Analysis of tactical patterns variables in different formats of small-sided football games

Análisis de las variables de los patrones tácticos en diferentes formatos de juegos reducidos de fútbol

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Abstract

Introduction: Research in football has increasingly highlighted the value of small-sided and conditioned games (SSCGs) for learning and skill acquisition.
Objective: This study aimed at how player density affects collective positioning and team spacing in junior football players.
Methodology: Twenty-two male players Under-14 years participated in two SSCGs formats (GK+4v4+GK and GK+5v5+GK) played on the same pitch (46m × 33m). Positional data were collected using 15Hz GPS units and used to calculate team width, team length, and team surface area. Data were analysed using descriptive statistics and a two-way mixed-design ANOVA.
Results: The results revealed significant different ($p \leq 0.05$) in the width and surface area dimension for game formats and during attacking and defending phases. Specifically, greater team width during attack than defence and larger team surface area in the GK+5v5+GK format.
Discussion: The results indicate that manipulating player density were associated with collective spatial organization. The GK+5v5+GK format was associated with greater team length and surface area, whereas the GK+4v4+GK format provided more available space for player dispersion, leading to different emergent collective tactical behaviours.
Conclusions: Coaches can manipulate SSCGs to target specific tactical behaviours. The larger format was associated with greater team length and team surface area, whereas the smaller format was associated with more compact team organisation. These findings help practitioners alter player spacing to design more effective training programs.

Keywords

Collective tactical behaviour; football; small-sided and conditioned games (SSCGs); task constraints.

Resumen

Introducción: La investigación en fútbol ha destacado cada vez más el valor de los juegos reducidos y condicionados (SSCGs) como herramientas eficaces para el aprendizaje y el desarrollo de habilidades.
Objetivo: Analizar cómo la densidad de jugadores influye en el posicionamiento colectivo y el espaciado del equipo en futbolistas juveniles.
Metodología: Participaron veintidós jugadores masculinos de la categoría sub-14 en dos formatos de SSCGs (GK+4v4+GK y GK+5v5+GK), disputados en el mismo terreno de juego (46m × 33m). Los datos posicionales se registraron mediante unidades GPS de 15Hz y se utilizaron para calcular la anchura, la longitud y el área de superficie del equipo. Los datos se analizaron mediante estadística descriptiva y un ANOVA mixto de dos vías.
Resultados: Se observaron diferencias significativas ($p \leq 0,05$) en la anchura y el área de superficie del equipo según el formato de juego y la fase del juego (ataque y defensa). En concreto, la anchura del equipo fue mayor durante la fase ofensiva que en la defensiva, mientras que el formato GK+5v5+GK presentó una mayor área de superficie del equipo.
Discusión: La manipulación de la densidad de jugadores se asoció con cambios en la organización espacial colectiva. El formato GK+5v5+GK se asoció con una mayor longitud y área de superficie del equipo, mientras que el formato GK+4v4+GK favoreció una organización más compacta y distintos comportamientos tácticos colectivos emergentes.
Conclusiones: Los entrenadores pueden manipular las restricciones de los SSCGs para favorecer comportamientos tácticos específicos. El formato con mayor número de jugadores se asoció con una mayor longitud y área de superficie del equipo, mientras que el formato reducido promovió una organización más compacta. Estos hallazgos aportan evidencia útil para diseñar programas de entrenamiento más eficaces mediante el ajuste del espaciado entre jugadores.

Palabras clave

Comportamiento táctico colectivo; fútbol; juegos reducidos y condicionados (SSCGs); restricciones de la tarea.

Introduction

Association football is an invasion team sport that has been characterized as an open complex system defined by the interactions between the players and the performance environment (Davids et al., 2005). From these interactions, self-organized patterns emerge under the constraints of the performance context, of which, the competing interests of each team is a key constraint (Araújo et al., 2023). Over the years, evidence from the previous research has highlighted the need for a complex systems approach to examined team sports behaviours (Davids et al., 2005; Davies et al., 2023; McGarry et al., 2002). Monitoring players during match play has become a fundamental approach for understanding the physical demands of football performance (Atan et al., 2023). This pragmatic approach has been revealed as an effective way for understanding spatial and temporal patterns in both individual and team sports (Davids et al., 2013; McGarry, 2009).

