EFFECTS OF ARTIFICIAL TURF AND NATURAL GRASS ON PHYSICAL AND TECHNICAL PERFORMANCE OF PROFESSIONAL SOCCER PLAYERS

EFECTOS DEL CESPED ARTIFICIAL Y LA GRAMA NATURAL SOBRE EL RENDIMIENTO FÍSICO Y TÉCNICO DE LOS JUGADORES PROFESIONALES DE FÚTBOL

Juan Carlos Ávalos-Guillén [1,2]
Randall Gutiérrez-Vargas (0000-0003-4187-3484) [1,2]
Gerardo Araya-Vargas [2]
Braulio Sánchez-Ureña (0000-0001-8791-6836) [1,3]
Juan Carlos Gutiérrez-Vargas[1] (0000-0002-0689-6771)
Daniel Rojas-Valverde (0000-0002-0717-8827) [1,2]

[1] *Centro de Investigación y Diagnóstico en Salud y Deporte, Escuela Ciencias del Movimiento Humano y Calidad de Vida, Universidad Nacional*
[2] *Escuela Ciencias del Movimiento Humano y Calidad de Vida, Universidad Nacional, Costa Rica*
[3] *Programa Ciencias del Ejercicio y la Salud, Escuela Ciencias del Movimiento Humano y Calidad de Vida, Universidad Nacional, Costa Rica*
drojasv@hotmail.com

Abstract

The purpose of this study was to compare the effect of artificial turf (AT) and natural grass (NG) on the physical and technical performance of professional soccer players. A total of 17 healthy male soccer players (24.0 ± 4.1 years, height 174 ± 6.1 cm; body weight 73.4 ± 6.3 kg; body fat % 14.2 ± 2.3; VO2max 55.5 ± 5.3 ml/kg/min) from a Costa Rican Professional Soccer League club were subjected to different tests in both types of surfaces (technical test, agility test, repeated sprint ability test, and a small-sided game [8 minutes, 32 x 32 meters, 5 vs. 5]). Players were monitored using a GPS in two sessions, separated by 48 hours, during the club's pre-season. There were no significant differences between the two types of surfaces for the technical, agility, and repeated sprint ability tests. The physiological and kinematic variables analyzed during the small-sided game presented significant differences in average heart rate (NG = 168.5 ± 8.8, AT = 154.8 ± 11.8, $p < .001$), maximum heart rate (NG = 183.2 ± 8.3, AT = 175.9 ± 10.4, $p = .02$), body load (NG = 34.3 ± 11.2, AT = 30.5 ± 11.4, $p = .03$), and total impacts (NG = 230.1 ± 89.5, AT = $194. 8 \pm 86.4$, $p = .03$). It is concluded that playing on the natural grass surface caused more impact on physiological and perceived body load in players. In the case of technical variables, it is concluded that there were no statistically significant differences between the two types of surfaces ($p < 0.05$).

Keywords: soccer, physical tests, exercise, training.

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Gerardo Araya-Vargas, Braulio Sánchez-Ureña,
Juan Carlos Gutiérrez-Vargas y Daniel Rojas-Valverde

Resumen

El propósito de este estudio fue comparar el efecto de la superficie artificial (AT) y la natural (NG) sobre el desempeño físico y técnico de los jugadores profesionales de fútbol. Un total de 17 jugadores de fútbol en buen estado de salud (24.0 ± 4.1 años, peso 174 ± 6.1 cm; peso corporal 73.4 ± 6.3 kg; porcentaje de grasa corporal 14.2 ± 2.3; VO2max 55.5 ± 5.3 ml/kg/min) de una liga profesional de fútbol de Costa Rica realizaron diferentes pruebas en ambas superficies (prueba técnica, agilidad, sprints repetidos y juego en espacio reducido [8 min, 32x32 m, 5 vs. 5]). Los jugadores se monitorearon con un GPS en dos sesiones, las cuales estuvieron separadas por 48 horas, durante la pretemporada del club. No se encontraron diferencias significativas entre ambas superficies de juego en cuanto a desempeño técnico, agilidad y sprints repetidos. Existieron diferencias significativas en las variables fisiológicas y cinemáticas analizadas durante el juego en espacio reducido en cuanto a frecuencia cardiaca promedio (NG = 168.5 ± 8.8, AT = 154.8 ± 11.8, p <.001), frecuencia cardiaca máxima (NG = 183.2 ± 8.3, AT = 175.9 ± 10.4, p =.02), carga corporal (NG = 34.3 ± 11.2, AT = 30.5 ± 11.4, p =.03) e impactos totales (NG = 230.1 ± 89.5, AT = 194. 8 ± 86.4, p=.03). Se concluye que practicar en terreno natural ocasiona mayor impacto en los jugadores en cuanto a la carga corporal y fisiológica. En el caso de las variables técnicas, se concluye que no hubo diferencias estadísticamente significativas entre los dos tipos de superficies (p <0.05).

