International Journal of Human Movement and Sports Sciences 9(6): 1470-1476, 2021 http://www.hrpub.org
DOI: 10.13189/saj.2021.090644

Analysis of the External and Internal Load in 4vs4 Large Sided Games: Differences between Fields of Different Sizes

Italo Sannicandro[1,*], Andrea Piccinno[2], Rosa Anna Rosa[2], Giacomo Cofano[2]

[1]Department of Humanities, Literature, Cultural Heritage, Education Sciences, University of Foggia, 71121, Foggia, Italy
[2]University of Foggia, 71121, Foggia, Italy

Received September 28, 2021; Revised November 3, 2021; Accepted November 28, 2021

Cite This Paper in the following Citation Styles

(a): *[1] Italo Sannicandro, Andrea Piccinno, Rosa Anna Rosa, Giacomo Cofano , "Analysis of the External and Internal Load in 4vs4 Large Sided Games: Differences between Fields of Different Sizes," International Journal of Human Movement and Sports Sciences, Vol. 9, No. 6, pp. 1470 - 1476, 2021. DOI: 10.13189/saj.2021.090644.*

(b): *Italo Sannicandro, Andrea Piccinno, Rosa Anna Rosa, Giacomo Cofano (2021). Analysis of the External and Internal Load in 4vs4 Large Sided Games: Differences between Fields of Different Sizes. International Journal of Human Movement and Sports Sciences, 9(6), 1470 - 1476. DOI: 10.13189/saj.2021.090644.*

Abstract This study aims to describe and analyse the internal and external load deriving from LSG exercises carried out on two fields, defined as SLSG and BLSG, in the 4vs4 format, with goalkeepers. 22 professional soccer players participated (average age: 23.59±4.87 years, weight: 77.8±7.6 kg; height: 183.5±7.5 cm) including 20 forward players and 2 goalkeepers; the goalkeepers were not considered in the data collection of the external and internal load. The LSG 4vs4 + 2 goalkeepers exercises were carried out on a natural grass playing field. The exercises were performed on a field 55x49m (269.5 m^2 per player) defined as "small" (SLSG) and on a field 60 x 54 meters (324 m^2 per player) defined as "big" (BLSG). The results of the internal load analysis show how the BLSG provides higher and more significant HR values than those emerged during the SLSG exercise. Instead, the analysis of the external load related to the observed and described parameters shows that the values emerged from the exercise carried out on the BLSG are higher, except for the distance travelled by walking (<7.30 km/h), in which the SLSG exercise provided higher values, although not relevant statistically. No significant data emerge from the statistical analysis in all the observed parameters. This is the first study that analyses the 4vs4 format in an LSG exercise. The results of this study show that large sided games prove to be very valid exercises if the goal is to modulate the intensity of the game related to what really happens during the match.

Keywords Large Sided Games, External Load, Internal Load, Soccer, Professional Soccer Players, GPS

1. Introduction

Technical staff and coaches are constantly looking for new training methods in order to achieve better adaptations and better performances for players [1 - 4].

For these reasons, the staff must precisely know the parameters of the internal (heart rate, blood lactate or evaluation of perceived exertion) and external load (distances covered in different speed zones, number of accelerations and decelerations, etc.) that emerge from the proposed exercises [1, 5].

Nowadays, these parameters can be monitored through the use of heart rate monitors, lactate meters or GPS: these findings become relevant for load control and for monitoring the correspondence between training and session objectives [5 - 6].

For this reason, the scientific literature has recently focused on the analysis and understanding of the loads related to the use of sport-specific exercises carried out by both professionals, non-professionals and young soccer

players [7 - 8].

These specific exercises can simultaneously train both the technical-tactical and the physical aspects. They are better known as small sided games (SSG): in the literature, these exercises have been extensively analysed in order to understand how different formats can influence the internal load [9 - 12], the external load [13 - 15] or both [16 - 18].

Other studies have also investigated the technical-tactical aspects that characterize SSGs [16, 19 - 20].

The formats used most often by the technical staff are 4vs4 and 5vs5 because they allow players to train with high intensity; these formats are placed above all in the first post-match training sessions for those players who have been used little during the competition. [21-24].

One of the aims of the technical staff is to monitor and increase the intensity of training. For this reason, SSG exercises called 'large sided games' have become more and more common, although no significant scientific publications emerge in the literature.

