Sports activities during any pandemic lockdown

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The coronavirus disease 2019 (COVID-19) pandemic forced the world’s population to alter daily routines, including exercise habits. This unusual situation has physical, psychological, and behavioral consequences to all individuals, including elite and recreational athletes. Life in lockdown has been difficult because everyone has to stay safe and healthy, while at the same time abiding by new norms. Currently, mitigation strategies have been widely implemented to contain the spread of COVID-19. These measures include lockdown, social distancing, personal protective measures, and environmental and surface cleaning [1]. Furthermore, the practice of physically active lifestyles is recommended to counteract health and mental consequences of the COVID-19 pandemic [2]. While sedentary behavior certainly has no effect on the immunity, exercising in moderation is associated with improved immune competency and a reduced risk of illness. Overtraining and high-intensity exercise induce transient immune dysfunction and are associated with a greater risk of illness, including upper respiratory tract infections, but this may not apply to elite sportsmen [3, 4].

Post-exercise immune depression, especially after a strenuous training, may be explained by an impaired cell-mediated immunity [5]. Various modalities, such as soccer, football, and triathlons, are considered high-intensity sports. Consequently, these activities lead to an open window of susceptibility to infection [6]. The introduction of the new routines in the context of COVID-19 will allow certain outdoor exercises, which facilitate SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) transmission due to increased ventilation rates during exercise and possible mass gathering at sporting venues, stadiums, jogging tracks, parks, or any recreational areas. Currently, there are no solid guidelines regarding the use of face masks for outdoor exercises during the COVID-19 pandemic. We advise people to wear face masks during low to moderate-intensity exercises outside such as brisk walking and jogging, while maintaining a safe physical distance (2 m away) and personal hygiene in public. However, the use of face masks may compromise breathing and oxygen uptake in high-intensity, which are not recommended during these times.

With the resumption of normal life during COVID-19 taking effect immediately, guidelines for outdoor exercise, recreational activities, and returning to competitive sports must be enacted with caution. To help delay and mitigate COVID-19 spread, staying at home is still encouraged and the Centers for Disease Control and Prevention (CDC) recommends daily physical activity for both children (60 min/day) and adults (30 min/day). Each sport and activity is categorized by risk, but the general classification is (1) low risk: exercise at home, alone or with shared household members, with owned and sanitized equipment; (2) medium risk: exercise at public, alone or with shared household members no more than 5 people, with own and sanitized equipment; and (3) group exercise with non-household members in private or public, not physically distant, with shared equipment [7].

The risk of opportunistic infection is more likely to be influenced by the pre-exercise physical, nutritional, and psychological well-being. It is known that regular and frequent exercise enhances rather than suppresses the immune response in individuals of all ages, and thus protects them from infections [8]. In addition to exercise, appropriate immune-nutritional support as well as proper management of psychological stress and sleep hygiene can reduce infection risk [5, 9]. Adoption of a proper diet and physical activity will eventually boost immunity (immune activation, immunosenescence, and vaccination efficacy) and metabolic systems (obesity, diabetes, and metabolic syndrome) [10].

During the self-isolation period, the majority of people grew accustomed to a sedentary lifestyle with less physical activity, fewer daily step counts, and rarely exercise, while athletes and certain people train individually to keep themselves fit and healthy [11]. Returning to normal exercise and
sports activities is set to be a fascinating yet challenging time. In fact, many formerly fit individuals struggle to achieve their previous physical performance when stepping out to exercise in the age of COVID-19. Detraining or a prolonged break from training leads to the deconditioning of physiological systems (e.g., musculoskeletal, neuromuscular, respiratory, and cardiovascular systems) as well as physical capabilities (e.g., power, strength, flexibility, speed, and endurance) [12]. A randomized clinical trial by Kramer et al. [13] found that healthy adults with no physical activity have significantly lower aerobic capacity and lean mass compared with their counterparts who performed three minutes of hopping exercise, six days per week, for 60 days. In addition, the bone mineral density, knee extension strength, knee flexion strength, and peak power output of the bed-rest group are significantly reduced, while the jumping group preserved these parameters.

