

Review paper

INJURIES IN WOMEN'S FOOTBALL: A SYSTEMATIC REVIEW OF THE RESEARCH

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Abstract: Women's football is striving to become the most popular women's team sport, as is the case with men's football. Women's football in the Republic of Serbia is practically in its initial stages, although lately there has been a greater interest among young girls for this sport. The most frequent injuries in women's football, as well as in men's, are injuries to the lower extremities (65%), the most frequent of which are knee and ankle injuries (Junge, & Dvorak, 2007). In this overview 14 papers were analysed, written between 2000 and 2018. According to the current research, we could conclude that injuries in women's football most frequently appear in the region of the lower extremities, especially to the knees and ankles. In case of the knee injury, it usually comes in the form of a rupture of the anterior cruciate ligament. Most injuries occur during training, and are non-contact injuries. When it comes to the timeline, injuries are most frequent at the beginning and the end of the season. At the beginning, injuries occur since players are inactive in the transition period, and at the end due to inadequate planning and programming of the training process and insufficient shape. Players who are technically better trained and have greater possession of the ball during the game are more susceptible to injuries than other players. It is very important that the training process is carried out adequately and professionally by the coaches and sports professionals. Programs designed for the prevention of injuries decrease the number of injuries, but cannot fully prevent the possibility of an injury.

Key words: *most frequent injuries, women's football, knee injury, anterior cruciate ligament*

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INTRODUCTION

Football as a sports game, as a part of a broader field of movement in physical education, represents at the same time a physical and mental activity which has unavoidably been imposed on people all over the world (Aleksić & Janković, 2006). Injuries are one of the factors which perhaps damage the quality of football itself the most, separating players from the field for longer or shorter periods of time, and in rare cases, forever.

The existing research has indicated that based on the frequency of injury, football players are second only to players of American football. Women's football is striving to become the most popular women's sports, as is the case with men's football. However, since football is a sport which is traditionally considered popular among the male population, the data on injuries among women are scant, and papers on this topic are few.

Women's football in the Republic of Serbia is practically in its inception, although lately there has been an increased interest of young girls in this sport. What indicates this is an increase in the number of registered players, as well as the number of women leading clubs in elite competitions.

Sports injuries mainly occur during participation in sports competitions, training or fitness activities. They can occur as a consequence of various causes both related to an athlete's health status, and the specific nature of each sport, including inappropriate training, inappropriate footwear, clothing or protective equipment (Daraboš, 2011). Furthermore, it is important to mention that sports injuries mostly affect the movement system – as much as 80% of all injuries fall under the category of injuries to the musculoskeletal system (Brzić, 2012).

The most frequent injuries in women's football are, as in men's football, injuries to the lower extremities (65%), most commonly injuries to the knee and ankle joint (Junge, & Dvorak, 2007). It has been noted that a majority of injuries take place at the very beginning (August) and the very end of the season (April, May) (Mallo, 2014), and they most frequently occur in the middle of the field.

The subject matter of this paper is a descriptive analysis of the existing studies related to the frequency and nature of injuries in women's football, both abroad and in the Republic of Serbia, with the aim of facilitating research on this topic in the upcoming period.

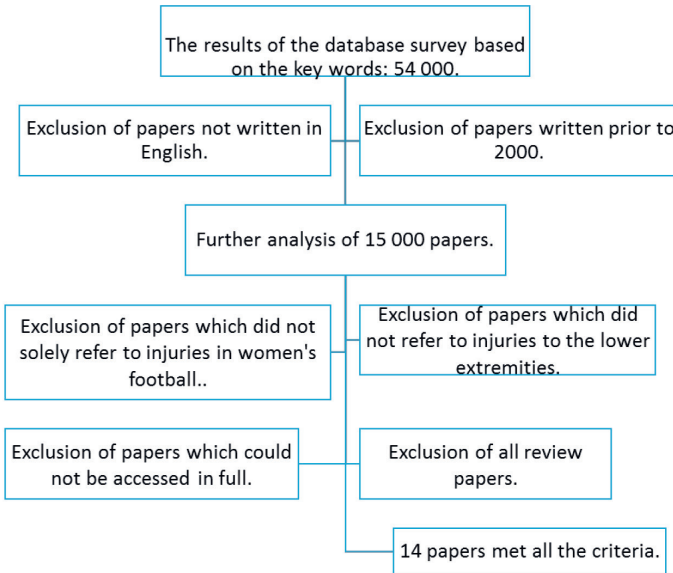
The analysis covered papers published from 2000 to 2018, while the procedure of the analysis and elimination process is shown in Figure 1.

