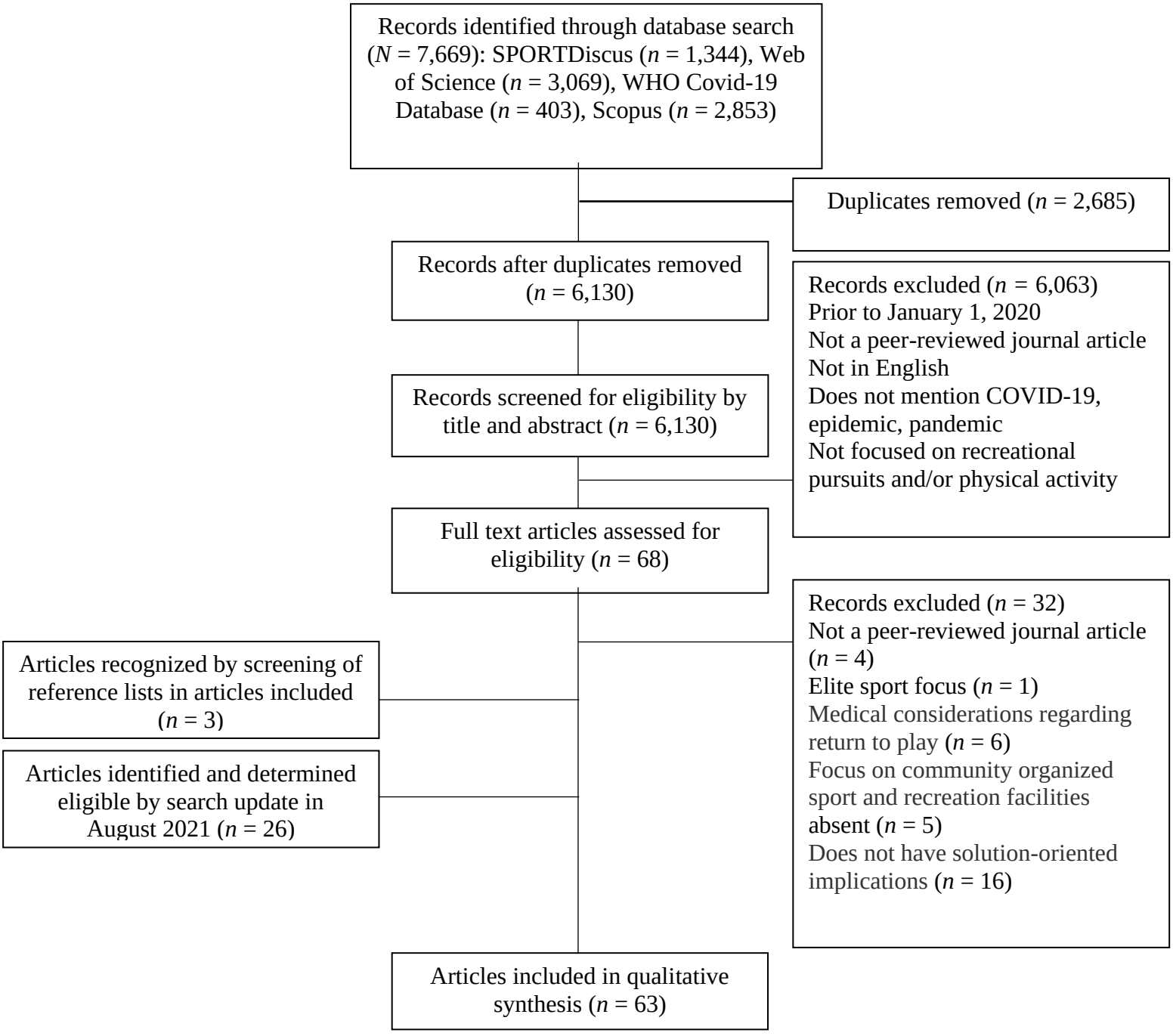

Figure 1. PRISMA flow chart.

Table 1

Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Published since January 1, 2020	Focused on elite sport (i.e., recommendations not realistic for community recreation)
English language	Focused on transmission risk while engaging in recreational physical activities, without recommendations for mitigation
Peer-reviewed academic publications including empirical articles, opinions/commentaries and reviews	Focused on injury prevention during return to sport
Focused on community organized sport and recreation facilities	Focused on park settings
Provides solution-oriented implications or recommendations	

Table 2

Summary of Recommendations for Elimination/Substitution

Element	Recommendation	Supporting Literature
Immunization Policy	1. Facility users must show proof of vaccination upon entry	DiFiori et al., (2021); Chu et al., (2021); Francis & Francis (2020); McElheny et al., (2021); McLarnon et al. (2021)

Table 3

Summary of Recommendations for Engineering Controls

Element	Recommendation	Supporting Literature
Built Environment	1. Improve ventilation and air handling procedures	Amagasa et al., (2020); Asif et al., (2020); Blocken et al., (2020); Blocken et al., (2021); Cilhoroz et al., (2021); Chu et al., (2021); Cortez et al., (2020); DiFiori et al., (2021); Dominski & Brandt (2020); Donadu et al. (2020); Drury et al., (2021); Fitzgerald et al., (2021); Gentil et al., (2020); Hodgson et al., (2021b); Jones et al., (2021); McElheny et al., (2021); Mercurio et al., (2020); Murakami et al. (in-press); Parker et al., (2020); Piotrowski et al., (2021); Wackerhage et al., (2020)
	2. Design or reorganize rooms and corridors to allow for physical distancing	Altavilla et al., (2021); Amagasa et al., (2020); Blocken et al., (2020); Carmody et al., (2020); Casasco et al., (2020); Castagna et al., (2020); Cilhoroz et al., (2021); Chu et al., (2021); Cortez et al., (2020); D'Agostino et al., (2021); Denay et al., (2020); DiFiori et al., (2021); Dominski & Brandt (2020); Donadu et al. (2020); Drury et al., (2021); Fitzgerald et al., (2021); Gentil et al., (2020); Hughes et al., (2020); Kim & Yang (2021); Mercurio et al., (2020); Matos et al., (2021); McElheny et al., (2021); Mulcahey et al., (2021); Murakami et al. (in-press); Pena et al. (2021); Piotrowski et al., (2021); Robinson et al., (2021a); Romano-Bertrand et al., (2020); Suhs et al., (2021); Wackerhage et al., (2020); Watson et al., (2021); Wong et al., (2020)
	3. Reduce the number of high-touch surfaces	Cortez et al., (2020); DiFiori et al., (2021); Drury et al., (2021); Gentil et al., (2020); Matos et al., (2021); McElheny et al., (2021); Parker et al., (2020); Pena et al. (2021); Robinson et al., (2021a)
	4. Hand washing stations should be installed throughout facilities	Almasri et al., (2020); Amagasa et al., (2020); Asif et al., (2020); Blocken et al., (2020); Carmody et al., (2020); Casasco et al., (2020); Cortez et al., (2020); DiFiori et al., (2021); Dominski & Brandt (2020); Drury et al., (2021); Gentil et al., (2020); Hughes et al., (2020); Matos et al., (2021);

