SOCCER FIELDS IN SYNTHETIC AND NATURAL GRASS: A COMPARATIVE STUDY ON MUSCULAR INJURIES OF THE LOWER LIMB

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Abstract
Research has shown that the surface of artificial turf soccer fields has caused more injuries than the natural turf surface in amateur footballers. The objective of the research was the detection of muscular injuries of the lower limb on a sample of one hundred senior athletes aged between 40 and 50 with an average age of 44.7 (sd +/- 4.26) for an average weight of 77.4 (range 68-89 kg.) and an average height of 178.3 cm (range 168- 187 cm). Study was conducted for eight months, from September 2018 to April 2019, on athletes divided into four teams, each composed of twenty-five members, who carried out four months of training and competitions on each surface and the results showed a greater percentage of accidents on artificial turf pitches compared to natural turf pitches. Yellow and red teams, which carried out training for the first four (September – December) on fields in synthetic turf, have shown, in the following four months (January - April), an improvement in performances in terms of continuous attendance during the official races. The monitoring was carried out by detecting the number and type of muscular injuries, classified according to the time of absence from sports activity, of the lower limb considering the conditions that induced a player to leave the field, therefore to interrupt the activity, which had an impact on participation in training and matches. The data collection relating to the number of muscular injuries of the lower limb, showed that, in total, the athletes sample suffered 67 muscular injuries (of which 5 relapses). These events mostly occurred during training (about 73%) compared to competitions (about 27%). There were 22 minor injuries (contractures - around 33%), 33 moderate injuries (stretches - around 50%) and 12 serious injuries (tears - around 17%).

Key word: *Soccer, Synthetic grass, Natural grass, muscular injuries.*

Introduction

The use of artificial turf fields has been spreading for decades. The choice of synthetic grass (Cheng, Reinhard, 2014), which for its quality and appearance is similar to a real natural lawn compared to natural grass occurs for several reasons, above all of for practical and economic ones, and among these reasons a better maintenance and different deterioration more hours to use it all over the year, sustainability in terms of pollution and resistance to climate change. It is important to point out that synthetic grass can offer more regular soils, without holes, less rigid, (Ekstrand, Tropp, 1990) therefore, less harmful to the health of the athletes even if some studies show, for synthetic fields, an incidence of injuries similar or even greater than the other fields (McGhie, Ettema, 2013; Montesano et al., 2016). Numerous are the sports that use fields in synthetic grass (hockey, american football, tennis, etc) but the soccer is one of the most widespread team sports in the world practiced by millions of people, both male and female. Soccer fields have different surfaces and those with natural grass, synthetic grass and, in some cases, fields without grass are also used. The game of football, both at a competitive and recreational level, is characterized by various high intensity, intermittent and continuous activities (Hoy et al., 1992; Inklaar, 1994; Montesano et al., 2019) (accelerations, decelerations, leaps and landings, changes of direction) so that the surface of race fields, natural grass and / or synthetic grass, is one of the significant factors affecting the service quality and the number and type of accidents. Athletes, both in competitive and amateur competitions, perform complex actions during training that are seldom repeated in the race due to variables, often uncontrolled, among which the surface of the competition fields is decisive (Taimela, Kujala, Osterman, 1990; Mazzeo & Volpe, 2016; Montesano et al., 2018). Furthermore the efficiency of the motor gesture is subject not only to the intensity of the performance, but also to the age, physical and mental health of the athlete, also in terms of health costs and lost working hours, as well as meteorological conditions, we understand the importance of using a playground with a balanced and well-maintained surface. The risk factors of inadequate performance and injuries (Malkogeorgos et al., 2011; Mazzeo et al., 2015), are therefore not only related to the incorrect execution of technical gestures (landings, leaps, sprints, changes of direction, torsions) but to the combination of various factors, intrinsic and extrinsic, such as inappropriate surfaces or unsuitable shoes (Ford et

al., 2006), which determine specific injury patterns (Hagglund, Walden, Ekstrand, 2006). In fact it is found that more injuries occur due to overloading in players with a higher average age, while injuries that characterize younger players are often due to trauma or contact, and some kinds of injuries, such as muscle injuries, mainly concern certain age groups compared to others.

