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A Comparative Study of the Effects of Small-Sided Game Formats on Internal Load and Technical Responses in Soccer

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ABSTRACT

This study aimed to evaluate the influence of game formats on soccer players' internal load and technical responses during small-sided games (SSGs) of the 2-a-side and 4-a-side. Twenty-four male soccer players played three SSGs: possession, mini-goal (MG), and goalkeeper (GK). The SSG interventions were randomly allocated to six training intervention groups using SSGs performed in possession, MG, and GK game formats. The internal load was assessed using the perceived exertion (RPE), enjoyment scale, and visual analog scale (VAS) rating during each SSG session. Mental Readiness Form-3 (MRF-3) was evaluated pre- and post-game for mental preparedness. Technical actions were also conducted using video footage captured during all SSG sessions. A one-way repeated-measures analysis of variance was performed to evaluate any significant differences in performance across the different SSGs. Following the interventions, RPE and VAS scores differed considerably between the possession, MG and GK games in the 2-a-side game ($P<0.05$). Enjoyment varied significantly among the GK, Possession, and MG games ($P<0.05$). The MRF-3 showed no significant difference between the games ($P>0.05$). The technical performance indicated significantly better passes and interceptions in possession games ($P<0.05$). In the 4-a-side games, RPE was markedly higher in possession than in MG and GK ($P<0.05$), with no significant differences in VAS, enjoyment, and MRF-3 scores ($P>0.05$). Technical performance favoured possession of games with more successful passes ($P<0.05$). The findings suggest that analyzing psychological, cognitive and physical aspects together when designing game formats can optimize player performance and promote soccer players' integral athletic and multidirectional skill development.

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INTRODUCTION

Small-sided games (SSGs) are a highly effective training method with modified rules for smaller pitches to optimize the demands of modern soccer matches (Arslan et al., 2021; Clemente et al., 2014a; Hill-Haas et al., 2011). As a high-intensity training method in soccer, SSGs increase physiological and psychological responses while providing long-term biological adaptation (Arslan et al., 2020; Davids et al., 2013). Evidence shows SSGs are more enjoyable, effective, and time-efficient training strategies to improve players' aerobic endurance performance than traditional running-based aerobic training (Clemente et al., 2014b; Los Arcos et al., 2015). Consequently, the application of SSG training is a comprehensive approach employed by coaches to foster the development of athletes' multiple attributes while also providing them with exposure to competitive environments to which they are typically subjected (Impellizzeri et al., 2006; Köklü et al., 2011; 2015; Soylu et al., 2022).

SSGs are played with varying numbers of player contacts (Dellal et al., 2011), smaller pitch areas (Köklü et al., 2011), modified rules (Silva et al., 2023), and goalkeepers' roles (Guard et al., 2022; Köklü et al., 2015; Sanchez-Sanchez et al., 2017), including actual movement patterns, technical skills, tactical awareness, and physical fitness, under simulated game conditions (Bujalance-Moreno et al., 2019). Specifically, different task manipulations and game formats employed in SSGs can enable players to achieve the desired level of effort in their physical, physiological, technical, tactical, and cognitive development (Hammami et al., 2018; Junior et al., 2023). Previous studies indicate that modifying the dimensions of a pitch can have significant effects on various aspects of player performance (Olthof et al., 2017; Castillo-Rodríguez et al., 2023; Castillo et al., 2021; Fernández et al., 2018). For instance, incorporating goalkeepers in SSGs with varying pitch sizes can influence players' workload, with smaller pitches resulting in increased workloads (Hůlka et al., 2016). Halouani et al. (2014) stated that the playing field dimensions in SSGs can influence player performance and game intensity. Furthermore, smaller field sizes and a reduced number of games have been associated with increased occurrences of technical actions, such as passing, dribbling, and shooting (Castelao et al., 2014; Soylu et al., 2022), while contrasting observations indicate a decrease in technical actions during games played on larger field dimensions (Casamichana & Castellano, 2010; Teoldo da Costa et al., 2011). SSGs are highly influential in determining player performance, encompassing various aspects, and the game's configuration is a crucial determinant of player performance.

Köklü et al. (2015) reported that in 2-a-side, 3-a-side and 4-a-side SSGs played with and without a goalkeeper, the without-goalkeeper format caused a higher workload and intensity. In another study, it was observed that in a 4-a-side game played in ball possession and mini-goal formats, possession games resulted in more workload and intensity than mini-goal games (Silva et al., 2023). In another study comparing mini-goal and goalkeeper formats, mini-goal games were more intense than goalkeeper games (Sarmento et al., 2018). In young soccer players, possession-based games concentrating on ball control instead of goal scoring can affect running performance and technical abilities (De Sousa Neto Segundo et al., 2021). By contrast, mini-goal games, which involve scoring through smaller goals, have been demonstrated to offer a training stimulus that is adequate and superior to other formats, effectively combining workload and recovery considerations (Giménez et al., 2017). Furthermore, games featuring goalkeepers, mainly when played on diverse pitch sizes, can affect external and internal loads experienced during small-sided contests, resulting in fluctuations in player workloads contingent upon goalkeepers' presence and the playing field's dimensions (Bergmann et al., 2022). Consequently, the game format can influence the intensity of play, with variables such as the number of players, game design, and goal type affecting the overall intensity of SSGs (González-Rodenas et al., 2015).