	McElheny et al., (2021); Mulcahey et al., (2021); Murakami et al. (in-press); O'Grady & Jordan (2021); Parker et al., (2020); Pena et al. (2021); Ramos e Corte et al., (2020); Robinson et al., (2021a); Robinson et al., (2021b); Romano-Bertrand et al., (2020); Timpka (2020); Vancini et al., (2021); Watson et al., (2021); Wong et al., (2020)

Table 4

Summary of Recommendations for Administrative Controls

Element	Recommendation	Supporting Literature
Standard Operating Procedures	1. Screen everyone who enters the facility for symptoms and general health	Amagasa et al., (2020); Blocken et al., (2020); Chu et al., (2021); Cilhoroz et al., (2021); Cortez et al., (2020); Denay et al., (2020); DiFiori et al., (2021); Dominski & Brandt (2020); Donadu et al. (2020); Fitzgerald et al., (2021); Hodgson et al., (2021a); Hughes et al., (2020); Kim & Yang (2021); Mercurio et al., (2020); McElheny et al., (2021); Mulcahey et al., (2021); O'Grady & Jordan, (2021); Parker et al., (2020); Pena et al. (2021); Ramos e Corte et al., (2020); Robinson et al., (2021a); Robinson et al., (2021b); Romano-Bertrand et al., (2020); Sikka et al., (2020); Wackerhage et al., (2020); Watson et al. (2021); Wong et al., (2020)
	2. COVID-19 management plans should be developed and integrated into standard operating procedures to manage suspected or confirmed cases, and train staff.	Bae et al., (2020); Blocken et al., (2020); Carmody et al., (2020); Castagna et al., (2020); Chu et al., (2021); Cilhoroz et al., (2021); D'Agostino et al., (2021); Denay et al., (2020); Drury et al., (2021); Fitzgerald et al., (2021); Hodgson et al., (2021a); Hodgson et al., (2021b); Hughes et al., (2020); McLarnon et al. (2021); O'Grady & Jordan, (2021); Parker et al. (2020); Pena et al. (2021); Robinson et al., (2021b); Romano-Bertrand et al., (2020); Sikka et al., (2020); Wackerhage et al., (2020); Watson et al., (2021)

	3. Increase the frequency of cleaning rooms, surfaces and equipment	Amagasa et al., (2020); Asif et al., (2020); Blocken et al., (2020); Castagna et al., (2020); Cilhoroz et al., (2021); Cortez et al., (2020); DiFiori et al., (2021); Dominski & Brandt (2020); Donadu et al. (2020); Drury et al., (2021); Fitzgerald et al., (2021); Gentil et al., (2020); Haddad et al., (2021); Hodgson et al., (2021a); Hodgson et al., (2021b); Hughes et al., (2020); Kim & Yang (2021); Matos et al., (2021); McElheny et al., (2021); Mercurio et al., (2020); Mulcahey et al., (2021); Murakami et al. (in-press); Pena et al. (2021); Piotrowski et al., (2021); Ramos e Corte et al., (2020); Romano-Bertrand et al., (2020); Schumacher et al. (2021); Timpka (2020); Tinaz & Emiroglu (2020); Suhs et al., (2021); Wackerhage et al., (2020); Watson et al., (2021); Wong et al., (2020)
	4. Educational communication strategies should be developed to influence safe user behaviour and reinforce personal hygienic practices	Almasri et al., (2020); Amagasa et al., (2020); Bae et al., (2020); Carmody et al., (2020); Casasco et al., (2020); D'Agostino et al., (2021); DiFiori et al., (2021); Donadu et al. (2020); Drury et al., (2021); Fitzgerald et al., (2021); Francis & Francis, (2020); Gentil et al., (2020); Hodgson et al., (2021a); Hodgson et al., (2021b); Hughes et al., (2020); Kim et al., (2020); Kim & Yang (2021); Martin et al., (2021); McElheny et al., (2021); Mercurio et al., (2020); Mulcahey et al., (2021); O'Grady & Jordan, (2021); Parker et al., (2020); Pena et al. (2021); Piotrowski et al., (2021); Robinson et al., (2021a); Robinson et al., (2021b); Romano-Bertrand et al., (2020); Suhs et al., (2021); Timpka

		(2020); Tinaz & Emiroglu (2020); Vancini et al., (2021); Wong et al., (2020)
	5. Food and concession services should be opened gradually with disposable and individually wrapped items	Casasco et al., (2020); Donadu et al. (2020); Drury et al., (2021); Hughes et al., (2020); Parker et al., (2020); Ramos e Corte et al., (2020)
	6. A system should be created for the correct disposal of contaminated material	Hodgson et al., (2021a); Hodgson et al., (2021b); Pena et al. (2021); Shurlock et al. (2020)
	7. Suppliers should schedule strict delivery times and minimize contact with facility staff	Blocken et al., (2020); Cortez et al., (2020); Donadu et al. (2020)
Facility Capacity and Spacing	8. Facility and room capacity should be reduced to allow for physical distancing	Almasri et al., (2020); Blocken et al., (2020); Carmody et al., (2020); Cilhoroz et al., (2021); Cortez et al., (2020); Dominski & Brandt (2020); Donadu et al. (2020); Drury et al., (2021); Fitzgerald et al., (2021); Hughes et al., (2020); Kemp et al., (2021); Kim & Yang (2021); McElheny et al. (2021); Piotrowski et al., (2021); Ramos e Corte et al., (2020); Robinson et al., (2021b); Suhs et al., (2021)
	9. User travel within a facility should be minimized or altered	Blocken et al., (2020); Cortez et al., (2020); DiFiori et al., (2021); Donadu et al. (2020); Drury et al., (2021); Fitzgerald et al., (2021); Kim & Yang (2021); Parker et al., (2020); Robinson et al., (2021b)

	10. The use of change rooms should be minimized or altered to allow for physical distancing	Asif et al., (2020); Blocken et al., (2020); Cilhoroz et al., (2021); Hughes et al., (2020); Fitzgerald et al., (2021); Parker et al., (2020); Ramos e Corte et al., (2020); Romano-Bertrand et al., (2020); Timpka (2020); Wong et al., (2020)
	11. Spectator areas may need to adhere to larger physical distancing radiuses and stricter measure then general facility spaces	Hughes et al., (2020); Mulcahey et al., (2021); Murakami et al. (in-press); Parker et al., (2020)
Activities and Equipment	12. Adhere to public health guidelines and if possible, engage public health to help assess each activity and space to develop temporary frameworks that promote safety or justifiably cancel a particular activity altogether.	Altavilla et al., (2021); Amagasa et al., (2020); Asif et al., (2020); Bae et al., (2020); Blocken et al., (2020); Carmody et al., (2020); Casasco et al., (2020); Cortez et al., (2020); D'Agostino et al., 2021); Denay et al., (2020); DiFiori et al., (2021); Dominski & Brandt (2020); Donadu et al. (2020); Gentil et al., (2020); Fitzgerald et al., (2021); Francis & Francis, (2020); Hodgson et al., (2021a); Hodgson et al., (2021b); Hughes et al., (2020); Kim & Yang (2021); Kemp et al., (2021); Matos et al., (2021); McElheny et al., (2021); McLarnon et al. (2021); Mercurio et al., (2020); O'Grady & Jordan (2021); Ramos e Corte et al., (2020); Robinson et al., (2021a); Romano-Bertrand et al., 2020); Shurlock et al., (2020); Timpka (2020); Tinaz & Emiroglu (2020); Vancini et al., (2021); Wackerhage et al., (2020); Wong et al., (2020)

