Physical Therapy in Sport 37 (2019) 190–196

Contents lists available at ScienceDirect

Physical Therapy in Sport

journal homepage: www.elsevier.com/ptsp

Literature Review

A review advocating caution with Major League Soccer expansion and investment in more rehabilitation professionals

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ARTICLE INFO

Article history:
Received 9 January 2018
Received in revised form
15 April 2018
Accepted 8 May 2018

Keywords:
Congested schedule
MLS
Injury prevention
Season length

ABSTRACT

Background and purpose: Major League Soccer (MLS) has aggressively expanded from 10 teams to 23 teams. With the addition of more teams, the league will have to dictate a schedule that maximizes the league's popularity, while also maintaining the health of the players. A longer season and congested game schedule could increase the risk of injury for players. The purpose of this commentary is to make recommendations for the prevention of injuries among MLS players with respect to proposed league expansion.
Description Of topic: MLS has lengthened the regular season with each expansion in teams. An increase in season length was seen in conjunction with the MLS expansion from 14 to 19 teams during the 2008 through 2013 seasons. Data from the inaugural MLS season found injury rates were higher in games compared to practices and more injuries occurred later in the season. With the expansion of MLS, anterior cruciate ligament tears appeared to have increased each year.
Discussion: Current evidence suggests the implementation of a proper preseason in addition to the once-per-week game frequency would best promote player health and well-being. Players may benefit from in-season injury prevention training and weekly load monitoring.

1. Background and purpose

Major League Soccer (MLS) is one of the fastest growing professional sports in the United States (US). From 1996 to 2018, MLS has aggressively expanded from 10 teams to 23 teams, with plans for future expansion to 28 teams(Stejskal, 2017). With the addition of more teams, the league will have to dictate a schedule that maximizes the league's national and global popularity, while also maintaining the health of the players. A longer season and congested game schedule could increase the risk of injury for MLS players(Morgan & Oberlander, 2001).

MLS may be in a conundrum applying injury prevention strategies and planning the schedule of the season. A longer season is necessary to minimize congestion, which may result in a shorter off-season. The alternate option involves lengthening the off-season to enhance recovery time from the previous season and lengthening the pre-season time, however this would lead to increased congestion during the regular season play.

Historically, MLS has lengthened the regular season with each expansion in teams. With the addition of the two expansion teams, Minnesota United Football Club (FC) and Atlanta United FC, the MLS 2017 season had one of the earliest regular season starts in league history. As the league approaches 28 teams, MLS may be forced to further increase the length of the season and possibly congest teams' schedules with less recovery in between games.

The purpose of this commentary is twofold: 1) to highlight the expansion goals of MLS, in addition to the strategies MLS has previously employed to accommodate additional teams to the league, and 2) to make recommendations for the prevention of injuries among MLS players with respect to proposed league expansion.

1.1. Expansion of major league soccer

Following a national rise in the popularity of soccer during the 1994 Fédération Internationale de Football Association (FIFA) World Cup, the US Soccer Federation created MLS and the inaugural

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https://doi.org/10.1016/j.ptsp.2018.05.008
1466-853X/

Fig. 1. History of Major League Soccer expansion since the inaugural 1996 season.

season took place in 1996. Over the course of the next 22 years, the league expanded from 10 teams in 1996 to 22 teams in 2017 (Fig. 1).(Stejskal, 2017) This number has surpassed the 20 team limit that FIFA recommends in the top division of professional soccer in each member country. For example, the Barclay's Premier League (England) has 20 teams and the Bundesliga (Germany) has 18. In both leagues, every team plays each other at home and away for a total of 34–38 regular season games. In the 2018 MLS season, Los Angeles FC has become the 23rd team to join MLS. Several other cities have submitted proposals to be included in the MLS expansion, with locations in various geographical regions and time zones. The geographical area of the US is among the largest in the world and travel distance between cities can reach up to 3000 miles.

