Exploring external load variations in elite female soccer players during 6v6 small-sided games

Análisis de las variaciones de la carga externa en jugadoras de fútbol de élite durante las tareas de 6 contra 6 en campo reducido

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Abstract

Purpose: The aim of this study was to describe and compare the external loads response of elite female soccer players to different small-sided games (SSG). Twelve elite female soccer players (26.5 ± 5.7 years, 58.6 ± 5.6 kg, 164.4 ± 5.3 cm) performed four different 6vs6 SSG: two different sizes (20x20m and 30x30m) and with minigoals (MG) and without mini-goals (NG). **Methods:** Total distance (TD), low-intensity running distance (LIR), high-intensity running distance (HIR), sprint distance (SD), accelerations (ACC), decelerations (DEC), repeated sprints (RS) and Bodyload (BL) was collected using a 15Hz global positioning satellite system. The variables were compared across all SSG formats using a one-way analysis of variance (ANOVA) (p<.05) and non-clinical magnitude-based inferences (Cohen´s d). **Results:** Compared to 20x20m SSG, the 30x30m SSG induced greater TD (p=.001, d=1.20), LIR (p=.001, d=1.06), HIR (p=.001, d=1.20) and BL (p=.008, d=1.04) in NG condition. Similarly, in SSG with MG, greater number of ACC (p=.003, d=.38), DEC (p=.005, d=.42), LIR (p=.009, d=.86) and HIR (p=.070 d=.61) occurred in 30x30m vs. 20x20m. When NG 30x30m and 20x20m SSG were played, greater TD (p=.001, d=1.70; p=.001, d=1.13; respectively), LIR (p=.001, d=1.84; p=.001, d=1.39), ACC (p=.54, d=.39; p=.003, d=.74; respectively) and BL (p=.001, d=1.60; p=.001, d=1.15; respectively) were noted compared to MG. **Conclusion:** greater external load response of elite female soccer players was observed in SSG without mini-goals and played in greater pitch sizes. These findings are usefulness for coaches and physical trainers to design proper training tasks according to game demands.

Keywords: GPS, acceleration, high intensity running, training task.

Resumen

Propósito: El objetivo de este estudio fue describir y comparar la respuesta de las cargas externas de las jugadoras de fútbol de élite a diferentes juegos reducidos (SSG). Doce jugadoras de fútbol de élite (26,5 ± 5,7 años, 58,6 ± 5,6 kg, 164,4 ± 5,3 cm) realizaron cuatro diferentes SSG 6vs6: dos tamaños distintos (20x20m y 30x30m) y con mini-porterias (MG) y sin ini-porterias (NG). **Métodos:** Se recogió la distancia total (TD), la distancia de carrera de baja intensidad (LIR), la distancia de carrera de alta intensidad (HIR), la distancia de sprint (SD), las aceleraciones (ACC), las deceleraciones (DEC), los sprints repetidos (RS) y la carga corporal (BL) mediante un sistema de posicionamiento global por satélite de 15Hz. Las variables se compararon entre todos los formatos de SSG utilizando un análisis de varianza de una vía (ANOVA) (p<.05) y las inferencias basadas en la magnitud del tamaño del efecto (d de Cohen). **Resultados:** En comparación con el SSG de 20x20m, el SSG de 30x30m indujo una mayor TD (p=0,001, d=1,20), LIR (p=0,001, d=1,06), HIR (p=0,001, d=1,20) y BL (p=0,008, d=1,04) en la condición NG. Del mismo modo, en SSG con MG, se produjo un mayor número de ACC (p=0,003, d=0,38), DEC (p=0,005, d=0,42), LIR (p=0,009, d=0,86) y HIR (p=0,070 d=0,61) en 30x30m frente a 20x20m. Cuando se jugó NG 30x30m y 20x20m SSG, se observó una mayor TD (p=.001, d=1.70; p=.001, d=1.13; respectivamente), LIR (p=.001, d=1.84; p=.001, d=1.39), ACC (p=.54, d=.39; p=.003, d=.74; respectivamente) y BL (p=.001, d=1.60; p=.001, d=1.15; respectivamente) en comparación con MG. **Conclusión:** se observó una mayor respuesta a la carga externa de las jugadoras de fútbol de élite en SSG sin ini-porterias y jugadas en terrenos de juego de mayor tamaño. Estos hallazgos son útiles para que los entrenadores y preparadores físicos diseñen tareas de entrenamiento adecuadas según las exigencias del juego.

