Pitch Size and Game Surface in Different Small-Sided Games. Global Indicators, Activity Profile, and Acceleration of Female Soccer Players

Jorge López-Fernández,[1] Leonor Gallardo,[1] Álvaro Fernández-Luna,[2] Victor Villacañas,[1] Jorge García-Unanue,[2] and Javier Sánchez-Sánchez[2]

[1]IGOID Research Group (Research in Management of Organizations and Facilities Sports), University of Castilla-La Mancha, Toledo, Spain; and [2]School of Sport Science, European University, Madrid, Spain

Abstract

López-Fernández, J, Gallardo, L, Fernández-Luna, Á, Villacañas, V, García-Unanue, J, and Sánchez-Sánchez, J. Pitch size and game surface in different small-sided games. Global indicators, activity profile, and acceleration of female soccer players. *J Strength Cond Res* 33(3): 831–838, 2019—The aim of this research was to evaluate the influence of game surface and pitch size on the movement profile in female soccer players during small-sided games (SSGs) of 4 v 4. Sixteen women played 3 different 4-a-side (400, 600, and 800 m^2) on 3 surfaces (ground [GR], artificial turf [AT], and natural grass [NG]). Time-motion variables were assessed through GPS devices (Spi Pro X, GPSports, Australia). Ground had the worst outputs on most variables. NG achieved higher results than AT in terms of total distance (SSG 400 [+37.000 m; $p = 0.006$]; SSG 600 [+59.989 m; $p < 0.001$]; and SSG 800 [+42.284 m; $p = 0.001$]). However, the smaller SSG (400) had the lowest values on most variables. However, although the middle SSG (600) presented higher output than the bigger one (800) for body load (NG [+7.745 a.u.; $p < 0.001$]; AT [+8.207 a.u.; $p < 0.001$]; and GR [+5.879 a.u.; $p < 0.001$]), it had lower results for high-intensity distance (NG [−13.15 m; $p = 0.025$] and AT [−13.59 m; $p = 0.026$]). Despite women's performance being higher on AT than GR, the NG surface still showed the highest outcomes in the most intense SSG. Moreover, although the performance increases in bigger pitches, if the size is too large the outputs could be reduced.

Key Words four-a-side, GPS, motion analysis, sports surfaces, women, football

Address correspondence to Jorge López-Fernández, jorgelopfdez@gmail.com.

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Introduction

Female soccer is growing year by year, exceeding 1.2 million federative licenses only in this continent (29). Thus, there are now several studies quantifying the physical demands of matches and drills (14,22,25,31–33). Because of their influence in goal situations, high-intensity actions (jumps, kicks, high-speed running, sprints, changes of direction, turns, accelerations, and decelerations) are considered the most relevant ones in performance despite their short duration (4,32). That is the reason why coaches design their training to replicate the high-intensity demands of matches together with other objectives.

Nowadays, it is common to use small-sided games (SSGs) in training, as they allow coaches to replicate the technical tactical and physical demands of competition through controlled drills (6,11,26). However, the numerous studies focussed on SSG have demonstrated that the intensity of these games is influenced by several external variables such as the game surface (5), the number of players (18,24), the size of the pitch (21), the presence or absence of keepers or goals (23), the length of the game (20), or the number of touches allowed (8).

Among all these variables, some authors have analyzed the influence of the game surface on physical and physiological responses of soccer players because of the importance of these factors in developing a suitable performance level (12,18,27). However, only a few studies have studied these factors in SSGs (5,22). Thus, for example, Brito et al. (5) found a greater number of high-intensity actions and sprints on asphalt and higher physiological load on artificial turf (AT) than sand, thus demonstrating the importance of this factor on players' responses.

However, authors like Fradua et al. (13) highlight that soccer players' ability to get used to small spaces is an essential element in soccer success; SSGs being useful for increasing this ability. However, as demonstrated by Kelly and

Drust (21) and Rampinini et al. (26) among others, players' responses and game intensity may change depending on the pitch size of the SSG. Thus, coaches should consider this variable when designing their drills as players seem to perform higher number of high-intensity actions whenever the pitch size increases (6,19).