Traditionally, football training has focused on developing the physiological capacities and technical skills of players (Aguiar et al., 2012; Hill-Haas et al., 2011; Reilly et al., 2005). To address limitations in traditional methods, Reilly et al. (2005) promoted the use of modified games as a training paradigm to merge, within the same session, the physiological, technical/tactical and competitive (interpersonal) demands of match play. As an example, small-sided games typically involve modified practice tasks with the aim of simulating sub-phases of competitive performance. Previous studies and recent reviews have highlighted that by altering the ratio of area per player (i.e. divide total space by number of player) or number of players on the pitch during SSCGs, it can enhance the players' performance (Muhyi et al., 2025; Sousa et al., 2022) increase in the technical-tactical actions performed (Clemente et al., 2023; Essafi et al., 2026).

The ecological dynamics approach suggests that performance in football emerges from the interactions between players, teammates, opponents, and their general performance environment, rather than from the behaviour of each individual player (Araújo et al., 2023). Rather, team behaviour can be considered as a self-organising system that can be understood through the interpretation of collective behaviour, rather than as the sum of individual players' behaviours (Araújo et al., 2006; Duarte, Araújo, Correia, et al., 2012). The development of technologies for positional tracking of players has enabled this approach to gaining insight on performance, as it is now possible to quantify these emerging interactions in full sided football games and SSCGs. Several studies have shown that positional collective variables derived from tracking data such as team width, team length, team surface area, and team centroid provide meaningful information about the coordination of movements between players in a defensive organisation (Duarte et al., 2010; Folgado et al., 2019; Folgado et al., 2018; Folgado et al., 2012; Frencken et al., 2011). These collective variables reflect the organisation of a team in adaptation to the interactions between players, rather than describing individual players actions. Thus, positional analysis has become a useful tool to reveal information about the emergence of collective tactical behaviours.

Task constraints are considered to be one of the main factors that regulate and promote the emergence of collective behaviour in football. Pitch dimensions and player numbers are important task constraints and modifying them changes the space and interactions experienced by players in SSCGs. Previous studies have shown that playing on a larger pitch leads to teams expanding more, quantified as increases in team width, team length, and effective playing space, while a reduction in the space available provokes adaptations to a more compact spatial organisation (Silva et al., 2014). These findings can be explained by the fact that changes in space availability on the pitch alter affordances and effect the emergence of positioning, organisation and interactions between players during a game. While many studies have compared pitch dimensions and player numbers with respect to technical, physical, and physiological variables in SSCGs, fewer studies have examined the effects of player density on collective organisation during attacking and defending with pitch size constant. This factor is particularly important to examine, as keeping a constant pitch size prevents the confounding effect of adapting to a larger or smaller pitch in response to changes in player numbers. Within the context of the ecological dynamics framework for performance analysis of football, collective variables as described above are an emergent property of the system resulting from the interactions between players, teammates, opponents, and task constraints. Therefore, variations in player density offer a valid approach to examining the effect of manipulated task constraints on collective organisation and coordination in football SSCGs (Borges et al., 2022).

Despite growing evidence that task constraints shape football performance, limited research has examined how player density, while maintaining a constant pitch size, is associated with collective spatial organisation during attacking and defending phases. Research into how task constraints regulate emergent collective behaviours may have important implications for designing representative training environments. The aim of this study, therefore, was to investigate the effects of manipulating player density on values of team width, team length, and team surface area during attacking and defending phases of small-sided football games with Under-14 players. It was hypothesized that the larger format would result in higher values of team length and team surface area, while attacking teams would be more spatially dispersed than defending teams.

Method

This study adopted a quasi-experimental quantitative design to examine how changes in player density were associated with collective tactical behaviours during SSCGs.

Participants

Twenty-two male Under-14 football players (age: 13.36 ± 0.49 years) from a local football club participated in this study on a voluntary basis. They were classified as intermediate-level players according to their playing and training experience (from three to four years) and their engagement in practice (i.e., participation in four 60-minute weekly training sessions and at least one competitive match). To recruit a relatively homogeneous sample, national or regional level players were excluded, since their highly specialized behaviours might reflect the results. Novice players who had not mastered specific football skills (i.e., passing, dribbling and shooting) were also excluded. As Under-14 football players are still developing their tactical awareness, decision making and teamwork, studying how specific task constraints affect their collective play can reveal important insights into how youth players build tactical expertise. The participants and their parents/guardians were fully informed of the procedures and provided written informed consent. The experiment respected the ethical principles of the American Psychological Association and was approved by the university research ethics committee (JKEP:5/2025).

A power analysis was not conducted a priori due to the exploratory character of the research and because of the lack of available players in the club. However, the sample encompassed all the available Under-14 squad players and fitted in with the average sample sizes of previous studies analysing collective tactical behaviour in football SSCGs (Folgado et al., 2019; Silva et al., 2015).