Palabras clave: GPS, aceleración, carrera de alta intensidad, tarea de entrenamiento.

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Introduction

The popularity of female soccer has increased in the last few years gaining over 64% in the number of licenses since 2013 (UEFA, 2017). This increase could be associated with more competitions and training period demands. The external load of female soccer players during competition have been described recently (Bangsbo et al., 2006; Datson et al., 2017; Gabbett & Mulvey, 2008; López-Fernández et al., 2017; Mara et al., 2016; Mohr et al., 2008; Trewin, 2017; Trewin, Meylan, Varley, & Cronin, 2018; Trewin, Meylan, Varley, Cronin, et al., 2018). An international female soccer team covers an average of 10,321 ± 859 meters during official matches being 2,520 ± 580 covered at high speed, 313 ± 210 at very high-speed, and 168 ± 82 in sprints (Datson et al., 2017), being these values influenced by field position (Mohr et al., 2008). Just and handful number of studies have described the intensity demands, measured as the distance and/or number of actions per minute. In those studies, the elite players cover between 106.7 ± 9.7 m·min-1 (Trewin, Meylan, Varley, Cronin, et al., 2018) and 108 ± 10 m·min-1 (Trewin, Meylan, Varley, & Cronin, 2018) during international official matches. Of that, 99.2 ± 8.3 m·min-1 are covered at low speed (below maximal aerobic speed) and 9.7 ± 3.7 at high speed (over maximal aerobic speed) (Trewin, Meylan, Varley, & Cronin, 2018). Also, players perform 0.62 ± 0.19 high-speed running efforts·min-1 and 0.21 ± 0.10 sprints·min-1. These high intensity activities have been shown to discriminate between top class and high-level female soccer players (Mohr et al., 2008). Due to the differences between player levels (Mohr et al., 2008) and positions (Martín-García et al., 2018), an optimal manage of external load is necessary for team staff members to balance training adaptations and controlling training load while also minimizing the risk of injury (Drew & Finch, 2016). In recent years some training tasks, where conditional technical-tactical skills are trained simultaneously, have emerged (Gabbett & Mulvey, 2008). These training drills, called small sided-games (SSG), are played in smaller training areas than the fields used during real competitions. Having fewer players and adapted rules this kind of training task have been proven to be an efficient and effective alternative to traditional training methods (Hammami et al., 2017). SSG may induce high physical and technical-tactical demands, in line with improvements in VO2Max, vertical jump, sprint time, agility, repeated sprint ability, and intermittent endurance (Hammami et al., 2017). Due to the different variables that can be manipulated in SSG, studies with professional male soccer players have shown different physical and technical-tactical demands depending on pitch size, number of players, relative area/player (Casamichana & Castellano, 2010; Castellano et al., 2013; Gómez-Carmona et al., 2018), the presence of goals or mini-goals (Gómez-Carmona et al., 2018; Mallo & Navarro, 2008), rules modification (Aasgaard & Kilding, 2018), coach encouragement (Rampinini et al., 2007), among others. In this sense, the use of larger pitch sizes (with the same number of players) promotes higher physical (López-Fernández et al., 2017) and physiological responses which are accompanied by greater effective playing time and higher RPE (Casamichana & Castellano, 2010). On the other hand, introducing mini goals during small sided games reduced both the external and internal loads of the training task (Castellano et al., 2013; Gómez-Carmona et al., 2018). However, it is unclear whether SSG replicate the intensity of the movement patterns and repeated-sprint demands in elite female soccer competitions. As in previous studies with male soccer players (Casamichana & Castellano, 2010; Castellano et al., 2013), it was hypothesized that increasing pitch size and eliminating goals would induce higher external load during SSG. Therefore, the aim of this study was to describe and compare the external load responses of elite female soccer players in different small-sided games in terms of pitch size dimensions and the presence of mini-goals.

Methods

Participants

Twelve elite female soccer players (n=12) from the same soccer team belonging to the Spanish first league participated in this study (mean ± SD: age 26.5 ± 5.7 years, weight 58.56 ± 5.58 kg, height 164.4 ± 5.3 cm, body mass index (BMI) 21.63 ± 1.3, bone mass 16.9 ± 1.52%, fat mass 21.74 ± 3.2 %, muscle mass 40.6 ± 2.95 %). Participants´ body composition was determined by skinfold measurements (Stewart et al., 2011). They have been played in the highest Spanish soccer league for at least one year. Players trained 1.5-2.5 hours per session, 4 times/week during a typical weekly match competition. All players were notified of the research design and its requirements. They gave their informed consent before the start of the investigation, as well as the team staff.