1.2. Season length and time between games

In 1996, MLS regular season began on April 6th. In 2017, the season began 35 days earlier, on March 3rd. With the addition of more teams to the league, MLS has lengthened the regular season (Fig. 2). From 2009 to 2017, the MLS season has started earlier in March, seemingly to accommodate all 22 teams. Due to the increased season length, the MLS playoff games are played later in the year. MLS is unique compared to other soccer leagues in the world because there is a postseason tournament to determine a league champion after the regular season, where as other leagues like the English Premier League (EPL), Italy's Serie A, and Spain's La Liga declare a league champion at the end of the regular season. Since the inception of MLS, the number of playoff teams has increased from 8 teams to 12 teams. Currently, during each round of the playoffs, both teams play at home and away, and the team with the best aggregate score advances. The MLS Cup, the post-season tournament, concludes with one final game and is awarded to the winner. The addition of more teams to the league has made a clear increase in the total season length. Beginning with the inaugural season in 1996, the MLS Cup final has been held between mid-October and mid-November. Since the 2012 season, the MLS Cup

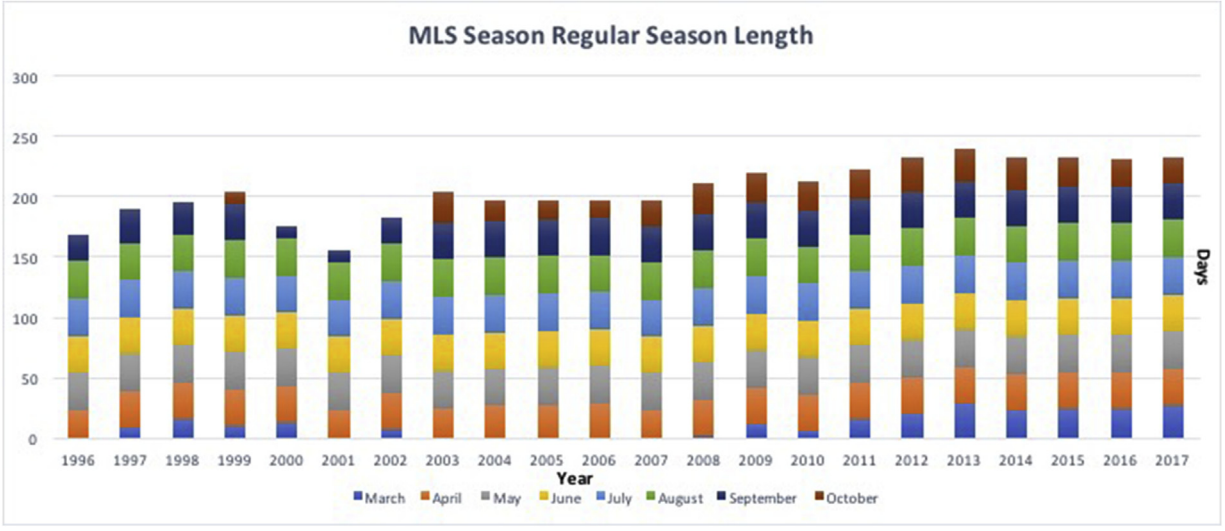

Fig. 2. Major League Soccer regular season length in days from each season.

final has been moved to early December. Interestingly, the number of playoff games has not changed dramatically since 1996, where a team would have to win 6 games to be MLS Champions. In 2017, although a different playoff format, a team would have to win between 5 and 6 games depending on how they finished the regular season to become champions. Last year, Toronto FC won the MLS Cup, and played in at least 41 games (34 MLS regular season games, 5 MLS playoff games, 2 Canadian Championship games).

In direct contrast to European professional soccer leagues, which begin each autumn and continue through the spring, MLS competition begins in the spring and runs through each autumn. An increase in season length was seen in conjunction with the MLS expansion from 14 to 19 teams during the 2008 through 2013 seasons (Fig. 2). Another reason for an increase in season length could be due to the MLS implementing breaks in the season for tournaments such as the World Cup, Gold Cup and other international games.