According to Smith et al. (2018), soccer players must have a high mental capacity to ensure that physical load does not affect their technical and tactical skills and decision-making processes. Cognitive states during performance cause reluctance to decrease attention levels and fail to achieve expected results (Boksem & Tops, 2008). Enjoyment from soccer-specific training methods has been associated with the number of players during training and their psychological reactions to the training (Carraro et al., 2014). Enjoyment and satisfaction are key factors that can improve positive behavior during training (Rhodes & Kates, 2015) and increase exercise motivation (Carraro et al., 2014; Los Arcos et al., 2015). Moreover, mental fatigue, preparation, and mood during training are essential to soccer players' performance. Research has indicated that mental fatigue impacts several aspects, including mood state (Lorist et al., 2000), cognitive task performance (Boksem et al., 2005), and physical task performance (Lew & Qu, 2014). According to Tauer and Harackiewicz (2004), an increased mood state during training can increase motivation and focus on creative thinking, thus enabling soccer players to perform more successfully. For this reason, the formats of SSGs used in training should be prepared by considering cognitive states such as technical skill and enjoyment, perceived exertion, mental fatigue, mental preparation, and physical capacity.

Therefore, this study examines the effects of possession, mini-goal (MG), and goalkeeper (GK) game formats on the indices of internal load and technical responses in 2-a-side and 4-a-side SSGs in soccer. We hypothesized that the possession game format would increase soccer players' internal load responses and technical actions during SSGs.

METHODS

Participant

24 young male amateur soccer players (age = 21.00 ± 1.47 years; height = 175.92 ± 2.98 cm; weight = 66.58 ± 3.54 kg; body mass index = 21.51 ± 0.79 kg/m−2) voluntarily participated in this study. All participants regularly trained five days a week and played at least once in an official competition. The study was conducted at the beginning of the season, during the preparation period. Players who had not experienced physical or psychological fatigue, injury, discomfort, or illness before the study voluntarily participated. The participants were verbally informed about the study's content, methods, procedures, benefits, and possible risks. The research was conducted following the Declaration of Helsinki and was approved by the Ethics Committee of Tokat Gaziosmanpasa University (2022-05-01).

Procedure

An observational, cross-sectional study design was used to test the hypotheses. The current study examined the consequences of three different game formats (possessions, MG, and GK) on soccer players' internal load and technical abilities in two SSGs (2-a-side and 4-a-side). The participants underwent a two-week pre-season training program. During the initial session, the participants were informed of the study's details and were briefed on Borg's scale for perceived exertion, enjoyment, and mental fatigue. Before SSGs, the players' fitness (Yo-Yo Intermittent Recovery Test Level-1) was evaluated before assigning them to SSG teams based on test results to ensure equal teams. Internal load and technical actions were recorded for all SSGs. Certified soccer coaches (UEFA B) provided various forms of encouragement during the game. Additionally, players reported perceived exertion, enjoyment, and mental fatigue between bouts and after each SSG session. Mental Readiness was recorded both before and after each game. All testing and SSGs were performed on an artificial soccer pitch at similar times to minimize the influence of daily rhythms (chronobiological characteristics) on the results. Following a standardized warm-up, the players randomly performed each SSG format. A minimum of 72 hours of rest was allowed between each SSG session to minimise

the impact of fatigue on performance. The detailed features such as game design, field size, number of sets, duration, and rest interval of SSGs are featured in Table 1 based on of previous study (Köklü et al., 2015).

Table 1
The Features of All Small-Sided Games

Variables	2-a-side SSGs			4-a-side SSGs		
	Possession	Mini-Goal	Goalkeeper	Possession	Mini-Goal	Goalkeeper
Number of Bouts	4	4	4	4	4	4
Bout Duration (min)	2	2	2	4	4	4
Resting Duration (min)	2	2	2	2	2	2
Pitch Dimension (mxm)	15x27	15x27	15x27	25x32	25x32	25x32
Relative Pitch Size (m^2)	1:100	1:100	1:100	1:100	1:100	1:100

Data Collection Tools

Psychophysiological Responses

In the current study, psychophysiological measurements were used, including the rating of perceived exertion (RPE), enjoyment, visual analogue scale (VAS) and mental readiness form-3 (MRF-3), which are cost-effective, user-friendly and practical tools. RPE, VAS and enjoyment were collected between bouts and after in all games, and MRF-3 was measured before and after the games by researchers in five minutes. Players' perceived exertion was assessed using a validated 20-point Borg scale following each session of the SSGs to determine internal training intensity (Foster et al., 2021). A previous study demonstrated the validity and reliability of this scale to estimate the intensity of effort (Impellizzeri et al., 2004). A standardised question (How was and how did you feel the exercise?) was used to ensure consistency. To preclude potential bias, players provided their responses individually and were acquainted with the scale before their answers, thereby enhancing the reliability of their responses. The RPE scale ranged from 6 to 20, with higher scores indicating greater exertion. Participants evaluated their level of enjoyment during the exercise regimen using a 1-7 Likert scale, which assessed their enjoyment during the rest intervals between sets and at the end of the session. The enjoyment scale was validated by Raedeke (2007) and Soylu et al. (2023) as a marker of exercise enjoyment among Turkish adolescents and adult athletes. The VAS is a self-report scale that assesses mental fatigue during exercise sessions. The VAS scale consists of an 11 mm horizontal line labelled 'not tired at all' at one end and 'extremely tired' at the other. MRF-3 was used to assess cognitive anxiety during SSGs. The MRF-3 questionnaire, with three 11-point Likert scales, measured cognitive anxiety, somatic anxiety, and self-confidence.

