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ORIGINAL ARTICLE

High training/competition ratio, less incidence of injury? Professional football calendar exploration

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Received 26 June 2020; accepted 28 September 2020

Available online 21 January 2021



KEYWORDS

Football;
Football injuries;
Injury prevention;
Incidence of injuries;
Sports calendars

Abstract

Objectives: This study theorizes that a high training/competition ratio predisposes to fewer injuries in professional footballers. This has not been studied in elite professional players. The objective of this study was to investigate the incidence of injuries in professional players who had a frequency of one competition per week for twelve seasons. Furthermore, it highlights the importance of recovery-training cycles lasting from five to eight days between competitions.

Method: This research is an analysis of prospectively recorded data on injuries in an Argentine professional football team. Data was collected throughout twelve seasons and on a daily basis.

Results: The evaluated team had a frequency of 3.85 competitions per month and the ratio was 8.4 training hours per match hour throughout this twelve-year study. The injury incidence rate obtained in this investigation was 4.2 per 1000 training and competition hours. The injury incidence rate in training sessions was 2.3 injuries per 1000 training hours. The injury incidence rate in competition was 20.5 injuries per 1000 competition hours. Of 65% of all injuries, players returned to play (RTP) within seven days, with medical and kinesiological treatment customized for each athlete. Comparison tables with European Football are shown.

Conclusions: Sports calendars with a high training/competence ratio and a recovery/training period lasting from 5 to 8 days between competitions could cause a decrease in injuries requiring longer RTP time and result in a relatively low injury incidence rate in professional footballers.

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<https://doi.org/10.1016/j.apunsm.2020.100338>

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Introduction

There is a link between sports calendars and injuries. The relationship between training and competitions suggests that a high training/competence ratio could lead to fewer injuries.¹ This has not been studied in elite football players.² This study sought to investigate this correlation between the exposure of professional footballers playing one competition per week, with regular recovery-training cycles lasting from 5 to 8 days between competitions and their incidence of injuries.

This research presents the analysis of all injuries recorded throughout twelve years in a Professional Football team of First Division (Defensa y Justicia Club) in the "National B Tournament", organized by the Argentine Football Association (AFA).

Statistical analysis at the end of each season provides epidemiological data which are generally used to compare with data of previous seasons, other teams and bibliographic data. This aims to evaluate the season and to provide tools, specially, of injury prevention.³⁻⁶

The Union of European Football Associations (UEFA) has expressed concern about the demands on modern footballers and the translation of these physical and mental demands into injury syndromes.² The absolute training load, accumulated hourly, which the professional footballer experiences, is lower among those who play a single championship than those who participate in two or more championships.

This study shows the incidence of injuries and their characteristics in a South American Professional Football team participating in a single tournament divided into 38 rounds. The monthly frequency was 3.85 matches. This frequency was low compared to other European teams who must participate simultaneously in two or more tournaments and who usually participate in 6 matches per month.⁷

In elite football, some players can play up to 70 competitions per season. Due to this frequency, players are required to play consecutive matches intermingled every 3 days without fully recovering from physical performance. When the workload exceeds the athlete's ability, it leads to excessive fatigue and an increased risk of injury.⁸

Finding the right amount proper training sessions and competitions in relation to the annual schedule is desirable.

This study suggests the importance of sport calendar organization and of the control and research on sports seasons in professional football for preventive purposes.

Methods

The author of this study is a physician responsible for the professional football team Defensa y Justicia Club on whom this research is based. The seasons evaluated (from 2003 to 2012 inclusive) correspond to the twelve seasons during which the team participated in the National B tournament organized by the Argentine Football Association (AFA). (In this period, the team took part in 7 competitions from another tournament—Copa Argentina).

The aforementioned professional was in charge of the clinical evaluation, diagnosis and treatment of the team under research. This task was carried out jointly by

kinesiologists of the Club and doctors specialized in imaging procedures working outside the club.