With plans to expand to 28 teams, MLS will face the difficult task of creating a game schedule that maximizes popularity of the league while minimizing the risk of injury among players. Injury data from the inaugural 1996 MLS season found injury rates were higher in games compared to practices and more injuries occurred later in the season(Morgan & Oberlander, 2001). We theorize that an increase in MLS season length could cause an increase in injury rate. Likewise, a shorter, more congested game schedule has demonstrated higher injury rates in other leagues(Bengtsson, Ekstrand, Waldén, & Hägglund, 2017; Bengtsson, Hallén, Vouillamoz, & Papadimitriou, 2016; Dupont et al., 2010; Ekstrand, Waldén, & Hägglund, 2004).

The scheduling of an MLS season can be very complicated and problematic for MLS in the future due to increase in number of teams, large geographical area, television contracts (ESPN, Fox, Univsion, TSN, TVA), other soccer tournaments (CONCAF, US Open Cup, etc) and US Soccer Federation and Canadian Soccer Association schedule(Hall, 2017). Even though MLS has lengthened the season, the number of games played during the regular season (32 ± 2 games) and postseason (5–6 games) has not changed dramatically. In 1996, each team played 32 games in the regular season, and in 2017 each team played 34 games. Although there has been no significant increase in the number of in-season games with addition of more teams to the MLS, teams must balance in-season play with other tournaments and international play. The time between games can be as short as three days for some MLS teams competing in other competitions such as the Confederation of North, Central American, and Caribbean Association Football (CONCACAF) Champions League games, friendly matches against visiting European teams and the US Open Cup in addition to the MLS season games. European teams such as Real Madrid, FC Barcelona, Manchester United, Chelsea, and Arsenal have come to the US to play exhibition games during their summer preseason. Playing against these teams provide a high financial and profile benefit for MLS teams. Furthermore, MLS must often heed national team competition schedules, which can further increase exposure to games for players who also participate in international competition during the MLS season. In the 2017 MLS season, most teams receive at least one week of rest between league games, however some must play both MLS and CONCACAF Champions League games in the same week. Playing multiple games in a week is not only a problem for MLS, but other premier leagues in Europe as well. Raymond Verheijen from the World Football Academy has reported that most teams who play in the Champions League or Europa League during the week yield less points, less goals and more goals against during their national league play on the weekend(Verheijen, 2012). Also, there was an increase in muscle injury rates with four or less days recovery between matches compared to six or greater days rest and more matches were lost with three or less days recovery ($p = 0.048$) in Europa League matches(Bengtsson, Ekstrand, & Hägglund, 2013).

1.3. Paucity of research

While research specific to MLS is limited, a review by Junge and Dvorak found MLS to have the highest match incidence of injury with 35.5 injuries per 1000 h in 1996 when compared to other leagues(Cantu, 2010; Erickson et al., 2015, 2013; Farber, Harris, Kolstad, & McCulloch, 2014; Junge, A, Dvorak, 2004; Mansfield, Beuomont, Tarnary, & Sllvers, 2013.; Morgan & Oberlander, 2001; Poulos et al., 2014). In comparison, incidence of match injuries for the three highest-level leagues in England was 25.9 injuries per 1000 h(Junge, A, Dvorak, 2004). The higher MLS injury rate could be attributed to differences in schedule and inexperienced players. Experience, age, and previous injury were significantly correlated to increased risk of injuries such as muscle strains and ligamentous sprains in 12 elite football teams(Haxhiu, Murtezani, Zahiti, Shalaj, & Sllamniku, 2015). In 1996, MLS started league play in April and ended in October (8 months), whereas the leagues in the UK typically start in August and conclude in May (9 months). Additionally, 1996 was the inaugural year of MLS, which likely had less experienced players compared to other established European leagues. Continued injury rate monitoring is necessary so MLS can make changes to decrease injury risk.