Studies have shown strong correlations between MRF-3 and the Competitive State Anxiety Inventory-2, making it a reliable alternative (Krane, 1994).

Technical Responses

The SSGs were captured with a high-resolution digital video camera (Canon LEGRIA HF R806, Tokyo, Japan), positioned at a height of two meters and located in the midfield area of the pitch. The video files were subsequently transferred to a computer, where a notational analysis was conducted using the eAnalyze Soccer (Espor Digital, Ankara, Türkiye) software. Technical activities were analysed by an expert, highly qualified, experienced, and certified match and performance analysis coach. The collected data included successful passes, unsuccessful passes, lost balls, and interceptions.

Data Analysis

The statistical package SPSS for Windows version 26 (IBM SPSS Statistics, Chicago, IL, USA) was used to analyse the data. The Kolmogorov-Smirnov test was used to verify the normality of the variables, and the results showed that they were normally distributed. The collected data underwent temporal standardisation and were subjected to comparative analysis among the experimental conditions using one-way analysis of variance (ANOVA) with repeated measures. The effect size was quantified by calculating the partial eta-squared ($\eta 2$) value (Hopkins et al., 2009). The level of significance was set at $P < 0.05$.

RESULTS

This section of this study presents the statistical results of the psychophysiological responses and technical actions of SSGs played in different formats. Table 2 indicates the values of the soccer players' psychophysiological responses according to the different Possession, MG, and GK formats on the 2-a-side SSGs. The results revealed that the RPE and VAS scores in the possession game were more significant in the MG and GK. Enjoyment significantly differed between the GK game, Possession, and the MG. The MRF-3 showed no significant differences between the games.

Table 3 shows the psychophysiological responses of soccer players in different formats of possession, mini-goal, and goalkeeper in the 4-a-side SSGs. The results revealed that the RPE value in the possession game was significantly higher than in the mini-goal and goalkeeper games. However, there were no significant differences in the VAS score, enjoyment, or MRF-3.

Table 2
Psychophysiological Performance Variables for 2-a-side SSGs (possession, mini-goal, and goalkeeper)

2-a-side	RPE	VAS	Enjoyment	MRF-3
Possession	16.83 ± 2.94*	4.83 ± 1.84Ω	46.21 ± 6.23	3.46 ± 2.12
Mini-Goal	14.05 ± 3.33	4.00 ± 1.70	46.34 ± 6.77	3.61 ± 2.84
Goalkeeper	13.92 ± 2.94	4.08 ± 1.85	49.40 ± 4.99✤	3.26 ± 2.49
Statistical Differences	Poss > MG, GK (F=18.355, p < 0.000, η^2 = .444)	Poss > MG, GK (F=4.575, p < 0.043, η^2 = .166)	GK > Poss, MG (F=10.963, p < 0.003, η^2 = .323)	(F=0.410, p > 0.528, η^2 = .017)

Note. * = significant differences(p<0.05); Poss = Possession game; MG = Mini-goal game; GK = Goalkeeper game; RPE = Rate of perceived exertion; VAS = Visual analogue scale; MRF = Mental readiness form

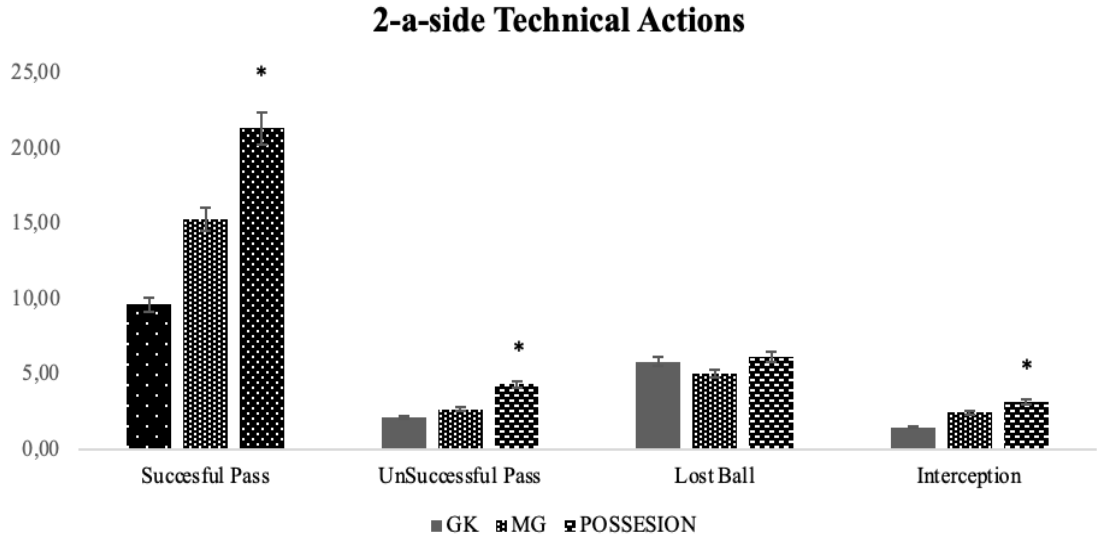
Table 3
Psychophysiological Performance Variables for 4-a-side SSGs (possession, mini-goal, and goalkeeper)