Despite the importance of the game surface and pitch size and the other external factors in the planning of SSGs, to the authors' knowledge, only a few studies have analyzed the effect of different types of SSGs in female soccer (14,22,24). Among the findings of these works, SSGs seem to be useful for replicating the aerobic and movement patterns of female matches. However, contrary to male soccer, SSGs in women may not provide sufficient high-intensity or repeated sprint stimuli in top female players (14). However, most investigations on SSGs either on female or male soccer only assess the effect of 1 extrinsic factor on SSG performance (5,6,14,21). Thus, to address the gap in the literature regarding the effect of 2 or more extrinsic factors on SSGs performance, this work aims to evaluate the influence of game surface and pitch size on the movement profile in subelite female soccer players during SSG of 4 v 4. This work is focused on possession games as it seems to be more intense than those SSGs with goalkeepers (15). Therefore, this study expects to provide relevant information for designing training based on the use of SSGs.

Methods

Experimental Approach to the Problem

Before starting the study, players performed a familiarization session to gain previous experience with either the 3 surfaces or the 3 SSGs' pitch sizes. Moreover, players also became accustomed to the Global Positioning System devices (GPS; Spi Pro X, GPSports, Canberra, Australia) used during the study during this familiarization session.

The main part of the study took place on 3 consecutive weeks (2 days per week), in which participants played 3 four-a-side games with different pitch sizes (Table 1) on the 3 selected surfaces: natural grass (NG; grass' height: 25 mm); AT (fiber: monofilament of polyethylene, 60 mm in height; infill: 20 $kg \cdot m^{-2}$ of styrene-butadiene rubber and quartz sand with 0.3–0.8 granulometry); and ground (GR; uniform and dry dirt). To increase the reliability of data, each SSG was played twice in nonconsecutive days. Therefore, players completed 18 drills altogether and there were recorded a total of 96 events. The order of both pitch sizes and surfaces were established randomly for each test day, so that every day participants played 1 sort of SSG on each surface. To guarantee a full recovery between SSGs players performed 10 minute of active recovery (ball pass exercises at low intensity and 3 incremental sprints at the end of the recovery time).

All tests were conducted under the same environmental conditions (dry condition, 20–24.5° C and 22–30% relative humidity) and same training time (19:00–21:00) to reduce the possible influence of circadian rhythms. Moreover, the soccer field was located at the same altitude (770 m over the sea level). An independent expert on sports GR surfaces stated that the 3 surfaces were in good condition for playing soccer; but the mechanical properties of the selected surfaces were not measured.

Subjects

Sixteen women from 1 team of the Spanish Second Division participated in the study (measured mean ± *SD*: 19.56 ± 1.97 years; 57.74 ± 4.89 kg; 161.57 ± 5.83 cm; 24.93 ± 4.1% body fat). All of them have previous experience playing soccer on AT and NG (5.81 ± 0.75 years) and play soccer 3 days per week with a weekly competition. Moreover, players used to play from 4 to 5 matches on GR every season, although most of them were friendly matches. All participants passed the examination required to play soccer and did not report any cardiopulmonary disease nor took any kind of medication during the study.

Players, coaches, and the club were informed about the possible risks of this study and signed the informed consent form. Parents of all players younger than 18 years also signed informed consent. The methodology of this work was approved by the local Clinical Research Ethical Committee from University of Castilla-La Mancha based on the Declaration of Helsinki.

Table 1. SSG characteristics.*

	Game duration (min)	Duration of the recovery between SSGs (min)	Pitch area (m)	Pitch total area (m^2)	Pitch ratio per player (m^2)
SSG 400	4	10	20 × 20	400	50
SSG 600	4	10	24.5 × 24.5	600	75
SSG 800	4	10	28.3 × 28.3	800	100

*SSG = small-sided game.