This gap is even more evident if analysed from the perspective of the spaces that should be explored and managed during official matches, for both professionals [5, 21] and non-professionals [18, 25].

Indeed, large sided games (LSG) are these sport-specific exercises carried out with a ball, on fields where each player exploits from 270 to 325 square meters.

It is useful to underline this definition because in the literature the term LSG is often adopted by some authors that analyse formats involving multiple players (i.e. from 8vs8 to 10vs10) [21, 22, 26, 27].

Moreover, regarding the definition of LSG, it is also useful to make a further distinction in Small - Large Side Games (SLSG) and Big Large Side Games (BLSG), according to the different square meters considered for each player and which are derived from the measurements of the official fields.

Even in this case, the literature lacks data capable of supporting methodological choices.

Therefore, this study aims to describe and analyse the internal and external load deriving from LSG exercises carried out on two fields, defined as SLSG and BLSG, in the 4vs4 format, with goalkeepers.

2. Materials and Methods

2.1. Participants

22 professional soccer players participated (average age: 23.59±4.87 years, weight: 77.8±7.6 kg; height: 183.5±7.5 cm) including 20 forward players and 2 goalkeepers. Out of the 20 movement players, 2 were not considered in the data analysis as they did not perform both 4vs4 exercises. The goalkeepers were not considered in the data collection of the external and internal load. The study included the players who had not reported injuries in the previous 60 days and who had played at least two matches in the 4 weeks prior to these LSGs. All footballers knew how to work with GPS monitoring systems and heart rate monitors. The study was carried out respecting the principles contained in the Declaration of Helsinki.

2.2. Procedures

For the analysis of the internal load, heart rate (HR) and ratings of perceived exertion (RPE) parameters were measured. The HR measurement was conducted with a telemetry system and heart rate monitors (Polar Electro Oy, Kempele, Finland) and the analysed values are the average HR and the peak HR in beats per minute (bpm) and as a percentage referred to the maximum HR (% HRmax); while for the RPE the CR10 Borg scale was used [28].

During the two LSG exercises, the players were monitored using global positioning system (GPS) instrumentation at 18.18 Hz (GPEXE® System, Exelio srl, Udine, Italy) recently validated [29]. The parameters detected and examined are: total distance covered (m), distance covered per minute (m), maximum speed (peak in km/h), average metabolic power (W/kg), average metabolic power (W/kg) during active phases (MPE avg power) and during recovery phases (MPE rec avg power), the number of accelerations (>2 m/s) and decelerations (<2 m/s) and the equivalent distance covered (m). Furthermore, the same distance covered in different speeds has been analysed: walking/jogging (<7.30 km/h), low intensity running (7.30-14.50 km/h), moderate intensity running (14.50-19.90 km/h), high intensity running (19.90-25.20 km/h) and very high-speed running (> 25.2 km/h), better known as "sprint" [30 - 31]. Also, the distance covered at different intensity pf power has been analysed: low intensity power (<20.00 W/kg), high intensity power (20.00 - 35.00 W/kg), very high intensity power (35.00 - 50.00 W/kg) and maximal intensity power that is > 50 W/kg [32].

The LSG 4vs4 + 2 goalkeepers exercises were carried out on a natural grass playing field. The size of the two fields respected those of the playing fields for professionals (105x68 meters, Fifa data) and non-professionals (100x60 meters).

The exercises were performed on a field 55x49 m (269.5 m^2 per player) defined as "small" (SLSG) and on a field 60x54 meters (324 m^2 per player) defined as "big" (BLSG).

No. 5 soccer balls were used, positioned both inside the goal and outside the perimeter of the field to speed up the match when the ball ended out. Regular goals (7.32x2.44 m) were used. LSG's exercises were carried out with the encouragement from the technical staff and with the limitation of consecutive touches (3) of the ball. The characteristics of the LSGs are summarized in table 1.

Table 1. The SSG formats used in the study

	SMALL LSG	BIG LSG
Number of Bouts	4	4
Bout Duration (min)	5	5
Resting Duration (min)	2	2
Pitch Dimension (m x m)	55 x 49	60 x 54
Relative Pitch Size (m^2)	1:269,5	1:324
Goalkeeper	yes	yes
Specific Rules	Max 3 touches	Max 3 touches
Coach Encouragement	yes	yes

2.3. Design

Before starting, players have warmed up for about 15 minutes. The warm-up included an aerobic activation phase, dynamic stretching, conditioning exercises for acceleration and exercises with a ball.