4-a-side	RPE	VAS	Enjoyment	MRF-3
Possession	13.28 ± 2.13*	4.26 ± 1.69	50.13 ± 3.52	3.36 ± 1.89
Mini-Goal	12.80 ± 2.58	4.48 ± 2.13	50.86 ± 3.37	3.40 ± 2.11
Goalkeeper	12.01 ± 3.33	4.34 ± 2.44	50.58 ± 3.09	3.60 ± 2.26
Statistical Differences	Poss > MG, GK (F=9.574, p < 0.005, η^2 = .294)	(F=0.29, p > 0.865, η^2 = .001)	(F=0.441, p > 0.513, η^2 = .019)	(F=0.635, p >0.434, η^2 = .027)

Note. * = significant differences(p<0.05); Poss = Possession game; MG = Mini-goal game; GK = Goalkeeper game; RPE = Rate of perceived exertion; VAS = Visual analogue scale; MRF-3 = Mental readiness form-3.

A repeated-measures ANOVA revealed a statistically significant difference in 2-a-side SSGs technical actions for successful pass (F = 81.109, p < 0.000, η2 = .779), unsuccessful pass (F=19.234, p < 0.000, η2 = .455), and interception (F=81.109, p < 0.000, η2 = .779), but not for lost ball (F=.177, p > 0.678, η2 = .008). Post-hoc tests showed significantly better successful passes, unsuccessful passes, and interceptions from possession games than from mini-goal and goalkeeper games (Figure 1).

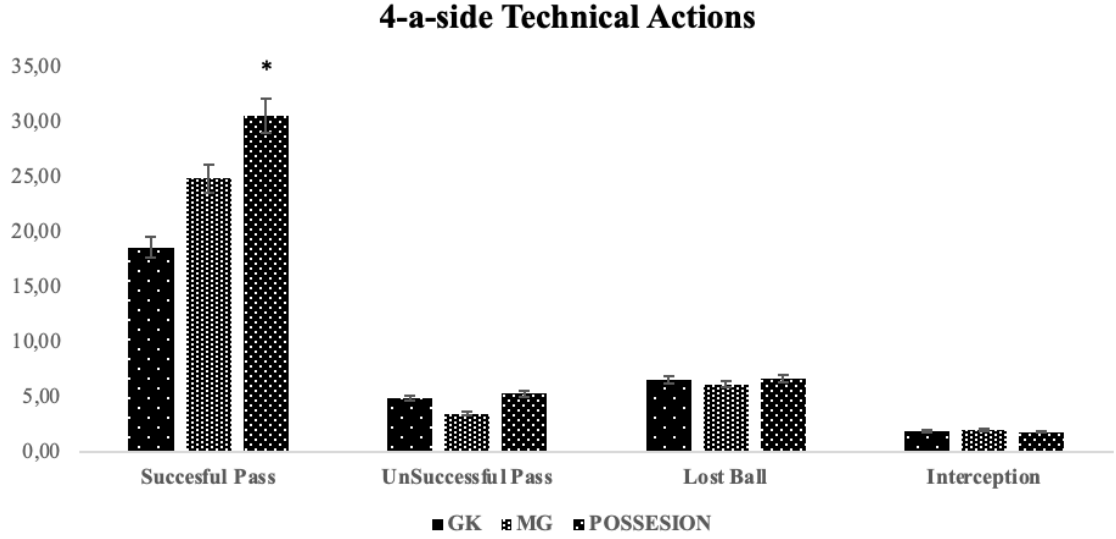
Figure 1
Technical Performance Variables for 2-a-side SSGs (Possession, mini-goal, and goalkeeper)



Note. * = significant differences($p<0.05$)

Figure 2 shows that a repeated-measures ANOVA revealed no statistically significant differences between possession, mini-goal, and goalkeeper SSGs in 4-a-side technical actions for unsuccessful passes ($F = .396$, $p > 0.535$, $\eta2 = .017$) and lost balls ($F = .048$, $p > 0.829$, $\eta2 = .002$). and interception ($F = .009$, $p > 0.927$, $\eta2 = .000$), but not for successful pass ($F = 67.069$, $p < 0.000$, $\eta2 = .745$). Post-hoc tests showed significantly more successful passes from possession games than from MG and GK games.

Figure 2
Technical performance variables for 4-a-side SSGs (Possession, mini-goal, and goalkeeper)



Note. * = significant differences($p<0.05$)

DISCUSSION

In this study, the 2-a-side SSGs game results revealed that the RPE and VAS scores in the possession game were more significant in the mini-goal (MG) and goalkeeper (GK). Enjoyment is different in the GK game, Possession, and the MG. The MRF-3 showed no significant differences between games. The technical action results of the 2-a-side SSGs' showed significantly better successful passes, unsuccessful passes, and interceptions from possession games than the MG and GK games. In the 4-a-side game, the RPE value in the possession game was significantly higher than in the MG and GK games. However, there were no significant differences in the VAS score, enjoyment, or MRF-3. The 4-a-side SSGs technical action results showed significantly better successful passes from possession games than from MG and GK.