Procedures

Participants agreed to rest for 72 hours before each test day and maintain the same eating habits. Moreover, they used the same soccer boots in all tests (always rubber studs). Fifteen minutes before the beginning of each test, players attached the GPS (Spi Pro X) (2). To avoid possible alterations in data and get the maximum accuracy, a minimum of 8 satellites was established and participants used the same GPS device during the whole research. Finally, before the first four-a-side drill, players performed a standardized warm-up of 10 minutes and 3 sprints of 30 m at increasing intensity before the beginning of each test day (28).

Four-A-Side Small-Sided Game. With the aim of getting balanced teams, coaches gathered the players in 4 teams of 4 participants each. Teams and matches were the same during the whole investigation. Contrary to other previous studies, the SSG's objective was to maintain the ball as much time as possible; so, neither goals nor keepers were included in the study (5,6,19). Players were encouraged by their coaches during the whole study and balls were replaced whenever they went outside the pitch to optimize the playing time.

Physical Performance: Global Indicators. Through GPS attached to the players, the following global indicator data were recorded: total distance of each SSG (TD); meters covered by minute ($m \cdot min^{-1}$); peak speed ($\dot{V}_{max}$peak); average speed ($\dot{V}_{mean}$); work/rest rate (W:R) defined as distance covered at speed $\geq$4 $km \cdot h^{-1}$ (work) per distance covered at speed $\leq$4 $km \cdot h^{-1}$ (rest); and body load (BL) registered in arbitrary units (a.u.), which is determined through the 100-Hz triaxial accelerometer included in the GPS combining the body movement axes (vertical [y], horizontal [x], and anteroposterior [z]) (7,10,27). All these variables were calculated through the manufacturer software Team AMS (version 2016.7, GPSports, Canberra, Australia).

Physical Performance: Physical Variables. Physical variables were assessed in 3 ways also using the Team AMS software: the speed ranges (establishing 6 speed zones [all in $km \cdot h^{-1}$] 0–7; 7–10; 10–13; 13–16; 16–18; and >18) which were tracked as both absolute and relative variables regarding the TD (17); the acceleration and deaccelerating ranges (selecting 4 zones for both [all in $m \cdot s^{-2}$] 1.5–2; 2–2.5; 2.5–2.75; and >2.75) (10); and the high-speed actions (all actions over 13 $km \cdot h^{-1}$) which were analyzed in detail recording the following values: high-intensity distance (m), number of high-intensity actions (n°), average duration of sprints (s), average maximum speed ($km \cdot h^{-1}$), average distance of sprint (m), and acceleration max mean ($m \cdot s^{-2}$).

Statistical Analyses

Results are presented as mean and standard deviations (±*SD*). The verification of the normality and homogeneity of the variance was assumed by mean of the Kolmogorov–Smirnov test and the Levene's statistic. The comparison between results was developed through 2-way analysis of variance (surface × game situation) tests. Confidence interval (CI of 95%) was included to identify the magnitude of changes. Effect sizes (ESs) were calculated and defined as follows: trivial, <0.19; small, 0.2–0.49; medium, 0.5–0.79; and large, >0.8 (9). Data were analyzed with the statistical software SPSS v 20.0. The level of significance was established at $p \leq 0.05$.

Results

Global Indicators and High-Intensity Actions

Table 2 displays the global indicator results and the high-intensity actions. The NG surface had significantly higher values than GR in the 3 SSG for TD (SSG 400 [+37 m; $p =$ 0.006; ES: 0.964; CI: 8.400–65.600]; SSG 600 [+59.989 m; $p <$ 0.001; ES: 1.152; CI: 31.824–88.155]; SSG 800 [+42.284 m; $p =$ 0.001; ES: 0.880; CI: 15.074–69.494]) and $\dot{V}_{mean}$ (SSG 400 [+0.556 $m \cdot s^{-1}$; $p =$ 0.006; ES: 0.974; CI: 0.127–0.985]; SSG 600 [+0.900 $m \cdot s^{-1}$; $p <$ 0.001; ES: 1.154; CI: 0.477–1.322]; SSG 800 [+0.633; $p =$ 0.001; ES: 0.875; CI: 0.225–1.042]). Natural grass also had significantly higher values than AT for TD (SSG 600 [+11.582 m; $p =$ 0.047; ES: 0.633; CI: 0.252–56.062]); W:R (SSG 600 [+2.974 a.u.; $p =$ 0.034; ES: 0.561; CI: 0.17–5.779]); $\dot{V}_{mean}$ (SSG 600 [+0.422 $m \cdot s^{-1}$; $p =$ 0.047; ES: 0.627; CI: 0.004–0.841]); high-intensity distance (SSG 600 [+13.71 m; $p =$ 0.025; ES: 0.546; CI: 1.3–26.11]; SSG 800 [+13.46 m; $p =$ 0.023; ES: 0.545; CI: 1.37–25.56]), and number of high-intensity actions (SSG 600 [+2.54 a.u.; $p =$ 0.049; ES: 0.50; CI: 0.88–5.07]).