	13. Activities should adhere to strict schedules and participants must minimize unnecessary use of facilities	Blocken et al., (2020); Cortez et al., (2020) Gentil et al., (2020); Hughes et al., (2020); McElheny et al., (2021); O'Grady & Jordan, (2021); Ramos e Corte et al., (2020); Suhs et al., (2021); Watson et al., (2021)
	14. Special accommodation must be considered for users who are vulnerable to COVID-19	Amagasa et al., (2020); Carmody et al., (2020); Hodgson et al., (2021b); Hughes et al., (2020)
	15. Users should use only their own personal equipment	Asif et al., (2020); Blocken et al., (2020); Casasco et al., (2020); Chu et al., (2021); Cortez et al., (2020); DiFiori et al., (2021); Dominski & Brandt (2020); Fitzgerald et al., (2021); Gentil et al., (2020); Hodgson et al., (2021b); Hughes et al., (2020); Matos et al., (2021); McElheny et al. (2021); O'Grady & Jordan (2021); Pena et al. (2021); Ramos e Corte et al., (2020)
Staff Requirements	16. Basic staff requirements will be heightened with new duties and ensuring absences can be managed if quarantine is necessary.	Blocken et al., 2020); DiFiori et al., (2021); Hodgson et al., (2021a); Hodgson et al., (2021b); Hughes et al., (2020); Matos et al., (2021); Parker et al., (2020); Tinaz & Emiroglu (2020)
	17. Staff should be trained on facility-specific COVID-19 standard operating procedures	Carmody et al., (2020); D'Agostino et al., (2021); Hodgson et al., (2021a); Hodgson et al., (2021b); Parker et al., (2020); Robinson et al., (2021b); Vancini et al., (2021); Wackerhage et al., (2020)
	18. Staff whose tasks can be completed at home should work from home to reduce	Blocken et al., (2020); Cortez et al., (2020); Ramos e Corte et al., (2020); Wong et al., (2020)

	the number of people inside the facility	
19.	Third party personnel and organizations should be considered when developing return to sport protocols	Castagna et al., 2020); DiFiori et al., (2021); Feiler et al., (2021); Francis & Francis (2020); Kemp et al., (2021); Mercurio et al., (2020); Ramos e Corte et al., (2020)

Table 5

Summary of Recommendations for Personal Protective Equipment

Element	Recommendation	Supporting Literature
Personal Protective Equipment	1. All facility occupants should be required to wear masks when not participating in physical activity and extra personal protective equipment should be available	Amagasa et al., (2020); Asif et al., (2020); Blocken et al., (2020); Castagna et al., (2020); Cilhoroz et al., (2021); Chu et al., (2021); Cortez et al., (2020); Cunningham et al., (2021); D'Agostino et al., (2021); Denay et al., (2020); DiFiori et al., (2021); Doherty et al., (2021); Dominski & Brandt (2020); Donadu et al. (2020); Drury et al., (2021); Egger et al., 2021; Epstein et al., (2021); Fitzgerald et al., (2021); Gentil et al., (2020); Haraf et al., (2021); Hodgson et al., (2021a); Hodgson et al., (2021b); Hopkins et al., (2020); Jones et al., (2021); Kim et al., (2020); Kim & Yang (2021); Lakicevic et al., (2021); McElheny et al., (2021); Mercurio et al., (2020); Mulcahey et al., (2021); Murakami et al. (in-press); O'Grady & Jordan, (2021); Parker et al., (2020); Pena et al. (2021); Ramos e Corte et al., (2020); Romano-Bertrand et al., (2020); Suhs et al., (2021); Shurlock et al., (2020); Sikka et al., (2020); Watson et al., (2021); Wackerhage et al., (2020); Wong et al., (2020)

Appendix A

Search Terms

SPORTDiscus:

- Search Options:
  - Search mode: Boolean/phrase
  - Applied related words
  - Applied equivalent subjects
  - Date: Jan 2020 onward
  - English only
  - Searched all text
- Search Terms with the AND operator between each line
  - Facility OR Facilities OR centre* OR center* OR gym OR gyms OR gymnasium OR stadium* OR infrastructure OR building* OR club*
  - Recreation* OR sport* OR fitness OR exercis* OR “physical activity” OR “physical activities” OR game*
  - “Covid-19” OR coronavirus OR “SARS-COV-2” OR lockdown OR pandemic OR epidemic OR return OR reboot OR restart OR reopen OR resume OR recommendation* OR safe* OR " infectious disease" OR "infectious diseases"

SCOPUS:

- Search Options:
  - Date: Jan 2020 onward
  - English only
  - Search within: All fields
- Search Terms with the AND operator between each line
  - Facility OR Facilities OR centre* OR center* [DB1] OR gym OR gyms OR gymnasium OR stadium* OR infrastructure
  - Recreation* OR sport* OR fitness OR exercis* OR “physical activity” OR “physical activities”
  - “Covid-19” OR coronavirus OR “SARS-COV-2”
  - Return OR restart OR reboot OR reopen OR resume OR recommendation

Web of Science:

- Search Options:
  - Date: Jan 2020 onward
  - English only
  - Search within: All fields
- Search Terms with the AND operator between each line

    - Facility OR Facilities OR centre OR centres OR centers OR center OR gym OR gyms OR gymnasium OR stadium OR stadiums OR infrastructure
    - Recreation OR recreational OR sport OR sports OR fitness OR exercis* OR "physical activity" OR "physical activities"
    - "Covid-19" OR coronavirus OR "SARS-COV-2" OR return OR restart OR reboot OR reopen OR resume OR recommendation

World Health Organization Covid-19 Database:

- Search Options:
    - Date: Jan 2020 onward
- Search Terms with the AND operator between each line
    - Facility OR Facilities OR centre* OR center* OR gym OR gyms OR gymnasium OR stadium* OR infrastructure
    - Recreation* OR sport* OR fitness OR exercis* OR "physical activity" OR "physical activities"
    - "Covid-19" OR coronavirus OR "SARS-COV-2" OR return OR restart OR reboot OR reopen OR resume OR recommendation