The study showed that the possession format resulted in higher RPE values than the mini-goal and goalkeeper formats in 2-a-side and 4-a-side SSGs. The results of different studies in the literature are similar to those of our study. A similar study on semi-professional players reported that games without a GK resulted in higher heart rates than those with a goalkeeper (Castellano et al., 2013). Köklü et al. (2015) reported that in 2-a-side, 3-a-side, and 4-a-SSGs played with and without a GK, the without-goalkeeper format caused a higher RPE. In a 4v4 SSG study performed with and without GKs' in different field sizes, the participation of GKs' in the game caused a decrease in the maximum heart rate and mean heart rate values (Santos et al., 2021). Similar studies have shown that including GKs' results in lower RPE values (Mallo & Navarro, 2008; Sassi et al., 2005). In another study, in a 4-a-side SSG played in ball possession and MG formats, possession resulted in more RPE than MG (Silva et al., 2023). A similar study found that the RPE values of possession games were higher than those of MG games (Bujalance-Moreno et al., 2022). In another study comparing the MG and GK formats, the MG game resulted in a higher RPE than the GK game (Sarmento et al., 2018). In MG and GK format games, the time the ball stays in play is less than in the possession game because the ball leaves the field of play during goals scored or missed goal positions. For this reason, it can be said that RPE values are lower in MG and GK games than in possession games, as it can allow players to recover physiologically during periods when the ball is out of play.

The results of the present study on enjoyment and mental fatigue showed that 2-a-side SSG possession games resulted in more mental fatigue than MG and GK. By contrast, GK games resulted in more enjoyment than possession and MG games. In possession games, the

increase in physical demands in the effort to possess the ball may cause players to experience more mental fatigue than in mini-goal and goalkeeper games. Badin et al. (2016) state that mental fatigue does not impair physical performance despite increasing effort perception. In contrast, mental tiredness hampers offensive and defensive techniques. Competing in an intensive match and training program may cause athletes to experience mental fatigue with increased psychological demands, resulting in decreased performance (Coutts, 2016; Smith et al., 2018). Arslan et al. (2020) reported that SSGs were more enjoyable than high-intensity interval training. Since small-sided games require more technical demands than large-field games, such games result in more enjoyment (Los Arcos et al., 2015). Goalkeeper games are physiologically less intense than MG and possession games. However, preventing the opponent's goal positions in defense, assisting, and scoring goals in an attack can increase the players' motivation. Therefore, the GK game results in more enjoyment than the possession and MG formats.

Considering the technical performance of the 2-a-side *SSGs*' possession game, technical action results showed better successful passes, unsuccessful passes, and interceptions from possession games compared to the MG and GK games. In the 4-a-side SSGs, technical action results showed significantly better successful passes from possession games than from MG and GK. In the possession game, players' constant effort to possess the ball causes more successful passes, unsuccessful passes, and interceptions than in the MG and GK games. However, the number of technical actions may increase parallel because possession time is higher in possession games than in MG and GK games. Therefore, technical actions may occur more often in possession than in MG and GK games.

CONCLUSION

In conclusion, the analysis of the 2-a-side and 4-a-side SSGs results revealed exciting insights into the effects of different game formats on various parameters. In the 2-a-side SSGs setting, there were significant differences in the RPE and VAS scores during possession games compared with the MG and GK games. Enjoyment levels also differed significantly among GK, possession, and MG games, suggesting that each format had a unique experiential dimension. Surprisingly, the MRF-3 scores showed no significant variation, indicating that players' psychological readiness was consistent regardless of game configuration. Technical action results further highlight the impact of game formats. There were significant improvements in successful passes, unsuccessful passes, and interceptions during possession

games, which suggests that players' technical execution and strategic awareness were enhanced compared to MG and GK games. This research informs coaches and practitioners seeking to optimize training regimens and underscores the intricate connections between game type and player responses. Further research on the complicated dynamics between game structure and player development could yield more profound insights and potentially redefine training paradigms within the sports domain.

PRACTICAL IMPLICATIONS

The players frequently enjoyed using goalkeepers in SSGs. Soccer coaches can design SSGs with goalkeepers to make training more enjoyable. In the current study, players performed more technical actions and were exposed to higher visible loads during the ball possession of SSG. The study results demonstrate that coaches can improve players' technical and physiological capacities using the possession game format. Recently, soccer training has evolved towards more integrated physical training methods that prioritize the quality and density of players' specific actions and inter-communication over pure physical development. Therefore, coaches should consider using different game formats to increase the number of high-intensity actions players perform.

Limitations

The findings of this study should be interpreted with caution because of several limitations. First, the participants were young soccer players with amateur backgrounds. Therefore, the findings may not be generalizable to other age groups, skill levels, and competitive contexts. Second, the study only used psychological and technical responses in 2-a-side and 4-a-side game formats. These results may not fully represent the effects of physiological and kinematic parameters. Third, this study only assessed immediate responses during and shortly after game sessions. However, the long-term implications of these observed differences have not yet been explored.

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Declaration of conflict interest

The authors declare no conflict of interest concerning this article's authorship and/or publication.

Authors' contributions

The first and second authors contributed conception and design of the study. The first author collected data. The first and second authors contributed data analysis and interpretation, drafting the article and/or its critical revision and final approval of the version to be published.

Ethics Statement

The research was conducted following the Declaration of Helsinki and was approved by the Ethics Committee of Tokat Gaziosmanpasa University (2022-05-01).