However, despite SSG 400 having lower results than the other SSG for the global indicator variables, the significant differences for the 3 surfaces only appeared for TD, $m \cdot min^{-1}$ and $\dot{V}_{mean}$. Moreover, the SSG 600 had significantly higher results than SSG 400 for BL (NG [+7.745 a.u.; $p <$ 0.001; ES: 1.685; CI: 5.467–10.023]; AT [+8.207 a.u.; $p <$ 0.001; ES: 1.499; CI: 5.853–10.56]; GR [+5.879 a.u.; $p <$ 0.001; ES: 0.996; CI: 3.483–8.274]); and lower outcomes than SSG 400 for high-intensity distance (NG [−13.15 m; $p =$ 0.025; ES: 0.439; CI: −25.44 to −1.25]; AT [−13.59 m; $p =$ 0.026; ES: 0.539; CI: −25.99 to −1.18]), and number of high-intensity actions (NG [−1.59 a.u.; $p =$ 0.036; ES: 0.498; CI: −2.83 to −0.36]; AT [−1.72 a.u.; $p =$ 0.004; ES: 0.565; CI: −2.99 to −0.45]).

Activity Profile

Figure 1 shows the results for each of the 6 zones of speed. The significant differences across surfaces were only found in zone 1, zone 2, and zone 4; the significant differences in the high-speed zones were only present for zone 5 but among SSGs instead of among surfaces. The main significant differences among SSG appeared in zone 5 where the SSG 800 had higher values than the SSG 400 in the 3 surfaces (NG [+1.21%; $p <$ 0.001; ES: 0.935; CI: 0.46–1.96]; AT [+1.13%; $p =$ 0.001; ES: 1.224; CI: 0.37–1.89]; and GR [+0.85%; $p =$ 0.025; ES: 0.762; CI: 0.08–1.61]). The values of the SSG 800 were also higher than the SSG 600 ones on the AT ([+0.89%; $p =$ 0.015; ES: 0.819; CI: 0.13–1.65]).

Accelerations and Decelerations

Table 3 displays the accelerations and decelerations in each of the 4 zones established. The most significant differences

TABLE 2. Covered distance, load indicators, and heart rate values during the 4-min game in the 3 surfaces and the 3 SSGs.*