COVID-19 caused the suspension of sporting events, closure of gyms and fitness centers, and restrictions on outdoor activities. These factors led athletes to modify their exercise programs and train at home, most of which are not supervised by medical staff or coaches. Several athletes have a mini gym and/or fitness equipment at home to train individually. During this period, their aim should be to maintain or at least not lose their current fitness level [14]. The use of telehealth or other audiovisual-guided sessions for expert opinions is also useful during this difficult time. Cooperation with a multidisciplinary team involving medical staff, nutritionists, coaches, trainers, and psychologists can help athletes manage all the factors that influence performance, including physical conditioning, nutrition, hydration, sleep quality, and mindset.

Assuming a reduction in strength, flexibility, endurance, proprioceptive, and neuromuscular control, there is a greater risk of injury faced by athletes when transitioning from an unprecedented lockdown to high-level sports-specific practice. Learning from the National Football League (NFL) lockout in 2011 [15], following the premature transition from the end of lockout to the beginning of competitive fixtures, there was an unprecedented number of Achilles tendon ruptures during the training camp and preseason. Two-thirds of the players who ruptured their Achilles tendon returned to play in the NFL after Achilles tendon repair and around 11 months of rehabilitation, while the rest never went back to competition. These injuries likely represent career-changing and frequently career-ending moments for professional athletes. Despite maximum efforts from the club medical staff, there was a higher relative risk of reinjury during resumption of a full-contact training, pointing to lingering neuromuscular deficits in the athletes (Table 1).

COVID-19 lockdown can have similar impacts on other team-sports competitions. For example, soccer-specific training necessitates acceleration and deceleration, changes in direction, and chasing the ball at full speed. To date, blisters and minor injuries have been reported by a number of players following the return-to-pitch training, and we may see an increase in load-related problems (e.g., hamstrings, adductors, Achilles tendons, and patella tendons) and more serious injuries (e.g., ligaments and meniscuses) in the future. Zone7, an artificial intelligence platform specialized in predicting injury risk, conducted research in the English Premier League, which suggested an increase in injury incidence by 25% due to a congested schedule (eight matches plus training in 30 days) [16]. Therefore, the return to training and competitive action must be gradual, accompanied by regular risk assessment, and preceded by sports-specific medical assessment. Four phases have been suggested, beginning with small group training, then entire team training, followed by national league competition, and finally international competitions. Each player must be tested negative in two successive RT-PCR (reverse transcription polymerase chain reaction) SARS-CoV-2 pharyngeal swabs over a five-day interval, followed by continuous tests and monitoring [17–19]. Functional movement, maximal oxygen consumption (VO₂ max), and lactate threshold heart rate (LTHR) should be evaluated to help stratify the risk of injury and fatigue and indicate the level of current performance based on biomechanical, aerobic, and anaerobic capacity [20–22].

For healthy individuals, prolonged sitting during work or stay at home should be avoided while incorporating a healthy diet and physically active lifestyle into their daily routines is encouraged [23]. Sedentarism negatively impacts neuromuscular system (rapid muscle wasting, nerve fibers degeneration, and neuromuscular junction damage), muscle protein metabolism (suppression of muscle protein synthesis and upregulation of protein breakdown), impaired glucose homeostasis (reduced insulin sensitivity), cardiorespiratory system (reduced aerobic capacity), and energy balance (excessive fat deposition, systemic inflammation, and antioxidant activation) [24]. Besides maintaining productivity, their goal should be to avoid unnecessary weight gain and adopt a healthier and more sustainable lifestyle as a habit. At present, virtual gym classes and personal coaching are widely available online, while appointments for medical consultation are within the fingertips of the general population. With a more flexible schedule, healthy individuals can adjust their exercise modality, frequency, volume, and intensity with home-based exercises [2]. They must know their limits and abstain from any forms of exhaustive, strenuous, or high-intensity training, which can compromise the immune system. Meanwhile, moderate-intensity endurance training and resistance training are recommended to boost immunity and maintain fitness and health. With all these options, the COVID-19 pandemic and related restrictions should no longer be an excuse for not maintaining a physically active lifestyle.

