

PUBLIC HEALTH CARE**RISK FACTORS FOR INJURIES IN PROFESSIONAL FOOTBALL PLAYERS**Bekim Haxhiu^{1,2}, Ardiana Murtezani^{1,2*}, Bedri Zahiti³, Ismet Shalaj², Sabit Sllamniku⁴¹Clinic of Physical and Rehabilitation Medicine, ²Department of Physical and Rehabilitation Medicine, Faculty of Medicine, ³Department of Cardiology, Clinic of Internal Medicine, ⁴Orthopaedic Clinic, University Clinical Center of Kosovo, Prishtina, Kosovo**ФАКТОРЫ РИСКА ПОЛУЧЕНИЯ ТРАВМ ПРОФЕССИОНАЛЬНЫМИ ФУТБОЛИСТАМИ**Беким Хаксиу^{1,2}, Ардиана Муртезани^{1,2*}, Бедри Захити³, Исет Шалаж², Сабит Шламнику⁴¹Клиника медицинской реабилитации, ²Кафедра медицинской реабилитации, Медицинский факультет, ³Кафедра кардиологии, Клиника внутренних болезней, ⁴Ортопедическая клиника, Косовский университетский клинический центр, Приштина, Косово**ABSTRACT**

AIM: The aim of this study was to identify risk factors related to the occurrence of injuries in football players. **MATERIALS AND METHODS:** The study included 216 football players from 12 teams in the elite football league. Football-related injury data were collected prospectively during the 2012/2013 competitive season. At baseline the following information was collected for the players: anthropometric measurements (weight, height, BMI, subcutaneous skinfolds), playing experience, injury history, physical fitness performance test (agility run), peak oxygen uptake. The incidence, type and severity of injuries and training and game exposure times were prospectively documented for each player. **RESULTS:** Most of the players (n = 155, 71.7%) sustained the injuries during the study period. The overall injury incidence during the regular season was 6.3 injuries per 1000 athlete-exposures (95% confidence interval, 4.31-9.67). Multivariate logistic regression analysis showed that playing experience (odds ratio [OR] = 0.44; 95% CI = 0.32-0.61, p < 0.01), age (OR = 2.05; 95% CI = 1.49-2.81, p < 0.01) and a previous injury (OR = 4.4; 95% CI = 2.14-9.07, p < 0.01) were significantly correlated to increased risk of injuries. Body mass index was not associated with risk of injury. Strains (34.19%) and sprains (25.81%) were the major injury types. Twenty-seven percent of injured players were absent from football for more than 1 month, with knee injuries (25.42%) being the most severe type. **CONCLUSION:** The risk factors that increase injury rates in football players were previous injury, higher age and years of playing. Future research should include adequate rehabilitation program to reduce the risk of injuries.

Key words: risk, injury incidence, football players

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РЕЗЮМЕ

Цель: Установить факторы риска получения травм футболистами. **МАТЕРИАЛЫ И МЕТОДЫ:** В исследовании принимало участие 216 футболистов из 12 клубов высшей футбольной лиги. Данные о травмах, связанных с футболом, собраны во время спортивного сезона 2012-2013 года. В начале исследования среди игроков были проведены следующие измерения антропометрических показателей: веса, роста, BMI, толщины подкожного жирового слоя; были учтены игровой опыт и история получения травмы; с каждым спортсменом был проведён тест на физическую выносливость с измерением максимальных аэробных возможностей. В отношении каждого спортсмена были зарегистрированы частота, тип и тяжесть травм, нагрузка во время тренировок и частота игрового участия. **РЕЗУЛЬТАТЫ:** Большинство игроков (n = 155, 71.7 %) получило травмы в период исследования. Частота получения травм в период активного игрового сезона составляет 6.3 на 1000 игровых часов (95%-ный доверительный интервал, 4.31-9.67). Логистический множественный регрессионный анализ установил, что игровой опыт (OR = 0.44; 95% CI = 0.32-0.61 p < 0.01), возраст (OR = 2.05; 95% CI = 1.49-2.81, p < 0.01) и наличие предыдущей травмы (OR = 4.4; 95% CI = 2.14-9.07, p < 0.01) сигнификантно связаны с повышенным риском получения травмы. Индекс массы тела не соотносится с риском получения травмы. Растяжения связок (34.19 %) и вывихи (25.81 %) являются основными типами травм. Двадцать семь процентов травмированных игроков не принимали участия в играх свыше 1 месяца, при этом травмы в области колена являются наиболее тяжёлыми повреждениями (25.42 %). **ЗАКЛЮЧЕНИЕ:**

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Существенными факторами риска получения травм футболистами являются наличие предыдущих травм, более старший возраст и игровой опыт. В будущих обследованиях необходимо включить и исследование программ для адекватной медицинской реабилитации, направленных на снижение риска получения травм.