Appendix B

Study	Purpose	Methods/Design	Source Characteristics	Applicable Context	Practical Implications
Almasri (2020) Saudi Arabia	Assess the behaviour of gym attendees toward preventative precautions prior to the pandemic and the behavioural changes that will be accommodated after the new policies and procedures are implemented	Empirical	198 adults	Indoor facilities	-High need for promoting awareness on the importance of personal hygiene and sanitation practices among gym users for public gym users even prior to the outbreak of COVID-19 -Gyms should limit capacity -Personal towels and disposable sanitization products should be readily available
Altavilla (2021) Italy	Investigate trends and changes of physical activity during the COVID-19 pandemic, the training modes used during the lockdown and physical activity outdoors compared to current safety standards with the prolonged closure of gyms	Empirical	90 Italian adults	Indoor facilities	-Outdoor fitness classes may be a safe alternative to indoor activities -Physical distancing should be implemented so that people can be safe while active
Amagasa (2020) Japan	Introduce exercise facilities guidelines in Japan and provide reference for the rest of	Commentary	NA	Indoor/outdoor	-Hygiene control and maintenance can be achieved through providing sanitization stations and advertise recommended use, refreshing air in training rooms consistently, sanitizing facilities and equipment regularly, wearing face masks, and

	the world to reopen exercise facilities safely in the post pandemic period as well as prevent future outbreaks				providing sufficient space to enable physical distancing -Symptom and close contact screening as well as temperature checks should be used for determining eligibility to use or work at facilities -Patrons should also be screen for underlying medical conditions so that appropriate accommodations can be made if possible -As per local public health guidelines, event size should be minimized through avoiding group activities and limiting facility capacity if group activities cannot be avoided
Asif (2020) United States	Synopsis of 10 Covid-19 related questions is presented to help offer guidance	Commentary	High school athletes	Return to Sport	-Prioritize non-contact activities to promote physical distancing and isolated groups to minimize disease spread if infection occurs -Use face masks when physical distancing not possible -Enable regular hygienic practices -Frequently sanitize high traffic areas and equipment -Minimize use of gathering spaces where physical distancing is challenging -Avoid spaces with poor ventilation -Encourage individuals to use their own water bottles and equipment
Bae (2020) South Korea	Conduct an epidemiological investigation on an outbreak of COVID-19	Empirical	1,687 contacts stemming from fitness centre outbreaks	Indoor facilities	-Physical distancing and mask wearing should be recommended and educational campaigns should be implemented to raise awareness -Contact tracing, isolation, and testing close contacts can be used effective to control outbreaks at fitness facilities

	in fitness centers in Korea				-In areas where physical distancing is challenging, people are more vulnerable to infection
Blocken (2021) Netherlands	To examine ventilation and air cleaning as measures to limit the build-up of aerosol concentrations in the indoor environment of a gym	Empirical	35 adults	Indoor facilities	-High concentrations of aerosol particle concentrations are of concern in sport and recreation facilities, but with proper ventilation or air cleaning, aerosol particle deposition can be enhanced -High-quality AC units can be similarly effective compared to mechanical ventilation systems with aerosol filtering -Ventilation at the minimum flow rates as required by building codes is critically important
Blocken (2020) Netherlands	To discuss the challenges in safe reopening of indoor facilities and the measures already suggested by others to tackle existing challenges	Commentary	NA	Indoor facilities	-Staff and facility users should wear faces masks or respirators, physical distance at all times, sneeze and cough into one's elbow cavity and using paper towels, stay at home after being diagnosed with the virus, when symptoms manifest, or after coming in contact with someone who has symptoms or tested positive Operators should: -Limit capacity in the facility -Provide appropriate personal protective equipment and sanitization stations -Regularly sanitize high contact surfaces -Implement screening protocols -Train employees on pointing out unsafe behavior -Organize movement within facility to maximize physical distancing Visitors should: -Require a reserved time slot -Using the sanitary facilities at home instead of in the center

					-Ensure good personal hygiene practices are conducted upon arriving, during visit, and leaving the facility Employees should: -Working from home when possible -Engage in regular personal hygiene practices upon arriving, during visit, and leaving the facility -Use their own tools Suppliers should: -Announce arrival 15 min in advance, wear gloves, announce where the goods will be placed, give preference to delivery at the doorstep Built environment: -Indoor facilities could benefit from enhanced ventilation systems -Consider real-time monitoring of environmental parameters (e.g., aerosol concentrations) at strategic locations in the facility -Consider moving indoor training outside if weather permits and space is available with equipment positioned so that no one is downwind and exposed to exhaled droplets Government authorities should: -Consider implementing a certificate of equivalence in terms of aerosol exposure when facilities achieve aerosol concentrations similar to other facilities allowed to reopen earlier
Carmody (2020) Europe	Overview of factors to consider when	Commentary	NA	Return to sport	Key measures to decrease risk of COVID-19 at sporting events: -Risk assessment

	recommencing professional sport				-Good personal hygiene practices -Educational awareness campaigns -Minimize number of persons on site/at event -Minimize those of high risk (>65, underlying conditions) -Contact tracing
Casasco (2020) Italy	Recommendations for the development and performance of physical exercise sessions for the general population obliged to stay at home during the lockdowns	Commentary	NA	Outdoor facilities	-Engage in activity within the boundaries of local public health guidelines -Be sure to physical distance at least 5m from others and at least 20m for biking style activities -Take all personal belongings when leaving facility -Practice good personal hygiene -Use personal water bottle(s)
Castagna (2020) Italy	Provide health and physical fitness guidelines for soccer match officials	Commentary	NA	Indoor/outdoor	-Regular diagnostic testing should be considered to reduce transmission -Physical distancing should be enforced during training sessions and individual training sessions should be encouraged if possible -Facility spaces should be sanitized regularly, people should wear masks when in the facility, and the number of people in a space should be organized or capped to ensure everyone can maintain a safe distance -The health of referees should be considered when developing return to sport protocols
Chu (2021) Hong Kong	Investigated an exercise event that was considered a 'super spreader' in Hong Kong	Commentary	N/A	Indoor facility	-Screening and contact tracing should be implemented -Preventive measures such as required wearing a mask, physical distancing in large spaces and individual use of equipment/items can mitigate viral transmission -Adequate ventilation exchange rates as per local recommendations is important in indoor facilities for

					reducing aerosolized droplets -Regular sanitization of spaces -Regular diagnostic testing and immunization can also prevent viral spread
Cilhoroz (2021) United States	Outline safety protocols used in fitness facilities	Commentary	NA	Indoor facilities	-Temperature should be checked upon arrival and sanitization stations should be used -Portable HEPA filtration systems should be used to clean and circulate air -Reduce duration of classes and number of participants in each class -Require face masks -Maintain physical distancing or at least 2m; visible markings on floor can aid with organization -Regularly sanitize spaces and surfaces -Close locker rooms and ask patrons to arrive in necessary clothes -Implement digital sign ups for contact tracing -Implement screening tool for employees
Cortez (2020) Brazil	Provide recommendations for reopening and maintained availability of physical activity spaces during the COVID-19 pandemic	Commentary	N/A	Indoor facilities	-Recommend participants use stationary equipment to prevent further dispersal of airborne droplets -Implement safety certification systems issued by public health departments that could permit facilities to reopen if certain protocols are followed -Implement protocols for responsible exercising that promote the use of face masks, physical distancing, covering nose and mouth using the elbow fold when coughing or sneezing, discarding tissues immediately, good personal hygeine, not sharing personal items, staying home when presenting symptoms or coming in close contact with someone presenting symptoms, staying home after testing