After the warm-up, players began with LSG exercises: 4 sets of 5 minutes each, with 2 minutes of passive recovery between each set. During the whole exercise, players were monitored through the use of a heart rate monitor in telemetry and GPS instruments. At the end of each exercise, the RPE value was analysed individually.

The exercises were carried out in different days, with a recovery pause of at least 48 hours.

2.4. Statistical Analysis

Descriptive statistics (M ± SD) was applied to all observed variables; Student's t-test for paired data was used to verify the existence of statistically significant differences between the average values obtained using the Statistical Package for Social Sciences (SPSS 15.0 for Windows) software. Significance was set at $p<0.05$. Cohen's d was used to verify the effect size index [33].

3. Results

The results of the internal load analysis show how the BLSG provides higher and more significant HR values than the those emerged during the SLSG exercise. Specifically, the results that emerged are: HR peak (bpm) 189.72±3.19 vs 184.56±9.19 ($p<0.05$, medium d= -0.59); the peak of the % HRmax 95.17±1.65 vs 92.44±4.19 ($p<0.05$, medium d= -0.68); the average HR (bpm) 170.94±6.85 vs 166.39±6.56 ($p<0.05$, medium d= -0.64) while the average HR in terms of % HRmax is 85.83±3.55 vs 83.61±2.91 ($p<0.01$, medium d= -0.69). RPE also appears to be higher during the BLSG (7.67±0.68 vs 7.61±1.15) although statistically, no significant difference appears.

Instead, the analysis of the external load related to the observed and described parameters shows how the values emerged from the exercise carried out on the BLSG are higher, except for the distance travelled by walking (<7.30 km/h), in which the SLSG exercise provided higher values, although not relevant statistically. No significant data emerge from the statistical analysis in all the observed parameters. The results of the external and internal load and relative significance are summarized and described in table 2 and in table 3.

Table 2. Results of external load recorded in the SLSD and in BLSG

	4vs4 SLSG	4vs4 BLSG	Cohen's d
Total distance (m)	2721.5±112.2	2920.4±132.3 ‡	-1.29
Distance/min (m)	135.9±5.5	146.0±6.6 ‡	-1.46
Maximum speed (km/h)	25.0±2.0	26.5±0.8 *	-0.59
Avg Metabolic power (W/kg)	11.05±0.5	12.02±0.6 ‡	-1.21
MPE avg power (W/kg)	21.1±1.2	22.3±0.4	
MPE rec avg power (W/kg)	6.7±0.4	7.3±0.9	
Acceleration (n°)	26.0±8.8	27.7±4.1	
Deceleration (n°)	26.5±8.5	33.2±8.0 *	-0.52
Equivalent distance (m)	3182.1±134.5	3428.3±166.2 ‡	-1.25
Walking (m)	724.8±38.3	706.5±42.3	
Low intensity running (m)	1303.2±96.0	1331.8±157.2	
Moderate intensity running (m)	535.4±57.1	654.4±82.0 ‡	-1.64
High intensity running (m)	147.8±66.2	217.1±47.6 †	-0.70
Sprint running (m)	11.8±14.0	15.3±7.7	
Distance low-power (m)	1939.0±55.4	1982.5±121.2	
Distance high-power (m)	517.2±63.9	627.6±62.0 ‡	-1.97
Distance very high-power (m)	178.9±36.2	223.5±50.0 †	-0.71
Distance maximum power (m)	87.2±49.5	94.0±23.6	

Legend: * $p<0.05$; † $p<0.01$; ‡ $p<0.005$

Table 3. Results of internal load recorded in the SLSD and in BLSG

	4vs4 SLSG	4vs4 BLSG	Cohen's d
HR peak (bpm)	184.56±9.19	189.72±3.19*	-0.59
HR peak (% HRmax)	92.44±4.19	95.17±1.65 *	-0.68
Average HR (bpm)	166.39±6.56	170.94±6.85 *	-0.64
Average HR (% HRmax)	83.61±2.91	85.83±3.55 †	-0.69
RPE	7.61±1.15	7.67±0.68	

Legend: * p<0.05; † p<0.01; ‡ p<0.005

4. Discussion

This is the first study that analyses the 4vs4 format in an LSG exercise. Analysing the values related to the internal and external load, it is clear that the BLSG field has higher values, although not strictly significant.

