# STUDY REGARDING THE EFFECTS OF SPRINTS ON THE INJURY RATE OF FOOTBALL PLAYERS

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***Abstract.*** *The football game in Romania begins to be played according to certain scientifically proven benchmarks, which is evidenced by the results and studies published every year. The latest international studies show that photocell-controlled sprinting over a 50-meter distance at an intensity of more than 95% of the player's maximum potential decreases the risk of injury during a match. This is due to the fact that there are weekly competitive microcycles in which, through the chosen exercises or just by the nature of the position played, many athletes do not experience this scenario during training but they are fully faced with it during a match. Thus, our purpose was to conduct a comparative study in order to observe the effects of sprints on the injury rate of football players during matches across weekly cycles. Participants in this study were 20 professional football players who, according to the established protocol, followed a preventive injury programme including sprints performed at an intensity of over 95%. These exercises must be practised throughout the training period, our study intending to demonstrate that the game activity is the reference point when building training sessions, and each game scenario should be simulated or practised in the training process.*

***Keywords:*** *football, injury, sprinting effects.*

## Introduction

This research cannot be addressed without referring to sports traumatology that is defined by Gornea (2010) as follows:

- sports traumatology is part of general traumatology, which aims to treat injuries that occur during sports activities;
- sports injuries are caused by external forces through the action of mechanical factors - hard collision, blow, fall, etc., which results in the production of injuries, contusion or even fracture, in the worst cases;

Sports traumatology has several characteristics ("Considerații generale asupra traumatologiei sportive" [General considerations on sports traumatology], n.d.), the aspects related to the causes and mechanisms of injury being specific to different branches of sport and directly depending on athletes, coaches, training mistakes, nutritional deficiencies and sports equipment. The main purpose of sports traumatology is the complete recovery of the injured anatomical and functional part of the body. There must be a close connection between the optimisation of recovery time and the athlete's return to activity. One of the important objectives of sports traumatology is focused on the diagnosis of diseases in the reversible stage and the prevention of their occurrence by applying treatment in the preclinical stage.

We will present below a short classification of sports injuries (Drăgan, 2002):

According to the type of affected structure:

- Contusion;
- Muscle strain;
- Muscle tear;
- Dislocation and fracture.

According to the mechanisms involved in the aetiology of trauma:

- Accidental injuries;
- Stress or overload injuries.

In sports traumatology, there are several factors that may or may not be related to the athlete, therefore the causes and factors that favour injury occurrence can be classified as follows:

Extrinsic factors:

- Poor or incorrectly performed physical training;
- Climatic conditions such as air humidity and temperature;
- Aspects related to sports facilities: training ground/gym;
- Improper nutrition;
- Insufficient rest;
- Psychological factors;
- Risk factors specific to certain contact sports, etc.

Intrinsic factors:

- Certain anatomical variations;
- Discrepancies between the length of the lower/upper limbs;
- Muscle imbalances;
- Reduced mobility and flexibility;
- Certain neuromuscular disorders;
- Dysfunctions in the kinetic chain;
- Body disproportion;
- Genetic and endocrine factors.

*Poor or incorrect physical training*

Most of the time, training errors are due to the wrong training methodology applied in different training periods or the incorrect planning by stages, which are often eliminated. Commonly, an incorrect approach to the training volume and intensity during periods when certain criteria must be met leads to major mismatches.

As regards strength training, the anatomical adaptation of the body is first required in order to make the transition to weight training, but if these steps are not followed, the body will not be able to withstand successive shocks and will give up.

Any motor action that involves high intensity should be gradually introduced in the training session, preferably after a few weeks of adaptation.

*Weather conditions*

Some people are influenced by weather conditions and atmospheric pressure, which is why their influence is extremely important. Also, the areas where the climate has extreme and even aggressive manifestations should not be avoided. All these considerations accompanied by inadequate hydration and poor nutrition can be decisive factors in the occurrence of sports injuries.

Research shows that the higher the temperature and humidity, the lower the viscosity of collagen, but if changes in atmospheric pressure are added, there will also be changes in the process of tissue oxygenation (Meyer, 2019).