In MLS, of the players who sustained an anterior cruciate ligament (ACL) injury and subsequent ACL reconstruction (ACLR), 77% returned to play after reconstruction, and the resultant mean career length after ACLR was 4.0 ± 2.8 years(Erickson et al., 2013). Interestingly, the case-control study found that from 1996 to 2012, there was a statistically significant ($p < 0.001$) increase in the number of ACL tears by year in the MLS. Between the 1996 and 2001 season, the number of ACL tears each year ranged from 0 to 2, with 6 ACL tears occurring across the 6 seasons. From 2002 to 2010, the number of ACL tears per year ranged from 5 to 7 each season, with a total of 49 ACL tears during this 9-season period. In the 2011 and 2012 season, the number of ACL tears were 9 and 11, respectively, the most out of all the seasons from 1996 to 2012. The upward trend of ACL tear incidence merits further inquiry into how changes in the league schedule, expansion, game congestion, and rest between games has on injuries in the league. The increase in number of ACL tears could be related to expansion of MLS and changes to the schedule to accommodate more teams, with the 2011 and 2012 MLS seasons increasing the number of teams to 18 and 19, respectively. Another study assessed 78 men's professional soccer clubs in Europe between the years 2001 and 2015 and found a non-significant average annual increase in ACL injury rate ($p = 0.20$).(Waldén, Hägglund, Magnusson, & Ekstrand, 2016). Interestingly, this study did not find a statically significant annual increase in ACL injury rate over 15 years for European professional soccer teams, whereas there was a significant annual increase in ACL injury rate in MLS.

In a study assessing career length and athletic exposure in MLS players with ACL reconstructions from January 2011 to March 2016, it was discovered that players were not at a greater risk of lower extremity injury after primary ACLR, but have a shorter career length and do not participate in as many games as age-matched controls(Arundale, Silvers-Granelli, & Snyder-Mackler, 2018). Of note, during the 2011 and 2016 MLS seasons, the league gradually lengthened the season, which could potentially affect the success a player has returning to play after ACLR. More studies on injury trends in MLS are warranted in order to provide insight on return to play success.

Congested game schedules have shown to have a negative

impact on performance, in addition to placing players at increased risk for injury(Dupont et al., 2010). A study of the 2002 World Cup in Korea/Japan found that players who participated in a more congested schedule prior to the tournament demonstrated decreased performance (as appraised by three international soccer experts: over performance, normal performance, underperformance) and experienced a higher injury rate than players who had a less congested schedule (12.5 v 9 games $p < 0.05$)(Ekstrand et al., 2004). The players who underperformed in the World Cup played in more games in the 10 weeks leading up to the World Cup than the players who over performed according to the experts. Studies that analyzed Union of European Football Associations (UEFA) Champions League competition also found increased injury rates among players during congested match schedules(Bengtsson et al., 2013; Dupont et al., 2010). Two matches per week did not have a negative effect on physical performance (total distance covered, high-intensity distance, sprint distance, number of sprints), however, injury rate was found to be significantly higher during the second match each week(Dupont et al., 2010). Current research suggests 72–96 h between matches is sufficient to maintain performance, yet is not enough recovery time to prevent an increase in injury rate(-Bengtsson et al., 2017, 2013; Dupont et al., 2010; Ekstrand et al., 2004; Nédélec et al., 2013). In a more recent study, Bengstsson and colleagues found no difference in muscle injury rates in elite male soccer players who had 4 or 5 days (96 or 120 h) recovery between matches. However, injury rates were lower during matches with 6 days (144 h) or 7–10 days (168–240 h) rest when compared to matches with only 3 or less days (72 h or less) rest(Bengtsson et al., 2017).

The examination of game scheduling within a professional sports league is not solely unique to the sport of soccer in the US. The National Football League (NFL) and National Basketball Association (NBA) have been criticized for season length and congested game schedules. The implementation of Thursday night NFL games in 2006 has garnered commentary from sports writers, athletes and fans(Simmons, 2012). Many have argued that teams have less time to rest and prepare for a Thursday night game after playing the previous Sunday, which leads to lackluster performances and increased injury rates. The NFL has countered these arguments, reporting lower injury rates for Thursday night games compared to Sunday games(Florio, 2016). Although injury rates have shown to be lower during Thursday games, further consequences resulting from playing a game with less recovery time than usual, such as game performance and within-season fatigue, are unknown. Without sufficient evidence on the effects of a congested game schedule, the example of the NFL further aids the call for future research on game scheduling and recovery time in professional athletics.