	Natural grass (NG) (†)			Artificial turf (AT) (†)			Ground (GR) (†)		
	SGG 400 (a)	SSG 600 (b)	SSG 800 (c)	SGG 400 (a)	SSG 600 (b)	SSG 800 (c)	SGG 400 (a)	SSG 600 (b)	SSG 800 (c)
Movement profile									
TD (m)	398.98 (33.35)†	457.18 (45.17)†‡	458.63 (52.03)†‡	371.94 (40.83)	429.02 (43.88)†‡	442.88 (40.87)‡	361.98 (43.39)	397.19 (58.99)‡	416.35 (44.03)‡
$m \cdot min^{-1}$ (m)	99.75 (8.34)†	114.29 (11.29)†‡	114.66 (13.01)†‡	92.99 (10.21)	107.26 (10.97)†‡	110.72 (10.22)‡	90.50 (10.85)	99.30 (14.75)‡	104.09 (11.01)‡
W:R (a.u.)	6.36 (2.42)	12.52 (6.39)†‡	12.02 (5.44)†‡	6.63 (2.99)	9.54 (4.24)‡	10.06 (4.33)‡	5.33 (2.14)	8.15 (5.90)	8.76 (4.66)‡
BL (a.u.)	9.70 (2.72)	17.44 (4.66)†‡	11.30 (2.63)	8.30 (2.13)	16.51 (5.90)†‡	10.32 (2.36)	7.50 (2.32)	13.30 (5.97)‡	9.21 (2.24)
$\dot{V}_{max}$ peak ($km \cdot h^{-1}$)	16.55 (1.93)	18.05 (2.36)†‡	18.07 (1.89) ‡	16.02 (2.48)	16.96 (2.34)	17.35 (1.83)‡	15.65 (2.53)	16.07 (1.98)	17.30 (1.84)‡
$\dot{V}_{mean}$ ($km \cdot h^{-1}$)	5.99 (0.50)†	6.86 (0.68)†‡	6.88 (0.78)†‡	5.58 (0.61)	6.44 (0.66)†‡	6.64 (0.61)‡	5.43 (0.65)	5.96 (0.88)‡	6.25 (0.66)‡
High-intensity actions									
High-intensity distance (m)	21.03 (11.33)	42.98 (23.74)†‡	55.06 (31.27)†‡	18.25 (11.69)	31.54 (18.13)‡	41.59 (19.19)‡	14.86 (11.61)	31.19 (24.25)	32.39 (16.07)‡
No. of high-intensity actions (a.u.)	2.27 (1.73)	4.20 (2.26)†‡	5.66 (3.21)†‡	1.70 (1.03)	3.08 (1.73)‡	4.38 (1.84)†‡	2.09 (0.95)	3.00 (2.15)	3.03 (1.80)
Average duration of sprints (s)	1.69 (0.51)	1.93 (0.34)	1.95 (0.34)	1.81 (0.76)	1.95 (0.52)	1.80 (0.40)	1.83 (0.88)	1.96 (0.53)	2.11 (0.57)
Sprint $\dot{V}_{max}$mean ($km \cdot h^{-1}$)	15.70 (1.73)	15.91 (1.12)	16.03 (0.86)	15.68 (1.36)	15.70 (1.38)	15.74 (1.08)	16.03 (1.72)	15.22 (1.35)	16.24 (2.71)
Average distance of sprint (m)	9.50 (13.66)	8.28 (2.30)	8.06 (1.61)	7.41 (3.56)	8.61 (3.14)	7.63 (2.40)	8.06 (4.55)	10.08 (9.09)	8.90 (2.80)
Acceleration max mean ($m \cdot s^{-1}$)	2.39 (0.15)	2.50 (0.15)	2.40 (0.13)	2.39 (0.12)	2.40 (0.12)	2.46 (0.16)	2.42 (0.14)	2.39 (1.86)	2.41 (0.17)

*SSG 400 = small-sided game 400; SSG 600 = small-sided game 600; SSG 800 = small-sided game 800; TD = total distance; a.u. = arbitrary units; BL = body load.
†Significant differences with the surface indicated ($p \leq 0.05$).
‡Significant differences with the SSG indicated ($p \leq 0.05$).
Values measured mean ± *SD*.

