Volume 19 Issue 8 September 2019 ISSN 1746-1391

European Journal of Sport Science

European Journal of Sport Science
The Official Journal of the European College of Sport Science

Routledge
Taylor & Francis Group

Routledge

ISSN: 1746-1391 (Print) 1536-7290 (Online) Journal homepage: https://www.tandfonline.com/loi/tejs20

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To cite this article: Rauf Nouni-Garcia, María Rosario Asensio-Garcia, Domingo Orozco-Beltran, Adriana Lopez-Pineda, Vicente F. Gil-Guillen, Jose A. Quesada, Roberto Carlos Bernabeu Casas & Concepcion Carratala-Munuera (2019) The FIFA 11 programme reduces the costs associated with ankle and hamstring injuries in amateur Spanish football players: A retrospective cohort study, European Journal of Sport Science, 19:8, 1150-1156, DOI: 10.1080/17461391.2019.1577495

To link to this article: https://doi.org/10.1080/17461391.2019.1577495

European Journal of Sport Science, 2019
Vol. 19, No. 8, 1150–1156, https://doi.org/10.1080/17461391.2019.1577495

The FIFA 11 programme reduces the costs associated with ankle and hamstring injuries in amateur Spanish football players: A retrospective cohort study

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Abstract
This study aimed to assess the cost-effectiveness of the "Fédération Internationale de Football Association (FIFA) 11" injury prevention programme for ankle and hamstring injuries. This retrospective cohort study included eighty-four male amateur football players aged 18–40 years. The exposed group performed the FIFA 11 protocol twice a week throughout the 2010–2011 and 2011–2012 seasons; the unexposed group performed the usual training during the 2008–2009 and 2009–2010 seasons. Lateral ankle ligament and hamstring injuries were recorded over the whole study period. We compared the mean costs associated with lateral ankle ligament and hamstring injuries in the two groups. The mean cost per player and lateral ankle injury was EUR 928 in the unexposed group versus EUR 647 in the exposed group ($p = 0.19$). The mean cost of hamstring injury per player was EUR 1271 in the unexposed group versus EUR 742 in the exposed group ($p = 0.028$). The mean total cost per player was EUR 2199 in the unexposed group versus EUR 1273 in the exposed group ($p = 0.008$). We concluded that the use of the FIFA 11 injury prevention programme reduced both the direct and indirect costs associated with lateral ankle ligament and hamstring injuries.

Keywords: *Primary prevention, injuries, ankle injuries, football, costs and cost analysis*

Highlights
- Injuries have a notable impact on healthcare expenditure and might be considered a matter of public interest.
- Amateur football players who completed the FIFA 11 protocol suffered fewer hamstring and lateral ankle ligament injuries.
- The FIFA 11 injury prevention program reduced both the direct and indirect costs associated with hamstring and lateral ankle ligament injuries in amateur football players.
- The cost of implementing the FIFA 11 is more than compensated by the resulting reduction in costs associated with lateral ankle ligament and hamstring injuries.

Introduction

In 1984, there were about 60 million licensed football players and 150 countries registered with the Fédération Internationale de Football Association (FIFA). Nowadays, there are 208 registered countries and about 300 million football players, coaches and arbitrators. These data show that football is one of the most popular sports in the world at both the amateur and professional level (Andersen, Larsen, Tenga, Engebretsen, & Bahr, 2003). The increase in physical activity among the population results in an increased risk of suffering sports injuries in either professional or amateur athletes (Timpka et al., 2014). In countries where the sport is widely played, injuries have a notable impact on healthcare expenditure and might be considered a matter of public interest (Inklaar, 1994). According to Casais Martínez (2008), sports clubs tend to focus more

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on treating injuries than on preventing them, and this approach not only disrupts participation in training and competitive events but may also incur a considerable economic cost (although this fact is debatable). Football injuries can occur with or without direct contact with other players, and some strategies can help prevent noncontact injuries (Romero Rodríguez & Tous Fajardo, 2010).