(a) Internal load parameters

The observed internal load parameters show how the HR in the BLSG is always higher and significant than SLSG values. These data show how covering a greater density of space demands a higher effort, which causes an increase in HR both in terms of bpm and % HRmax.

The higher effort observed with HR is also confirmed by RPE. Although not significant, the RPE that emerged during 4vs4 on the BLSG is slightly higher, even if the values are very similar (7.67±0.68 vs 7.61±1.15).

In the literature there are some LSG studies that have analyzed both HR and RPE with which to make a comparison.

Specifically, some authors [18] used the 6vs6 + goalkeepers on a field of 300 square meters/player. The values of % HRmax and % averageHR detected (98±5 and 88±6); appear to be higher than those shown in the SLSG (92.44±4.19 and 83.62±2.91,) and in the BLSG (95.17±1.65 and 85.83±3.55). Other authors [37], on the other hand, used the format of 5vs5 + goalkeepers on a field of 330 square meters/player. This study provides values of % HRmax (86.5±4.5) and RPE (6.6±1.2) which are lower than both the SLSG (92.44±4.19 and 7.61±1, 15) and BLSG (95.17±1.65 and 7.67±0.68).

(b) External load parameters

The parameters of the external load, in the numerical analysis, are all higher in the BLSG except for the distance covered at low intensity, although not statistically significant.

The BLSG, in relation to the larger dimensions of the playing surface, obtains higher and significant values in terms of distance covered (p<0.005; large d= -1.2973), distance covered per minute (p<0.005; large d= -1.46104), equivalent distance covered (p<0.005; large d= -1.25271) and maximum speed (p<0.05; medium d= -0.59553).

The higher intensity provided by the BLSG is also confirmed by other parameters related to the external load, such as the distance covered at moderate intensity (p<0.005; large d= -1.6483) and at high intensity (p<0.01; medium d= -0.70387). The distance covered in sprints is also higher in the BLSG, although not statistically significant.

This trend related to speed is also confirmed in terms of power. The distance covered at high power (p<0.005; large d= -1.97743) and at very high power (p<0.01; medium d= -0.71683) is higher and significant in the BLSG. The distance covered at maximal power is also higher in the BLSG, but not significant for sprints. This shows how, during the 4vs4 performed on two LSG fields, high intensity is more discriminating than the very high intensity.

Another parameter which confirms the intensity of LSG exercises is the average metabolic power expressed throughout the exercise. Both fields show higher values than those observed during matches involving both young and adult soccer players [34 - 36]. In particular, the values of the average metabolic power are higher and more significant (p<0.005; large d= -1.2125) in the BLSG. The emerged values of the metabolic power expressed both during the active phases and during the recovery phases are also higher in the BLSG, although not statistically significant.

The number of high accelerations and high decelerations is higher during the 4vs4 played on BLSG. The significant differences emerge only in the analysis of the decelerations (p<0.05; small d= -0.52522).

The LSG carried out on a "small" field or on a "big" field is exercises that use the aerobic metabolism in terms of power, given the high intensity they are able to produce. These exercises can thoroughly strengthen the ability in terms of stops and starts, thus with an important use of eccentric contraction.

Therefore, from the various parameters analysed it can be seen how both fields used provide intense exercises for both internal and external load.

In the literature, a comparison appears implausible, due to the fact that this is the first study that analysed the 4vs4 format in an LSG.

If we consider the space given to each player, the results of this study could be compared with the analysis from the use of 5vs5 or 6vs6 formats, where each athlete was given at least 300 square meters.

Regarding the total distance covered, it can be seen that the measured values are higher than what emerged during a 6vs6 + goalkeepers played on a field with a density of 300 square meters/player [18], whereas they appear to be

lower than in another study that used the same density for the BLSG but the format of the 5vs5 + goalkeepers and a total training time higher than 15 minutes [21].

The maximum speed detected in this study, both in the SLSG (25.07±2.04 km/h) and in the BLSG (26.57±0.84 km/h), shows a significant difference between the two playing fields used ($p<0.05$; medium d= -0.59553), is higher than in another study that investigated large sided games during the 5vs5 + goalkeepers [37]. The same phenomenon is observed by comparing the meters covered per minute.