METHOD

To compile the needed literature, the following index databases were used: PubMed, SCIndex, Web of Science, and Google Scholar. When review-

ing the literature, the search included the following keywords: women's football, injuries, prevention of injury, etc. Based on the key words, 54 000 papers were selected. The method of selection of the papers is shown in Figure 1.

Figure 1. *The analysis procedure and elimination procedure*



Inclusion criteria

Type of research studies

All studies written in English and concerning women's football were taken into consideration.

Type of participants

Participants belonging to all age categories were females who practiced football irrespective of their age.

Type of injury

The analysis covered research studies that focused on injuries of the lower extremities in women's football.

Type of output data

The primary data which were sought were the percentages of the prevalence of injuries depending on the type of injury, how the injury occurred and the time when the injury occurred.

Exclusion criteria

The exclusion criteria were the following:

- all papers written before 2000;
- all papers not written in English;
- all papers which did not focus solely on injuries in women's football;
- all papers which could not be accessed in full;
- all papers which were written as review papers.

The data analysis in the selected papers

A review of the papers selected for the analysis is presented in Table 2. The papers are presented chronologically and in alphabetical order. Tables, in addition to the names of the authors included the obtained results in the given studies, which were further analysed. The data were grouped based on the country in which the research had been carried out, the number of participants, how the injury occurred, the time when the injury occurred, and the type of injury.

Table 2. *An overview of the research studies that provided numeric results*

First author and year of publication	The participants			Injury location	How the injury occurred	Activity during which the injury occurred	Timeframe of most injuries
	Number of participants	Country of research	Competition level/Age of participants				
Del Coso, Herrero, & Salinero, 2018	25,397	Spain	All registered female players	K 30.4% SZ 17.9%	BK 51% SK 42.6%		
Macura et al., 2018	185	Serbian	The players of the Serbian SuperLiga and Serbian First Women's League	K 34.1% SZ 29.7%	TT 44.2% TU 42.7%		
Kaneko et al., 2017	518	Japan	University level teams and 4 four teams from the national league	K = 80	BK 61% SK 39%	TU 62%	
Robert et al., 2017	140	Belgium	Members of the national teams	K 27.8% SZ 15.9%	BK 68% SK 26.2%	TT 53.5% TU 31.5%	January August
Mallo, 2014	22	Spain	Primera División	K ↑ SZ ↑		TT 69% TU 31%	August April May
Kiani et al., 2010	1,506	Sweden	Ages 13 to 19	K < 77%	BK < 90%		
Junge, & Dvorak, 2007	/	/	International competitions	SZ 84%			

Le Gall, Carling, & Reilly, 2007	119	France	Ages 15 to 19	SZ 35%		TT 64.6% TU 35.4%	September
Tegnander et al., 2007	181	Norway	Norwegian First Division Women	DE ↑		TT 53% TU 47%	
Faude et al., 2006	143	Germany	Women's Federal League	ACL	BK 35.8% SK 64.2%		
Jacobson, 2006	269	Sweden	The Damallsvenskan	DE 82%	/	TY 49%	/
Faude et al., 2005	165	Germany	Women's Federal League / 22.4 ± 5 yrs	K 27.9% SZ 26%	BK 49.5% SK 50.5%	TT 42% TU 58%	
Giza et al., 2005 b	202	USA	National Women's Soccer League Western Division	K 31.8% ACL ↑		P/U 12.63 P/T 1.17	
Söderman et al., 2001	146	Sweden	The second and third division	DE ↑			

Legend : **K**- the = prevalence of knee injuries; **SZ** – the prevalence of injuries of the ankle joint; **BK** – non-contact injury; **SK** – injury sustained during contact with another player; **TT** – injuries which occurred during practice; **TU** – injuries which occurred during a match; **DE ↑** - the greatest number of injuries related to the lower extremities; **ACL ↑** - the greatest number of injuries related to damage to the anterior cruciate ligament; **K <** - the prevalence of decrease in knee injuries following the implementation of the program which had been applied during the research; **BK <** - the extent of the decrease in the non-contact injury following the implementation of the program which had been applied during the research; **P /U** – the ratio between injury and 1000 hours spent in the game; **P /T** – the ratio between injury and 1000 hours spent in training;

RESULTS AND DISCUSSION

As previously indicated, injuries have a great impact on the quality of the game itself. They have a destructive effect on quality by separating the players from the field for longer or shorter periods of time, depending on the severity of the injury.

