**Return to elite football after the COVID-19 lockdown**

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**Abstract**

The COVID-19 pandemic has changed the conditions for competitive football around the globe dramatically. Several competitions and leagues have been cancelled or postponed. Players have firstly been forced to training in solitude. In a second stage, players start training in small groups with strict contact restriction and return to competitive play might occur after only few weeks of normal team training preparation. These special circumstances are likely to impact football performance and injury risk in the upcoming competitions. Thus, clubs, coaching and medical staff, as well as players are challenged on the prioritization of fitness and performance, which easily can create several *“catch-22-dilemmas”*. The present article presents views on fitness training, physical preparation and recovery during these uncommon conditions, and how elite football players can return to the competitive field well-prepared for post-crisis football endeavours around the world. Due to the multifaceted physiological demands in elite football, the long recovery requirements after match-play and an upcoming reality with many games within a short period, elite football players, managers and clubs may face extraordinary challenges associated with return to play under the current circumstances.

**Key words:** Fitness training, performance, fatigue, recovery, testing, injury, soccer.

**Introduction**

The outbreak of the COVID-19 pandemic may be considered as the greatest global state of emergency since World War II. COVID-19 will no-doubt result in a global economic crisis. Whilst the last economic crisis of 2007-2008, had major consequences for non-sporting and sporting industries across Europe (Parnell et al., 2017), it had a limited negative impact on elite professional football industry. Indeed, the football industry was somewhat protected and delivered impressive revenue performance (Deloitte, 2017). The COVID-19 crisis is somewhat different and has had real and tangible impacts on the sport and football industry (Parnell et al., 2020). Moreover, like the rest of the population, elite athletes including football players have been living restricted lives and have been instructed to self-isolation and assigned individual training protocols. Such individual training regimes may be especially challenging in a multifaceted competitive team sport like football as they are lacking match-intensity and timing in football-specific intense actions such as headers, shots, tackles and decelerations and are lacking football specific movement patterns and muscle involvement during the high-intensity aerobic training and anaerobic speed endurance training. Therefore, we are expecting a lowered football-related physical fitness, elevated match-induced fatigue and injury risk as well as longer recovery times of the players returning to football after a period with individual training. As such, for the survival and future of the game intense scrutiny is quite rightly placed on the helping prepare players for their return to protect well-being, maintain their competitiveness and for the football industry to survive.

Football match-play can be considered as a multiperformance sport where endurance exercise, high-intensity runs and explosive muscle actions are performed in a random order with varying recovery intervals (Bangsbo et al., 2006). In addition, a high number of specific skills are performed with simultaneous cognition efforts such as decision making under high physiological stress. Thus, athletes in complex sports such as football may experience the greatest challenges in relation to maintaining training status during the COVID-19 lockdown (Krustrup et al. 2006, Christensen et al. 2011). Performance in competitive football is governed by different physiological systems. Football endurance appears to be largely related to the muscle oxidative capacity, high-intensity football performance is related to ion regulation and football speed is related to recruitment of fast-twitch muscle fibres (Mohr et al., 2016a). Thus, the multifactorial physiological demands in elite football are linked to a multitude of physiological systems, which must be stimulated in training (Mohr and Iaia, 2014). Table 1 provides principals of aerobic and anaerobic training in elite football, which are the main physical training categories in the sport. This may create a situation hard to comprehend when players return to normal training after the longest “self-managing” period in modern elite football history and may be obligated to be match-fit within a short period, with awaiting congested fixtures over the coming months.

A further physiological characteristic of elite football is the long recovery of performance and several physiological systems after a game (Krustrup et al. 2011; Mujika et al. 2013). In the aftermath of the COVID-19 lockdown players are likely to be required to play games with short recovery, which may affect the physical performance (Rago et al. 2019) and tactical synchronization (Folgado et al, 2015) and increase the risk of injury (Bengtsson et al., 2018). Similarly, changes in physical performance affect individuals differently; reductions in physical outcomes vary between positions and players should be monitored on an individual basis (Varley et al, 2018). Therefore, clubs, coaches and clinical staff may face extraordinary challenges in the organization of physical preparation for football competition and fitness-related decision-making during matches. The objective of this article is to discuss the organization of fitness training and fitness-related decisioning when elite football players are returning to play, to elucidate physiological effects of the COVID-19 lockdown management and the potential impact on performance and injury risk.