Ключевые слова: *риск, частота травм, футболисты*

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INTRODUCTION

Football is one of the most popular sports worldwide despite the high rate of injuries occurring in this sport.¹ Several studies have been carried out to investigate the type, location, and severity of injuries in football.²⁻⁵ Many studies have examined the injury risk factors and found that higher age,⁶ years of playing^{6,7} and previous injury⁸ seem to increase the risk of injuries. Ostenberg and Roos⁶ followed 123 female football players - using a multivariate model they found that older players were at greater risk of injury. Previous injury has been shown to be the most important risk factor for subsequent injury.⁹⁻¹¹ A study done in an adult male soccer players in one year prospective cohort study found greater risk of injury for soccer players with a history of ankle problems.¹¹ Watson followed 102 football players and found that previous injury was a significant predictor of future injury.¹²

AIM

The aim of the present study was to analyze the influence of risk factors on the occurrence of football injury.

MATERIALS AND METHODS

A prospective cohort study of Kosovo professional male football was carried out during the 2012/2013 competitive season.

SUBJECTS

Two hundred and sixteen male football players of 12 teams from Kosovo's elite league participated in the study (Table 1). The players were informed about the aim and the design of the study prior to the study; they signed a written informed consent for participation. Self-administered questionnaires were distributed among the football players at the beginning of the season. They responded to the

Table 1. Characteristics of players

Variables	All players	Injured players	Uninjured players	p
	mean \pm SD n = 216	mean \pm SD n = 155	mean \pm SD n = 61	
Age (yrs)	22.3 \pm 3.3	22.8 \pm 3.4	22.2 \pm 3.5	0.03
Height (cm)	180.1 \pm 5.4	180.1 \pm 5.3	179.8 \pm 5.9	0.64
Weight (kg)	74.5 \pm 6.7	75.1 \pm 6.3	73.0 \pm 7.3	0.05
BMI	23.0 \pm 1.7	23.1 \pm 1.6	22.6 \pm 1.8	0.04
Football experience (yrs)	7.9 \pm 3.2	7.4 \pm 2.9	8.7 \pm 3.8	0.01
Illinois Agility Run	15.9 \pm 0.7	15.9 \pm 0.7	16.0 \pm 0.7	0.61
VO ₂ Max (ml.kg ⁻¹ .min ⁻¹)	52.2 \pm 4.6	52.3 \pm 4.6	51.9 \pm 4.5	0.60
Injury history (% yes)	72.7	82.6	47.5	0.01
Smoking (% yes)	46.3	45.8	46.6	0.81
Subcutaneous skinfolds (mm)				
Triceps	77.0 \pm 24.9	77.1 \pm 23.1	77.0 \pm 29.2	0.99
Subscapular	81.5 \pm 18.8	81.2 \pm 18.6	82.5 \pm 19.6	0.65
Abdominal	82.2 \pm 28.6	80.5 \pm 26.7	86.7 \pm 32.6	0.19
Thigh	80.7 \pm 35.5	79.8 \pm 33.5	83.0 \pm 40.5	0.58
Calf	76.0 \pm 25.0	75.5 \pm 25.7	77.1 \pm 28.3	0.69

questions under the observation and guidance of an athletic therapist. The study was approved by the Ethic Committee of the Faculty of Medicine in the University of Kosovo.

DATA COLLECTION

The baseline information included a self-administered questionnaire, medical examination, and a football specific test. The questionnaire included questions about sociodemographic data, details about previous injuries, number of years playing football, as well as aspects of training and playing football. The medical examination incorporated anthropometric measurements, (weight, height, body composition), subcutaneous skinfolds, and peak O₂ uptake. Each player completed a football specific test, the Illinois agility test (IAT).

During the 1-year follow-up, all teams were visited weekly by a physician who documented all injuries and complaints and the amount of time spent in training and games using a special documentation sheet for each player. Data on the type and location of the injury, injury mechanisms, and number of days of practice or play missed because of the injury.

INJURY DEFINITION

An injury was defined as any tissue damage caused by football, resulting in medical attention, inability to complete a session, or missing a subsequent session.⁶ Injuries were classified as severe, if the complaints lasted for more than 4 weeks or the tissue damage was severe. Injuries were also classified into four severity categories according to the length of absence from training sessions and matches: slight (1–3 days); minor (4–7 days); moderate (8–28 days); major (> 28days).¹³

BASELINE PHYSICAL MEASUREMENTS

Skin-fold measurements were taken from five different areas by the same examiner: triceps brachii, subscapular, abdomen, anterior thigh, and medial calf using the Lange Skinfold Calipers manufactured by Beta Technology. Percentage fat was estimated according to Carter's equation.¹⁴

Body mass index (BMI) was calculated as weight (in kilograms) divided by height (in meters) squared.