					positive for the virus or coming in close contact with someone who tested positive Facility managers should: -Limit the number of people in the facility at once -Provide appropriate personal protective equipment for staff and patrons -Reduce number of high touch surfaces -Ensure regular cleaning of spaces, particularly those with high traffic -Conduct temperature checks of staff and patrons at the entry -Carefully monitor actions of staff to guarantee they meet the biosecurity protocols -Clearly mark appropriate distances between equipment and spaces to ensure physical distancing -Encourage people to use individual water bottles -Implement scheduling of facility use -Direct appropriate travel throughout facility if needed -Set up sanitization stations around the facility -Ensure proper ventilation -Reduce need for unnecessary personnel in building and/or organize deliveries to reduce contact with staff -Implement protocols that align with local public health measures -Encourage staff to work from home is possible
Cunningham (2021) United States	Examine county-level associations of physical activity with	Empirical	3142 counties in the United States	Indoor/outdoor	-Mask wearing may be more prevalent in countries where health and fitness is a part of the culture

	coronavirus disease cases and deaths				
D'Agostino (2021) United States	Describe the transmission of COVID-19 among youth and staff at day camps in North Carolina	Empirical	5,344 youth	Return to sport	-Risk mitigation measures should be implemented including masking, good hygiene practices, physical distancing, thorough staff training, and the development of resources dedicated to reducing transmission risk within sport and recreation facilities
Denay (2020) United States	Action statement on considerations for sports and physical activity	Commentary	NA	Indoor/outdoor	-Physical distancing and face masks can offer protection from virus transmission -Symptom and close contact screening and tracing should be implemented, particularly in high-contact risk sports and activities -Diagnostic testing may be most important for high-contact risk sports and activities, but should be based on local public health guidelines
DiFiori (2021) United States	Describe important considerations for professional sports leagues assessing when and how to resume phased operations, including practices and games	Commentary	NA	Return to sport	-Create and maintain risk of exposure-based categories encompassing each set of individuals necessary to operate, facilitate and participate in the event -Enforce strict physical distancing protocols -Require face masks when not active and physical distancing is not possible -Develop educational awareness campaigns to promote appropriate preventive measures and communicate risk awareness -Provide all people entering facility with appropriate personal protective equipment -Schedule regular sanitization -Ensure adequate ventilation recommendations are met -Implement screening and close contact training protocols

					when or prior to arrival -Use easily visible markings to direct flow of foot traffic to reduce crowding -Provide sanitization stations throughout facility -Install automatic sensors to reduce contact with high touch areas -Recommend use of personal water bottles, towels and equipment -Have dedicated personnel monitor events and promptly address non-compliance with preventive measures -Consider the needs of facility users when developing reopening protocols -Stay up to date on local infection rates by monitoring public reports
Doherty (2021) Canada	Determine the impact of wearing cloth or surgical masks on the cardiopulmonary responses to moderate-intensity exercise	Empirical	12 adults, 5 female	Return to sport	-Wearing a surgical or cloth mask during a relatively short bout of moderate-to-vigorous exercise has minimal impact on the physiological responses for young health individual
Dominski (2020) Brazil	N/A	Commentary	NA	Indoor/outdoor	-Physical distancing is recommended for indoor and outdoor activities -Face masks should be used when physical distancing is not possible -Daily screening should be implemented -The number of people in the facility at one time should be limited to 10m2 to 15m2 per person -Duration at facility should be limited to decrease exposure time -Use of natural ventilation and increased mechanical

					ventilation rate is recommended to avoid air recirculation -Each person should use their own water bottle -Sanitization stations should be easily accessible -Equipment should be sanitized regularly -A brief interval of at least of 10 min should be allocated between indoor group exercise classes to ensure proper cleaning, ventilation and sanitization procedures can be completed
Donadu (2020) Italy	Discussion of the guidelines developed by the Federal Medical-Scientific Commission for the resumption of professional football team and referee training and practice	Commentary	N/A	Indoor/outdoor	-Regular sanitization procedures should be in place for facility -Patrons and staff should be provided with appropriate personal protective equipment, which should always be worn -Educational awareness campaigns should be undertaken to promote uptake of preventive measures -Symptom screening stations should be placed at facility entrance (e.g., temperature checks) -Floorplan with equipment should be appropriately spaced to enable physical distancing -Training sessions should be scheduled outdoors, or if not possible, in well-ventilated indoor areas with a limited number of participants -In indoor spaces where physical distancing is a challenge, the number of people able to use of these spaces should be capped -Food services should be self-service -Facility staff should work from home where possible -Movement within facilities should be limited to essential employees

					-Suppliers must be assigned predefined methods, routes, and times in order to reduce contact with staff on site.
Drury (2021) United Kingdom	Review the behavioural risks and possible mitigations for re-opening large venues	Commentary	NA	Indoor/outdoor	-Reorganize and reduce the number of people that can be in the facility to enable physical distancing -Effectively manage flow of people in and around the facility -Enforce wearing of face masks -Provide sanitization stations throughout facility -Maximize touchless features (e.g., doors, soap dispenser) -Develop an effective communication strategy to promote risk mitigation -Ensure facility has adequate ventilation -Implement regular sanitization procedures -For spectators, enable access to refreshments via service in their seats
Egger (2021) Germany	Measure exhaustion, and cardiorespiratory and metabolic responses of athletes exercising while wearing masks	Empirical	16 well-trained adult athletes	Indoor/outdoor	-Mask wearing associated with significant reduction in maximal performance and discomfort at higher intensities
Epstein (2021) Israel	Assess the physiological effects of wearing surgical masks and N95 respirators during short-term strenuous exercise	Empirical	16 healthy, active, young adult males	Indoor/outdoor	-Strenuous activity can be completed safely by healthy young people while wearing either a surgical mask or an N95 respirator -Although wearing face masks may be associated with discomfort, there are only minor effects on physiological parameters while active -Individuals with underlying health conditions should consult a physician before attempting to be active with a mask

Feiler (2021) Germany	Investigate how strong sports clubs have been affected so far by COVID-19 and which capacities help or hinder clubs in dealing with the crisis	Empirical	German sports clubs	Return to sport	-Third party organizations should be consulted when making decisions
Fitzgerald (2021) Australia	Explore challenges regarding the physical and psychosocial importance of maintaining an active sport programme for young athletes during the pandemic	Commentary	NA	Return to sport	-Physical distancing, masking, and good personal hygiene practices must be encourage and followed to minimise the risk of disease transmission -Organize the flow of entrance/exit to reduce crowding in communal areas and ensure safe passage -If possible, test regularly -Implement a screening and close contact tool as well as temperature checks upon or prior to arrival, and if possible regular testing -Sanitize equipment and spaces regularly -Limit sharing of all items if possible -Reduce access to communal spaces -Encourage changing at home before attending facility, or if not possible, limit capacity of individuals in locker rooms -Ensure effective ventilation is in place indoors including the use of Ultraviolet-C radiation can be used in sports settings -Apps can be used to conduct contact tracing -Activities should be stratified into low, medium and high risk for infection
Francis (2020)	Explores considerations for immunization of youth athletes in order	Commentary	N/A	Indoor/outdoor	-Immunization may protect players, staff and spectators although immunization may not be possible for some due to underlying health conditions