REFERENCES

Arslan, E., Kilit, B., Clemente, F. M., Soylu, Y., Sögüt, M., Badicu, G., Akca, F., Gokkaya, M., & Murawska-Ciałowicz, E. (2021). The Effects of Exercise Order on the Psychophysiological Responses, Physical and Technical Performances of Young Soccer Players: Combined Small-Sided Games and High-Intensity Interval Training. *Biology, 10*(11), 1180. https://doi.org/10.3390/biology10111180

Arslan, E., Orer, G., & Clemente, F. (2020). Running-based high-intensity interval training vs. small-sided game training programs: effects on the physical performance, psychophysiological responses and technical skills in young soccer players. *Biology of Sport, 37*(2), 165-173. https://doi.org/10.5114/biolsport.2020.94237

Badin, O. O., Smith, M. R., Conte, D., & Coutts, A. J. (2016). Mental fatigue: impairment of technical performance in small-sided soccer games. *International journal of sports physiology and performance, 11*(8), 1100-1105. https://doi.org/10.1123/ijspp.2015-0710

Bergmann, F., Braksiek, M., & Meier, C. (2022). The influence of different game formats on technical actions and playing time parameters – a study with under-7 and under-9 soccer players in a competitive context. *International Journal of Sports Science & Coaching, 17*(5), 1089-1100. https://doi.org/10.1177/17479541211051654

Boksem, M. A., & Tops, M. (2008). Mental fatigue: costs and benefits. *Brain research reviews, 59*(1), 125-139. https://doi.org/10.1016/j.brainresrev.2008.07.001

Boksem, M. A., Meijman, T. F., & Lorist, M. M. (2005). Effects of mental fatigue on attention: an ERP study. *Cognitive brain research, 25*(1), 107-116. https://doi.org/10.1016/j.cogbrainres.2005.04.011

Bujalance-Moreno, P., Latorre-Román, P. Á., & García-Pinillos, F. (2019). A systematic review on small-sided games in football players: Acute and chronic adaptations. *Journal of sports sciences, 37*(8), 921-949. https://doi.org/10.1080/02640414.2018.1535821

Bujalance-Moreno, P., Latorre-Román, P. Á., Martínez-Amat, A., & García-Pinillos, F. (2022). Small-sided games in amateur players: rule modification with mini-goals to induce lower external load responses. *Biology of Sport, 39*(2), 367-377. https://doi.org/10.5114/biolsport.2022.105336

Carraro, A., Gobbi, E., Ferri, I., Benvenuti, P., & Zanuso, S. (2014). Enjoyment perception during exercise with aerobic machines. *Perceptual and Motor Skills, 119*(1), 146-155. https://doi.org/10.2466/29.06.PMS.119c15z3

Casamichana D, Castellano J. (2010). Time-motion, heart rate, perceptual and motor behaviour demands in small-sided soccer games: effects of pitch size. *Journal of Sports Sciences, 28*(14):1615–1623. https://doi.org/10.1080/02640414.2010.521168

Castelao D, Garganta J, Santos R, Teoldo da Costa I. (2014). Comparison of tactical behaviour and performance of youth soccer players in 3v3 and 5v5 small-sided games. *International Journal of Performance Analysis in Sport, (3)*:801–813. https://doi.org/10.1080/24748668.2014.11868759

Castellano, J., Casamichana, D., & Dellal, A. (2013). Influence of game format and number of players on heart rate responses and physical demands in small-sided soccer games. *The Journal of Strength & Conditioning Research, 27*(5), 1295-1303. https://doi.org/10.1519/JSC.0b013e318267a5d1

Castillo, D., Raya-González, J., Yanci, J., & Clemente, F. (2021). Influence of pitch size on short-term high intensity actions and body impacts in soccer sided games. *Journal of Human Kinetics, 78*, 187-196. https://doi.org/10.2478/hukin-2021-0037

Castillo-Rodríguez, A., Durán-Salas, Á., Giménez, J., Onetti-Onetti, W., & Suárez-Arrones, L. (2023). The influence of pitch dimensions during small-sided games to reach match physical and physiological demands on the youth soccer players. *Sensors, 23*(3), 1299. https://doi.org/10.3390/s23031299

Clemente, F. M., Martins, F. M., & Mendes, R. S. (2014b). Periodization based on small-sided soccer games: Theoretical considerations. *Strength & Conditioning Journal, 36*(5), 34-43. http://dx.doi.org/10.1519/SSC.0000000000000067

Clemente, F. M., Wong, D. P., Martins, F. M. L., & Mendes, R. S. (2014a). Acute effects of the number of players and scoring method on physiological, physical, and technical performance in small-sided soccer games. *Research in Sports Medicine, 22*(4), 380-397. https://doi.org/10.1080/15438627.2014.951761

Coutts, A. J. (2016). Fatigue in football: it's not a brainless task!. *Journal of sports sciences, 34*(14), 1296-1296. https://doi.org/10.1080/02640414.2016.1170475

Davids, K., Araújo, D., Correia, V., & Vilar, L. (2013). How small-sided and conditioned games enhance acquisition of movement and decision-making skills. *Exercise and sport sciences reviews, 41*(3), 154-161. http://dx.doi.org/10.1097/JES.0b013e318292f3ec