According to Woods, Hawkins, Hulse, and Hodson (2002), 12% of all football injuries involve the hamstring muscles. In their 2006 study, Müller-Rath, Schmidt, Mumme, Andereya, and Miltner (2006) found that the most commonly injured joint was the ankle. The findings of Noya Salces, Gómez-Carmona, Gracia-Marco, Moliner-Urdiales, and Sillero-Quintana (2014) study showed the top 3 injuries among elite players were thigh muscle injuries, ankle sprain and hip muscle injuries. A previous study among different age and skill levels groups (Peterson, Junge, Chomiak, Graf- Baumann, & Dvorak, 2000) also found that most of the injuries were strains and sprains of the lower extremities, especially in the ankle and knee and, despite the exposure to football was lower, in the low-level group the frequency of injury was higher. According to Martínez (2008), football players in the top categories may suffer fewer and less severe injuries than amateur players, who train less.

Askling, Karlsson, and Thorstensson (2003) reported that preseason strength training targeting the hamstrings could help elite football players to avoid injuries and enhance performance. Current injury prevention strategies in amateur football include the FIFA protocol called "The FIFA 11" (http://www.ffiri.ir) and two variations of this programme have been developed: FIFA 11 and FIFA 11+ (a revised version of the FIFA 11 programme). This prevention programme focuses on plyometric training, core stabilization, agility and neuromuscular control (Rodas, Pruna, Til, & Martin, 2009). The effectiveness of both has already been documented in previous studies (Junge et al., 2011; Pomares-Noguera et al., 2018; Silvers-Granelli, Bizzini, Arundale, Mandelbaum, & Snyder-Mackler, 2017). When Mayo, Seijas, and Alvarez (2014) conducted a review from March to April 2013 to examine the effectiveness of neuromuscular warm-up on injury prevention, they found that the FIFA 11 programme reduced ankle sprains by 58% and anterior cruciate ligament injuries by 27%. In our previous study (Nouni-Garcia, 2017), we observed that players who completed the FIFA 11 protocol suffered fewer hamstring and lateral ankle ligament (LAL) injuries than those who did not.

However, as far as we know, there are few studies which analyse the cost- effectiveness of the FIFA injury programme (Bizzini, Junge, & Dvorak, 2013; Rössler et al., 2018). The aim of this study was to assess the cost-effectiveness of the FIFA 11 programme for these injuries in amateur male Spanish football players during the regular season.

Material and methods

Design

This was an analytical observational retrospective cohort study.

Participants

Participants were players from two men's amateur football teams belonging to the same club. They competed in the first regional division of the Valencian Community Football Federation (group VII) in Spain; the regional divisions comprise the lowest tier of the Spanish men's league and are reserved for amateur players. They are organized by the regional federations of the Royal Spanish Football Federation. All players must be licensed and, based on the completed season results, the teams are promoted, relegated or remain unchanged.

We included amateur football players from different seasons (2008/09, 2009/10, 2010/11 or 2011/12). In a previous study by our group, we analysed the relationship between the implementation of the FIFA 11 protocol and the rate of hamstring and LAL injuries (Nouni-Garcia, 2017), observing a decrease in the incidence of hamstring and LAL injuries in players who completed the FIFA 11. In the present study, we determined whether the FIFA 11 injury prevention programme reduced the costs associated with injuries. We compared the costs generated by players who performed the FIFA 11 during the season with the costs generated by players who did not, through the follow-up of players during the season and the recovery time of the injury.

Inclusion criteria were: male amateur football players, aged 18–40 years, with a full medical and player record for the relevant season (2008/09, 2009/10, 2010/11, or 2011/12) and who provided written informed consent. Exclusion criteria were: players who withdrew from the team before the end of the season for reasons other than injury. For statistical reasons, players who competed during both the pre-intervention and post-intervention period were removed.

Sampling

Consecutive sampling.

Description of exposure

The FIFA 11 intervention was implemented in the football club starting in the 2010/11 season, with the exposed group undertaking the FIFA 11 protocol twice weekly under the supervision of the team physiotherapist. The unexposed group performed the usual training during the 2008/09 and 2009/10 seasons.

Data collection

The team physiotherapist collected all study variables retrospectively from medical and player records for the seasons studied; these records included all LAL and hamstring injuries that had occurred during training sessions and competitions (Supplemental Figure 1). Data collection adhered to recommendations from the F-MARC Football Medicine Manual (FIFA, 2006 http://www.ffiri.ir).