Palabras clave: fútbol, pruebas diagnósticas, ejercicio, entrenamiento.

Introduction

Soccer has become a phenomenon with a great social impact. According to Gallardo (2009), over 245 million people play soccer worldwide. Likewise, the Fédération Internationale de Football Association (FIFA,2006a) Big Count for 2006 claimed that 4% of the World's population actively participated in this sport. As a response to this large-scale phenomenon, soccer fields have proliferated during the last decade.

According to Gallardo, Felipe, Burillo, and Gallardo (2010), soccer fields have become one of the most widely used sports facilities, both for competitive and recreational purposes (Gallardo, Sánchez, Gallardo, Felipe, and Burillo, 2013).

Developments in the world of soccer such as material resources – specifically playing surfaces – have evolved through time, depending on aspects such as climate, use, and/or socioeconomic context. Different types of fields can be currently found, including natural grass, soil, artificial turf, and even mixed fields (Díez and Burillo, 2012; Sánchez-Sánchez et al., 2016).

Artificial turf is a surface that is intended to imitate the properties of natural grass, seeking to solve problems such as maintenance costs and care associated with natural grass fields. This type of surface has proven to be promising for sports, being used in diverse sporting disciplines (Gallardo, 2009).

Based on data from the Spanish Soccer Federation, Sanchis, Rosa, and Magraner (2010) indicated that there has been an enormous increase in the number of soccer fields with artificial turf, especially due to the technological developments that have taken place since they were first used. In fact, in 2004 FIFA included artificial turf as a playing surface in official competitions.

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According to Sánchez-Sánchez et al. (2016), in spite of the massive proliferation of soccer fields, few studies analyze the influence of the different types of playing surfaces in soccer since there are no tests to make the comparison. Hernández, Romero, and Vaca (2013) also indicate that, as of yet, there are no specific studies to contribute in this area.

One of the few investigations available is the one conducted in Spain by Díez and Burillo (2012). They analyzed three types of surfaces (soil, natural grass and artificial turf), adapting different types of tests to soccer and found that in agility tests ("a quality that allows body control in space, with adequate precision and speed", Cañizares, 2011, p. 65), significant differences were observed between natural grass (where lower times were obtained) with respect to the other two types of surfaces. However, no significant differences were found between natural grass and artificial turf in the fatigue index. This data suggests that a natural grass surface is more favorable to physical and technical performance.

A study conducted by Andersson, Ekblom, and Krustrup (2008), which examined movement patterns, ball skills, and impressions of elite Swedish soccer players during competitive matches on artificial turf and natural grass indicates that there were no significant differences between these types of surfaces in terms of overall distance covered (10.2 km vs. 10.9 km) or high-intensity running (1.86 km vs. 1.87 km). Players, furthermore, reported a negative impression of ball control and greater physical effort on artificial turf, as opposed to natural grass. It was concluded that playing pattern and technique were similar during matches on both artificial turf and natural grass surfaces.

The studies by Díez and Burillo (2012) and Andersson, Ekblom, and Krustrup (2008) coincide that there are no significant differences in physical performance and technique when playing on different types of surfaces and also show that the natural surface is perceived as more favorable by players.

Given the existing dispute on the effects of artificial turf on soccer players' performance, the highest governing body of this sport worldwide, FIFA, conducted a study in 2006 and analyzed two matches of the Union of European Football Associations (UEFA) (one on artificial turf and the other one on natural grass). The study concluded that artificial turf did not affect the development of the match, which showed clear similarities with the match on natural grass. Data suggested that players on artificial turf controlled the ball more easily, and made a larger amount of effective passes. Although it would seem that artificial turf improved the development of the match, this data contrasted with the overall negative perception players have of this type of surface(FIFA,2006b).