*Training or competition site*

The issues related to the site where the training or competition takes place are particularly important. The quality, composition, hardness and elasticity of the playing field are decisive aspects in many sports, and this can sometimes be crucial in the occurrence of athletic injuries.

It should also be taken into account when making the transition from one surface to another, for example, when athletes make the transition from a natural to an artificial grass field, that its impact on muscles and joints can vary pretty much. For this reason, we recommend performing several adaptation training sessions to prevent injury.

*Athlete nutrition*

In many cases, the importance of nutrition is of minimal importance to athletes, but it can often be of major importance in the occurrence of stress fractures due to the calcium deficiency that athletes will experience at some point. Most injuries are caused by a poor diet, which is low in nutrients and vitamins. If the dehydration caused by physical exertion is added to all of this, the result will be disastrous.

Generally, in competitive sports, exercise intensity is high for relatively long periods, with a high rate of energy production, which leads to increased water and electrolyte losses.

The decisive factors in injury production during sports training are (Bahr & Krosshaug, 2005):

- according to their role in injury production:
  - predisposing factors;
  - triggering factors;
  - favouring factors.
- by their origin - the causes can be related to:
  - the injured athlete;
  - the opponent;
  - the conditions of the external environment where the training session takes place;
  - poor organisational issues.

The authors of this classification (Bahr & Krosshaug, 2005) explain it as follows:

- predisposing factors - refer to some acquired or congenital physical disabilities that can be observed in athletes after injury;
- triggering factors - are closely related to the athlete's level of fatigue that may occur because of errors in the training or recovery process;
- favouring factors - involve the emergence of a disease caused by internal or infectious agents, of a problem caused by vitamin or food deficiency, atmospheric or training conditions, or related to equipment.

Classification of sports injuries (Zamfir, 2006):

1. Macrotrauma
2. Microtrauma
3. Chronic disease

4. Hyper-functional disorders of the musculoskeletal system as localised forms of overtraining or overload

One of the main limiting factors of sports activities is the level of exercise tolerance by the support system. This tolerance varies from one football player to another, and an effort considered appropriate for one may be inappropriate for the other.

Speed is developed through exercises that can be performed at maximum speed or close to it. Speed should be perfectly mastered in technical terms and dosed so that the occurrence of fatigue does not reduce it. Improving the speed of a technical element is conditioned by a large number of repetitions but this can lead to stagnation (speed barrier). This blockage affects all levels but the means of combating it are different, depending on players' skills.

Whatever the category of athlete, it should be mentioned that: there is no relationship between reaction time and the ability to run fast; the ability to accelerate is relatively independent of the ability to run at a constant speed; speed transfer occurs only when performing movements whose coordinates are similar (Stoica, 2000).

Being genetically programmed (inherited) rather than acquired, speed is quite impractical and depends on many factors (Stoica, 2000):

- physiologically, the mobility of nerve processes, the rapidity of the transition of motor nerve centres from the state of excitation to the state of inhibition and vice versa:
- excitability of sensory and motor nerve pathways;
- muscle excitability;
- muscle ATP content (biochemical basis of speed quality);
- speed of ATP dissociation under the influence of nerve influx;
- mental factors;
- capacity for mental mobilisation;
- ability to focus attention;
- involvement of analysers in the sensation of advancement and the real perception of the movement speed;
- other motor qualities (muscle strength and neuromuscular endurance);
- technique of the motor act;
- anthropometric parameters;
- men and women have approximately equal follicles that are proportional to stature;
- frequencies are similar.

Although the speed factor is generally considered a gift that can be increased very little through training, sprinting can progress even in adulthood by improving other factors, but strength is the most important one. Among the speed components, we should not forget the acceleration factor, which must be related to the speed of movement but against resistance.

The study by Haugen et al. (2018) shows that differences in sprint mechanical properties vary from small to very large. All data obtained provide a holistic picture of the strength-speed-power continuum in sprint football players and serve as useful background information when diagnosing individual players and prescribing training programmes.

Another research confirms that performing specific exercises for explosive power, sprinting and changes of direction can stimulate neural adaptation by improving the ability to play football (Fiorilli et al., 2020).

According to Reneker et al. (2019), performing sensorimotor exercises during eight global training sessions leads to the prevention of sports injuries.