**Return to training during the COVID-19 outbreak**

Fitness training in football is multifaceted due to the multidimensional nature of the game. Table 1 displays an overview over fitness training categories in elite football. Especially, aerobic high-intensity training and speed-endurance training have been demonstrated as highly potent and efficient methods to improve aerobic power and anaerobic capacity of elite football players (Iaia et al., 2009; Thomassen et al., 2010; Fransson et al., 2018). Power training in football can be separated into basic, transference and football-power training (Bangsbo and Andersen, 2015), which all are interconnected and should be performed on a regular basis. Finally, injury prevention training is an essential part of conditioning programmes in football but may need to be highly prioritized during the COVID-19 outbreak. For example, during a normal off-season period football-specific fitness has been shown to decline by 11% in elite male players (Krustrup et al., 2006). However, the lock-down period is likely to have caused a greater decline due to the long duration and restricted possibilities to train. In the model developed by Purdam et al. (2015), only two weeks of training at 60% of the normal volume and intensity - which may resemble the COVID-19 isolation training period - results in a 10-day progressive build up to full training in order to reduce injury risk. The beneficial impact of a qualified preparatory interval prior to competitive games should be further highlighted, since the number of preseason training sessions appears to reduce injuries during the season (Ekstrand et al, 2020).

When a competitive league terminates under normal conditions players go on holidays for around four weeks; still, fitness level might be maintained partly by adhering to individual training programmes (Bangsbo and Mohr, 2014) focussing on attenuating the decay of endurance- and neuromuscular-related performance parameters (Silva et al, 2016). Following the off-season period, clubs may normally allocate around six weeks to preseason team training including training games. Thus, the dire circumstances in most countries during the COVID-19 outbreak has forced players into an individual course of *“self-management”* under highly restricted conditions (Hammami et al., 2020). Thereafter, training has been completed in small groups for a few weeks in some countries prior to starting up the normal team training potentially lasting only a few weeks before the reopening of the season. The current situation is highly dissimilar to normal off-season and preseason scenarios, which impacts both the probability of optimal performance as well as injury risk.

**Injury prevention and potential risks**

The potentially higher risk of non-contact injury while returning to football training and matches after the COVID-19 lockdown could be associated with an abrupt increase in workload after a long period of detraining or home-based training (Lolli et al., 2019b). Also, a rapid shift from non-football-specific to football-specific movements, actions and speeds of movement might not allow players to cope with the congestion fixtures that will follow in the period from June to August 2020 (Carling et al., 2016). No doubt that the prolonged isolation-training period due to the COVID-19 outbreak would have a profound negative effect on the physical capabilities (mainly endurance and muscle strength) associated with performance and injuries (Silva et al., 2016). Restoration of fitness to the pre-COVID 19 levels is of paramount importance. Assuming that players stayed without football-specific training for ~4 weeks and that their workload during that period was about 20-40% of that in the normal competitive period, the recommended time for returning to full training without a high risk of injury is estimated to 3-5 weeks (Purdam et al., 2015). Thus, players will need time to re-adapt to football-specific actions.

**Preparations to consider**

Depending on the length of the isolation-training period, one may expect a decrease on general fitness that would be related to the lack of high-intensity exercise performed during this period (Krustrup et al., 2006; Thomassen et al., 2010; Christensen et al., 2011). Training contents (i.e. in the single session), sequence (i.e., in the session and across the functional micro-cycle) and progression (i.e. across the precompetitive period) should be controlled and regulated according to the individual responses (i.e. internal load). Biochemical markers of fatigue and muscle damage coupled with psychometrics measurements and heart rate variability would result vital in fine tune the dose-response dynamic in the process of the return to training during the COVID-19 pandemic (Gabbett et al., 2017).

Overall, players might have received general guidelines for home-based exercise training with frequent sessions of aerobic training and strength training (Hammami et al., 2020), whereas players in some countries may have been advised to limit high intensity interval training with the aim to avoid a deterioration in immune system function (Eirale et al., 2020), which is highly controversial (Hull et al., 2020). Thus, players may be advised quite differently on training prescriptions due to cultural diversity and variability in health maintaining approaches. Anyway, it is quite difficult to predict the general fitness of players at re-start and fitness testing seems advisable, including maximal or submaximal Yo-Yo IE2 or IR2 testing (Bangsbo et al. 2008; Krustrup et al. 2015). Assuming the associated risk of return to training in a non-zero risk scenario, the training sessions should be personalized with precision considering the individual bio-physiological make-up of the individual player.

The first week of the return to training in small groups should be devoted to moderate and high intensity aerobic training (see Table 1) performed in a football-specific manner, which is crucial to familiarize players with realistic movement patterns, combined with basic power training (see Figure 1). Still, the use of standardized drills replicated in a progressive way across the training days in the form of structured warm-up or ball-circuit would help in controlling player’s readiness to training. This strategy would enable an on-field adjustment of the prescribed external load and a greater control over expected internal load.