The distance covered at moderate intensity (>14.50 km/h) appears to be higher in both exercises, compared to another study [21] which used the 5vs5 + goalkeepers, the same density of the BLSG and a longer playing time, demonstrating how these two exercises highlight higher values, although in the analysis of the total distance they have lower values. Regarding the running intensity, if the goal of the session of training is intensity and not volume, the exercise is certainly more intense and specific.

The abovementioned analysis does not follow the same trend if we consider the distance covered at high power (>20 W/kg). Indeed, it emerges that the SLSG and BLSG values are lower than those provided by reference [21]. This could be due to the higher working time used by the authors in the exercise. These differences suggest that probably the distance covered in terms of power and speed does not follow the same trend.

5. Conclusions

The results of this study show how the difference of 55 square meters/player can make the two exercises completely different both in terms of external load and internal load, even if both dimensions used during exercises are defined 'large sided games'. Accordingly, both dimensions can be used within a microcycle adapted to the goals of the session. In fact, in relation to the two dimensions of the field analyzed, it is advisable to use the large field in the first weekly session, on the day following the match; while the small field in the fourth weekly session, three days before the match.

Large sided games prove to be very valid exercises if the goal is to modulate the intensity of the game related to what really happens during the match. Further analyses will should investigate the volume of the proposed exercise in order to try to understand which duration can provide the closest peak and average values, similar to those observed during matches.

REFERENCES

[1] Poehling R. A., Tsai M. C., Manson S. A., Koehle M. S., Meylan C., "Physical performance development in a female national team soccer program", *Journal of science and medicine in sport*, vol. 24, no. 6, pp. 597–602, 2021, https://doi.org/10.1016/j.jsams.2020.12.009

[2] Raiola G., Altavilla G., "Testing motor skills, general and special coordinative, in young soccer", Journal of Human Sport & Exercise, 15, Supplementary Issue, 1Proc Winter event Costa Blanca, 2020, pp. 206-212

[3] Fischetti F., Cataldi S., Greco G., "Lower-limb plyometric training improves vertical jump and agility abilities in adult female soccer players", *Journal of Physical Education and Sport*, vol. 19, no. 2, pp. 1254-1261., 2019, doi:10.7752/jpes.2019.02182

[4] D'Isanto T., D'Elia F., Raiola G., Altavilla G., "Assessment of sport performance: Theoretical aspects and practical indications", *Sport Mont*, vol. 17, pp. 79-82, 2019, doi: 10.26773/smj.190214

[5] Riboli A., Coratella G., Rampichini S., Cé E., Esposito F., "Area per player in small-sided games to replicate the external load and estimated physiological match demands in elite soccer players", *PLoS ONE*, vol. 15, no. 9, pp. e0229194, 2020, doi.org/10.1371/journal.pone.0229194

[6] Sannicandro I., Cofano G., Raiola G., Rosa A.R., Colella, D., "Analysis of External Load in Different Soccer Small-Sided Games Played with External Wildcard Players", *Journal of Physical Education and Sport*, vol. 20, no. 2, pp. 672-679, 2020a, doi:10.7752/jpes.2020.02098

[7] Dello Iacono A., Martone D., Cular D., Milic M., Padulo J., "Game Profile-Based Training in Soccer: A New Field Approach", *Journal of strength and conditioning research*, vol. 31, no. 12, pp. 3333–3342, 2017, https://doi.org/10.1519/JSC.0000000000001768

[8] Dello Iacono A., Unnithan V., Shushan T., King M., Beato, M., "Training load responses to football game profile-based training (GPBT) formats: effects of locomotive demands manipulation", *Biol Sport*, vol. 39, no. 1, pp. 145–155, 2021, doi:10.5114/biolsport.2021.102919

[9] Halouani J., Chtourou H., Dellal A., Chaouachi A., Chamari K., "Soccer small-sided games in young players: rule modification to induce higher physiological responses", *Biology of Sport*, vol. 34, no. 2, pp. 163-168, 2017, doi: 10.5114/biolsport.2017.64590

[10] Martone D., Giacobbe M., Capobianco A., Imperlini E., Mancini A., Capasso M., Buono P., Orrù S., "Exercise Intensity and Technical Demands of Small-Sided Soccer Games for Under-12 and Under-14 Players: Effect of Area per Player", *Journal of strength and conditioning research*, vol. 31, no. 6, pp. 1486–1492, 2017, https://doi.org/10.1519/JSC.0000000000001615