Another study by Al Attar and Alshehri (2019), who analysed the effectiveness of injury prevention programmes in football players, found a 34% reduction in all injuries and a 29% reduction in lower limb injuries. These results were obtained from a meta-analysis. The combination of all previous meta-analyses into a single source in this paper has produced conclusive evidence that the risk of injury in football is reduced as a result of FIFA's injury prevention programmes.

Elerian et al. (2019) investigated the effect of including Nordic exercise as a post-workout on decreasing the initial, recurrent injury rates and their severity. Following this study, the authors concluded that the use of Nordic exercise as a prevention protocol was effective in reducing all hamstring injuries, with the greatest effect when used during pre- and post-training.

Implementation of exercises in football injury prevention programmes is essential for both coaches and players. A research compared the effects of implementing injury prevention programmes, especially the FIFA 11+ programme, among football coaches in Australia and Saudi Arabia. The study findings show that Australian coaches are more aware of injury prevention programmes and more accustomed to the FIFA 11+ programme than Saudi coaches. Even so, there is a gap between the coaches' knowledge and their actual practice. (Al Attar et al., 2018)

A study conducted in the UK indicates the main risk factors, which include reduced lower-limb and eccentric hamstring strength, proprioception and muscle imbalances. Also, the most used screening methods were joint range of motion, jump tests, video functional analysis and single-leg squats. The most important means used included: endurance, flexibility and agility development, plyometrics and balance training. These means were applied once or twice a week during warm-ups or independent workouts. The conclusions specify that the frequency and type of training used may be insufficient to trigger an adequate stimulus to address relevant risk factors based on current recommendations. (Read et al., 2018)

The research conducted by Rusciano et al. (2017) shows that injury prevention in football players is often viewed from a physical, tactical, biomechanical and metabolic perspective, but psychophysiological adaptation, resilience and the level of technical execution are also fundamental. The above authors have implemented a new training method with an integrated autonomic effect called Neuroplus biofeedback, which aims to improve resilience, visual attention and injury prevention. The analysis of this research shows a significant improvement in physiological adaptation, recovery after training and injury prevention.

One of the largest studies conducted on 465 football players shows the effects of static stretching versus dynamic stretching on injury prevention after performing warm-up. The study is completed without proving a significant difference between static and dynamic stretching. Finally, it concludes that static stretching does not offer additional benefits to dynamic stretching for injury prevention prior to exercise. (Zakaria et al., 2015)

According to Owen et al. (2013), injuries may vary throughout a season. The researchers investigated football players in the Scottish Premier League and European competition, concluding that a multicomponent training programme for injury prevention may reduce the number of muscle injuries during a season but may not be appropriate to reduce all injuries.

The term speed includes three elements: reaction time, movement frequency per time unit and travel speed over a certain distance. The correlation between these three factors determines performance in a speed exercise. (Stoica, 2000)

In football, speed is classified into two types: general and specific. General speed is the ability to quickly perform any type of movement, while specific speed involves the ability to perform an exercise or skill at a certain speed. A runner does not immediately reach maximum speed but only after accelerating at least 30 meters after the start and continuing like this up to 80 meters (Blejan, 2019).

Speed development is influenced by numerous specific factors including heredity, reaction time, the athlete's ability to overcome an external resistance, technique, power of concentration and muscle elasticity.

Compared to strength and endurance, which athletes without extraordinary talent can significantly improve if they train properly, speed is determined by heredity, requiring more native talent. Consequently, the mobilisation of nervous processes, the rapid alternation between excitation and inhibition and the ability to regulate the neuromuscular coordination system may result in reduced motor frequency.

The property of skeletal muscle is a limiting factor of the speed potential. This reflects the constitutive difference and the proportion of slow (red) and fast (white) fibres, which contain a lower number of red pigments and have a slightly lighter appearance.

Fast (white) fibres contract quicker than red fibres, which is a big advantage for a sprinter. The final maximum speed is limited by the intrinsic speed of muscle tissue, suggesting that heredity is an important factor in performing rapid movements.