Cost measurement

Table I presents the standard costs considered in the economic evaluation. The analysis included: FIFA 11 intervention costs (exposed group); direct healthcare costs, including the use of healthcare facilities as a result of injuries, such as emergency medical consultations, specialist consultations, diagnostic tests and physiotherapy; and indirect injury-related costs, including lost wages and school absenteeism.

The accrued cost of exposure (i.e. intervention cost) was EUR 2500, which was the monthly salary of the physiotherapist for the 10-month season. This worked out to EUR 116 per player/season, or EUR 1 for each of the 86 training sessions (43 weeks) and 30 matches in the season.

We obtained information concerning injury management and their costs to calculate direct healthcare costs from the reference hospital through an arrangement with the insurer of the registered footballer players:

- LAL injury: standard protocol included one X-ray (EUR 30), one medical consultation in the emergency department (EUR 70), emergency nursing care (EUR 20), traumatology consultation (EUR 70) and two physiotherapy sessions (EUR 30 each). The total cost per LAL injury was EUR 250 (Table I).
- Hamstring injury: standard protocol included one ultrasound (EUR 70), one medical consultation in the emergency department (EUR 70), emergency nursing care (EUR 20), traumatology consultation (EUR 70) and two physiotherapy sessions (EUR 30 per session). The total cost per hamstring injury was EUR 290 (Table I).

The physiotherapist had assessed the injuries when they occurred, referring all injured players to the emergency room of the reference hospital. After standard injury management, players needing more sessions of physiotherapy received them from the team physiotherapist until full recovery without additional cost.

Indirect costs are understood to be any loss of resources caused by illness. Recent studies have explored the best methods for measuring these costs, and an increasing number of publications are including them in their analysis of a given technology (Oliva Moreno, 1999). In Spain, due to lack of consensus, the inclusion of indirect costs is optional but not a standard recommendation (Sacristán, Badía, & Rovira, 1994). Our evaluation of indirect costs employed the revealed preference method, which is based on social perceptions of the value of human life; this same method is used by courts of law when granting compensation for accidents, disability, incapacity and other. The Spanish health system defines the economic benefit for temporary incapacity as the loss of income resulting from an illness or accident that prevents workers from performing their job. This figure, which can change slightly from year to year, is defined by the Ministry of Economy and published in the Spanish Official State Gazette (BOE, 2012). As our study period ended in 2012, we used the amount set that year – EUR 56.60 per day for each lost work day (BOE, 2012) – to calculate indirect costs associated with LAL and hamstring injuries for the whole study period (Table I).

The traumatologist at the reference hospital decided when football players could return to work and when they could go back to playing football. We recorded the number of days each injured player had missed work due to injury during the study period and multiplied this number by EUR 56.60 to determine the indirect injury-related cost

Table I. Direct and indirect costs[a].

Exposition costs	
Training session with the FIFA 11 per player	1€
Costs of attendance match per player	1€
Costs per player and per season	116€
Direct healthcare costs (per test or session)	
X-ray test	30€
Medical consultation in emergency services	70€
Emergency nursing assistance	20€
Traumatology consultation	70€
Ultrasound test	70€
Physiotherapy session	30€
Indirect costs (per player)	
Lost work day	56.60€

[a]The information of the injury management and their costs were obtained from the reference hospital through an arrangement with the insurer of the registered footballer players.

for that player. This figure depended on the severity of injury and recovery time of each player. So we used the average number of days per injury to calculate the economic benefit received for temporary incapacity (indirect costs).

Economic analysis

Total cost per participant includes direct and indirect costs of injury and the cost associated with the implementation of the FIFA 11 programme for the exposed group. Cost-effectiveness was calculated considering the mean total cost (cost of exposure together with direct and indirect costs of injury) per participant in the exposed and unexposed groups.

Statistical analysis

We performed a descriptive analysis of the quantitative explanatory variables in each group. To meet our study objective, we calculated the minimum, maximum, mean and standard deviation of the costs in each group, for each injury type and for total injuries. We applied the Student's *t*-test to compare the means and then calculated their 95% confidence intervals. Analyses were conducted using SPSS Statistics, version 18.0.

Ethical considerations

The Miguel Hernandez University Ethics Committee approved this study. All participants gave written informed consent before data collection began. We respected the participants' right to confidentiality and conducted the study in compliance with Good Clinical Practice Guidelines and current legislation on data protection, Spanish law 15/99.