According to the proposal of Winter & Maughan, (2009), these data arose from the daily player monitoring in which player activities are routinely measured over the course of the season. Therefore, ethics committee clearance was not required. The study conformed nevertheless to the recommendations of the Declaration of Helsinki.

Design

The players were familiarized with the different SSG and the equipment used during the experimental procedures. Two different pitch size (20x20m and 30x30m), with or without the presence of mini-goals were used during SSG. Therefore, four different SSG (experimental conditions) were analyzed: SSG in a 20x20m pitch size with mini-goals (20MG), SSG in a 20x20m pitch size without mini-goals (20NG), SSG in a 30x30m pitch size with mini-goals (30MG), and SSG in a 30x30m pitch size without mini-goals (30NG) (Figure 1).

Methodology

External load during SSG was measured using a global positioning system (GPS- SPI Pro X, GPSports Systems, Australia) worn in a harness at the scapulae level. The device is comprised of a 5 Hz GPS microcontroller and a proprietary interpolation algorithm that outputs positional data at a 15 Hz frequency. The device also incorporated a 100 Hz triaxial accelerometer. The validity and reliability of the GPS system have been previously reported (Coutts & Duffield, 2010). To reduce the inter-unit error, each player wore the same GPS unit throughout the different SSG. In addition, to limit the possible effects on data collection due to the GPS signal, the devices were switched on 15 minutes before the start of the session and a minimum of 8 connections to GPS satellites were established. Data from each GPS unit were downloaded to a laptop computer and analyzed using commercially available Team AMS software (v.R1.215.3). The GPS devices allowed the measurement (relative to each minute of played SSG) of: total distance (TD) (m·min-1); low intensity running (LIR) (distance covered at <15 km·h-1 in m·min-1); high intensity running (HIR) (distance covered >15km·h-1 in m·min-1); sprint distance (SPD) (distance covered >2m·s-2 or >20km·h-1 in m·min-1); accelerations (ACC; changes in velocity >2m/s2) (n·min-1); decelerations (DEC; changes in velocity <-2m/s2 (n·min-1)(Vázquez-Guerrero et al., 2020); repeated sprints (RS) defined as 2 consecutive sprints in less than 20 seconds (n·min-1); Bodyload (BL) (Arbitrary Unit·min-1). Bodyload was determined through the GPS's 100 Hz triaxial accelerometer, which combines the body movement axes (vertical (y), horizontal (x), and anteroposterior (z)) (Ehrmann et al., 2016) and it´s largely correlated with Edward´s TRIMP (Rabbani et al., 2019). To be able to compare results, speed thresholds were based on previous research (Ramos et al., 2017). Only field players were included in the analysis. Participants were measured in the same place where they usually train. Each training session was carried out on artificial turf. The SSG characteristics are shown in table 1. Each SSG consisted of the same players in each team team, playing time per set (4 minutes), and recovery time between sets (2 minutes).

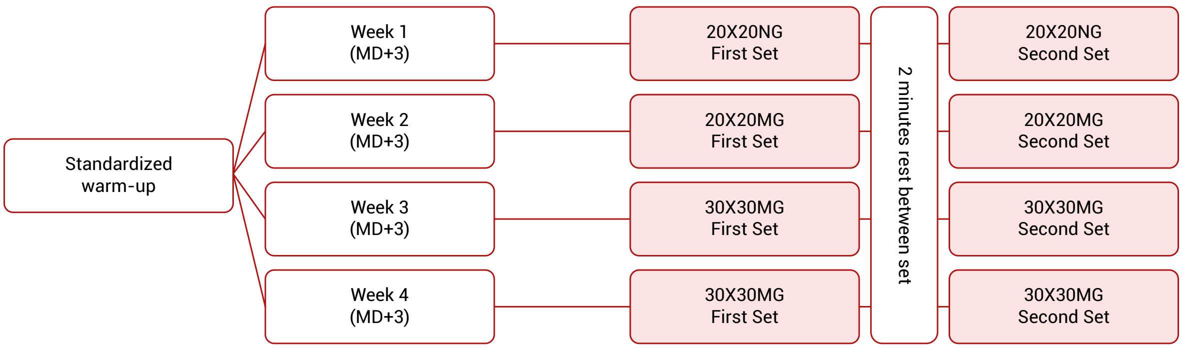

Figure 1. Weekly distribution of small-sided games.
MD+3: 3rd day after the last competition match. NG: no goals. MG: mini-goals. 20x20 and 30x30: pitch size.