De Sousa Neto Segundo, J. F., Pitz Vieira, J., Pereira Ventura, A., Vitor Wan-zuit, J., Souza Pereira, G., Cangiani Sanches, P. H., Santiago Teixeira, A., & Fernandes da Silva, J. (2021). Tactical rule and pitch size change the physical and technical performance of young soccer players during small-sided games. *Brazilian Journal of Kineanthropometry & Human Performance, 23*. http://dx.doi.org/10.1590/1980-0037.2021v23e70479

Dellal, A., Lago-Penas, C., Wong, D. P., & Chamari, K. (2011). Effect of the number of ball contacts within bouts of 4 vs. 4 small-sided soccer games. *International journal of sports physiology and performance, 6*(3), 322-333. https://doi.org/10.1123/ijspp.6.3.322

Fernández, J., Sánchez-Sánchez, J., Rodríguez-Cañamero, S., Ubago-Guisado, E., Colino, E., & Gallardo, L. (2018). Physiological responses, fatigue and perception of female soccer

players in small-sided games with different pitch size and sport surfaces. *Biology of Sport, 35*(3), 291-299. https://doi.org/10.5114/biolsport.2018.77829

Foster, C., Boullosa, D., McGuigan, M., Fusco, A., Cortis, C., Arney, B. E., Orton, B., Dodge, C., Jaime, S., Radtke, K., van Erp, T., de Koning, J. J., Bok, D., Rodriguez-Marroyo, J. A., & Porcari, J. P. (2021). 25 Years of Session Rating of Perceived Exertion: Historical Perspective and Development. *International Journal of Sports Physiology and Performance, 16*(5), 612–621. https://doi.org/10.1123/ijspp.2020-0599

Giménez, J., Liu, H., Lipińska, P., Szwarc, A., Rompa, P., & Gómez, M. (2017). Physical responses of professional soccer players during 4 vs. 4 small-sided games with mini-goals according to rule changes. *Biology of Sport.* https://doi.org/10.5114/biolsport.2018.70754

González-Rodenas, J., Calabuig, F., & Aranda, R. (2015). Effect of the game design, the goal type and the number of players on intensity of play in small-sided soccer games in youth elite players. *Journal of human kinetics, 49*(1), 229-235. http://dx.doi.org/10.1515/hukin-2015-0125

Guard, A., McMillan, K., & MacFarlane, N. (2022). Influence of game format and team strategy on physical and perceptual intensity in soccer small-sided games. *International Journal of Sports Science & Coaching, 17*(5), 1109-1118. https://doi.org/10.1177/17479541211056399

Halouani, J., Chtourou, H., Gabbett, T., Chaouachi, A., & Chamari, K. (2014). Small-sided games in team sports training: a brief review. *The journal of strength & conditioning research, 28*(12), 3594-3618. http://dx.doi.org/10.1519/JSC.0000000000000564

Hammami, A., Gabbett, T. J., Slimani, M., & Bouhlel, E. (2018). Does small-sided games training improve physical-fitness and specific skills for team sports? A systematic review with meta-analysis. *The Journal of sports medicine and physical fitness, 58*(10), 1446-1455. https://doi.org/10.23736/S0022-4707.17.07420-5

Hill-Haas, S. V., Dawson, B., Impellizzeri, F. M., & Coutts, A. J. (2011). Physiology of small-sided games training in football: a systematic review. *Sports medicine, 41*, 199-220. http://dx.doi.org/10.2165/11539740-000000000-00000

Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive Statistics for Studies in Sports Medicine and Exercise Science. *Medicine & Science in Sports & Exercise,* 41(1), 3–13. https://doi.org/10.1249/MSS.0b013e31818cb278

Hůlka, K., Weisser, R., & Bělka, J. (2016). Effect of the pitch size and presence of goalkeepers on the work load of players during small-sided soccer games. *Journal of Human Kinetics, 51*(1), 175-181. https://doi.org/10.1515/hukin-2015-0180

Impellizzeri, F. M., Marcora, S. M., Castagna, C., Reilly, T., Sassi, A., Iaia, F. M., & Rampinini, E. (2006). Physiological and performance effects of generic versus specific aerobic training in soccer players. *International Journal of Sports Medicine, 27*(6), 483-492. https://doi.org/10.1055/s-2005-865839

Impellizzeri, F. M., Rampinini, E., Coutts, A. J., Sassi, A., & Marcora, S. M. (2004). Use of RPE-based training load in soccer. *Medicine & Science in Sports & Exercise, 36*(6), 1042–1047. https://doi.org/10.1249/01.MSS.0000128199.23901.2F

Junior, J. M. M. M., de Mello, D. B., Rosa, G., dos Santos, L. A., Nunes, R. A. M., & de Souza Vale, R. G. (2023). Effects of scoring method on the physical, technical, and tactical

performances during football small-sided games (SSGs): A systematic review *Retos, 49*, 961-969. https://doi.org/10.47197/retos.v49.98459

Köklü, Y., Asçi, A., Koçak, F. Ü., Alemdaroğlu U., & Dündar, U. (2011). Comparison of the physiological responses to different small-sided games in elite young soccer players. *The Journal of Strength & Conditioning Research, 25*(6), 1522-1528. https://doi.org/10.1519/JSC.0b013e3181e06ee1