In Costa Rica there has been a proliferation of soccer fields with artificial turf. According to Jiménez (2009), fields with artificial turf had gained ground rapidly in the country, with four stadiums using artificial turf at the time of the study and 6 teams in the process of installing it during the course of the year.

The decision of changing to artificial turf took place without the support of scientific studies providing adequate criteria to ensure players' safety and development of games, in addition to

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the lack of justification for the financial investments made. Further investigations should focus more on this issue, since, as previously discussed, physical and technical performances are not jeopardized, and may even be favored in some cases, by artificial turf. Given the problems presented, the objective of this study was to compare the effect of the type of surface, whether artificial or natural, on the physical and technical performances of professional soccer players.

Methods

Participants

Seventeen healthy professional male soccer players, with a mean age of 24.0 ± 4.1 years, height of 174 ± 6.1 cm, body weight of 73.4 ± 6.3 kg, body fat of $14.2 \pm 2.3\%$, and $VO_{2\,max}$ of 55.5 ± 5.3 ml/kg/min, who trained regularly between 4 and 5 times a week and were part of a Costa Rican Professional Soccer League.

Ethical Statement

All subjects were informed of the details of the experimental procedures and the associated risks and discomforts. Each subject gave a written informed consent previously approved by the Academic Committee of the Sports Science Program from Universidad Nacional and based on the Declaration of Helsinki regarding biomedical research involving human subjects (18th Medical Assembly, 1964; revised in 2008 in Seoul).

Instruments and Materials

Participants were characterized based on measurements of aerobic capacity using equipment to measure oxygen consumption (VO_{2max}, VO_{2000}, measured using a MedGrapics® system, Minnesota, United States). Body weight was measured with an Elite digital scale, Series BC554, Tanita-Ironman®, Illinois, United States, with 0.1 kg sensitivity. A wall-mounted measuring rod was used to determine height. Body fat percentage was obtained based on dual absorptiometry using X Rays (General Electric enCORE 2011®, software version 13.6, Wisconsin, United States).

Technique was measured using the test described by Sans and Frattarola (1999), which consists of a series of activities involving different basic soccer techniques such as short pass, wall pass, ball control, long pass, and shot on goal, with scores ranging from 0 to 50 points, as shown in Figure 1.

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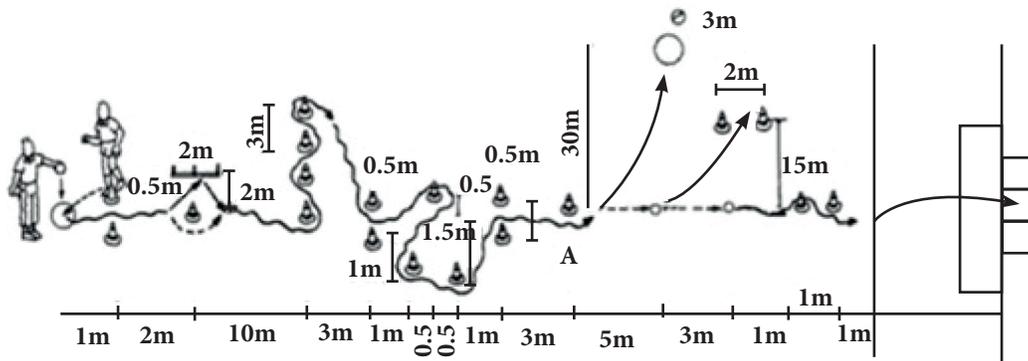*Juan Carlos Gutiérrez-Vargas y Daniel Rojas-Valverde*

Figure 1. Representation of technical test by Sans and Frattarola (1999).

The test described by Sans and Frattarola (1999) was used to measure players' agility on both surfaces, as indicated on Figure 2. Two sets of photoelectric cells were employed, as well as a Newtest Powertimer for Throwing Gate test, No. 10700®, (Oulu, Finland).
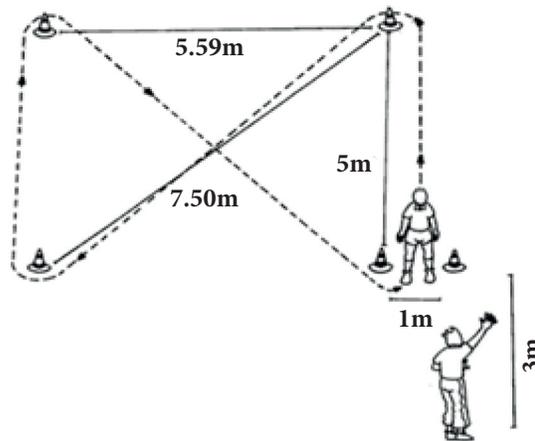

Figure 2. Representation of the agility test by Sans and Frattarola (1999).