The NBA has also been scrutinized for the intense travel schedule and season length(Teramoto et al., 2017). Game schedules were found to be a significant factor for injuries that occur during a game in an analysis of the 2012–2013 and 2014–2015 seasons(Teramoto et al., 2017). The results indicate participation in both back-to-back games (3–4 games in five days) and away games were predictors of injury(Teramoto et al., 2017). Another study demonstrated that travelling in the NBA can affect the number of points scored(Steenland & Deddens, 1997). Nonetheless, NBA teams have recently been disciplined by the NBA commissioner for resting star players as it is thought to negatively impact game attendance, fan experience and the quality of play(Bontemps, 2017.). Many coaches and their medical staff may elect to rest certain players during back-to-back games as a strategy to prevent these players from suffering injury during congested times in their schedules.

2. Discussion

There is a paucity of evidence to assist MLS to make changes to the league related to player health and injury trends. Therefore MLS must to rely on articles published in other leagues and other sports, while continuing to support its own research initiatives in their own league. One of the research initiatives needs to assess the affects of expansion, change of schedule and optimal rest between games to maintain a low injury rate. The discussion section is divided into four sections: Injuries in Soccer, Load Monitoring and Preseason Length, Travel and Recovery, and Call to Action.

2.1. Injuries in soccer

Lower extremity injuries account for 66%–77% of total injuries sustained by soccer players(Agel, Evans, Dick, Putukian, & Marshall, 2007.; Dick, Putukian, Agel, Evans, & Marshall, 2007; Morgan & Oberlander, 2001.). Ekstrand analyzed injury incidence and patterns in UEFA soccer competitions, and found an injury incidence of 8.0 injuries per 1000 h(Ekstrand, Hägglund, & Waldén, 2011). Re-injuries accounted for 12% of all injuries and resulted in more time lost versus initial injuries(Ekstrand et al., 2011). Injuries to the ankle are the most common, as 13% of injuries in UEFA competition involved the ankle, with 51% resulting in lateral ligament ankle sprains(Agel et al., 2007.). Ankle injuries occurred with a rate of 1.0 per 1000 h(Waldén, Hägglund, & Ekstrand, 2013). Although knee injuries are not as common as ankle injuries, they often lead to significant time loss from play(Agel et al., 2007.). Lower extremity muscle injuries are very common in soccer, and in UEFA competition, the greatest muscle injuries occurred to the hamstrings ($n = 900$), adductors ($n = 523$), quadriceps ($n = 394$), and calf muscles ($n = 306$), respectively(Martin Hägglund, Waldén, & Ekstrand, 2013). Hamstring injuries are one of the most prevalent injuries in professional soccer with hamstring strains making up 11% of injuries in professional soccer in England, 13% in Norway, and 16% in Iceland(Liu, Garrett, Moorman, & Yu, 2012). In English and Australian professional soccer, hamstring strains resulted in an average of 90 days lost time and 15 to 21 matches missed per club per season(Liu et al., 2012).

According to the injury analysis of the inaugural MLS season, 197 of the 256 injuries resulted in time loss from competition. Fifty-four of the injuries occurred to the knee and 46 of the injuries occurred at the ankle(Morgan & Oberlander, 2001.). Muscle strains in MLS most commonly occurred to the adductor muscles ($n = 29$), hamstring muscles ($n = 23$), and quadriceps muscles ($n = 3$).(Morgan & Oberlander, 2001).

2.2. Load monitoring and preseason length

The concept of load monitoring has played an integral role in injury prevention efforts for professional athletes(Drew & Finch, 2016; T.; Gabbett, 2016; Quarrie et al., 2017; Windt & Gabbett, 2017; Windt, Gabbett, Ferris, & Khan, 2017). Load is defined as the amount of work, effort, and stress an athlete exerts during training and games(T. Gabbett, 2016). Coaches and medical staff can influence an athlete's load through manipulation of the volume, intensity and frequency of training sessions and games. Load can be measured externally (distance, speed, acceleration, etc) and internally for physiological changes such as heart rate(Windt & Gabbett, 2017; Windt et al., 2017).