Information about injuries was recorded, including the type, severity, site of the injury, evolution time, injury mechanism and whether it happened during a match or a training session.

This research is an analysis of epidemiological data prospectively recorded in professional players. It was carried out with a rigorous daily medical record.

Data was collected from the beginning of the team's pre-season to the week of the last training session, which usually coincides with the last competitive match of the championship.

The definition of injury was based on the description given by J. Dvorak and A. Junge (2000) published in *AJSM*, which defines an injury as a physical complaint resulting from training and causing the athlete to be absent from a training session(s) and match(es) and requiring an anatomical diagnosis of damaged tissue and corresponding treatment.^{3-5,8,9}

In this study, the instances of absence from training due to sickness were not recorded as injuries since, in contrast to other studies, their exclusion could show greater specificity in relation to the epidemiology of football.

For assessing injury severity, the concept by the FIFA Medical Research Center was used, defined as "the length of time from which a player has incurred an injury to the day he returns to full participation in training and availability for match selection".^{3,6,10,12}

The recovery time of each injury was recorded up to players' return to football practice. The severity of the injury was determined by the number of days players were absent from training.^{4,10} The UEFA suggests the classification: minimal (1–3 days), mild (4–7 days), moderate (8–28 days) and severe (more than 28 days).^{4,12}

However, for this study, the classification of the severity of injuries described by Dr. Vicente Paus¹³ was used. This is a modification of the classification by Dvorak and Junge⁵ based on the recovery time demanded for return to sports activity^{11,12}:

Grade I (mild): 1–7 days; Grade II (moderate): 1–3 weeks; Grade III (severe): 3–8 weeks; Grade IV (most severe): more than 8 weeks.

The main result of epidemiological research on sports injuries is the incidence of injuries and is usually expressed as a ratio between numerator and denominator. The numerator considers the cases (number of injuries) over a defined period of time and the denominator the total number of athletes exposed (athletes at risk).⁹ In team sports, the incidence of injury is generally expressed in number of injuries per 1000 participation hours.^{4,8,12,14}

In many sports, exposure during competition is easy to register. However, accurately recording exposure to training loads in football can be difficult.¹⁰ The total time of each training session varied widely. Training time was considered from the beginning of warm-up to cool-down without using GPS.

In football, exposure in training is defined as the different individual and team-based physical activities, under the control or guidance of the training staff, or team training aiming to maintain or improve the football skills or physical condition of players.¹⁰

This research considered, in accordance with recent studies, an injury incidence rate during training and an injury incidence rate during matches.^{1,4,10,11,16}

The football teams evaluated in these twelve years consisted of an average of 28 professional players per season. The age range was 17–38 years and average age was 26 years old.

All experimental procedures were designed in accordance with the Declaration of Helsinki for research on human subjects and the Ethical Standards in Sport and Exercise Science Research.

Results

The team under evaluation had a frequency of 3.85 matches per month. During the twelve years of the study, 4710 training hours and 715 competition hours were observed. The training/competition ratio was 8.4 training hours per match hour. This monthly and annual frequency of matches could be considered low compared to other European football teams who participate in the local championship and in international cups.

Throughout these 12 years of follow-up, players attended 8317 medical consultations as part of 3364 training sessions and 461 competencies. A total of 797 injuries were diagnosed.

During these twelve seasons, the standard deviation of the study was 6.31; median was 68.5; the lowest number of injuries in a season was 53 and the highest number of injuries in a season was 73; the range of the twelve seasons studied was 20.

The information obtained in this research shows that the injury incidence rate was 4.2 injuries per 1000 h (training and competition).

The injury incidence rate in training sessions was 2.3 injuries per 1000 training hours. The injury incidence rate in matches was 20.5 injuries per 1000 competition hours.

The average absence rate due to injury was 21.4 h. The injury burden was 90 days per 1000 h (training and competition).

The most common injury was described as Muscular (44.54%),^{10,15,16} followed by Knee joint injury (17.3%) and Ankle (16%) (Fig. 1).