[11] Sanchez-Sanchez J., Hernández D., Casamichana D., Martínez-Salazar C., Ramirez-Campillo R., Sampaio, J., "Heart Rate, Technical Performance, and Session-RPE in Elite Youth Soccer Small-Sided Games Played With Wildcard Players", *Journal of strength and conditioning research*, vol. 31, no. 10, pp. 2678–2685, 2017, https://doi.org/10.1519/JSC.0000000000001736

[12] Sannicandro I., Cofano G., "Small-Sided Games: Analysis of the Internal Load and Technical Skills in Young Soccer Players", *International Journal of Science and Research*

(IJSR), vol. 6, no. 3, pp. 735-739, 2017, doi: 10.21275/ART20171583

[13] Sannicandro I., Piccinno A., Rosa A.R., Raiola G., Cofano G., "Analysis of external load during SSG 5vs5 with and without external wildcard (jolly) soccer players", *Sport Science*, vol. 14, no. 1, pp. 65-71, 2020b

[14] Nevado-Garrosa F., Suárez-Arrones L., "Comparación de las demandas físicas de tareas de fútbol reducido y la competición en jugadoras de fútbol sub 13. (Comparison of physical demands in small sided games and competition in football players under 13)", *Cultura, Ciencia Y Deporte*, vol. 10, no. 30, pp. 235-243, 2015, https://doi.org/10.12800/ccd.v10i30.592

[15] Gaudino P., Alberti G., Iaia F.M., "Estimated metabolic and mechanical demands during different small-sided games in elite soccer players", *Human Movement Science*, vol. 36, pp. 123-33, 2014, doi: 10.1016/j.humov.2014.05.006

[16] Sannicandro I., Cofano G., "*Small-Sided Games 2",* Edizione Correre, 2019, pp. 1 - 192

[17] Campos Vazquez M.A., Casamichana Gomez D., SuarezArrones L., Gonzalez Jurado J.A., Toscano Bendala F.J., Leon Prados J.A., "Medium-sided games in soccer: physical and heart rate demands throughout successive working periods", *Journal of Human Sport and Exercise*, vol. 12, no. 1, pp. 129- 141, 2017, doi: https://doi.org/10.14198/jhse.2017.121.11

[18] Castellano J., Puente A., Echeazarra I., Casamichana D., "Influence of the number of players and the relative pitch area per player on heart rate and physical demands in youth soccer", *J Strength Cond Res*, vol. 29, no. 6, pp. 1683–1691, 2015, doi: 10.1519/JSC.0000000000000788

[19] Halouani J., Chtourou H., Gabbett T., Chaouachi A., Chamari, K., "Small-sided games in team sports training: a brief review", *Journal of strength and conditioning research*, vol. 28, no. 12, pp. 3594–3618, 2014, https://doi.org/10.1519/JSC.0000000000000564

[20] Hill-Haas S. V., Dawson B., Impellizzeri F. M., Coutts A. J., "Physiology of small-sided games training in football: a systematic review", *Sports medicine (Auckland, N.Z.)*, vol. 41, no. 3, pp. 199–220, 2011, https://doi.org/10.2165/11539740-000000000-00000

[21] Goto H., King J. A., "High-Intensity Demands of 6-a-Side Small-Sided Games and 11-a-Side Matches in Youth Soccer Players", *Pediatric exercise science*, vol. 31, no. 1, pp. 85–90, 2019, https://doi.org/10.1123/pes.2018-0122

[22] Clemente F.M., Sarmento H., Rabbani A., Van Der Linden C.M.I.N., Kargarfard M., Costa, I.T., "Variations of external load variables between medium- and large-sided soccer games in professional players" *Res Sports Med*, vol. 27, no. 1, pp. 50-59, 2019, doi: 10.1080/15438627.2018.1511560

[23] Póvoas S., Randers M. B., Krustrup P., LarsenM. N., Pereira R., Castagna C., "Heart rate and perceived experience differ markedly for children in same-versus mixed-gender soccer played as small- and large-sided games" *Bio Med Res Int*, 2018:7804642, pp. 1-9, 2018, https://doi.org/10.1155/2018/7804642