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Table 1. Small-sided games characteristics.

	Small-sided games			
	20MG	**30MG**	**20NG**	**30NG**
Players	6 vs 6	6 vs 6	6 vs 6	6 vs 6
Duration per set (min)	4	4	4	4
Pitch area (m^2)	400	900	400	900
Rest between sets (min)	2	2	2	2
Pitch size (m)	20x20	30x30	20x20	30x30
Area per player (m^2)	33	75	33	75
Goals (high x width) (cm)	91x63	91x63	No goals	No goals

Two sets of each SSG were performed (Figure 1). During 20NG and 30NG the aim was to maintain ball possession as much as possible, while the aim during 20MG and 30MG SSG was to score in the goals. Encouragement from staff was provided to increase motivation during SSG (Rampinini et al., 2007). In addition, staff assistants were located around the playing field to ensure quick restarts of the game (Halouani et al., 2014). Data acquisition took place during the third day after the last competition match (MD+3) in order to ensure the maximal recovery of the players after the last match (Silva et al., 2018). Each SSG was carried out consistently during different training sessions on MD+3. Every SSG were carried out at the same time in the afternoon to limit the effects of circadian rhythms on performance (Drust et al., 2005). Prior to SSG, a standardized warm-up was carried out. This warm-up consisted of 2 minutes of low-intensity running, 3 minutes of mobility-dynamic stretching, and 5 minutes of a passing and moving drill.

Statistical analysis

Data are presented in a descriptive way (means ± standard deviation -SD-). Moreover, comparisons between SSG were carried out through one-way analysis of variance (ANOVA), with a post-hoc Bonferroni to identify statistical significance between pairs ($p < 0.05$), and non-clinical magnitude-based inference (Cohen's d) at 90% of confidence interval The estimated magnitudes were classified in standardized units as follow: <0.2 trivial, >0.2-0.6 small, >0.6-1.2 moderate, >1.2-2.0 large, and >2 very large (Hopkins et al., 2009). These magnitude thresholds were also analyzed in probabilistic terms as <0.5% almost certainly not, >0.5-5% very unlikely, >5-25% unlikely, >25-75% possible, >75-95% likely, >95-99% very likely, and >99% almost certainly. Changes were considered meaningful if the qualitative change was >75% (likely to almost certainly) and the effect size (Cohen's d) greater than 0.2 (Hopkins & Batterham, 2016).

Results

Figure 2 displays the distance covered per minute during the different speed thresholds (low and high running intensity) and the individual response for total distance across the different SSG. Greater TD and LIR was observed during 30NG compared to 20NG (*p*=.001, *d*=1.20; *p*=.001, *d*=1.06, respectively), 30MG (*p*=.001, *d*=1.70; *p*=.001, *d*=1.84, respectively) and 20MG (*p*=.001, *d*=1.80; *p*=.009, *d*=1.74, respectively). In addition, 30NG induced greater HIR compared to 20NG (*p*=.001, *d*=1.20) and 20MG (*p*=.001, *d*=1.18).