Football is a team sport which is predominantly played with feet and so injuries in this sport are in terms of percentages greater in the area of the lower extremities than the rest of the body. However, research has indicated that injuries at a younger age are rare, even though the prevalence of injuries are greater at that age among girls than boys (Giza & J. Micheli, 2005).

The research that was carried out on a sample of 181 female football players from Norway indicated that as many as 81% of injuries affected the lower extremities (Tegnander, Egil Olsen, Tegdan Moholdt, Engebretsen & Bahr, 2007), while the prevalence of injuries to the lower extremities in seven professional international competitions is somewhat smaller and has a value of 65% (Junge, & Dvorak, 2007). The research which was carried out in Sweden on a sample of 146 female participants also indicated the prevalence of injuries to the lower extremities that was significantly higher than the prevalence of other injuries (Söderman, Alfredson, Pietilä, Werner, 2001). The reason for the greater percentage of prevalence of injury to the lower extremities is

explained by the fact that football is primarily played with the feet, rendering the lower extremities most susceptible to injury.

When it comes to the injuries to the lower extremities, they usually occur in the region of the ankle joint and knee. In Spain, a study was carried out on a sample of 25,397 registered female players, among whom 30.4% of the injuries were injuries to the knee, while 17.9% of the injuries were to the ankle joint (Del Coso, Herrero & Salinero, 2018). A study carried out in Belgium provided similar results, 27.8% of the overall number of injuries was related to the knee, while 15.9% was related to the ankle joint (Robert & Vandewyngaerde, 2017). In Germany, in their national league, the prevalence of knee injuries and the prevalence of ankle joint injuries is somewhat closer than in the previous examples, with a value of 27.9% and 26% respectively (Faude, Junge, Kindermann & Dvorak, 2005). In the French national league, a study was carried out on the frequency of injury and it was found that the most frequent injury is to the ankle joint, at a rate of 35% of the overall number of injuries to the lower extremities (Le Gall, Carling, & Reilly, 2007). Giza, Mithöfer, Farrell, Zarins & Gill (2005) carried out a study on 202 female football players of the Western Division of the US league, with the aim of determining the prevalence of injury, and concluded that the most frequent injury was to the knee joint (31.8%). The only study of this kind carried out in our country indicated that the extent of prevalence of injury to the knee joint is as high as 34.1%, while it is lower for the ankle joint and has a value of 29.7% (Macura, Đuričić, Marković & Leontijević, 2018).

Knee injuries are far less frequent among women than men, and what contributes to it in most cases is the physiognomy of the female body, although the causes of knee injury also include the lack of physical preparedness of the female players. The most important factors of a high prevalence of the rupture to the anterior cruciate ligament (ACL) among women are:

- anatomical factors: an increased Q angle and a smaller intercondylar notch;
- the influence of hormones on the ligaments and stability of the knee joint;
- muscle strength and coordination;
- reflex activity (neuromuscular junctions).

In addition to the fact which part of the body is more susceptible to injury, it is important to determine how and when injuries most often occur. When it comes to how injuries occur, opinions are twofold, divided into two basic groups, contact injuries and non-contact injuries. In Spain, during a study, a conclusion was reached that 51% of all injuries occur when there was no contact with another player, while 42.6% of all injuries occur during contact with another player (Del Coso et al., 2018).

Research carried out in Belgium has indicated that as many as of 68% of injuries are non-contact, while only 26.2% of injuries are contact injuries (Robert et al., 2017). In the German national league, results were obtained that contact and non-contact injuries are similar in number, 50.5% (are contact) and 49.5% (are contact) (Faude et al., 2005). At international competitions, however, it has been proven that the greatest number of injuries occurred as a result of contact with another player with 84% (Junge & Dvorak, 2007). Injuries that occur without contact can be a consequence either of insufficient preparation of the players or overtraining and exertion. In a study carried out in Germany, and at international competitions, it was proven that contact injuries can often be an indicator that at these competitions more aggressive football is played, and involves more contact.