The repeated sprint ability (RSA) test described by Díez and Burillo (2012) was used to measure the fatigue index. Kinovea 0.8.15 software was used to subsequently measure data obtained from this test, as implemented in sports biomechanical studies.

The technical test is 50 points, in which the higher the score the better the result, while in the agility test, the lower the time, the better the result. In the case of the RSA test, which

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measures the fatigue index of each player, the lower the value, the more ability the player has to maintain an anaerobic effort.

Small-sided games were also played for 8 minutes, with a pitch size of 736m² (activity based on Casamichana, Castellano, and Hernández, 2009), in order to analyze soccer techniques, such as goals, passes, and shots on goal of two teams on both types of surfaces. Small-sided games simulate, totally or partially, a soccer match, and are considered a highly valuable strategy to improve soccer players' performance (Sánchez, Yagüe, Fernández, and Petisco, 2014). Teams were randomly selected.

Global Positioning System (GPS) tracking from GPSports (SP PRO X II, 15 Hz; Canberra, Australia) was used to measure physiological variables. Validity and reliability of the GPS devices with different frequencies have been established by Edgecomb and Norton (2006) when evaluating different speeds in circuits of different lengths (r =.998, r=.989. r=.999).

The results obtained using GPS devices and actual distances measured with a measuring tape were highly correlated (r= .99). The GPS mean error was 4.8%, which showed moderate-to-high reliability (according to the study by Edgecomb and Norton, 2006). In addition, Barbero-Álvarez, Coutts, Granda, Barbero-Álvarez and Castagna, (2010) showed that measurements made with this equipment present a high correlation between maximum speed values and performance in the repeated sprint ability test (r^2= .87, p< .001; r^2= .94, p< .001). This instrument was used to quantify the variables of distance covered, average speed in meters per minute, average and maximum heart rate, impacts, accelerations, decelerations and body load.

Each individual's impacts were analyzed using Team AMS software, which records the amount and intensity of impacts above a 5 g threshold. These impacts, called performance stressor impacts, were categorized by Carling, Reilly, and Williams (2009) as follows: slight impacts (5 – 6 g), collisions and contacts with the field (6 – 6.5 g), moderate-to-strong impacts (6.5 – 7 g), strong impacts (7 – 8 g), very strong impacts (8 – 10 g), and severe impacts > 10 g).

A SONY high-definition camera, model HDV HDR-FX1E, was used to analyze technical actions in the small-sided games. A template created by Gutiérrez-Vargas et al. (2015) was also used to include variables such as number of goals scored, total passes, successful passes (those reaching the recipient), unsuccessful passes (not reaching the recipient), total fouls made and received, offsides, corner kicks, counter-attack moves, total shots on goal, direct shots on goal (aimed at the rival's goal), indirect shots on goal (rebounds from the rival's goal posts), and effective playing time (time during which the ball was in play). For the purposes of this study, only the variables of goals scored, positive passes, negative passes, and direct and indirect shots on goal were considered due to the characteristics of the small-sided games, obtaining qualitative information about differences in technical actions on the two types of surfaces for later analysis.

Tests on a natural surface were conducted in a field located in San Antonio de Belén while tests on artificial turf were on a field in the Central canton of Belén. This field is designed for high traffic and the surface is 55 mm thick. Turf was installed on sand and crushed rubber (FIFA 1 star) in 2008, with a use life of approximately 10 years. Both fields meet FIFA's regulatory measurements and provide appropriate conditions for playing professional soccer.

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Procedures

The present study was conducted at the beginning of the club's pre-season, in two sessions with a 48 hr rest in between. In addition, both sessions took place at the same time (8:00 AM) and players had to wear the same types of shoes and clothing.