The popular, but not evidence-based motto *“no pain no gain”* should not be in the coaches mind and highly discouraged if in players’ mind. This is because exhaustive training sessions may increase injury risk and reduce immune system function. The general medical rules suggest physical distancing. Thus, training prescription should, in an initial stage, grant a 2-m distance between players to prevent saliva droplets to convey to other players. Aerobic fitness should be progressively increased with football-specific high intensity drills (Iaia et al., 2009; Bangsbo and Mohr, 2014; Fransson et al., 2018) with players training at social distance. This may enable players to prepare to the casual intermittent high-intensity activity that they will face ahead during matches.

The forced confinement and associated difficulties to perform high-intensity training sessions such as small-sided games are expected to affect high-intensity performance during match-play. However, main concerns should be on the expected match congestion for the 2-3 months to resume the season. The resulting bio-physiological load will be relevant and magnified by the limited time available to build up appropriate aerobic fitness. Post-match residual fatigue should be monitored using various markers like creatine kinase and delayed onset of muscle soreness to optimize players recovery (Mohr et al., 2016b; Silva et al., 2018). Proper sleep and rest strategies, the use of compression garments, and a carbohydrate enriched diet are efficient and safe recovery strategies. Attention to hygiene issues should be given to contrast baths, which are also used regularly for recovery. With the aim to protect players’ health, temporary changes in the Laws of Football should be discussed in the attempt to lower match acute and residual fatigue (e.g., increasing the number of substitutions during matches).

**What can coaches and players do?**

To prepare the players for the complex match demands in football, fitness coaches must ensure appropriate training on football-specific actions and drills that mimic the football match demands (Nassis et al., 2019), also on individual basis. Training strategies should follow three major rules: 1) progressiveness of loading, 2) specificity of actions and speeds, and 3) preparation for the worst-case scenario.

Progressiveness might prevent sharp increases and spikes in workload (Lolli et al., 2019a; 2019b; 2020; Nieman & Wentz, 2019). This increase should be planned around the total distance covered, the distance covered in high intensity running and sprinting, as well as accelerations and decelerations. We acknowledge there may be more variables of external workload associated with neuromuscular load and injuries and the multifactorial complexity of injuries (Nassis and Gabbett, 2017), but progressive overloading should be a priority in injury risk management (Lolli et al., 2019b), as well as performance enhancing strategies.

To improve muscle power, a combination of basic and transference power training with inclusion of football-specific actions (football power; see Fig. 1) should be preferred (Silva et al., 2015; Bangsbo and Andersen, 2015). To speed-up endurance adaptations, intensified training using small-sided games and especially speed endurance production training is highly recommended (Fransson et al., 2018; Paul et al., 2019; Bangsbo and Mohr, 2014, see also Table 1).

Players should be prepared to be ready to compete in congested fixtures (see for example Mohr et al., 2016b). While sprinting has been associated with hamstring injuries, the lack of adequate speed training during the preparatory period may be a risk factor for injury as well (Malone et al., 2018). Therefore, training should include adequate speed training. To counteract the effect of fatigue, coaches should consider scheduling power training towards the end of training sessions (Paul et al., 2014) or in the mornings on training days with afternoon training. Lower extremity muscle power and balance exercises should be of priority (Brunner et al., 2019; see Table 2), and micro-dosing power training should be considered.

An integrated approach taking into consideration external and internal workload monitoring, as well as wellness and readiness assessments is recommended to guide better decisions during this sensitive period (Lolli et al., 2019b). Thus, when external workload is low, but players still perceive it as highly stressful, workload should be lowered. In contrast, a relatively high external workload in combination with good level of wellness and readiness should be taken as a positive sign and may indicate a lower risk of non-contact injury (Gabbett et al., 2017; Lolli et al., 2019b).

**Conclusion**

We conclude that the COVID-19 crisis and its consequence on the football ecosystem has created a myriad of challenges for the elite game, including returning optimally and safely to competitive football competitions. During this extraordinary preseason we recommend a progressive build-up of aerobic high-intensity, speed endurance and power training. Players’ fitness level and health situation should be monitored closely, and high emphasis should be given on optimal recovery protocols including a high focus on nutrition and injury prevention strategies. Football clubs should be aware of that these are special circumstances and be prepared for a future unlike anything experienced before.

**Disclosure statement**

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**Tables**

Table 1: Principles of aerobic (A) and anaerobic (B) training in elite football. The tables provide an overview of exercise intensities as well as exercise and recovery durations, and provides practical examples. Modified from Bangsbo and Mohr 2014 and Hammami et al. 2020.