When answering the question of how injuries occur, we divide them into injuries which occur during training and those that occur during a match. It is difficult to believe, but studies have indicated that the frequency of injury during training is greater than during matches. In Spain, as part of a study carried out on a sample of 22 female players, it was concluded that as many as 69% of all injuries occurred during training (Mallo, 2014). In Belgium that ratio is similar, the number of injuries which occurred during training is 53.5% (Robert et al., 2017). In addition, a study in Norway has proven that the prevalence of injuries during training is higher than during matches (53%) (Tegnander et al., 2007), while in the German national league the prevalence of injuries during training is only 42% (Faude et al., 2005). In France the difference between the number of injuries that occurred during a match and training might be the greatest, and in favor of injuries during training, going as high as 64.6% (Le Gall et al., 2007). In Serbia, however, it has been indicated that the number of injuries during matches is 42.7%, while the number of injuries during training is 44.2% (Macura et al., 2018). The causes of a greater number of injuries during training could be an insufficient level of preparation of the players and the intensity of the training. In addition, players sometimes take training sessions too lightly, and so do not perform the exercises with the utmost concentration and dedication, which causes injuries.

Studies have indicated that the frequency of the incidence of injuries depends on the part of the season, so injuries mostly occur at the beginning and end of the season. Mallo (2014) found that the highest number of injuries occur in August, April and May, that is, at the beginning and the end of the season, while Le Gall (2007) suggests that the highest number of injuries occur in September, which would again be the beginning of the season. The fact that the most injuries occur in preliminary periods prior to the beginning of the season or at the very beginning of the season is a consequence of the extended break that players take between seasons or half-seasons. During breaks a small number of players train and stay fit on their own, which results

in overload during the preliminary period as well as the inability of the players to prepare sufficiently for the beginning of the season.

A connection between the position of the players and the frequency of injury is not clearly defined, since various results were obtained from various studies. The only thing that is certain is that a literature overview has proven that the players who were technically more advanced were more susceptible to injuries than their co-players, which is explained by the fact that higher quality players possess the ball for longer periods of time and are more active during matches (Soligard, Grindem, Bahr & Andersen, 2010).

The knee, as the most frequently injured part of the body among female football players, is a topic often studied with the goal of determining how and why the injury occurs. In Japan, a study was carried out which indicated that of 518 girls, 80 had a rupture of the anterior cruciate ligament, 62% of which occurred during a match, while 61% of the ruptures of the anterior cruciate ligament occurred while there was no contact with another player (Kaneko et al., 2016). In Sweden, due to the tendency of increase in knee injuries, a study was carried out with the aim of decreasing the number of injuries among female football players aged 13 to 19. The program included improvement of motor abilities, body control and muscle activity. The program results were a decrease in knee injuries by quite impressive 77% (Kiani, Hellquist, Ahlqvist, Gedeberg, Michaëlsson, & Byberg, 2010).

In various studies on men's football the aim was to determine which factors have the most significant impact on the occurrence of knee and ankle joint injury. One such study was carried out on female football players in Norway, where 12 teams participated, that is, 173 female football players. The statistically significant factor for injury to the upper leg was increased BMI, for knee injury the increased valgus angle of the knee, while the injuries to the knee and foot were statistically significantly more frequent among individuals who had already undergone knee surgery (Nilstad, Einar Andersen, Bahr, Holme & Steffen, 2014).

CONCLUSION

Based on the existing research, it can be concluded that injuries in female football most frequently occur in the region of the lower extremities, especially the knee and ankle joint area. When it comes to knee injuries, it is usually a case of ruptures of the anterior cruciate ligament. A majority of injuries occur during training, and while there is no contact with another player. When it comes to the time period, injuries are most common at the beginning and end of the season. At the beginning of the season, injuries occur due to the fact that the players are inactive during the transitional periods, and final-

ly due to inadequate planning and programming of the training process and sports form. Players who are technically better trained and have greater possession of the ball during matches are more susceptible to injuries compared to other players. It is very important that coaches and sports professionals adequately and professionally carry out the training process so that the already greater physiological and biological predisposition of women in football for the occurrence of injuries to the lower extremities, and especially of the knee, is reduced to a minimum. Programs for the prevention of injuries reduce the number of injuries, but cannot completely prevent the possibility of injuries.

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