[24] Gonçalves B., Esteves P., Folgado H., Ric A., Torrents C., Sampaio J., "Effects of Pitch Area-Restrictions on Tactical Behavior, Physical, and Physiological Performances in Soccer Large-Sided Games" *J Strength Cond Res*, vol. 31, no. 9, pp. 2398-2408, 2017, https://doi.org/10.1519/JSC.0000000000001700

[25] Castagna C., D'Ottavio S., Cappelli S., Póvoas S.C.A., "The Effects of Long Sprint Ability-Oriented Small-Sided Games Using Different Ratios of Players to Pitch Area on Internal and External Load in Soccer Players", *Int J Sports Physiol Perform*, vol. 29, pp. 1265-1272, 2019, doi: 10.1123/ijspp.2018-0645.

[26] Owen A.L., Dunlop G., Rouissi M., Haddad M., Mendes B., Chamari K., "Analysis of positional training loads (ratings of perceived exertion) during various-sided games in European professional soccer players", *International Journal of Sports Science & Coaching*, vol. 11, no. 3, pp. 374-381, 2016, https://doi.org/10.1177/1747954116644064

[27] Rampinini E., Impellizzeri F. M., Castagna C., Abt G., Chamari K., Sassi A., Marcora S. M., "Factors influencing physiological responses to small-sided soccer games", *Journal of sports sciences*, vol. 25, no. 6, pp. 659–666, 2007a, https://doi.org/10.1080/02640410600811858

[28] Borg G., "Psychophysical bases of perceived exertion", *Med Sci Sports Exerc*, vol. 14, no. 5, pp. 377-381, 1982

[29] Hoppe M. W., Baumgart C., Polglaze T., Freiwald J., "Validity and reliability of GPS and LPS for measuring distances covered and sprint mechanical properties in team sports", *PloS one*, vol. 13, no. 2, pp. e0192708, 2018, https://doi.org/10.1371/journal.pone.019270

[30] Di Salvo V., Pigozzi F., González-Haro C., Laughlin M. S., De Witt J. K., "Match performance comparison in top English soccer leagues", *International journal of sports medicine*, vol. 34, no. 6, pp. 526–532, 2013, https://doi.org/10.1055/s-0032-1327660

[31] Rampinini E., Bishop D., Marcora S. M., Ferrari Bravo D., Sassi R., Impellizzeri F. M. "Validity of simple field tests as indicators of match-related physical performance in top-level professional soccer players", *International journal of sports medicine*, vol. 28, no. 3, pp. 228–235, 2007b, https://doi.org/10.1055/s-2006-924340

[32] Osgnach C., Poser S., Bernardini R., Rinaldo R., di Prampero P. E., "Energy cost and metabolic power in elite soccer: a new match analysis approach", *Medicine and science in sports and exercise*, vol. 42, no. 1, pp. 170–178, 2010, https://doi.org/10.1249/MSS.0b013e3181ae5cfd

[33] Cohen J., "A power primer", *Psychological Bulletin*, vol. 112, no. 1, pp. 155-159, 1992, doi: 10.1037//0033-2909.112.1.155

[34] Savoia C., Iellamo F., Caminiti G., Doran D.A., Pullinger S., Innaurato M., Annino G., Manzi V., "Rethinking training in elite soccer players: comparative evidence of small sided games and official match play in kinematic parameters", *The Journal of Sports Medicine and Physical Fitness*, Dec 14., 2020, doi: 10.23736/S0022-4707.20.11400-2

[35] Castagna C., Varley M., Póvoas S.C.A., D'Ottavio S., "Evaluation of the Match External Load in Soccer: Methods Comparison", *Int J Sports Physiol Perform*, vol. 12, no. 4, pp. 490-495, 2017, doi: 10.1123/ijspp.2016-0160

[36] Hoppe M.W., Baumgart C., Slomka M., Polglaze T., Freiwald J., "Variability of Metabolic Power Data in Elite Soccer Players During Pre-Season Matches", *Journal of Human Kinetics*, vol. 58, pp. 233-245, 2017, doi:10.1515/hukin-2017-0083

[37] Casamichana D., Bradley P.S., Castellano J., "Influence of the Varied Pitch Shape on Soccer Players Physiological Responses and Time-Motion Characteristics During Small-Sided Games", *Journal of Human Kinetics*, vol. 64, pp. 171-180, 2018, doi: 10.1515/hukin-2017-0192