A)



B)



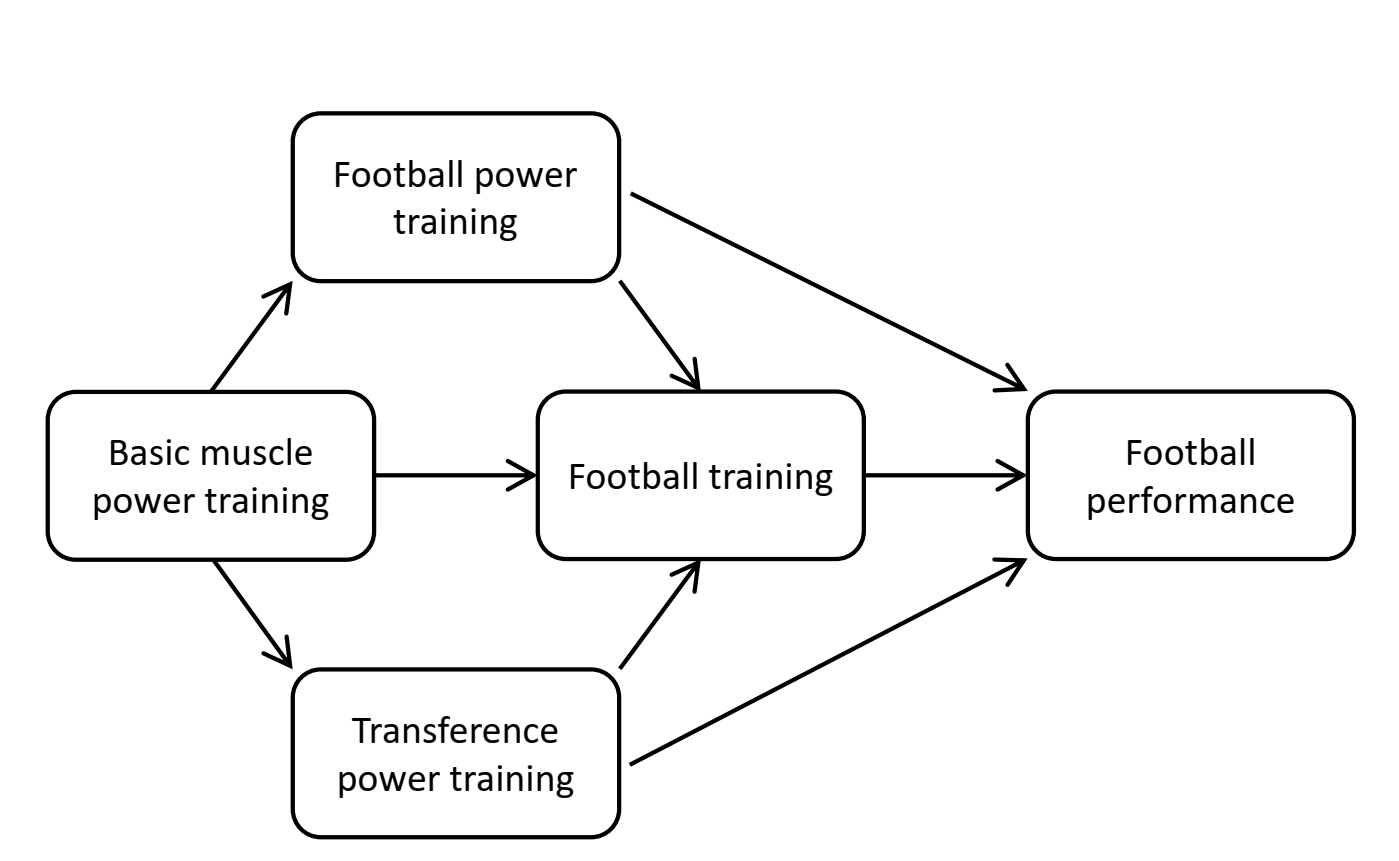
Table 2. Example of a pre-season basic power training program for elite football players.



Table 2. Strength training in elite football. The table shows an example of a training program for the lower extremites that can be performes during a normal 6 week preseason. The program includes exercises, as well as the number of sets and repitions. It is suggsted that the program is performed twice a week during the first four weeks (which could be the individual or group training period during the corona crisis) and 1-2 times weekly during the team training preparation (last two weeks). The figure is modofied from Bangsbo & Andersen, 2015.

**Figure**

Figure 1.



**Legends to figures**

Figure 1. The figure shows the interactions between power training caregories in elite football. Basic football power training is the fundament that impacts the quality of both transference and football power training, which are necessary to get full outcome of the training in the gym and translate it into football performance. Also, basic power training improves the quality of the normal football training, which again improves performance.