Reaction time is also inherited. It represents the time between exposure to a stimulus and the first muscle reaction or the first movement performed. Reaction time is a determining factor in most sports, and athletes can improve it through proper training. The reaction time to a visual stimulus is shorter in trained individuals compared to untrained individuals.

Speed, movement frequency and reaction time are often a function of the technique. Acquiring an effective form promotes the rapid execution of a skill by shortening the levers, correctly positioning the centre of gravity and efficiently using energy.

Muscle elasticity and the ability to relax agonist and antagonist muscles are important in obtaining high movement frequency and mastering a correct technique.

Joint mobility is an essential element for reaching high range of motion in any sport that requires fast running. Consequently, it is necessary to follow a daily mobility training programme, especially for the ankles and thighs.

The latest international studies show that photocell-controlled sprinting over a 50-meter distance at an intensity of more than 95% of the player's maximum potential decreases the risk of injury during a match. This is due to the fact that there are weekly competitive microcycles in which, through the chosen exercises or just by the nature of the position played, many players do not experience this scenario during training but they are fully faced with it during a match. For example, a central defender is often put in this position during a match, more precisely when participating in an offensive corner, with the opponent quickly recovering the ball and triggering the counterattack, which forces that player to cover the distance to their own field at maximum speed and do everything possible to stop this action. If the defender is not prepared for this scenario, there is an enormous risk of injury during the match. (Beato & Drust, 2020)

In this research, we started from the following hypothesis: performing photocell-controlled sprinting at an intensity of 95% during training reduces the risk of injury.

## Methodology

*Participants*

Participants in this study were football players aged 18-30, with over 10 years of experience.

*Device*

Electric photocells are the most accurate way to assess speed in all its forms. This device is represented by 3 photocells, an antenna for transmitting information and a laptop. The cells are positioned on the support at approximately 60-100 cm from the ground so that they can record the athlete's movements. This equipment provides real-time data for each player.

*Procedure*

The proposed protocol starts with determining each player's maximum potential over the distance of 50 meters. The protocol was applied on the 8th day of training, thus eliminating any risk of injury and ensuring that the player is prepared to exercise at maximum intensity. Each player is entitled to three attempts with an active 3-minute break between repetitions, during which they have to maintain their warm-up level. The best run is recorded, taking it as a 100% reference point. From this percentage, the running time corresponding to the 95% intensity is calculated. The protocol was implemented for 20 field players.

The research continued during each competitive week when the microcycle dynamics allowed it. In the microcycles with less than 4 days between matches, we did not use this "training" because we thought that players were not at their maximum potential to perform maximum efforts and that it did not make sense because the next game was very close. For this scenario, the athletes who did not play performed the "training" the day after the game.

How to work: Speed running was performed 72 hours after the end of the match in order to make sure that the players were prepared for this effort, in neuromuscular terms.

After a 10-minute warm-up that always includes the same exercises, the players perform a 10-m sprint followed by a 2-minute break. A 30-m sprint is also followed by a 2-minute break. Then, a 50-m sprint is performed as preparation for what follows. We make sure that all players are ready for the 50-m sprint as close as possible to their maximum potential.

The sprint is initiated at a distance of 50 cm behind the starting line, and the start is individual; the first photocell (at the start) starts the timer when the player passes in front of it. After crossing the finish line (photocell finish), the software instantly shows at what intensity the player ran according to their maximum potential. Each player had an individual token. If a player's running intensity has exceeded the 95% intensity of their maximum potential, that player does not have to perform the next run because the goal has been met. If the intensity was below 95%, the player has to perform one or two more runs until achieving the goal of the

exercise. If one of the players runs at a higher intensity than the one provided in the initial protocol, that run is taken as a reference point and represents 100% henceforth.

These exercises must be performed throughout the training period, our study intending to demonstrate that the game activity is the reference point when building training sessions, and each game scenario has to be simulated or practised in the training process.

## Results

The number of injured players returning to the 2018-2019 championship and the statistical interpretation of data are shown in Table 1 and Table 2.