Köklü, Y., Sert, Ö., Alemdaroglu, U., & Arslan, Y. (2015). Comparison of the physiological responses and time-motion characteristics of young soccer players in small-sided games: The effect of goalkeeper. *The Journal of Strength & Conditioning Research, 29*(4), 964-971. https://doi/org/10.1519/JSC.0b013e3182a744a1

Krane, V. (1994). The mental readiness form as a measure of competitive state anxiety. *The Sport Psychologist. 8*(2), 189-202. https://doi.org/10.1123/tsp.8.2.189

Lew, F. L., & Qu, X. (2014). Effects of mental fatigue on biomechanics of slips. *Ergonomics, 57*(12), 1927-1932. https://doi.org/10.1080/00140139.2014.937771

Lorist, M. M., Klein, M., Nieuwenhuis, S., De Jong, R., Mulder, G., & Meijman, T. F. (2000). Mental fatigue and task control: planning and preparation. *Psychophysiology, 37*(5), 614-625. https://doi.org/10.1111/1469-8986.3750614

Los Arcos, A., Vázquez, J. S., Martín, J., Lerga, J., Sánchez, F., Villagra, F., & Zulueta, J. J. (2015). Effects of small-sided games vs. interval training in aerobic fitness and physical enjoyment in young elite soccer players. *PloS one, 10*(9), e0137224. https://doi.org/10.1371/journal.pone.0137224

Mallo, J., & Navarro, E. (2008). Physical load imposed on soccer players during small-sided training games. *Journal of sports medicine and physical fitness, 48*(2), 166. PMID: 18427410

Olthof, S., Frencken, W., & Lemmink, K. (2017). Match-derived relative pitch area changes the physical and team tactical performance of elite soccer players in small-sided soccer games. *Journal of Sports Sciences, 36*(14), 1557-1563. https://doi.org/10.1080/02640414.2017.1403412

Raedeke, T. D. (2007). The relationship between enjoyment and affective responses to exercise. *Journal of Applied Sport Psychology, 19*(1), 105-115. https://doi.org/10.1080/10413200601113638

Rhodes, R. E., & Kates, A. (2015). Can the affective response to exercise predict future motives and physical activity behavior? A systematic review of published evidence. *Annals of Behavioral medicine, 49*(5), 715-731. https://doi.org/10.1007/s12160-015-9704-5

Sanchez-Sanchez, J., Hernández, D., Casamichana, D., Martínez-Salazar, C., Ramirez-Campillo, R., & Sampaio, J. (2017). Heart rate, technical performance, and session-RPE in elite youth soccer small-sided games played with wildcard players. *The Journal of Strength & Conditioning Research, 31*(10), 2678-2685. https://doi.org/10.1519/JSC.0000000000001736

Santos, F. J., Verardi, C. E., de Moraes, M. G., Filho, D. M. P., Macedo, A. G., Figueiredo, T. P., Ferreria C. C., Borba R. P., & Espada, M. C. (2021). Effects of pitch size and goalkeeper participation on physical load measures during small-sided games in sub-elite professional soccer players. *Applied Sciences, 11*(17), 8024. https://doi.org/10.3390/app11178024

Sarmento, H., Clemente, F. M., Harper, L. D., Costa, I. T. D., Owen, A., & Figueiredo, A. J. (2018). Small sided games in soccer–a systematic review. *International journal of performance analysis in sport*, *18*(5), 693-749. https://doi.org/10.1080/24748668.2018.1517288

Sassi, R., Reilly, T., & Impellizzeri, F. (2005). A comparison of small-side games and interval training in elite professional soccer players. *Science and football V. Oxon: Routledge,* 352-4.

Silva, M.E.S., Ribeiro, B. L. L., Ferreira F., Nakamura, FY., Oliveira, RS., & Mortatti, A. L. (2023). Impact of Altering the Method to Score During Small-sided Games on Internal and External Training Loads in Youth Soccer Players. *Research Square.* https://doi.org/10.21203/rs.3.rs-2521574/v1

Smith, M. R., Thompson, C., Marcora, S. M., Skorski, S., Meyer, T., & Coutts, A. J. (2018). Mental fatigue and soccer: current knowledge and future directions. *Sports Medicine, 48,* 1525-1532. https://link.springer.com/article/10.1007/s40279-018-0908-2

Soylu Y., Ramazanoglu F., Arslan E., Clemente F. (2022). Effects of mental fatigue on the psychophysiological responses, kinematic profiles, and technical performance in different small-sided soccer games. *Biology of Sport. 39*(4), 965– 972. https://doi.org/10.5114/biolsport.2022.110746

Soylu, Y., Arslan, E., & Kilit, B. (2023). Egzersiz ve Keyif: Ergen ve Yetişkin Sporcular İçin Ölçek Uyarlama Çalışması. *Spormetre Beden Eğitimi ve Spor Bilimleri Dergisi, 21*(1), 93-104. https://doi.org/10.33689/spormetre.1183236

Tauer, J. M., & Harackiewicz, J. M., 2004. The Effects of Cooperation and Competition on Intrinsic Motivation and Performance. *Journal of Personality and Social Psychology, 86*(6), 849–861. https://psycnet.apa.org/doi/10.1037/0022-3514.86.6.849

Teoldo da Costa I, Garganta J, Greco PJ, Mesquita I, Muller E. (2011). Relationship between pitch size and tactical behavior of soccer player. *Revista Brasileira de Educacão Fısicae Esporte, 25*(1):79–96.