Most of the treatments used were bloodless (rehabilitation) and a minimum percentage required surgical procedure (1.24%).

The percentage of non-contact injuries was 57.1% and of contact injuries was 42.9%.

A total of 797 diagnosed injuries were classified according to recovery time:

Grade 1: 65% injuries; Grade 2 injuries: 20.82%; Grade 3 injuries: 8.53% and Grade 4 injuries: 6.02% (Fig. 2).

As a relevant fact, this study highlights that, of 65% of all diagnosed injuries, players returned to the play (RTP) within seven days with medical and kinesiological treatment customized to each athlete. According to UEFA severity classification, these injuries are minimal (1–3 days) and mild (4–7 days).

The analysis reveals that, of the 797 diagnosed injuries, 355 corresponded to muscle injuries. This line found that Grade 0 muscle injury, muscle pain without DOMS anatomical

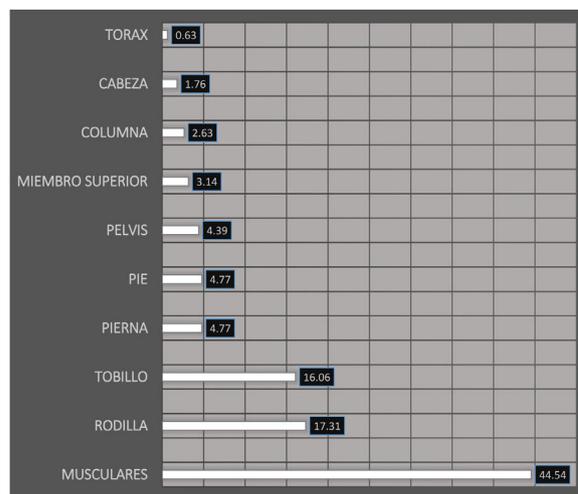
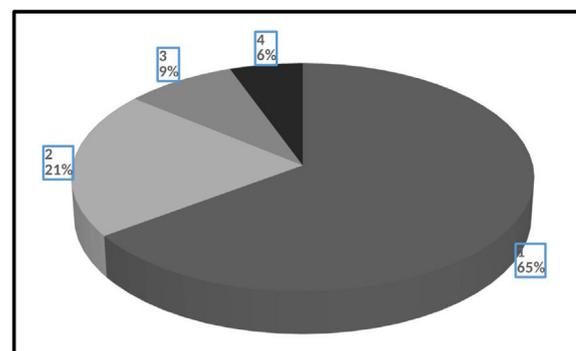


Figure 1 Injury location.



65 % antes de 1 semana
 20,82 % entre 1 y 2 semanas
 8,53 % entre 2 y 8 semanas
 5,65% más de 8 semanas

Figure 2 Recovery time before return to play (RTP).

injury or microscopic muscle damage (i.e. below the sensitivity of RMI)^{18,19,20,21,22} was the most common injury (23.84% of all injuries).

Players who suffered from these muscle injuries trained differently for less than a week.

Of all muscle injuries, the most affected group was the posterior thigh muscle²³ (Hamstrings) which comprised 53.46% of muscle injuries.

Data analyzed and presented in this research are compared to studies of European Football and shown in the pertinent tables (Tables 1 and 2).

Table 1 Incidence rate of injuries in competition and training per 1000 h.

	UEFA (injuries/1000 h)	X (injuries/1000 h)
Competition	30.5	20.5
Training	5.8	2.3

UEFA: "UEFA Champions League Study: A Prospective Study of Injuries in Professional Football during the 2001–2002".¹⁶ X: study "high ratio training/competition".

Table 2 Players post-injury return to play (RTP) before 7 days.

	UEFA	X
RTP within 7 days	27.1%	65%

UEFA: UEFA Elite Club Injury Study Report 2016/17. X: study "high ratio training/competition".

Discussion

The objective of this research was to analyze the correlation between the exposure of professional footballers to the frequency of one competition per week, with regular recovery-training periods lasting from 5 to 8 days between competitions and its incidence in injuries.