United States	to return to organized sport				-Those unable to be immunized should follow preventive measure recommendations as per the local health authorities -Educational awareness materials should be shared regarding immunization and contagion risk -Parents, coaches and administrators should be considered when developing protocols
Gentil (2020) Brazil	Address issues and make recommendations that facilitate the return of resistance training amidst COVID-19 health challenges	Review	N/A	Indoor facilities	-Use of face masks and regular sanitization of high contact surfaces -Good personal hygiene practices should be reinforced -Individuals should maintain physical distancing of at least 1 m from others -Sanitization stations should be provided throughout facility -Floor plan should be organized with ground markings to denote physical distancing and equipment should be spread accordingly -Training times should be scheduled -Personal water bottles should be used -Regular sanitization of equipment and rooms should be implemented -Minimize the need to contact high touch surfaces -Ventilation should be optimized
Haddad (2021) Morocco	Review of recommendations for continued training of swimmers during stay-at-home orders, lockdowns, and when training at home	Review	N/A	Indoor facilities	-Regular sanitization of spaces, surfaces and water

Haraf (2021) United States	Review the physiological and psychological impact of wearing face coverings at rest and during exercise for both healthy individuals and those with underlying heart and lung disease	Review	N/A	Indoor/outdoor	-N95 respirator masks provide greatest protection, followed by surgical masks, and then cloth masks -Surgical masks can be used safety during exercise, even for those with underlying health conditions
Hodgson (2021a) United Kingdom	Best practice recommendations that assemble early evidence for managing SARS-CoV-2 and integrates expert opinion to provide a uniform and pragmatic approach to enhance on- field and pitch- side safety for the clinician and player	Commentary	NA	Return to sport	-Appoint a COVID-19 officer/manager responsible for risk assessment and planning -Promote good hygiene practices and raise awareness of the importance of adopting preventive measures -Maintain physical distance as per local public health guidelines -Provide appropriate personal protective equipment based on risk assessment and ensure its use and proper disposal -Implement screening protocols and testing (if applicable) for all staff and patrons -Implement regular sanitization procedures
Hodgson (2021b) United Kingdom	Outline of guidance and recommendations for delivery of first aid/medical care during COVID-19	Commentary	N/A	Indoor/outdoor	Personal hygiene: -Good personal hygiene practices should be engaged in at all times -Each individual should bring their own labelled water bottle for personal use -Each individual should bring their own sanitizer and use frequently during session -Conduct a risk assessment regarding whether to wear personal protective equipment as it may be challenging in some circumstances

					-Adhere to local public health recommendations pertaining to physical distancing -Face masks should be worn and disposed of in proper bins if needed Environmental hygiene: -Minimise the use of any shared equipment or items -Regular sanitization protocols should be implemented for spaces and equipment and individuals should clean their spaces when complete -Train outdoors at all times when practically possible or use well-ventilated indoor facilities Additional measures: -Appoint a COVID-19 compliance officer who must be responsible for implementing and recording all recommended protocols -Create a risk mitigation strategy -Educate all staff about risk mitigation protocols -Identify individuals at high risk of infection and implement mitigation strategies as appropriate -Contact tracing protocols should be implemented -First aid kits should reflect the additional items that ensure safety during this COVID-19 pandemic inclusive of PPE and consideration should be applied to what items will become single use.
Hopkins (2020) United States	Synthesize available literature on the effects of various masks and face coverings on the cardiorespiratory system	Review	NA	Indoor facilities	-Face masks or respirators should be used to filter aerosols while active and evidence suggests wearing a face mask/respirator while active is unlikely to cause harm in healthy individuals

	during physical activity/exercise				
Hughes (2020) Australia	Outlines recommendations and procedures set by the Australian Institute of Sport to return to sport amid the COVID-19 pandemic	Review	N/A	Indoor/outdoor	-Preparation to resume should involve educational awareness campaigns about preventive measures and medical resources as well as implementation of training schedules and spaces that accommodate physical distancing -Athletes and staff should minimize unnecessary use of facilities (e.g., showers, communal areas) -Protocols to manage symptoms and illness should be implemented -Good personal hygiene practices should be promoted -Personal water bottles, towels and equipment (when possible) should be used -Contact tracing apps should be used -Aim to minimize the number of people present at the facility at one time -Determine appropriate sanitization strategies for spaces and equipment, ideally between sessions and matches (depending on activity) -Ensure sanitization stations are available in high traffic areas and entrances/exits -Encourage spectators to physical distance -Consider whether it is appropriate to provide food services at events -Adhere to local public health recommendations -Special accommodation should be made for those vulnerable to Covid-19
Jones (2021)	Outline the Team Sport Risk Exposure Framework-2 and its use	Commentary	N/A	Indoor/outdoor	-Indoor ventilation systems should meet appropriate recommendations -Activity should be undertaken outdoors as much as

United Kingdom	in identifying sports that present risk of transmission and participants at risk of COVID-19 exposure				possible, but when not possible, face masks are recommended to mitigate risk
Kemp (2021) United Kingdom	Outline the UK's five-stage model for returning to elite sport	Commentary	NA	Return to sport	Return to sport should occur in stages: -Stage 1: Organised training for individuals in hygiene optimised facilities while maintaining physical distancing at all times. -Stage 2: Open to close contact group and team training for sports where physical distancing may be challenging -Stage 3: Begin competition behind closed doors where physical distancing cannot be maintained at all times Regardless of sport or activity type, risk assessments should be undertaken when considering return in a safe manner
Kim (2020) South Korea	Understand the relationship between mask-wearing behavior and physical/non-physical leisure activity as well as the tendencies behind mask-wearing intentions within leisure activities	Empirical	545 active Korean adults	Indoor/outdoor	-Educational awareness campaigns should aim to promote positive attitudes towards mask wearing
Kim (2021) South Korea	Investigate perceptions of crowding and risk during leisure activities	Empirical	1078 Korean adults	Indoor/outdoor	-Measures must be taken to raise awareness of the importance of physical distancing and communicate risk of transmission in crowded spaces -Strategies to resolve crowding should be implemented

	amidst the COVID-19 pandemic				-Physical distancing procedures should be reviewed to suit the activity -Screening for symptoms and close contact should be implemented upon or prior to arrival at facility -Regular sanitization of spaces and surfaces should be undertaken -Face masks should be worn while active -Distancing and path separation should be based on spatial proximity zones -Facilities should limit the number of people in the space -Physical distancing should be reviewed to suit the activity for risk mitigation
Lakicevic (2021) Italy	Address possible effects of wearing a mask while exercising in non-COVID-19 affected individuals	Commentary	NA	Return to sport	-Reusable high-flux face masks that are easy to maintain, offer minimal impact on performance and a fair level of safety should be used for indoor activities when physical distancing my be challenging -Moving activities outdoors without a face mask may further reduce transmission and be preferable due to no breathing barrier
Martin (2021) United Kingdom	Assess the impact of COVID-19 restrictions on recreational sport players	Empirical	1213 adults	Indoor facilities	-Educational awareness campaigns should be implemented to advertise effective preventive measures to undertake when using the facility
Matos (2021) Portugal	Gain insights into the concerns Portuguese adults have regarding return to physical activity after COVID-19 lockdowns	Empirical	173 Portuguese adults	Return to Sport	-To ease concerns, facilities managers should implement preventive measures such as physical distancing, promotion of good personal hygiene, sanitization of spaces and equipment, and bans on activities with high risk of close contact -Sensors for doors, soap/sanitizer, lighting are