Traditionally, distance traveled and speed during a soccer match has been captured by video movement tracking systems with fixed cameras(Cummins, Orr, O'Connor, & West, 2013). Research on the use of global positioning systems (GPS) technology as a means of tracking elite athletes' performance in practice and games has

emerged(Randers et al., 2010). GPS was found to be as effective at measuring soccer game induced fatigue as video-based time-motion systems and semi-automatic multiple camera systems. However, significant differences have been found between the absolute distances covered between each system making data comparison suboptimal(Harley, Lovell, Barnes, Portas, & Weston, 2011).

Data captured from aforementioned systems is used to quantify the external load of an athlete during practices and match play(-Casamichana, Castellano, Calleja-Gonzalez, San Román, & Castagna, 2013; Cummins, Orr, O'Connor, & West, 2013; T. J.; Gabbett, 2010; Harley et al., 2011; Randers et al., 2010). GPS in conjunction with a measure of the internal demand (i.e. heart rate, rate of perceived exertion, etc) the players incur during a practice or match could benefit the decision making of the medical staff when calculating optimal loading(Randers et al., 2010).

Both inadequate load and excessive load have been associated with increased injury risk in sports, resulting in studies that aim to examine the optimal loads that maximize performance and minimize injury risk and chance of illness(Drew & Finch, 2016; T.; Gabbett, 2016; Quarrie et al., 2017; Windt & Gabbett, 2017; Windt et al., 2017). This necessitates coaches and medical staff to monitor load via data on the external and internal demands of an athlete. In a study of rugby athletes, researchers found that those who over trained were 70 times more likely to sustain a non-contact soft tissue injury, and emerging players are at increased risk of injury in games and training sessions compared to established players(Drew & Finch, 2016; Fortington et al., 2016). Malone demonstrated an association between practice and game loads with injury in elite soccer players from two European soccer clubs, and demonstrated the importance of monitoring week to week load(Malone et al., 2017). An adequate ratio of both acute and chronic workloads decreased the risk of injury in elite soccer players, whereas soccer players with excessive work load or suboptimal aerobic capacity were at increased risk of injury(Malone et al., 2017). The published literature suggests that if any professional soccer team is not monitoring load, they should be in order to enhance performance and decrease risk of injury.

In addition to load monitoring, having an adequate pre-season could help decrease injury risk. According to MLS, the 2017 pre-season games started on January 27th and concluded on February 25th. Most teams began team training between January 21st and January 23rd, which allowed the coaching staff just approximately six weeks of training prior to the start of the season. MLS offseason training schedules are unknown and may vary between teams and players. Off-season training programs may be affected by turnover of coaching staff and players in the offseason. Therefore, an evaluation of preseason length is necessary, particularly if the league lengthens the regular season schedule for the proposed expansion.

Inadequate or excessive load can increase injury risk in sports teams, while significant workloads over time have been shown to decrease injury rates(T. Gabbett, 2016). Research has found that rugby players who completed 18 weeks of training prior to their first injury were less likely to sustain another injury than rugby players who completed less than 18 weeks of training prior to their first injury(T. Gabbett, 2016; T. J. Gabbett & Domrow, 2005). The study suggests that adequate speed and endurance training can decrease injury rate which could support teams implementing a longer preseason. Furthermore, Windt and colleagues discovered that elite rugby players who participated in more preseason training sessions (10 sessions) than their peers had a lower percentage (5% reduction in games missed) of games missed due to injury (Windt & Gabbett, 2017; Windt et al., 2017). These studies may indicate that most teams and athletes could benefit from a longer preseason, regarding both injury prevention and performance.

2.3. Travel and recovery

Along with loading stress from practices and games, professional athletes must withstand the stress incurred through frequent travel. The addition of more teams to MLS in various geographic regions and time zones throughout North America will increase travel demands of the teams. The geographical area that the MLS encompasses is among the largest of any professional sports league in the world, with travel distance between cities reaching up to 3000 miles. These travel demands can negatively impact performance, injury rates, diet, sleep, and the circadian rhythms of the soccer players(Leatherwood & Dragoo, 2013).