The time of each training session varied widely. Training time was considered from the beginning of warm-up to cool-down.

Training time control might be more accurate if GPS was used.

GPS could also provide other significant data such as total workload in kilometers and exercise intensity levels.

In our club, the epidemiology of each season is reported to the Medical Department and the coaching staff. From this data, we plan prevention work and carry it out regularly. However, using a stable protocol is difficult due to successive replacement of the coaching staff members.

Data found over a twelve-season period on a professional football team could provide real data to plan sports calendars and to make comparisons with other more studied regions.

In the UEFA 2016/17 report, the ratio was 6.3 training hours per competition hour. In this research, the ratio was 8.4 training hours per competition. This could lead to a difference of 2.1 more training hours per competition hour during championships with one round per week in contrast to championships that have two rounds in a week. This increased number of training sessions could have a protective effect on injuries. Therefore, the high training/competition ratio should improve players' fitness, protect them against injuries, and generate endurance in competition.²⁵

In the UEFA Champions League,¹⁶ Walden et al. have analyzed injury incidence levels during the tournament. The risk of competitive injury has been significantly higher in the UEFA Champions League compared to the data obtained in this study (30.5 vs. 20.5 injuries per 1000 h of competition) as well as the difference in the risk of training injuries (5.8 vs 2.3 per 1000 h of training).

In the report of the English Football Association (FA) "Injury Surveillance of the Football Association Championship 2013–2016", the incidence of competition and training injuries was also higher than the data found in this study (23.8 vs 20.5 injuries per 1000 competition hours) as well as the incidence of training injuries (4 vs 2.3 injuries per 1000 training hours).

In relation to the severity of injuries, this study found that, of a high proportion of injuries (65%), players return to play (RTP) within 7 days. This proportion was above data reported in other European Football studies.^{1,3,5,16,17,23,24}

In the UEFA Elite Club Injury Study Report 2016/17 the RTP before 7 days was 27.1% while in the 16-year analysis of the UEFA Elite Club Injury Study, RTP before 7 days was 42%.²⁴

Therefore we can express that in this study most absences due to injuries were attributed to diagnoses of minor injuries. The combination of the frequency and severity of the injury, i.e. injury burden, is probably a clinical tool which is worthy of consideration to describe the impact of injuries on professional football teams.²⁶

In this study, the injury load was 90 days per 1000 h (training and competition).

In the 11-year-old study by Hagglund and Ekstrand on the UEFA Champions League, the injury burden was higher than in this study (130 days/1000 h).²⁸

This study also shows that the incidence rate of injury (4.2 per 1000 h) was low compared to other studies on European football.^{1,4,15,16}

These observed data seem to be related to the fact that the twelve years of the study coincided with regular seasons of 38 official matches, with recovery-training periods lasting from 5 to 8 days between competitions, with two annual competition cycles, two preparatory periods and two transition periods; in contrast to most European football teams which participate in an average of 60 matches with a competition period a preparatory period and a transition period.

The organization of the competitive system would transform recovery-training cycles between competencies into a relevant component when analyzing the incidence rate of injuries during a tournament.

This study seek to demonstrate that the regularity of official matches with a recovery period lasting from 5 to 8 days between matches and an adequate training-competence ratio could cause a lower proportion of injuries requiring longer recovery time and result in a relatively low injury incidence rate.^{16,26}

The application of protocols for the prevention of injuries in high performance sports is regarded as fundamental^{3,5,10,27} and this study could show that, within these protocols, a ratio of 8.4 training/competence could be a preventive factor for injuries in professional football. Future research is needed to find the right amount of competitions and proper training sessions in relation to the annual schedule.

The data from this research provide useful information to proactively work on the development and planning of sports calendars in relation to injury prevention.

Conflict of interest

The author declares that he has no known competing financial interests that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.apunsm.2020.100338](https://doi.org/10.1016/j.apunsm.2020.100338).

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