The subjects' agility was assessed using the Illinois agility test (IAT) according to the method of Miller et al.¹⁵ A hand-held stopwatch was used to take the subjects' time to the nearest 0.01 s. The run started with a standing start on the command 'GO' and subjects sprinted 10 m, turned, and returned to the starting line. When the subjects

reached the starting line, they zigzagged in between four markers and completed two 10 m sprints. The fastest time of the three trials was noted as the final agility time. A 5-min rest period was allowed between each trial.

Peak O₂ Uptake. The test was performed by walking and running on a treadmill. Four minutes of warm-up were performed with the treadmill speed set at 4.8 km·h⁻¹ and inclination set at 4%. The inclination was then increased every minute by 2%, up to a 20% inclination. If the player was still able to continue, the speed was further increased by 0.5 km·h⁻¹ until exhaustion. Gas exchange measurements were made continuously as the player breathed into a two-way breathing mask (Medical Graphics - Cardiopulmonary Exercise System CPX). Heart rate was monitored using Polar FT4 Heart rate monitor.

STATISTICAL ANALYSIS

Exposure time in matches was calculated by multiplying the total number of players on a team by the number of all matches during the season. Exposure time in training was calculated by multiplying the total number of players on a team by the number of practices for the entire season. Injury incidence was calculated as the number of injuries per 1000

Table 2. Characteristics of injury

Description	n	%
Mode of injury		
Contact	77	50
Non-contact	78	50
Type of injury		
Strain	53	34
Sprain	40	26
Concussion	8	5
Contusion	31	20
Fracture	6	4
Laceration	6	4
Dislocation	7	5
Other	4	3
Type of injury by duration		
Slight (1 to 3 days)	31	20
Minor (4 to 7 days)	25	16
Moderate (8 to 28 days)	57	37
Major (more than 28 days)	42	27

match or training hours and presented with 95% confidence intervals.

The statistical procedures were performed using statistical software package, Stata, version 12. Variables were first inspected, both formally and graphically, for the normality of their sample distribution. For interval variables with skewed distributions (age in our study), the Wilcoxon-Mann-Whitney test was used, while other interval variable means were tested using the Student's t-test. Differences in categorical variables between injured and un-injured players (injury history, smoking) were tested using the Chi-square test. Logistic regression model was used with entering all variables at once. The Wald test was applied to assess the significance of each explanatory variable.

RESULTS

Twelve teams participated in this study with a total of 264 players. Of these players, 216 (81.8%) consented to participate. Player's characteristics are summarized in Table 1.

Several significant differences (age, BMI, football experience, and injury history) existed between the uninjured and injured players in their baseline measures (Table 1).

A majority of players (155, 71.7%) were in-

Table 3. Injury location

Description	n	%
Upper extremities	23	15
Head	1	1
Neck	1	1
Face	1	1
Shoulder	6	4
Back	2	1
Chest-ribs	1	1
Abdomen	0	0
Arm (upper and lower)	4	3
Wrist	4	3
Hand/finger	3	2
Lower extremities	132	85
Hip/groin	27	17
Leg (upper and lower)	24	15
Knee	38	25
Ankle	33	21
Foot/Toe	10	6

Table 4. Factors significantly associated with the odds of injury (logistic regression analysis)

Factor	Odds Ratio	Standard Error	95% CI
Injury History	4.41	1.62	(2.14 to 9.08)
Age (1 year)	2.05	0.33	(1.50 to 2.81)
Experience (1 year)	0.44	0.07	(0.32 to 0.61)

jured during the 1-year observation period. Only 61 players (28.2%) sustained no injury. More than half self-reported injury history (72.68%).

The overall injury incidence during the regular season was 6.3 injuries per 1000 athlete-exposures (95% confidence interval, 4.31 - 9.67). The injury incidence during matches was significantly higher than during training ($20.7 \pm 10.8/1,000$ hrs vs $3.21 \pm 2.0/1,000$ hrs, $p < 0.0001$). Most incidents (49.7%) were contact injuries. There were 53 joint sprains (34%), 40 muscle strains (26%), 31 contusions (20%). Severe injuries (causing absence of > 28 days) accounted for 27% of all injuries (Table 2).