Current evidence suggests that body temperature and strength are negatively impacted when athletes must travel across time zones(Leatherwood & Dragoo, 2013). While symptoms associated with jetlag can be measured with a 1–3 h time change, significant deficits in strength and performance are seen among athletes on the evening of the first full day after a flight(Leatherwood & Dragoo, 2013). Interestingly, in NFL, NBA, and MLB, visiting teams traveling west to east outperformed teams traveling east to west, likely due to the west coast teams playing during optimal times, and visiting east coast teams playing closer to their bed time(Leatherwood & Dragoo, 2013). Decreased performance can negatively impact a team's record throughout the season, as seen in professional baseball. MLB teams who had an advantage over their opponent due to change in time zone had a higher winning percentage(-Winter, Hammond, Green, Zhang, & Bliwise, 2009). When teams had a 1, 2 or 3 h advantage the winning percentage improved to 51.7%, 51.8%, and 60.6%, respectively(Winter et al., 2009).

Veteran players, such as Michael Bradley, captain of Toronto FC, have lamented about the poor travel logistics during the MLS season. After a 16-day stretch that included five games with trips to Seattle and Columbus: “The league has to find a better way to handle some of the logistics. Two weeks in a row, we play on Wednesday night and we're the first game on Saturday afternoon”(“ESPNFC: Soccer Michael Bradley: MLS scheduling makes ‘you shake your head a little bit,’” 2017.). Many professional sports teams experience the detrimental effects of travel, therefore, consideration must be given to enhance travel logistics in preparation for further MLS expansion into new cities.

Several minor to major injuries (defined by time loss from team participation) in soccer have been associated with time of year in MLS, with a greater percentage of injuries occurring in the late season (August 4th through September 21st in 1996)(Morgan & Oberlander, 2001.). Injuries were classified by time loss and anatomical location, with 77% of injuries occurring to the lower extremity, 21% involving the knee, and 18% involving the ankle(-Morgan & Oberlander, 2001). Several soccer specific epidemiological studies categorize injuries by absence, “according to the UEFA consensus discussions, it's recommended that injury severity was initially categorized as minor (1–7 days absence), moderate (8–28 days), and major (28 days). The first group was later split into two categories (slight (1–3 days absence) and minor (4–7 days)) to facilitate comparisons with the studies of the FA group(M Hägglund, Waldén, Bahr, & Ekstrand, 2005). The severity should be based on real time loss from participation (calculated from the attendance record) and not from an estimated absence period.”(M Hägglund et al., 2005) Also, injuries could be classified into one of the following categories: sprain, strain, contusion, fracture, dislocation, other (wounds, concussion, etc), and overuse(M Hägglund et al., 2005). Poor recovery after a soccer match, congested match schedule, and season fatigue, could lead to earlier fatigue state in subsequent match if not given full time to recover. Therefore, it's important to understand how long it takes for various performance measures and specific biomarkers related to performance like

glycogen, creatine kinase, myoglobin, testosterone and cortisol to recover after a soccer match.

Evidence suggests 72–96 h is required for soccer players to recover to baseline performance measures (i.e. strength, speed, and agility) between games(Nédélec et al., 2013). Sprint performance can take up to 96 h to fully recover, whereas jump performance can take up to 72 h to recover(Nédélec et al., 2013). Despite return to baseline performance measures, 96 h has been shown to be an inadequate amount of time in lowering the risk of injury among players during the second game(Bengtsson et al., 2017, 2013; Dupont et al., 2010; Ekstrand et al., 2004; Nédélec et al., 2013).