Results

Design flowchart (Figure 1)

One of the players who was included in the unexposed group was also present during the exposure seasons. We excluded this player to prevent data contamination. We then randomly selected and eliminated one participant from the unexposed group to balance the numbers and provide a random selection (Figure 1).

Flow of participants through the study

The sociodemographic variables of our sample comprising 84 players are shown in Table II. Monitoring was carried out for four seasons: 2008/09, 2009/10, 2010/11 and 2011/12. The injuries sustained both

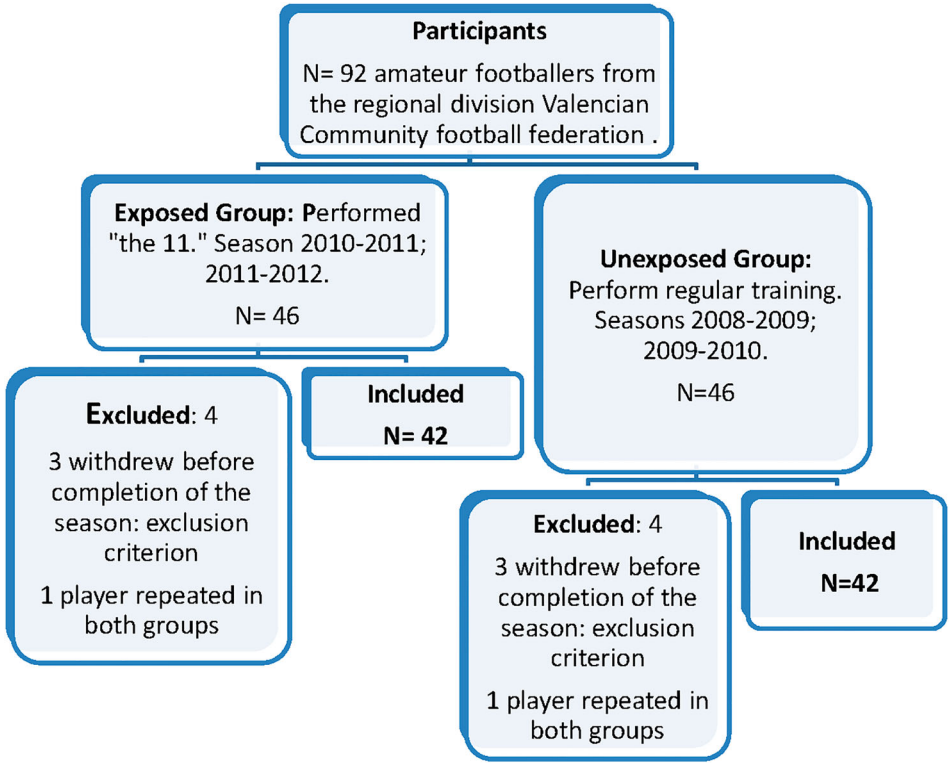

Figure 1. Design flowchart.

Table II. Analysis of sociodemographic variables and days lost to injury in the exposed ($n = 42$) and unexposed ($n = 42$) groups.

	Exposition	Min	Max	Mean	SD	*p*-value
Age (*yr*)	No	19	33	25.02	3.81	0.516
	Yes	19	34	24.45	4.20	
Weight (*kg*)	No	65	88	73.45	5.35	0.426
	Yes	65	83	74.33	4.72	
Height (*m*)	No	1.67	1.92	1.78	0.06	0.909
	Yes	1.68	1.92	1.78	0.05	
BMI (Kg/m^2)	No	21.6	24.7	23.15	0.94	0.103
	Ye	21.4	24.7	23.47	0.83	
Total work days lost per injured player	No	21	93	43.45	17.70	0.030*
	Yes	14	81	31.77	20.09	

BMI: body mass index; SD: standard deviation.
*p-value < 0.05.

in competition and in training were recorded during this time. During the first two seasons (2008/09 and 2009/10), the players did not perform the FIFA 11 programme, while during the next two seasons (2010/11, 2011/12) they did. All players trained twice a week for 1.5 h (Table II). Both groups were exposed to 6966 h of training and 990 h of matches. All football players who were injured received complete care management per protocol, with all injuries treated in the emergency department of the reference hospital.