The same warm-up exercises were conducted by the club's physical trainer in both sessions, followed by 20 minutes of practice to assimilate the technical and agility tests. The tests were then applied in the following order: 1) technical test, 2) agility test, and 3) RSA test (which consists of eight 30-meter sprints with 30 seconds of active rest between each repetition), concluding with a small-sided game (32 x 32 meters), 5 players on each side (the same 10 players in both sessions). This activity provided kinematic and physiological data measured using GPS; each small-sided game was recorded for further analysis using the template prepared by Gutiérrez et al. (2015) for technical actions of each team. The same procedure detailed previously was used in both sessions, on both natural grass and artificial turf.

Statistical Analysis

Descriptive statistics were used to present the characteristics of the samples and calculate averages and standard deviations. Data normality was evaluated using the Shapiro-Wilk test. In addition, the Student's paired t-test was used to compare dependent variables based on field surface (natural and artificial). Technical characteristics of the small-sided game on the different surfaces were also described, where relative differences were calculated by subtracting the results obtained on the artificial surface from the results obtained on the natural surface, and then expressed as a percentage of the result obtained on natural grass ((CA-CN) /CN), using the data obtained by each team in the template. SPSS (Statistical Package for the Social Sciences, IBM, SPSS Statistics, V 21.0 Chicago, IL, USA) was used. Significance for the decision making was $p < .05$.

Results

Table 1 shows averages obtained during the technical, agility, and RSA tests conducted in the different fields.

Table 1

Comparison of average values obtained in the technical, agility, and RSA tests on natural grass and artificial turf

Tests	mean ± S.D.		Sig.
	Natural grass	Artificial turf	
Technical test [pts]	12.9 ± 4.6	12.6 ± 2.9	.93
Agility test [s]	6.35 ± 0.13	6.43 ± 0.16	.10
RSA test (fatigue index)	4.74 ± 1.76	4.24 ± 1.62	.92

Note. All averages presented in Table 1 were obtained from n = 17 soccer players evaluated.

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Table 1 shows that no statistically significant differences were found in the results obtained from the technical test (p=.93), the agility test (p=.10), and the fatigue index (p=.92) evaluated on each type of surface.

Table 2 shows the average values of the physiological and kinematic variables measured using GPS in an eight-minute small-sided game.

Table 2

Physiological and kinematic variables in an eight-minute small-sided game in two different types of surfaces

Variables	mean ± S.D.		Sig.
	Natural grass	Synthetic turf	
Variables			
Average HR (heart beat/min)	168.5 ± 8.8	154.8 ± 11.8	<.001**
Maximum HR (heart beat/min)	183.1 ± 8.3	175.9 ± 10.34	.02*
Meters per minute	147.5 ± 9.8	147.2 ± 8.5	.52
Average speed (km/h)	8.9 ± 0.6	8.8 ± 0.5	.96
Total distance (m)	1 000.9 ± 98.8	1002.2 ± 107.8	.20
Distance (m) 0-11 km/h	301.8 ± 83.8	293.1 ± 69.2	.12
Distance (m) 11.1-14 km/h	172 ± 57.1	168.1 ± 10	0.10
Distance (m) 14.1-19 km/h	93 ± 38.8	102.8 ± 37.6	.15
Distance (m) 19.1-23 km/h	23.5 ± 20	24.3 ± 26	.67
Body load (wmu)	34.3 ± 11.2	30.5 ± 11.3	.03*
Magnitude of impact (g-force)	6.1 ± 0.1	6.1 ± 0.2	.61
Total impact	230 ± 89.5	194.8 ± 86.4	.03*

Note. S.D.= Standard deviation, wmu= without measuring unit, *p<.05, **p<.001. All average values shown in the Table were obtained based on n = 17 soccer players evaluated.

Statistically significant differences were found for average heart rate (p<.001), maximum heart rate (p=.02), body load (p=.03), and total impacts (p=.03). In all cases, averages were higher on the natural grass surface. No statistically significant differences were reported for the other variables (p>0.05).

Table 3 presents differences in technical actions obtained while playing a small-sided game for 8 minutes in the two different types of surfaces.

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Table 3

Values of technical actions obtained during an eight-minute small-sided game in two different types of surfaces

Action	Natural grass		Artificial turf		% change natural vs. artificial	
	Red team	Yellow team	Red team	Yellow team	Red team	Yellow team
+ Passes	38	45	63	55	65.8%	22.2%
- Passes	9	7	6	9	-33.3%	28.6%
Direct shots on goal	7	8	6	4	-14.9%	-50.0%
Indirect shots on goal	0	1	0	1	0	0
Goals scored	4	6	6	3	50.0%	-50.0%

Note. All values shown in Table 3 were obtained from team evaluations.