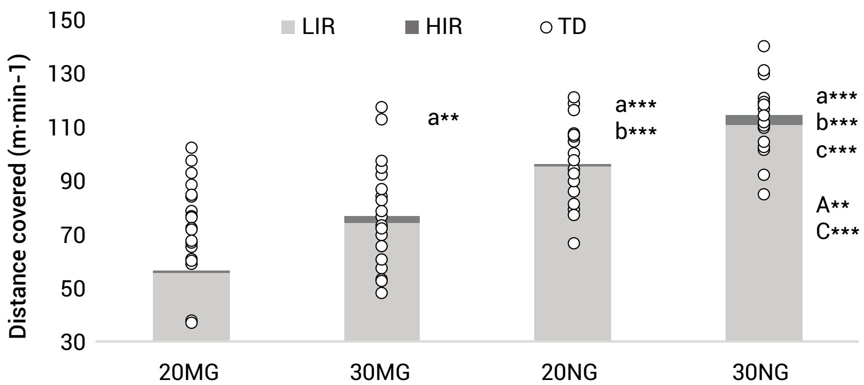

Figure 2. Total distance and distance covered during the different speed thresholds across the different SSG LIR=Low-intensity running (<15 $km \cdot h^{-1}$); HIR=High-intensity running (>15 $km \cdot h^{-1}$); TD=Total distance individual response. Note. a: significant difference compared to 20MG for LIR; b: significant difference compared to 30MG for LIR; c: significant difference compared to 20NG for LIR; [A]: significant difference compared to 20MG for HIR; [B]: significant difference compared to 30MG for HIR; [C]: significant difference compared to 20NG for HIR. *: *d*>0.6 and likely differences; **: *d*>0.6 and very likely differences; ***: *d*>0.6 and almost certainly differences.

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Figure 3 shows the differences in accelerations and decelerations carried out per minute through the different small-sided games The number of ACC and DEC was lower during 20MG compared to 30MG, 20NG and 30NG (p=.003-0.005, d=.72-0.74)

Table 2 displays the external loads responses across the different SSG. Greater BL was observed during 30NG compared to 20NG (p=.008, d=1.04), 20MG (p=.001, d=1.64) and 30MG (p=.001, d=1.60). No differences were observed in sprint distance and repeated sprints between any of the SSG conditions.

The magnitude of the differences in external load responses between SSG (table 3) showed that compared to 20NG, greater TD (*d*=1.20), LIR (*d*=1.06) and HIR (*d*=1.20) were observed in 30NG, with a *very likely* moderate-large difference, as well as for the number of decelerations (*d*=.31) and sprint distance (*d*=.28), with a possible small difference. Similarly, the expansion of the pitch size in SSG with mini-goals (30MG vs 20MG) induced greater LIR (*d*=.86, *very likely* moderate difference), HIR (*d*=.61, *likely* moderate difference), accelerations (*d*=.38, *likely* small difference), and decelerations (*d*=.42 *likely* small difference). The elimination of mini-goals during SSG in the bigger pitch area (30NG vs 30MG) induced greater TD (*d*=1.70, *very likely* large difference), LIR (*d*=1.84, *very likely* large difference), accelerations (*d*=.39, *likely* small difference), and sprint distance (*d*=.42, *likely* small difference). Similarly, the elimination of mini-goals during SSG in the smaller pitch area (20NG vs 20MG) induced greater TD (*d*=1.13) and LIR (*d*=1.39), with very likely moderate difference between conditions.

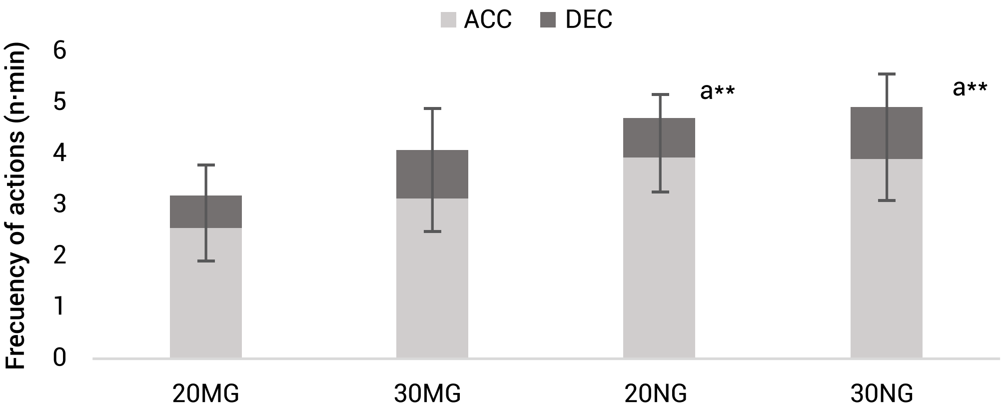

Figure 3. Accelerations and decelerations per minute during the different SSG
ACC=Number of accelerations per minute; DEC=Number of decelerations per minute. Notes. [a]: significant difference compared to 20MG for ACC. *: *d*>0.6 and likely differences; **: *d*>0.6 and very likely differences; ***: *d*>0.6 and almost certainly differences.

Table 2. External load response during different small-sided games (Mean ± SD).