Significantly more injuries occurred in the lower extremity than in the upper extremity (85% vs 15%, respectively, $p < 0.05$). The knee (25%) was the most commonly injured region followed by the ankle (21%), and hip/groin (17%) (Table 3).

Multiple logistic regression analysis showed that previous injury ($p < 0.001$), age ($p < 0.01$), and playing experience ($p < 0.01$) are significant predictors of injury. The results of logistic regression analysis show that players with a history of previous injuries are more than four times more likely to sustain an injury 4.41 (95% CI 2.14-9.08); the odds of sustaining an injury also were more than double for older players, 2.05 (95% CI 1.50-2.81). On the other hand, more experienced players were less likely to sustain an injury than players with less experience. The physical characteristics of players, such as BMI, were not associated with a risk of injury (Table 4).

The difference between the two groups in football experience and the history of previous injuries is statistically significant at 1% level of significance, while the difference in age and BMI is statistically significant at 5% level of significance.

Control included: BMI; All factors are statistically significant at $p \leq 0.01$; the value of 1, indicating same odds, excluded from the 95% CI.

DISCUSSION

The principal finding in this study is that the risk of injury in elite football players is associated with previous injury, football experience, and age.

Previous injury is the most important risk factor for future football injury. Our data confirm the results of previous studies.^{2,7,10,16-19} Arnason et al.¹⁰ in a study done in adult male football players examined risk factors in a multivariate model and reported that previous injury is a risk factor for subsequent ankle and knee injury OR = 5.3 (95% CI 1.5-19.4) and OR = 4.6 (95% CI 1.6-13.4). Kucera et al.¹⁸ reported the same findings that the players with an injury history were injured at a rate 2.56 (95% CI 2.17-3.01) times higher than those without an injury history. The relatively high rate of reinjury in football players might be accounted for by the inadequate rehabilitation or incomplete healing.

Another interesting finding in this study was the strong association observed between age and incident injury. Age as a risk factor for injury in football players is controversial. Our conclusion is consistent with the findings of several other authors that older players are more prone to injury.^{6,10,17,20,21} These findings agree with those of previous reports^{2,5,8} and might be explained by the players' greater exposure to injuries with increasing age.

Body mass index were not related to injuries, which is in accordance with previous studies on adult players.^{6,22}

In our study, more experienced players are less likely to sustain an injury than players with less experience. Consistent with our findings, Ekstrand et al.²¹ suggested that players that train and play more are in better physical condition, they also have better techniques and therefore they sustain fewer injuries. Conversely, Turbeville et al.²³ found that increasing experience might be related to increased risk of injury through repetitive, cumulative trauma. Moreover, more experienced players have more playing time in the game and thus have a greater opportunity to be injured.

The overall injury incidence in the present study was 6.3 injuries per 1000 athlete exposures (95% CI, 4.31-9.67). These injury rates are consistent with the findings of similar studies.^{19,24,25} In our study the injury incidence during matches was significantly higher than that during training. Our conclusion is consistent with the findings of several other authors.^{19,23,25-27} In an adolescent study, Soderman et al.²⁷ reported a 6-fold injury increase in games versus practices. In agreement with this

study, Emery et al.¹⁹ found the risk of injury to be 8-fold greater in games than in practice sessions. Matches characteristically involve more contact between players and are more aggressive and competitive in nature, which lead to more injuries.

Thirty-six percent of injured players were absent from football for less than 7 days. There is considerable literature to support these findings. Kimberly et al.²⁸ reported 38% of minor injuries, whereas Arnason et al.¹⁰ found 39% of injuries among football players (0 – 7 days missed). Emery et al.¹⁸ found greater frequency of injuries (75%) resulting in the inability of the players to play soccer for 7 days or less.

The injuries sustained were predominantly strains, sprains, and contusions, which supports the results of previous research of football players.^{3,19,21,23,25}

Examination of the mechanism of injury revealed that there were almost equal proportions of contact and noncontact injuries.^{2,7,19,23,29} Also, in our study most incidents (49.7%) were contact injuries.

Concerning the location of injuries, in the present study the lower extremity was involved in 85% of all cases, which is in accordance with 60% to 88% incidence of other reports.^{3,5,19,23,24} The upper extremity was involved in 15% cases, which is also in line with our findings. Findings of our study are in agreement with the results from other studies^{5,8,19,23,24} that the majority of injuries occur in the knees and ankles.

CONCLUSIONS

Injury history was associated with an increased injury rate. Age and previous injury were identified as the main risk factors for injury among elite football players. The findings suggest the need for increased prevention efforts to lower the risk of football - related injuries.

COMPETING INTERESTS

The author(s) declare that they have no competing interest.

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