					recommended as well as fixtures that people can use their forearms or feet instead of their hands (e.g., door handle) -Modify equipment to enable individuals to utilize their own or disposable devices that prevent them from touching high contact surfaces
McElheny (2021) United States	Highlight optimal prevention practices for transmission mitigation, with a particular focus on hygiene activity and travel considerations in professional sporting organizations	Commentary	NA	Return to sport	-Education awareness campaigns should be implemented to enhance personal hygiene practices -Assigned lockers should be spread a minimum distance from one another -Layout of communal spaces should be redistributed to ensure physical distancing is possible -Ventilation system should be fortified with air filtration and cleaning element -Reduce contact with high touch areas (e.g., doors, taps, soap dispensers) through installing electronic sensors -Individualize equipment use, or when not possible, limit to small subgroups -Provide sanitization stations in high traffic areas -Have patrons wear face masks -Regular sanitization of spaces, equipment and surfaces -Daily symptom screening and temperature checks should be considered -Staff, athletes and patrons should receive appropriate vaccinations -Gatherings in communal spaces should be minimized
McLarnon (2021) Ireland	Outline the potential for athletes requiring vaccine passports in the future	Commentary	NA	Return to Sport	-Electronic documents that outline previous exposure to the virus, testing, results and vaccination may help reduce transmission, particularly for those who travel

Mercurio (2020) United States	Overview of five myths that may affect a team's return-to-sport protocols and considerations based on the available data	Commentary	NA	Return to Sport	-Encouraging use of face masks, maximizing open spaces to ensure physical distancing, emphasizing personal hygiene, regularly sanitizing facilities and equipment, increased ventilation indoors and employing symptom and close contact screening tools are preventive measures that may reduce transmission when returning to play -Team physicians will play an important role in designing protocols and educating teams on how to stay safe and healthy -Additional considerations should be made for indoor activities due to increased infection risk
Mulcahey (2021) United States	Overview of the effects of COVID-19 in the athletic population; Presents considerations for training during the pandemic, as well as guidelines for return to sports as restrictions are lifted	Commentary	NA	Return to Sport	For athletes/exercisers: -Physical distancing is most effective means of prevention -Personal hygiene must be encouraged through providing sanitization stations -Sanitization of facilities and equipment should be completed regularly -Face masks may be beneficial -Symptom screening should be employed -Education materials should be presented to help people recognize symptoms For fans: -Physical distancing is most effective means of prevention -Risk communication should be presented -Screening tools and testing can reduce potential transmission

Murakami (2021) Japan	Modeling of how preventative measures may reduce spread of COVID-19 at the Olympic Games	Empirical	Simulation	Indoor/outdoor	Organizer-oriented preventive measures: -Physical distancing of spectators at entrances and exits -Sanitization of surfaces in concessions -Enhanced air ventilation in the facility -Spreading out spectators in the stands Spectator-oriented preventive measures: -Face mask required in concourses, restrooms, and concessions -Good personal hygiene practices
O'Grady (2021) United States	Outline how the Outliers Running Program planned to operate a youth summer training program when permitted by the State	Commentary	Youth	Outdoor Facilities	-Develop and communicate required protocols for using facilities and what to do in case symptoms manifest or close contact is detected -Encourage personal hygiene -Encourage individuals to bring their own equipment if possible -Organize scheduling and space to enable physical distancing -Use face masks -Implement screening protocols
Parker (2020) United States	To provide a layered approach to risk mitigation for various aspects of particular concern in arenas and stadiums	Commentary	NA	Indoor/outdoor	-Before reopening, facility managers should conduct health and safety evaluations, crowding assessments, and create communications plans, case management plans, and reopening plans -The communication plan should establish how leaders can effectively communicate with staff and visitors to promote transparency and ensure that everyone is fully informed of the ongoing efforts to prevent transmission within the venue -The case management plan should include wellness checks,

testing, medical response, disinfection response, contract tracing, and return to work plans

To ensure physical distancing can be maintained:
-Implement measures such as reducing the number of spectators, using mobile ticket sales, prohibiting bags for bag check, and staggering and controlling arrivals and departures
-Display clear and consistent messaging regarding entry and exit procedures should be available to all patrons including those requiring accommodations
-Allow patrons to leave via multiple designated paths
-Seating should be staggered between family or group units consisting of 10 or less people
-Spacing larger than six feet should be considered because of the potential for shouting that may spread aerosol droplets even when face masks are implemented
-Standing room only areas should be eliminated

Other practices to reduce transmission:
-If food service is available, mobile ordering should be encouraged and food items should be individually wrapped
-Face masks should be worn at all times by staff and spectators and spectators should be asked to refrain from shouting or singing while other patrons are near-by
-Communication of good personal hygiene practices should be posted in restrooms
-Doors leading to restrooms should remain open to reduce contact with surfaces, but if not possible, paper towels should be available along with a garbage can for disposal after use
-Consider adding more staff to ensure high traffic and

					contact surfaces are sanitized regularly -Sanitization stations should be present throughout venue -Visible marking should be used to indicate lines and proper distances patrons should adhere to while waiting for entry, exit and services. -Reduce need to touch high contact surfaces through use of no-touch recycling and trash bins as well as automatic water bottle refill stations or individual water bottles -Payment using card or mobile apps should be encouraged over cash -Screening for symptoms and close contact should be conducted prior to entrance to the venue and advertised so that athletes, staff and patrons are aware ahead of time -Locker rooms should be sanitized prior to use and athletes should be discouraged from lingering after event -Ventilation throughout the facility should be in line with recommendations set forth by the American Society of Heating, Refrigerating and Air-Conditioning Engineers
Pena (2021) Spain	Review of the effects of the pandemic on competitive sport, and evidence-based recommendations to avoid the consequences of detraining in confined athletes	Review	N/A	Indoor/outdoor	-The most effective risk mitigation strategies suggested are physical distancing and good personal hygiene practices Other risk mitigation strategies used in sport settings: -Mask wearing recommended, especially if physical distancing is not possible, along with appropriate disposal -Avoid touching high contact surfaces -Daily symptom screening and temperature checks -Post signs to raise educational awareness around risk mitigation strategies -Regular sanitization of spaces and surfaces -Prohibition of sharing equipment, towels and water bottles