Regarding the number of work days lost due to injuries during the study, the mean per player was 31.77 (SD 20.09) in the exposed group and 43.45 (SD 17.70) in the unexposed group (see Table II). We observed no significant differences between the two groups in sociodemographic variables including age, weight, height or body mass index (see Table II).

Economic analysis (Table III; Supplemental Figure 2)

For hamstring injuries, the mean total cost per player for the two seasons studied was significantly lower in the exposed group than in the unexposed group (EUR 742 vs. EUR 1271; $p = 0.028$). The FIFA 11 represented a mean savings of EUR 529 per player for two seasons, or EUR 264 per player per season. There was no significant difference in the costs associated with LAL injuries between the two groups ($p = 0.19$). The total mean cost of injuries per player in the unexposed group was almost double that of the exposed group (EUR 2199 vs. EUR 1273). In other words, the FIFA 11 represented a mean savings per player of EUR 924 for two seasons, or EUR 462 per player per season. Thus, the total investment was EUR 9766.68 and the total estimated avoided cost was EUR 38892, meaning that EUR 3.98 were obtained in return for each euro invested.

Discussion

This study showed that the FIFA 11 injury prevention programme reduced the costs associated with LAL and hamstring injuries in amateur Spanish football players.

As Bizzini, Junge and Dvorak reported in 2013, the injury prevention strategies included in the FIFA 11 prevention programmes help to reduce both the incidence of injuries (Junge et al., 2011; Soligard et al., 2008) and the costs related to their treatment. Nouni-Garcia et al. (2017) and Junge et al. (2011)

Table III. Mean cost per lateral ankle ligament injury, hamstring injury and total cost per player in the exposed and unexposed groups.

	Exposition	*N*	Min	Max	Mean	95%CI	*p*-value
LAL cost	No	42	0	3387	927.7	616.2–1239.3	0.190
	Yes	42	116	3107	647.0	352.1–942.0	
Hamstring cost	No	42	0	3070	1271.1	929.1–1613.0	0.028*
	Yes	42	116	5571	742.0	409.9–1074.1	
Total cost	No	42	0	6344	2198.8	1680.7–2717.0	0.008*
	Yes	42	116	5571	1272.8	820.2–1725.4	

*p-value < 0.05.
LAL: lateral ankle ligament; SD: standard deviation.

corroborate that exposure to the FIFA 11 programme is a protective factor in the prevention of LAL and hamstring injuries. Unlike in our prior study (Nouni-Garcia et al., 2017), Junge et al. (2011) collected information on all types of injuries, and it was not a physiotherapist who applied the protocol; nevertheless, these authors observed an overall decrease in the incidence of injury during matches and training. An injury prevention programme implemented in New Zealand called Soccer Smart also included the FIFA 11 protocol (FIFA, 2006 http://www.ffiri.ir). The accident compensation consortium invested NZD 650,000 and saved NZD 5,331,000, or NZD 8.20 for every dollar invested. In 2013, Krist, van Beijsterveldt, Backx, and de Wit (2013) showed that the FIFA 11 programme reduced costs associated with injuries among amateur Dutch football players, though the incidence of injury was not significantly lower in the exposed group. The authors attributed the cost decrease to a reduction in knee injuries, which are very costly. This may indicate that not all injuries are sensitive to the FIFA 11 protocol. While the injuries examined in this study are not serious, they are very prevalent in football (Müller-Rath et al., 2006; Woods et al., 2002) incurring considerable direct and indirect costs. The FIFA 11 could thus be valuable not only from the budgetary viewpoint but also in terms of productivity, since the mean total lost work days for the exposed group was less than for the unexposed group.

As well as the inherent limitations of a retrospective analysis, other limitations of our study include the risk of selection bias, which we tried to minimize through our inclusion and exclusion criteria, and the risk of information bias arising from the use of hospital reference prices to calculate direct costs. Healthcare costs might have changed over the four-year study period, although the insurer of the club did not provide us with this information.

In conclusion, this study demonstrates that in amateur male Spanish football players, the cost of implementing the FIFA 11 is more than compensated by the resulting reduction in costs associated with lateral ankle ligament and hamstring injuries.

Disclosure statement

No potential conflict of interest was reported by the authors.

Supplemental data

Supplemental data for this article can be accessed here (https://doi.org/10.1080/17461391.2019.1577495).

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