The percentage of change observed between the types of surfaces describes the tendencies of change for both types of surfaces, given that both teams improve or worsen the performance of some of the technical actions; for instance, the red team reported a 65.8% improvement in positive passes on artificial turf, but at the same time it showed a 14.9% decrease in direct shots on goal on that surface. The descriptive information shows that technical actions did not occur with equal frequencies, suggesting that the pattern of play may be changing and adapting depending on the type of surface used.

Discussion

This is the first study in the country comparing the effects of artificial and natural surfaces in Costa Rican soccer players' physical and technical performance.

As indicated in the introduction, the main motivation for conducting this study was the proliferation of soccer fields with artificial turf both locally and internationally and the existing debate about which surface is better and safer. This difference of opinions is reflected in articles published in the local newspaper *La Nación*, which constantly addresses this issue. For instance, in the article entitled *"Natural o artificial?"* Díaz (2007) states that natural grass is preferable, but events in Costa Rica show that it is convenient for soccer to change to artificial turf for economic reasons. However, as shown in the results of the present study, statements like this lack scientific foundation. In addition to economic variables (which have not been addressed in this study), there are physiological and technical variables that are directly related to soccer players' performance which must receive more consideration to decide whether to invest in soccer fields with natural grass or artificial turf.

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Anthropometrical data for the participants in this study is similar to the one presented by Enizeler (2005) in terms of age (24.4 ± 4.1 years old), weight (70.7 ± 3.1 kg), height (176.4 ± 6.2 cm), and body fat percentage (9.3 ± 3.4%). Furthermore, Sánchez and Salas (2009) reported a mean of 57.7 ± 8.8 ml/kg/min of maximum oxygen consumption in a sample of 219 Costa Rican first-division players, a value similar to the one reported in this study (VO_{2max} 55.5 ± 5.3 ml/kg/min). In addition, Clemente and Muñoz (2011) presented data regarding anthropometric characteristics, years of experience, and training frequency similar to the one from the participants in this study. Based on this evidence, it can be concluded that the subjects of this study can be characterized as high-performance players due to their level of physical abilities and anthropometric data.

In the case of the results obtained in the technical test, no differences between the two types of surfaces were reported. It is worth noting that this test has a limitation, since it is used for soccer schools. Bedoya (2014) mentions that these types of test batteries have a practical value during the training stages while they are only for reference during performance. Bedoya (2014) and Díez and Burillo (2012) state that there are no specific tests for soccer players and insist that the ability of a soccer player is not objectively measured in the existing tests. In this sense, the results obtained by this test must be regarded as references, since it is not possible to conclude with certainty that the surfaces used would have an actual impact on player performance.

The results reported in the agility test indicate that no significant differences existed between performance on artificial turf and natural grass. In spite of this, the results obtained are similar to those of Díez and Burillo (2012) who conducted an agility test without a ball, and found better times on natural grass than on artificial turf. Given this result, it may be proposed that the field with natural grass favors performance in terms of player agility, but since there is no scientific evidence and significant data to prove this, it cannot be regarded as certain that the type of surface has an impact on player performance.

The RSA test has been applied in multiple investigations, such as those of Arjol and Gonzalo (2012), Clemente and Muñoz (2011), and Rodríguez, Sánchez, and Villa (2014), due to its usefulness in measuring the effects produced by training on players' anaerobic capacity.

In this study, the results of the RSA test did not show significant differences in the fatigue index between fields with natural grass and artificial turf surfaces, which coincides with the findings by Díez and Burillo (2012). According to these findings, the fatigue index does not vary between the two types of surfaces, showing that anaerobic capacity was very similar in both cases and that players' physical performance, therefore, should be the same whether they play on grass or artificial turf.

With respect to small-sided games, no significant differences were found in the distances covered with different speeds (0- 11 km/h, 11-14 km/h, 14-19 km/h, 19-23 km/h), total distance covered, and number of impacts on both types of surfaces. Significant differences were reported in maximum and average heart rates, as well as between body load and number of total impacts, with playing on natural grass surfaces producing higher stress values (see Table 2).