Physical activity promotion represents a front-line issue in sport prescription among subjects aged between 40 and 50.Several studies have demonstrated the effectiveness of physical activity in reducing risk factors (Juonala et al., 2011) for acute and chronic diseases (i.e. cardiovascular diseases, musculoskeletal diseases, and others). Indeed, positive results about some cardiovascular and metabolic parameters and in decreasing inflammation processes have been demonstrated in childhood (Sirico et al., 2018;) and in adults (Abramson, Vaccarino, 2002; Biffi et al., 2018; Costagliola et al., 2009). To this scope, several studies reported increasing attention to prescription of physical activity and its promotion in different settings, such as workplace (Biffi et al., 2018) and in different subgroup of populations, such as subjects with different forms of disability (Spera et al., 2019). Nevertheless, the amount of physical activity among older is low, missing often to reach the thresholds of physical activity defined by international guidelines in this age group. It is necessary to promote participation in team (Di Onofrio, Montesano, Mazzeo, 2019) sports, even to improve socialization, personal skills, and health.

Table 1. Intrinsic and extrinsic factors .

Intrinsic factors	**Extrinsic factors**
Age	Type of shoes used
Muscle strength	Shin Guards
Joint stability/instability	Activity level
Symmetric/Asymmetry of muscle strength between the limbs	Tape and PC
Previous injuries	Exercise load
Ligamentous laxity	Positions and game roles
Proprioceptive abilities	Game Fouls
Ability to adapt to different surfaces	
Inappropriate fatigue and cures / treatments	

Considering what we have showed up to this point, a eight-month study was carried out (September 2018 - April 2019), on a sample of one hundred athletes divided into four teams (twenty-five for each team) , participating in an amateur football league at 11.

Each team carried out training (two weekly sessions) and competitions for four months on artificial turf fields and four months on natural grass fields to check any differences in performance, in terms of attendance at races, the number and type of accidents, paying more attention to the injuries concerning the lower limb muscle type, doms (delayed onset muscular soreness).

Methods

Participants
The participants were one hundred [13] senior male athletes, aged between 40 and 50 (Meyers, Barnhill, 2004) who had to play a number of races between 20 and 24. The players were members of clubs registered for amateur football championships and had passed the medical examination to be suitable to perform competitive activities. The research team, coordinated by the author, led the study with four companies, called yellow, green, red and blu, for the colour of the uniforms, each consisting of twenty-five players. The average age of the sample was 44.7 (sd +/- 4.26) with an average weight of 77.4 (range 68-89 kg.) and an average height of 178.3 cm (range 168- 187 cm).

Objectives
The research target was to verify the number and type of injuries of athletes, considering the number of appearances in official matches and the participation in training on different playing surfaces consisting of natural grass and / or synthetic grass. The monitoring was carried out by detecting the total average of attendance of the athletes for each team, the total average of the conditions (injury in training and / or in the race) that induced a player to leave the field, therefore to interrupt the activity, which had repercussions on participation in training and matches (Hocking et al., 2013). Injuries were also classified (table 2) based on the time of absence from sporting activity.

Table 2. Injuries classification.

<15 gg	Mild injury
between >15gg , < di 45 gg	Moderate injury
>45 gg	Serious injury

The research was conducted through an observational method and computerized data surveys, from September 2018 to April 2019. The four companies followed the same training program (June, 2011), drawn up jointly by the technical staff, consisting of two training sessions a week, characterized by athletic, technical and tactical exercises. The quality of the training is certainly an important factor that can affect on the onset of problems during a season and indicates how the absence of muscle injuries is directly linked to specific programs of pre-activity heating and correct use of stretching technique.