In addition to performance measures, the measurement of several biomarkers has recently emerged as a means of monitoring recovery following soccer games. Hydration status usually recovers within a 6-h time frame after a game is played, while glycogen depletion recovers 2–3 days (48–72 h) after a soccer match(Nédélec et al., 2013). Since glycogen is a major fuel source for muscle force production, a depletion of glycogen can result in lower energy levels and decreased performance, thereby demonstrating the importance of maximizing the recovery of glycogen between matches. Creatine kinase and myoglobin can take up to 120 h after a match to recover and play a key role in muscle function.[13] Hormones such as testosterone and cortisol have also been evaluated(Nédélec et al., 2013). Research on the recovery of cortisol levels is unclear, but testosterone levels are reduced up to 72 h after a match(Nédélec et al., 2013). Testosterone can promote muscle function and a deficit can negatively impact athletic performance. During congested times in the season, these biomarkers may not fully recover between games and require the athletes to utilize adequate recovery strategies and proper nutrition in between games. The science of biomarkers is relatively new to the professional soccer world, and more research is warranted in order to draw more specific conclusions at this time.

2.4. Call to action

Based on our clinical commentary we recommend the following changes to the MLS:

(1) Shorten the overall season length. Specifically, we recommend the season start in early April rather than March. By shortening the season and starting later, MLS can accommodate a longer off-season in the winter months. Also, by starting later, weather conditions will be better for soccer games and likely appeal to more fans that still have winter weather in early March.
(2) Increase the preseason time from approximately six weeks to eight to twelve weeks. By starting the MLS season a month later, this will allow for a more adequate preseason for managers to get their teams ready for the season.
(3) Teams should play one game per week to minimize risk of injury and utilize substitutes (bench players/non-starters) when required to play two games in a week to maximize match fitness and health of the roster.
(4) Add more rehabilitation and strength and conditioning professionals to individual teams in order to enhance compliance of proven injury prevention strategies and effectively monitor training load. MLS teams have very little control over the scheduling of games and may be forced to play a congested game schedule. Teams can maximize the implementation and compliance of evidence based injury prevention, rehabilitation and performance interventions by hiring more rehabilitation and strength and conditioning specialists.
(5) Maximize travel schedule for when teams cross more than 1-time zone. MLS has two geographical conferences, where each team plays other teams in their conference twice (both home and away) and play the teams in the other geographical conference at least once(Hall, 2017). Although teams play the majority of games in their geographical conference, they still have a lot of traveling with LA Galaxy flying more than 38,000 miles in the 2016 season(Hall, 2017). Also, most teams fly commercially rather than booking chartered flights which can make traveling frequently more difficult(Hall, 2017).

Players, coaches, medical staff and owners need to be invested in injury prevention as it can affect the team rankings, physical health and profit. Lower injury burden and a higher match availability of players were associated with a higher final league ranking in 24 European professional soccer teams across 11 seasons(Hagglund et al., 2013). Due to the paucity of existing literature about MLS, more research is necessary to determine the effects of a congested schedule on injury rates within the league.

This clinical commentary recommends implementation of a proper preseason in addition to the once-per-week game frequency in order to best promote player health and well-being. Players may also benefit from in-season injury prevention training and weekly load monitoring, particularly if the MLS game schedule remains congested. The investments in larger medical staffs and strength and conditioning specialists necessary to accommodate for these changes may improve the health and wellness of MLS players. Furthermore, as teams invest in these key staff members, compliance with evidence-based injury prevention interventions can be ensured. For example, the Nordic hamstring exercise program has been shown to decrease hamstring injuries by 50% and yet most Champions League and Norwegian Premier League football teams are non-compliant(Bahr, Thorborg, & Ekstrand, 2015). This is surprising, considering that a 2015–2016 UEFA injury analysis found that muscle injury burden can result in an average of 44 days' absence for every 1000 h of exposure.(Bengtsson, Hallén, Vouillamoz, & Papadimitriou, n.d.)

MLS may be in a conundrum regarding the planning of a season that maximizes the popularity of the league while keeping injury rates low. With an increased focus on player health, future research can identify injury trends and give MLS actionable data to make changes to the league.

Ethical statement

None declared.

Funding

No funding was utilized for this project.

Conflicts of interest

Authors have no conflicts of interest to report regarding this manuscript.

Acknowledgements

We would like to thank Amy Arundale and Josh Beaumont for their consultation on this manuscript.

Appendix A. Supplementary data

Supplementary data related to this article can be found at

https://doi.org/10.1016/j.ptsp.2018.05.008.

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