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These significant differences may be affected by the characteristics inherent in each of the surfaces used in this study. In the case of a field with an artificial surface, a study by Gallardo, Felipe, Burillo, and Gallardo (2010) showed that the main advantage of artificial turf compared to a natural grass surface is its endurance, the uniformity of the surface, and the good performance it provides, while a natural surface may be affected by climatic factors and require extensive maintenance. In addition, Báron and Ferreira (2010) indicated that artificial turf can withstand many hours of use without suffering significant deterioration, which is not the case with a natural surface, which requires time to recover.

In addition, *Guía FIFA para las superficies artificiales* (2011) indicates that a major characteristic of any surface, either natural or artificial, must be its shock absorption capacity (defined as "the capacity of a surface to absorb the impact of a player running on that surface"; own translations). It also indicates that a natural grass field in ideal conditions has a shock-absorption capacity ranging between 55% and 70%, and that existing artificial turf shows similar values.

Belloch, Soriano, and Figueres (2009) agree that the mechanical behavior of a field with an artificial turf surface is very similar to the one observed on natural grass fields. Rozas (2009) mentions that artificial turf surfaces provide impact-absorption and energy-return and dissipation, which is very similar to natural grass. Rabal and Casajús (2014) also claim that similar, or even better performance, may be found on artificial surfaces as opposed to traditional surfaces (soil and natural grass), considering they are adequately maintained.

This author also found higher osseous mass values in players that competed on natural grass than in those who competed on artificial turf surfaces, suggesting that this increase in bone density may be due to the fact that a greater body load and intensity are present when playing on natural grass. These findings are consistent with those observed in the present study, in which the values for the amount of impacts and body loads were significantly greater on natural surfaces than on artificial surfaces.

Athletes' performance is not only affected by their individual characteristics, but also by factors such as the ball and, of course, the pavement or playing surface with which they interact (Báron and Ferreira, 2010). In their study of trainers' and players' satisfaction with natural grass and artificial turf soccer fields, Gallardo et al. (2010) claimed that 72% of the trainers stated that a natural grass surface presents lower burden risks than a field with artificial turf; in addition, 74% said that shock-absorption of the impacts is significantly better on a natural grass surface, which contrasts the findings of this study. However, it should be noted that these are subjective observations and not opinions based on scientific data.

With respect to the differences found in average and maximum heart rate (see Table 2), there is no sufficient scientific evidence to explain this result. However, there may be greater body load when playing on a natural grass surface. It may be suggested that, given the greater physical burden experienced by the player, there may have a need for greater physical effort consequently raising the player's heart rate.

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Regarding the technical actions obtained in the eight-minute small-sided game, results presented in Table 3 show that different technical actions increased or decreased between different types of surfaces; for instance, positive passes were more frequent on synthetic grass, while direct shots on goal were less frequent compared to a natural grass surface. The variables of indirect shots on goal and goals scored did not show important variations between the types of playing surfaces studied. Based on the foregoing, no substantial changes have been found which may suggest important effects on playing patterns or on team performance, or that may indicate that differences between surfaces actually influence the differences observed.

Between 2006-2007, FIFA (2007) analyzed 14 soccer games, four played on artificial turf and 10 on natural grass, and concluded that playing patterns were not influenced by differences between artificial turf and natural grass surfaces; instead, it reported clear similarities between patterns of play on the different surfaces. In addition, no significant differences were found in the frequencies of passes made, passes received, ball control, and other technical actions studied. This data coincides with the one reported in this study, in which the analysis of the frequencies of these technical actions did not show important changes or suggest some variability in performance in either physical or technical aspects of players, who interact on a natural grass or artificial turf surface.

Conclusion

Based on the results of this study, it may be concluded that playing on natural surfaces caused greater impact and body load than playing on artificial turf, while in the case of technical aspects, differences between both types of surfaces did not have an important effect on technical performance in professional soccer players.

Recommendations and practical applications

Further research should be conducted to analyze body load and impacts when playing on natural and artificial surfaces with different characteristics and qualities. Scientific long-term data related to the technical level of Costa Rican soccer players should be collected from their early youth until they become professional players. The characteristics and quality of natural grass and artificial turf fields in Costa Rica should also be analyzed, following the recommendations and applying the tests prepared by FIFA for certifying soccer fields, as well as to study in more detail if playing patterns change depending on whether play takes place on natural or artificial surfaces.

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*Juan Carlos Ávalos-Guillén , Randall Gutiérrez-Vargas,
Gerardo Araya-Vargas, Braulio Sánchez-Ureña,
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