The training was carried out both on natural grass pitches and artificial turf fields for about four months for each type of surface. From September to December the yellow and red groups trained on the synthetic grass pitch while from January to April they made use of the natural grass pitch. The green and blue groups, on the other hand, carried out training on the natural grass pitch from September to December and the other four months, from January to April, on the synthetic grass pitch. The analysis also considered that the execution of technical gestures was subordinated not only to the surface but also to the physical conditions of the athletes and to the climatic conditions. It is clear that a technical gesture carried out on a natural grass field in constant sunshine and temperature is comparable to the one on a synthetic grass field. The situation is different if the weather conditions are disadvantageous (wind, rain, etc.). The ball bounce is different, the ground slipperiness is significantly different, the difficulty coefficient to make a stop or a passage is variable.

Materials and resources

- Soccer ball n.5
- Stadium
- Cones
- Small tools
- PC
- Grid

Results

During the eight months of manual and computerized detection, the sample of the four teams of senior athletes showed a total (Graphic 1) of 67 muscular injuries (equal to 90.55% of the total) and 7 traumatic injuries (distortions, fracture, etc. equal to 9.45% of the total). Muscular injuries (5 of which relapsed) have impacted more the leg (lower part of the lower limb) with a percentage of 67% while those of the thigh (upper part of the lower limb) are approximately 33%. These events mostly occurred during training (about 73%) compared to competitions (about 27%). With reference to the classification (table 2), 22 minor injuries (contractures about 33%), 33 moderate injuries (approximately 50% stretches) and 12 serious injuries (approximately 17% tears) occurred mainly in the hamstring and calf (soleus and gastrocnemius). Eighteen players from the yellow group (table 3), suffered a total of twenty-two muscle injuries, with three relapses. Sixteen players of the red group suffered a total of seven muscle injuries (table 3), with one relapse.

Table 3. Lower limb injuries yellow and red groups.

		yellow groups			**red groups**		
injuries			**injuries**			**time**	**T**
*	**	t	*	**	t		
3	4	7	1	4	5	< 15 gg	12
4	6	10	3	6	9	>15 < 45 gg	19
2	3-2***	5		3 – 1***	3	> 45 gg	8
9	13	22	4	13	17		39

legend = *sl (superior leg) – **il (inferior leg) –*** r (relapse)–t (group total) - T (Total)

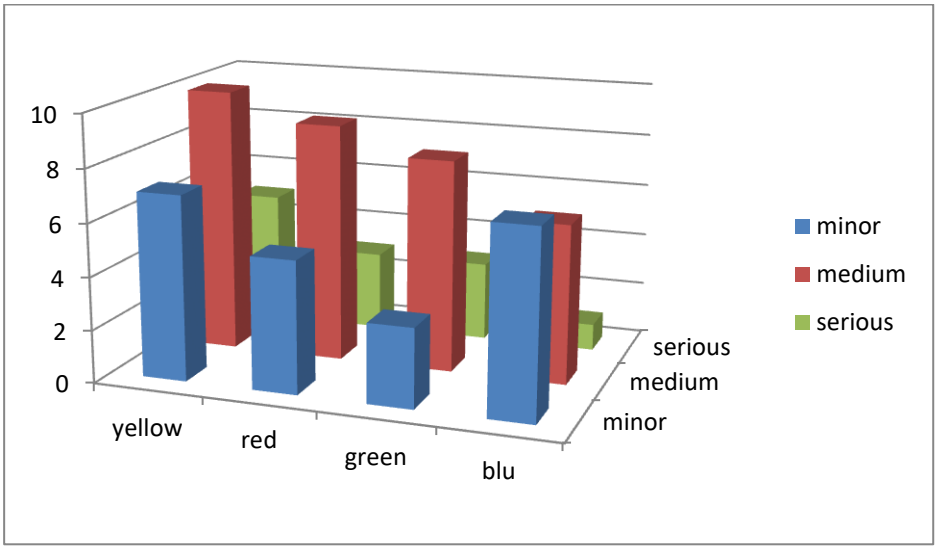
Twelve players in the green group suffered a total of fourteen muscle injuries (table 4), with two relapses.

Fourteen players of the blue group suffered a total of fourteen muscle injuries (table 4).