	20MG	30MG	20NG	30NG
TD (m·min-1)	73.44±16.13	76.90±18.44	96,46±13.12a,b	114,49±12.84a,b,c
LIR (m·min-1)	55.81±21.61	74,45±16.34a	95,42±12.96a,b	110,83±12.47a,b,c
HIR (m·min-1)	0.72±1.21	2.44±3.98	1.04±1.22	3,66±1.67a,c
SPD (m·min-1)	9.06±6.65	10.85±6.53	11.29±6.61	12.88±6.97
ACC (n·min-1)	2.55±1.28	3.13±1.57	3.91±1.44a	3.89±1.83
DEC (n·min-1)	0.63±0.58	0.92±0.81	0.77±0.45	1.01±0.63
RS (n·min-1)	1.03±1.01	0.95±0.62	1.16±0.94	1.04±0.84
BL (AU·min-1)	1.15±0.55	1.31±0.62	2.03±0.56a,b	2.77±1.19a,b,c

20MG = small-sided game 20m^2 with mini-goals; 30MG = small-sided game 30m2 with mini-goals; 20NG = small-sided game 20m2 without mini-goals; 30NG = small-sided game 30m^2 without mini-goals; TD = total distance; LIR = low intensity running; HIR = high intensity running; SPD = sprint distance; ACC = number of accelerations; DEC = number of decelerations; RS = repeated sprints; BL = Bodyload; AU: arbitrary unit; n·min-1: number per minute.
Notes. [a]: significant difference compared to 20MG; [b]: significant difference compared to 30MG; [c]: significant difference compared to 20NG.

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Table 3. Magnitude-based differences in and non-clinical probabilistic inferences between SSG.

		30NG vs 20NG	30MG vs 20MG	30NG vs 30MG	20NG vs 20MG	20NG vs 30MG	30NG vs 20MG
TD (m·min-1)	Δ% ± SD	19.00±2.40	4.70±7.40	52.10±13.80	33.70±13.70	27.70±11.10	59.20±15.80
	d ± SD	1.20±0.14	0.18±0.27	1.70±0.37	1.13±0.40	0.99±0.35	1.80±0.38
	Chances (%)	100/0/0	45/54/1	100/0/0	100/0/0	100/0/0	100/0/0
LIR (m·min-1)	Δ% ± SD	16.50±2.40	45.20±26.20	51.30±12.20	83.50±30.70	29.90±10.30	113.80±33.30
	d ± SD	1.06±0.15	0.86±0.41	1.84±0.36	1.39±0.38	1.16±0.35	1.74±0.36
	Chances (%)	100/0/0	99/1/0	100/0/0	100/0/0	100/0/0	100/0/0
HIR (m·min-1)	Δ% ± SD	226.40±179.20	108.00±216.10	25.50±75.80	42.50±119.30	-21.10±67.90	310.30±368.30
	d ± SD	1.20±0.53	0.61±0.76	0.19±0.47	0.30±0.64	-0.20±0.64	1.18±0.68
	Chances (%)	100/0/0	83/13/4	48/43/9	61/30/9	15/36/50	99/1/0
SPD (m·min-1)	Δ% ± SD	19.10±22.90	30.90±39.70	27.10±33.40	38.80±58.20	9.50±33.30	70.60±66.00
	d ± SD	0.28±0.30	0.31±0.34	0.42±0.46	0.38±0.47	0.16±0.53	0.62±0.44
	Chances (%)	67/33/1	71/28/1	79/19/1	74/24/2	45/42/13	94/6/0
ACC (n·min-1)	Δ% ± SD	-1.40±29.70	25.70±21.20	22.50±16.40	56.20±52.50	24.30±38.50	54.00±38.60
	d ± SD	-0.02±0.44	0.38±0.28	0.39±0.25	0.74±0.55	0.41±0.58	0.72±0.41
	Chances (%)	20/55/25	86/14/0	89/11/0	95/5/0	73/23/4	98/2/0
DEC (n·min-1)	Δ% ± SD	19.10±35.60	39.70±46.90	18.30±25.70	19.30±41.40	-26.30±37.50	52.90±62.10
	d ± SD	0.31±0.52	0.42±0.41	0.22±0.28	0.22±0.42	0.06±0.45	0.53±0.49
	Chances (%)	64/31/5	81/18/1	54/45/1	53/42/5	30/53/17	87/12/1
RS (n·min-1)	Δ% ± SD	1.50±32.00	3.30±34.70	14.40±47.20	-1.40±59.50	2.40±43.20	-10.50±37.00
	d ± SD	0.02±0.33	0.04±0.37	0.19±0.58	-0.02±0.64	0.03±0.59	-0.13±0.45
	Chances (%)	18/69/14	23/63/14	49/38/13	28/40/31	32/43/25	11/50/39
BL (AU·min-1)	Δ% ± SD	32.50±8.90	17.20±19.90	120.40±45.60	94.90±35.30	66.40±29.10	158.20±54.80
	d ± SD	1.04±0.25	0.27±0.29	1.60±0.42	1.15±0.31	1.03±0.35	1.64±0.36
	Chances (%)	100/0/0	67/33/1	100/0/0	100/0/0	100/0/0	100/0/0