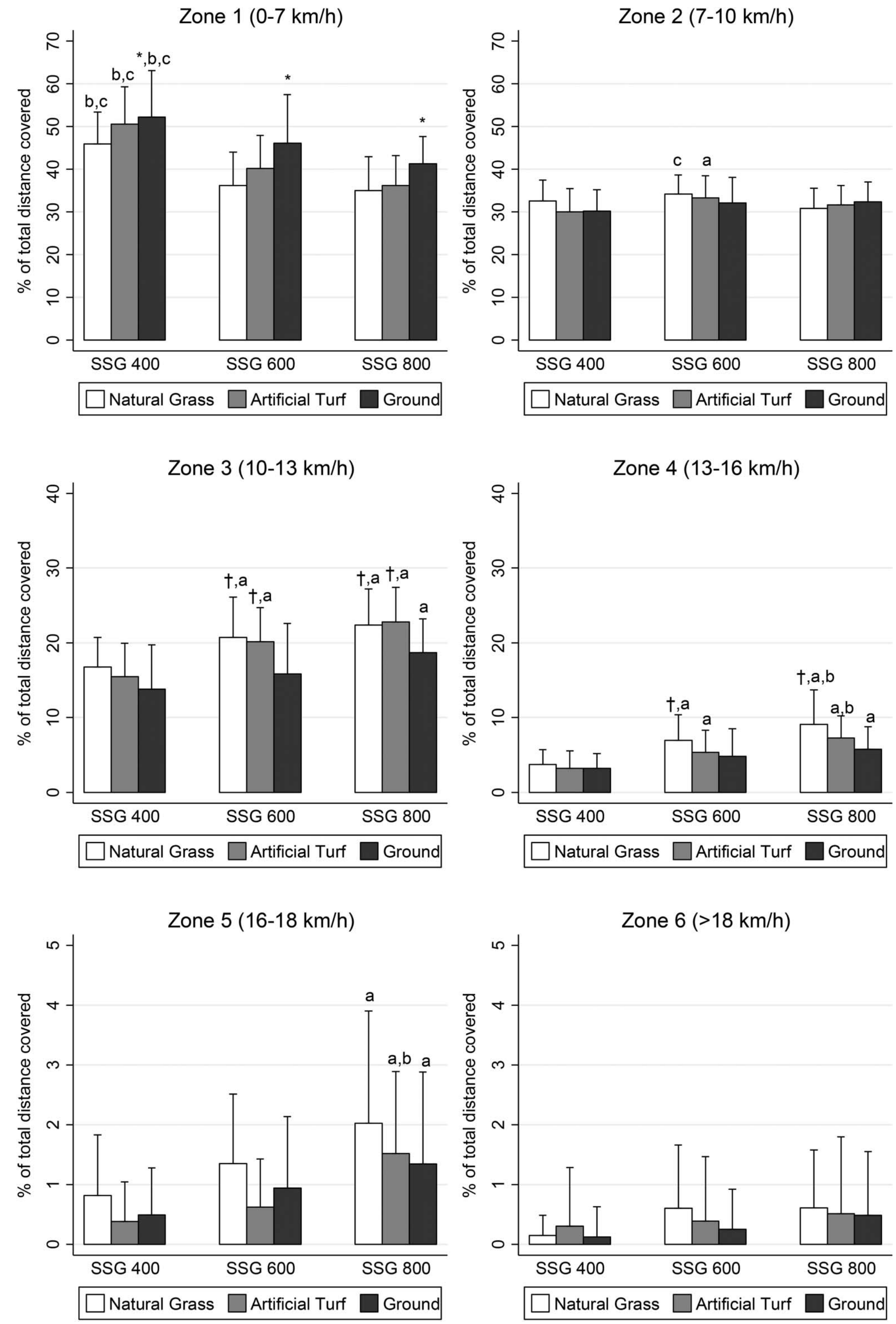

Figure 1. Activity profile in the 3 surfaces and 3 SSGs. Significant differences ($p \leq 0.05$): natural grass = *; and ground = †. Significant differences ($p \leq 0.05$): SSG 400 = a; SSG 600 = b; and SSG 800 = c. SSG = small-sided game.