Piotrowski (2021) Poland	Outline actions taken by gym and fitness club owners in relation to business restrictions imposed by the government during the coronavirus pandemic	Review	NA	Indoor facilities	Risk mitigation measures include good personal hygiene awareness, regular sanitization of equipment and common areas, frequent ventilation of rooms, limiting number of people using the facility based on 1 person per 10 m2, enforce physical distancing between users and equipment/machines/lockers
Ramos e Corte (2020) Brazil	Creation of a protocol for the resumption of training to be followed by players, managers/backroom staff and employees	Commentary	NA	Indoor/outdoor	Arriving at facility: -Reduce gatherings in small spaces such as restricting access to locker rooms -Screen for symptoms and close contact as well as temperature checks -Ask that only essential items are brought into the facility -Team physicians should be consulted with on return to sport protocols During training session: -Restrict sharing of water bottles and other items -Schedule training sessions in small groups, in different areas -Ensure staff physical distance and work from home is possible Post training session: -Provide sanitization stations for athletes and staff to practice good personal hygiene -Have individuals take all materials they used home with them -Direct only players in need of therapy to necessary facilities; sanitize thoroughly after each use and ensure

					masks are worn by all -Do not provide meals at the facility
Robinson (2021a) United Kingdom	Explore the literature related to the possible health benefits and risks of playing golf during the COVID-19 pandemic; and provide recommendations on golf-related activity from the relevant available literature	Review	NA	Outdoor Facilities	For outdoor sports such as golf, risk of transmission may be reduced by: -Educating participants about key measures to decrease risk -Screening for symptoms and close contact -Physical distancing in line with local public health guidelines -Following appropriate personal hygiene practices and provide necessary sanitization stations -Avoiding shared surfaces -Reducing time in indoor shared spaces
Robinson (2021b) United Kingdom	Report incidence and transmission regarding SARS-CoV-2 among professional golfers	Empirical	195 European Tour golfers	Outdoor facilities	Risk mitigation measure that should be put in place include: -Regular contact tracing, testing, and symptom monitoring -Encouraging physical distancing and good hygiene practices -Minimizing the number of attendees and travel within facilities -Educating staff and athletes about good personal hygiene practices, risk assessment and consideration of mitigation
Romano-Bertrand (2020) France	Assess the risk of SARS-CoV-2 transmission in rehabilitation pools and therapeutic water environments in order to provide specific recommendations to control viral spread while ensuring essential	Commentary	NA	Indoor/outdoor	-Good personal hygiene, physical distancing, the use of face masks are recommended and should be advertised tor patrons and staff, but these preventive measures can be challenging to implement in pools and water environments Additional preventive measures for participants and staff include: -Using individual dressing rooms

	rehabilitation care for patients				-Using appropriate protective gear (e.g., swim cap, goggles) -Screening for symptoms and close contact Preventive measures specific to these environments include: -Following appropriate water sanitization protocols -Frequent sanitization of surfaces -Following regulatory standards and local public health recommendations
Schumacher (2021) Qatar	Assess SARS-CoV-2 contamination of random surfaces in football training facilities	Empirical	Different surfaces	Indoor facilities	-Potential surface transmission may be low, but regular sanitization of surfaces should be undertaken using appropriate agents
Shurlock (2021) United Kingdom	Recommendations for face coverings while exercising during the COVID-19 pandemic	Commentary	NA	Indoor/outdoor	-10-20m is an optimal distance to reduce exposure to aerosol droplets when active -Face masks are safe for healthy individuals to use while engaging in activity, but individuals with underlying medical conditions should contact their physician for assessment prior to determining safety -When adequate physical distancing is not possible and/or individuals will have prolonged exposure to others, highly protective (i.e., at least medium thickness) face masks should be worn -Face masks may not be needed for outdoor activities with appropriate physical distance and there is no possibility of drafting -Safe disposal bins should be provided for soiled masks
Sikka (2020)	Overview of what steps to take and what missteps to avoid based	Commentary	NA	Indoor/outdoor	-Detailed preventive measure protocols, testing mandates, contact tracing and isolation of positive cases can reduce transmission

United States	on the reopening of professional sports in North America				-Proactive mask education may help with mask compliance if not already mandatory
Suhs (2021) United States	Investigated the spread of COVID-19 at a fitness center in Minnesota, US	Commentary	N/A	Indoor facilities	-Limit facility occupancy to 25% of fire code occupancy or up to 250 people (whichever is lower) -Ensure physical distancing between equipment and individuals -Regular sanitization of high touch surfaces -Masks required when not exercising -Implement reservation system to improve ease of regular sanitization -Educational awareness campaigns broadcasting risk mitigation strategies should be made over intercom
Timpka (2020) Sweden	Examine the consequences of the SARS-Cov-2 pandemic for sports and provide recommendations for response measures from the sports community	Commentary	NA	Return to Sport	-Activities that can be performed outdoors should -Reduce group sizes to facilitate physical distancing -Reduce need for shared spaces such as locker rooms -Provide sanitization stations -Sanitize equipment after each use -Communicate transmission reduction strategies to members
Tinaz (2020) Istanbul	General overview of the drastic effects of Covid-19 on the sports industry and attempts to contain its spread	Commentary	NA	Indoor/outdoor	-Best practices for preventive measures should be communicated to members (e.g., good personal hygiene) -Regular sanitization of space and equipment should be performed and evaluated -Regular meetings should be implemented to facilitate knowledge sharing to ensure proactive methods are implemented to avoid transmission

					-Group sessions should be divided into small groups or individualized training sessions if possible
Vancini (2021) Brazil	Present information about the pandemic to clarify health issues related to sport and physical activity participation, and to develop and present information to assist in educations and the health promotion and prevention	Commentary	NA	Return to Sport	-Implement strict personal hygiene measures -Communicate prevention strategies to ensure dissemination of accurate information -Follow local public health guidelines
Wackerhage (2020) Germany	Answer 5 questions about COVID- 19 from the perspective of sport and exercise	Review	NA	Return to Sport	-Employ screening tools in combination with testing -Facility managers should develop communication materials to educate themselves, staff and clients about the virus -Adhere to strict sanitization protocols for space and equipment, including pools -Limit exercise types that make physical distancing a challenge -Consider mandatory face masks -Ensure adequate ventilation of space(s)
Watson (2021) United States	Determine the incidence of COVID-19 among youth soccer athletes and the risk-mitigation	Empirical	Youth soccer club directors	Return to Sport	-Physical distancing, mask use, symptom monitoring, good hygiene practices and increased sanitization, staggered arrival and departure times, and return-to-play procedures after diagnosis or exposure should be implemented to reduce risk

	practices used by youth soccer organizations				
Wong (2020) Hong Kong	1) Track each players' time of close body contact and frequency of infection-risky behaviours to investigate the risk of virus transmission during football games; and 2) Investigate the physiological effect of wearing a facemask during exercise	Empirical	1) 4 male professional football players; 2) 23 healthy volunteers	Indoor/outdoor	-Limit the number of personnel in facilities -Screening for symptoms and close contact as well as temperature checks -For team meetings, use larger spaces to ensure physical distancing is possible -Maintain physical distancing when training and during other activities, use spaces that enable appropriate distancing or reduce the number of people if space does not permit appropriate distancing -Ban showers to reduce aerosolized transmission via mist -Sportsmanship practices such as handshaking should be discouraged -Masks should be worn when not playing -Educational materials should be presented to further encourage preventive measures -Good personal hygiene practices should be encouraged -Equipment should be cleaned frequently -Decisions to resume events should be based on local public health guidelines