20MG = small-sided game 20m^2 with mini-goals; 30MG = small-sided game 30m^2 with mini-goals; 20NG = small-sided game 20m2 without mini-goals;
30NG = small-sided game 30m^2 without mini-goals; TD = total distance; LIR = low intensity running; HIR = high intensity running; SPD = sprint distance;
ACC = number of accelerations; DEC = number of decelerations; RS = repeated sprints; BL = Bodyload. AU: arbitrary unit; n·min-1: number per minute.
Chances: expressed as percentage of chances of having +ve/trivial/-ve differences.

Discussion

The aim of this study was to describe and compare the external load responses of elite female soccer players in different small-sided games where pitch size and the presence of goals were modified. The main findings were that 30NG presented the highest activity profiles for TD, HIR, and BL while 20MG reported the lowest values in most of the variables. In this sense, current results demonstrate a clear pattern, whereas i) the increase in the pitch area of the SSG induced an increase in the external load, and ii) the exclusion of mini-goals during SSG increased the external load in the players.

Current results indicate that the increase in pitch size increases total distance (Δ% =1 9.00±2.40 – 4.70±7.40), low intensity running (Δ%=16.50±2.40 – 45.20±26.20), high intensity running (Δ%=226.40±179.20 – 108.00 ±216.10), and sprint distance (Δ% = 19.10 ± 22.90 – 30.90 ± 39.70). Previous studies, where area per player was modified, have shown a similar behavior. Decreasing player number (7vs7, 5vs5 and 3vs3) and maintaining pitch size (thus, increasing area per player) resulted in greater total distance covered (d=1.07-1.16). In addition, increasing the area available per player resulted in greater total and high intensity running covered per minute (d=.65-1.18) (Randers et al., 2018). In this sense, if players have more distance to cover, they will be able to perform longer accelerations which allows them to reach greater speeds and distances (Mara et al., 2016). In addition, bigger SSG pitch sizes promote higher effective playing time (Casamichana & Castellano, 2010) that can limit the time spent in stationary positions or walking, thus increasing the intensity of the task without modifying ball possession (Peñas & Álvarez, 2020). However, decreasing pitch size, and therefore reducing area per player, may involve higher individual and collective actions done by the players. Greater variability in the technical actions performed was als observed when pitch size is reduced (García-Angulo et al., 2020).

Regarding accelerations, decelerations and BodyLoad, expanding pitch size produced limited changes depending on the presence or absence of mini-goals. During NG SSG, increasing pitch size only produced large effects on BL (Δ%=32.50±8.90), while trivial changes were observed in ACC (Δ%=-1.40±29.70) and DEC (Δ%=19.10±35.60). During SSG where the aim is to retain the ball as long as possible, without a specific direction for the offensive and defensive actions (i.e., as during SSG without mini-goals), the game may become more chaotic, increasing BL. On the other hand, increasing pitch size in the presence of mini-goals induced greater acceleration (Δ%=25.70±21.20) and deceleration (Δ%39.70±46.90), although with a likely small magnitude, as well as greater BodyLoad (Δ%=17.20±19.90), with only a small possible magnitude. These results are slightly different compared to previously reported data (Mara et al., 2016). On that, players suffered trivial changes on acceleration distance when increasing field dimensions (with full size goals) while area per player remained constant (d=.18). In addition, increasing the area per player during four-a-side SSG aimed at ball-possession, did not produce differences regarding neuromuscular variables (López-Fernández et al., 2017). The differences between our results and data from previous studies may be explained due to the presence of mini-goals (Castellano et al., 2013), the different age (Abade et al., 2014), and pitch ratio per player (Casamichana & Castellano, 2010).