TABLE 3. Number of accelerations and decelerations in the 3 surfaces and the 3 SSGs.*

	Natural grass (NG) (†)			Artificial turf (AT) (†)			Ground (GR) (†)		
	SGG 400 (a)	SSG 600 (b)	SSG 800 (c)	SGG 400 (a)	SSG 600 (b)	SSG 800 (c)	SGG 400 (a)	SSG 600 (b)	SSG 800 (c)
Accelerations									
Accel. between 1.5 and 2 $m \cdot s^{-2}$ (n)	11.80 (3.03)	11.59 (3.21)†	11.47 (3.81)†	10.14 (4.01)	10.93 (2.86)†	10.56 (3.46)	9.75 (3.99)	8.46 (4.17)	8.84 (3.40)
Accel. between 2.0 and 2.5 $m \cdot s^{-2}$ (n)	6.17 (3.41)†	5.91 (2.90)†	6.75 (2.54) †	5.21 (1.57)	5.62 (2.31)†	5.22 (2.70)	4.32 (1.98)	3.40 (2.39)	4.34 (2.21)
Accel. between 2.5 and 2.75 $m \cdot s^{-2}$ (n)	1.23 (1.17)	1.19 (1.18)	1.13 (0.91)	1.28 (1.07)	1.52 (1.24)	1.69 (1.33)†	1.11 (1.03)	1.07 (0.98)	0.97 (1.09)
Accel. >2.75 $m \cdot s^{-2}$ (n)	1.10 (1.12)	2.34 (1.77)†‡	1.63 (1.45)	1.00 (1.00)	1.07 (1.10)	1.34 (1.26)	0.89 (0.89)	0.67 (0.90)	1.03 (0.97)
Decelerations									
Decel. between 1.5 and 2 $m \cdot s^{-2}$ (n)	9.60 (2.91)	11.22 (2.64) †	9.97 (3.65)	9.38 (3.18)	9.28 (3.12)	8.69 (2.96)	8.36 (2.90)	7.54 (2.86)	8.88 (3.31)
Decel. between 2.0 and 2.5 $m \cdot s^{-2}$ (n)	6.10 (2.72)	5.88 (2.32)†	5.38 (2.10)	4.90 (2.30)	6.14 (2.66)†	5.97 (2.37)	5.25 (2.88)	4.21 (1.98)	4.97 (2.15)
Decel. between 2.5 and 2.75 $m \cdot s^{-2}$ (n)	2.03 (1.30)†	1.94 (1.37)†	1.81 (1.38)	1.28 (0.88)	1.55 (0.99)	2.09 (1.28)	1.18 (1.06)	1.07 (1.15)	1.53 (1.39)
Decel. >2.75 $m \cdot s^{-2}$ (n)	3.70 (2.28)	4.41 (1.93)†	4.41 (2.17)†	2.69 (1.83)	3.34 (2.29)	3.60 (2.18)	2.61 (2.04)	2.25 (1.80)	2.69 (1.71)

*SSG 400 = small-sided game 400; SSG 600 = small-sided game 600; SSG 800 = small-sided game 800.
†Significant differences with the surface indicated ($p \leq 0.05$).
‡Significant differences with the SSG indicated ($p \leq 0.05$).
Values measured mean ± *SD*.

among surfaces were between NG and GR, where the NG had higher outcomes than GR. However, NG also had higher values than AT in the acceleration variables of zone 2 in the SSG 800 (+1.53 $m \cdot s^{-2}$; $p = 0.046$; ES: 0.858; CI: 0.02–3.04); and zone 4 in the SSG 600 (+1.28 $m \cdot s^{-2}$; $p > 0.001$; ES: 0.885; CI: 0.52–2.03); and in the deceleration variable of zone 1 in the SSG 600 (+1.94 $m \cdot s^{-2}$; $p = 0.043$; ES: 0.667; CI: 0.04–3.84). However, the only difference among SSG was found in the acceleration variable of zone 1, where the SSG 600 had higher results than the SSG 400 on the NG surface (+1.24 $m \cdot s^{-2}$; $p < 0.001$; ES: 0.858; CI: 0.50–1.99).

Discussion

This is the first study that compared the activity profile in subelite female soccer on SSG of different pitch size played on 3 distinct surfaces: NG, AT, and GR. Contrary to some previous studies, this work was focused on possession games (5,6,19) as these games are related with higher intensity levels than those games which include goalkeepers (15). The main finding of this research shows that either the game surface or the pitch size has a direct influence on high-intensity actions in subelite female soccer players; what makes advisable to control both variables when designing a SSG. However, it is important to be cautious when comparing these findings to other studies as they may use other sort of SSGs with different number of players, distinct objectives, or other pitch size proportions.