Table 1. *Injured players returning to the 2018-2019 championship*

| Subjects | Minor injury (muscle contracture, myositis, tendonitis) | Medium injury (fibrillar microtrauma) | Major injury (fibrillar rupture, fracture, major joint/ligament problems) |
|---|---|---|---|
| S1 | | 1 | |
| S2 | | | 1 |
| S3 | | | |
| S4 | | | |
| S5 | 2 | | |
| S6 | | 2 | |
| S7 | | | |
| S8 | 3 | | |
| S9 | | | |
| S10 | | 1 | |
| S11 | | | 2 |
| S12 | | | |
| S13 | | | |
| S14 | 2 | | |
| S15 | 1 | | |
| S16 | 1 | | |
| S17 | | 1 | |
| S18 | 1 | | |
| S19 | 2 | | |
| S20 | | 1 | |
| Total | 12 | 6 | 3 |

Table 2. *Statistical interpretation of injuries after returning to the 2018-2019 championship*

| Statistical interpretation | Minor injuries (muscle contracture, myositis, tendonitis) | Medium injuries (fibrillar microtrauma) | Major injuries (fibrillar rupture, fracture, major joint/ligament problems) |
|---|---|---|---|
| Arithmetic mean | 0.60 | 0.30 | 0.15 |
| Standard deviation | 0.75 | 0.44 | 0.70 |
| Coefficient of variation | 0.44 | 0.37 | 0.47 |

According to the statistical analysis of the first injury assessment after returning to the 2018-2019 championship, the average value of minor injuries is 0.60, the average value of medium injuries is 0.30, and that of major injuries is 0.15. The coefficient of variation has values between 0.37 and 0.47. The obtained data show that the spread is high and the average has low representativeness.

The number of injured players in the 2018-2019 championship round tournament and the statistical interpretation of data are shown in Table 3 and Table 4.

Table 3. *Injured players in the 2019-2020 championship round tournament*

| Subjects | Minor injuries (muscle contracture, myositis, tendonitis) | Medium injuries (fibrillar microtrauma) | Major injuries (fibrillar rupture, fracture, major joint/ligament problems) |
|---|---|---|---|
| S1 | 1 | | |
| S2 | | | |
| S3 | 1 | | |
| S4 | | | |
| S5 | | 1 | |
| S6 | | | |
| S7 | | | |
| S8 | | | 1 |
| S9 | | | |
| S10 | 1 | | |
| S11 | | | |
| S12 | | | |
| S13 | | 1 | |
| S14 | | | |
| S15 | 2 | | |
| S16 | | | |
| S17 | 1 | | |
| S18 | | | |
| S19 | | 1 | |
| S20 | 1 | | |
| Total | 7 | 3 | 2 |

Table 4. *Statistical interpretation of injuries in the 2019-2020 championship round tournament*

| Statistical interpretation | Minor injuries (muscle contracture, myositis, tendonitis) | Medium injuries (fibrillar microtrauma) | Major injuries (fibrillar rupture, fracture, major joint/ligament problems) |
|---|---|---|---|
| Arithmetic mean | 0.35 | 0.15 | 0.05 |
| Standard deviation | 0.40 | 1 | 0.70 |
| Coefficient of variation | 0.34 | 0.43 | 0 |
| Mean difference in the 2018-2019/2019-2020 championship round tournament | -0.25 | -0.15 | -0.10 |
| p-value | | 0.05 | |

Regarding injury assessment in the 2019-2012 championship round, the average value of minor injuries is 0.35, the average value of medium injuries is 0.15, and that of major injuries is 0.05. A decrease in injuries is noted after applying the means of a sprinting-based protocol.

Following the application of the t-test, the p-value is 0.05, which confirms the research hypothesis.

## Conclusion

The approach to traumatology in the game of football is multifaceted and needs much more advanced research in the medium and long term. Most studies show that injury prevention among football players is often viewed only from a physical and tactical perspective.

In the current study, we have managed to demonstrate that the application of means requiring high (maximum) intensity can reduce the risk of injury during the championship.

The training design should be done by building each game scenario and should be simulated or practised in the training process.

Implementation of specialised training programmes in the training of players participating in our research has led to a reduction in the number of muscle injuries throughout a season.

Statistical results confirm the research hypothesis that performing photocell-controlled sprinting at an intensity of 95% during training reduces the risk of injury.

## Authors' Contributions

All authors have equally contributed to this study.

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