Table 4 - Lower limb injuries green and blue groups.

		green groups			**blue groups**		
injuries			**injuries**			**time**	**T**
*	**	t	*	**	t		
2	1	3	2	5	7	< 15 gg	10
2	6	8	3	3	6	>15 < 45 gg	14
	3-2***	3		1	1	> 45 gg	4
4	10	14	5	9	14		28

legend = *sl (superior leg) – **il (inferior leg) –*** r (relapse) –t (group total) - T (Total)



Graph 1. Total injuries trend.

The final survey showed a numerical increase in the number of injuries that occurred during training, compared to those of the races, on the synthetic grass pitch (about 60%), with a prevalence in the first period (September - December).

Discussion

The aim of the research was to verify the onset of muscle injuries of the lower limb on 2 types of surfaces: natural and synthetic. The data confirmed that the synthetic grass significantly increases the injuries of the back of the thigh and the calf compared to those on natural grass. The sample of one hundred athletes carried out the same type of training (Mazzeo et al., 2016), disputed the same number of competitions and the medical-technical staff have checked the correct food diet (Ionescu, et al., 2014; Di Onofrio et al., 2019) and have evaluated the relative impact of drug supplementation among athletes included in the study, recording data about their consumption. Indeed, even if drug supplementations is common among younger (Sirico et al., 2018) the use of nutritional supplements and drugs to enhance performance is a relevant problem among older amateur and professional athletes too (Mazzeo, Santamaria, Montesano, 2019). No subjects included in the study used nutritional supplements during the study period. The anatomical and functional improvements, as well a good vision is essential for athletes, In particular, free radicals and oxidized lipoproteins in the aging retina are major local triggers of parainflammation, which is the chronic status responsible for the initiation and progression of age-related chorioretinal damage (Schenone et al., 2003). Statistical references report that muscle injuries occupy a large part of the rehabilitation process and, since it is a study relating to amateur football over 40, the social impact in terms of lost working hours (Montesano, 2018) and the duration of disability should not be overlooked. (19). Some studies have emphasized that muscle injuries are more frequent in the medium-high age, ours is 44.7 years, compared to traumatic injuries significantly detectable in the lower middle age (Hawkins, et al., 2001) but the climatic variables are to be considered. Nevertheless, the physical activity should not increase the risk of injuries in these patients, like musculoskeletal injuries reported in this paper. Several preventive activates should be carried out before and during execution of physical activity (Mazzeo, 2016). In our cohort of subjects, each subject was screened for cardiovascular problems according to available procedures and guidelines (Mazzeo et al., 2019). Nevertheless, the prevention of musculoskeletal injuries is a multifactorial action that requires some modification of the sport equipment and facilities, i.e. the type of field or the type of shoes adopted. The results of the present study highlights that field characteristics play a relevant role in the occurrence of lower-limb musculoskeletal injuries and should be considered as modifiable factors in soccer players aged between 40 and 50.

Conclusions

The study carried out has been carried out with the purpose of protecting the health of the individual, who can enjoy rewarding experiences through sport by improving organic functions, physical appearance, self-esteem and the development of skills and collaborative relationships. Few studies have been found in the literature concerning the theme of the comparison between the playing surfaces proposed by this research and expects the development of other studies on this subject always considering that the purpose is the well-being of the individual through a healthy sports activity (Mazzeo, 2016b). The study methodology adopted made it possible to make a comparison between four teams, each composed of twenty-five athletes, who carried out both training and

competitions on both surfaces, albeit at different times of the year. The critical factors (table 1) relating to the reliability of the data, in addition to the atmospheric variability determined by the different training periods of the four teams, can be identified in the scarce and not immediate adaptation of the athletes to the different surfaces with the consequent difficulty in developing and highlight certain technical-tactical skills. Another variable not to underestimate is the choice of clothing and in particular footwear. In fact, specialists in the field recommend certain types of synthetic grass while the indications for natural grass are a wider spectrum with greater indexes of flexibility and adaptation.

Results of the research, in fact, have emerged a greater adaptability of the sample on surfaces in natural grass, compared to those in synthetic grass, witnessed by a less number of muscular injuries. Therefore it is clear that the playing surface a significant variable that determines variability in performance and that significantly affects the type of injuries.

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Conflict of Interest
The authors declare that there is no conflict of interest.

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