In line with the findings of Brito et al. (5), but on NG, AT, and GR, the significant differences among surfaces found in this study indicate that the game surface have a direct influence on the high-intensity actions. Among the 3 selected surfaces, GR seem to be the less recommended surface for playing soccer as players got lower outputs on GR than on NG and AT either in movement profile variables or high-intensity actions. However, most of these differences were found in the SSG 600 which was the most intense SSG. Therefore, the lower outcomes in variables such as $m \cdot min^{-1}$, peak speed, or BL in GR than on the other both surfaces in the SSG 600 may be due to a lower players' stability on GR (27,28), thereby causing a lower number of explosive actions (3,5). However, the synthetic surface also showed lower values in most variables of the SSG 600 than the natural one, and lower high-intensity distance and lower number of high-intensity actions in the SSG 800. These results suggest higher rate of creatine phosphate breakdown and glycolysis on NG because of greater rates of anaerobic energy turnover (3,5,27) what contradict the findings of previous research in men as they reported similar performance on AT either in linear sprints or in high-intensity actions with change of direction. However, these findings may be due to different technical behavior on both surfaces, as players seem to perform a higher number of short passes and a lower rate of tackles on AT than on NG (1). Nonetheless, the high variability existing in the mechanical properties of AT systems makes further research necessary (28).

Previous research in male soccer concluded that game intensity of SSGs increase in bigger pitches (6,19), so that variables such as TD, $m \cdot min^{-1}$, W:R, $\dot{V}_{mean}$, $\dot{V}_{max}$, distance covered at high speed, and number of high-intensity actions increase in SSGs with a higher pitch ratio per player (6,19). The findings of this work are in line with these studies probably because of the higher effective playing time associated with bigger pitches (6). Moreover, most differences between the smaller SSG and the bigger ones were reported on NG and on AT as game intensity of SSGs is higher on these surfaces. However, contrary to the findings of these authors, there were no significant differences in the global indicator variables between the middle SSG (600) and the bigger one (800) except on BL, distance covered at high speed and number of high-intensity actions. Therefore, this work suggests that the intensity of game may stop to increase if the pitch size of the SSG is too big, agreeing with those studies which did not report differences when increasing the individual playing area (21). For that reason, similar muscle damage and oxidative stress (16) may be expected for either SSG 600 or SSG 800. These results are especially important because both technical and tactical actions seem to change according to the pitch size (21); therefore, when coaches use bigger pitch size as a control variable for the intensity of a SSG, they can choose the pitch size most suitable for the tactical and technical actions that they want players to train.

The accelerations of high intensity were mainly performed in actions such as dribbling, change of directions, or running; therefore, although they often start at low speed, they involve high-metabolic cost (30). Opposite to Sánchez-Sánchez (27), this research did show significant differences among surfaces in both accelerations and decelerations likely because the 3 selected surfaces are quite different. However, there were no significant differences in either accelerations or decelerations regarding the pitch size contrary to previous studies (19). The ability to accelerate quickly has been identified as a key element in the players' performance (10,30). However, because GPS systems are not very accurate in distinguishing between accelerations and decelerations, further researches are needed.

This research expects to help coaches to design their training because extrinsic variables such as game surface or pitch size can affect players' performance during SSG. However, it is important to be cautious when comparing this current study with previous ones because of the lack of studies about SSG in female soccer players. Moreover, because SSGs used in this investigation only last 4 minutes, more research is needed to understand the effect of these 2 variables in subelite female soccer.

Practical Applications

The main practical applications for coaches are that changes in the pitch size of SSG or training on different surface seem to affect the physical responses of subelite female soccer players. Training on NG seems to be more suitable when the objective of the SSG is of higher intensity. However, AT does not reduce the intensity of game drastically. However, the intensity of game seems to be higher in bigger SSG. Nonetheless, coaches should take care when designing SSG because the intensity of game may decrease when the pitch size is too large.

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