Compared to SSG with mini-goals, the absence of mini-goals in both pitch size SSG induced moderate-large effects on TD (Δ%=52.10±13.80 - 33.70±13.70) and LIR (Δ%=51.30±12.20 - 83.50±30.70) and likely small increases on SD (Δ%=27.10±33.40 - 38.80±58) Previous research demonstrated that eliminating goals, during different SSG (7vs7, 5vs5 and 3vs3) where the area per player was modified, induced significant increases in total distance covered, distance at 7.0-12.9 and 13.0-17.9km·h-1 (Castellano et al., 2013) in young male soccer players. Accordingly, a similar investigation carried out with female soccer players, exhibited greater jogging and sprint distance in possession-only games (i.e., without mini-goals) than during SSG with mini-goals.

Removing the goals produced different responses in Bodyload, accelerations and decelerations. BL presented certainly moderate to large effects (Δ% =120.40 ± 45.60 - 94.90 ± 35.30) while accelerations (Δ%= 22.50±16.40 - 56.20±52.50) and decelerations (Δ%= 18.30±25.7 - 19.30±41.40) underwent minor changes. Research into the effect of the introduction/elimination of mini-goals in SSG is limited (Castellano et al., 2013; Halouani et al., 2014, 2017a, 2017b; Mallo & Navarro, 2008). During these investigations it was proven that small-sided games without goals produce higher PlayerLoad, W:R ratio (Castellano et al., 2013), heart rate responses, blood lactate concentrations, and rate of perceived exertion (RPE) (Halouani et al., 2014, 2017a, 2017b). To our knowledge, just a handful number of studies looked at the effects of goals on accelerations, decelerations, and Player Load profile (Bujalance-Moreno et al., 2022; Gómez-Carmona et al., 2018). They observed more accelerations·min-1 (Δ%=23.62%%), decelerations·min-1 (Δ%=23.3%), and greater PlayerLoad (Δ%=38.67%%) in a 6vs6, 25x40m SSG without goals, especially in regard to an SSG with the same characteristics but with mini-goals. These results presented similar behaviors comparing to this study's findings; however, further research is needed in order to demonstrate the effects of goals on the neuromuscular profile during different SSG with different characteristics. We claimed that the differences observed in physical parameters may be explained due to the different objectives of each SSG. In possession games, the objective is to maintain or retrieve possession. This leads in more pressing situations that may produce more physical activity bouts. On the other hand, SSG with mini-goals promote higher defensive organization around the mini-goals, thus decreasing the activity profile of the task (Mallo & Navarro, 2008).

As a novelty, current results provide information regarding the effects of manipulating the pitch size and the presence of goals during SSG in the

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external load experienced by elite female soccer players. It is worth noting, however, that there are several limitations of this research. Due to the needs of the coaching staff, some of the players who initially participated in the investigation were replaced by others with reduced participation during competitions. Another limitation is the inability to compare by positions due to the low number of participants per playing position during the SSG. No information was obtained regarding distances covered ≥18km·h-1. In future research, it would be interesting to associate the effects of external load with internal load indices.

Manipulating pitch size and the presence of mini-goals affect the physical demands response in 6vs6 small-sided games in elite female soccer players. Expanding the playing area in no goals games induces a meaningful increase in covered distance variables (both at low and high speed but not in sprint) and Bodyload. Increasing the size of the playing area, in the presence of mini goals, increases the number of accelerations and decelerations performed per minute. It also produces an increase in the distance covered at low speed, although that increment is lower than produced by expanding the playing area without the presence of mini-goals. Eliminating goals in 30x30m SSG increases the total distance covered, the distance covered at low speed, the sprint distance, the number of accelerations and Bodyload; while eliminating the goals in 20x20m SSG leads to the same changes except for sprint distance.

Practical applications

Modifying the pitch size and the presence-absence of mini-goals affect the physical demands responses of elite female soccer players during 6vs6 SSG. These results provide valuable information to coaches and strength and conditioning coaches to control the training load, and/or sports therapists to manage the athlete external loads and facilitate a proper incorporation of the player into the team's dynamic. In addition, since this is the first research study describing different elite female soccer demands across different SSG, these results may offer important reference values for female soccer teams and players at similar levels.

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