Older individuals and those with underlying comorbidities, such as hypertension, diabetes, cardiovascular and cerebrovascular diseases, coagulopathy, kidney and liver problems, and chronic lung disease, are categorized as high-risk groups.
for contracting severe COVID-19 [25–32]. Under such a pandemic, they are forced into social isolation and quarantine at home, and most of these individuals are being physically inactive and mentally stressed (e.g., depression and anxiety) [33]. This may eventually increase the risk of mortality and morbidity in this group. These high-risk individuals should

| Table 1 | Insights for athletes, healthy individuals, and high-risk individuals |
|---------------------------------|---------------------------------|---------------------------------|
| **Problems caused by the COVID-19 pandemic** | **Athletes** | **Healthy individuals** | **High-risk individuals** |
| • No competition and game or match | • No competition and game or match | • No outdoor exercise | • Adverse health and mental consequences |
| • No team or group training | • No team or group training | • No access to gym, fitness center, or any public sports area | • Risk of sedentary behavior and physical inactivity |
| • Reduced access to training facilities | • Reduced access to training facilities | • Risk of sedentary behavior and physical inactivity | • Unfavorable body mass composition (decreased muscle mass and increased fat mass) |
| • Train at home, mostly unsupervised | • Train at home, mostly unsupervised | • Unfavorable body mass composition (decreased muscle mass and increased fat mass) | • Deteriorated mobility |
| • Declined physiological functions (e.g., musculoskeletal, neuromuscular, respiratory, and cardiovascular system) | • Declined physiological functions (e.g., musculoskeletal, neuromuscular, respiratory, and cardiovascular system) | • Developing chronic health problems | • Developing health complications from comorbidities (e.g., myocardial infarction and pulmonary emboli) |
| • Deconditioned physical capabilities (e.g., power, strength, flexibility, speed, and endurance) | • Deconditioned physical capabilities (e.g., power, strength, flexibility, speed, and endurance) | • Developing chronic health problems | • Developing mental issues (e.g., depression and anxiety) |

| **Consequences of physical inactivity or detraining** | **Goals during lockdown, isolation, and quarantine** | **Health risks for returning to normal activities during COVID-19** | **Recommendations for transitioning to normal activities during COVID-19** |
|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| • No outdoor exercise | • Maintain current fitness level | • Increased risk of injury | • Cooperation with multidisciplinary team, including medical staff, nutritionist, coach, trainer, and psychologist |
| • No access to gym, fitness center, or any public sports area | • Maintain favorable body mass composition | • Reduced performance | • Sports-specific medical assessment before returning to sports |
| • Risk of sedentary behavior and physical inactivity | • Maintain productivity | • Increased mortality and morbidity | • Gradual return to training and competitive action |
| • Unfavorable body mass composition (decreased muscle mass and increased fat mass) | • Avoid unnecessary weight gain | • Increased risk of fall | • • Avoid prolonged sitting during working or staying at home |
| • Developing chronic health problems | • Adopt a physically active lifestyle | • Decreased quality of life | • • Adopt a physically active lifestyle |
| • Unfavorable body mass composition (decreased muscle mass and increased fat mass) | • • Develop chronic diseases | • • Perform ADLs independently if possible | • • Perform home-exercise and adjust the modality, frequency, volume, and intensity based on individual capability |
| • Deteriorated mobility | • • Increased mortality and morbidity | • • Avoid prolonged sitting during working or staying at home | • • • Use telehealth instead of medical visit to healthcare facility |
| • Developing health complications from comorbidities (e.g., myocardial infarction and pulmonary emboli) | • • Increased mortality and morbidity | • • • Decreased quality of life | • • • Social interaction to improve compliance and reduce the risk of mental issues |
| • Developing mental issues (e.g., depression and anxiety) | • • Increased risk of fall | • • • Perform ADLs independently if possible | • • • Perform multicomponent home-exercise involving strength, aerobic, balance, and coordination |

ADLs, activities of daily living
aim to preserve their performance of activities of daily living (ADLS), such as eating, dressing, showering, toileting, and stair climbing. Home-exercise using various safe, simple, and easily applicable training methods is well suited to maintain fitness levels while and avoiding airborne COVID-19 [34]. A multicomponent exercise program that includes strength, aerobic, balance, and coordination training is considered the best fit for elderly [2]. The addition of social elements to improve compliance and reduce the risk of mental problems is feasible with the support by internet, media, and audiovisual technology. Considering the availability of telehealth in many medical specialties, people with advanced age and chronic diseases can consistently access this internet-based service. Telerehabilitation will undoubtedly help most chronically disabled individuals to exercise at home in an effective yet sustainable way [35].

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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