Procedure

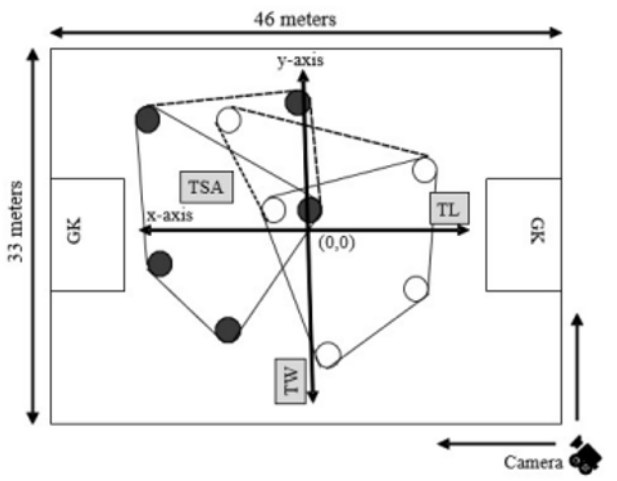
Raw positional data of individual players were obtained using 15Hz global positioning system (GPS) units (SPI Pro, GPSports, Canberra, Australia) to monitor player movement displacement during gameplay. The same GPS devices were allocated to each player in all testing session to avoid inter-unit error. The validity and reliability of GPS devices for measuring movement demands in team sports has been previously established with coefficients of variation typically <5% for team-sport movement (Coutts & Duffield, 2010). Prior to data collection, the playing area was calibrated by placing four GPS units at the corner of the pitch for approximately two minutes. The recorded longitude and latitude time-series data from the GPS units were subsequently transformed into two-dimensional Cartesian coordinates through the Universal Transverse Mercator (UTM) coordinate system. To ensure uniformity the length of time-series across all players for each test, missing data points were addressed using interpolation-based resampling techniques. Positional coordinates were then expressed in meters, followed by the application of a rotation matrix to align the playing field according to the x-axis (pitch length) and y-axis (pitch width). This alignment procedure was further applied to all player positional data, with the bottom-left corner of the pitch designated as the origin point (0,0) (Folgado et al., 2014). All data processing and computational analyses were conducted using MATLAB® R2012a (The MathWorks Inc., Natick, MA, USA).

Three compound positional tactical variables were evaluated during the SSCGs and the positional data from all outfield players on each team were calculated except the goalkeepers. We included goalkeepers in the small-sided games to maintain representative game conditions and authentic attacking and

defending behaviours but excluded them from the positional analyses because their specialized tactical role could bias the calculation of collective spatial variables. The positional data were taken by calculating; (i) team width (TW) - the maximum and minimum x- and y-coordinate values representing players' lateral movements on the pitch at each time frame; (ii) team length (TL) - the maximum and minimum x- and y-coordinate values associated with longitudinal movements; and (iii) team surface area (TSA) - a constructing polygon formed by connecting the positional coordinates of all outfield players for each pattern and time frame, representing the team's occupied or covered space (see Figure 1). These variables have been widely adopted in previous studies to describe collective team behaviours in both full-sided matches and small-sided and conditioned games (SSCGs) (Duarte et al., 2013; Folgado et al., 2012; Silva et al., 2014).

Each trial was then classified according to the corresponding periods of ball possession for each team. The collected possession data were evaluated from the moment a team gained control of the ball until the ball went out of play or was touched, intercepted, or blocked by the opposing team during the game. The attacking phase was defined as the time from gaining possession to the time possession ended by being lost, interrupted, intercepted, blocked, or when the ball went out of play, while the defending phase was defined as the corresponding time the opposing team was trying to win back possession. All valid possession sequences occurring during the SSCGs were considered in the analysis, giving a total of 100 possession sequences for both formats and game phases. A standardized coding procedure was used to analyse attacking and defensive phases, and to establish coding reliability. For coding reliability, a second expert analyst independently analysed 20% of the possession sequences, resulting in very good inter-rater agreement (Cohen's κ = 0.87).

Figure 1. Player positions of GK+4v4+GK (black line) and GK+5v5+GK (added black dashed line) relation to team surface area (TSA), team width (TW) and team length (TL).



Each player was assigned by their coaches into two teams of four players plus one goalkeeper for GK+4v4+GK format and five players plus one goalkeeper for GK+5v5+GK format. Data collection was performed on two different days for each format. The order of SSCGs formats was randomised across data collection sessions to minimise potential order effects. Participants were not informed of the specific research hypotheses, however, complete blinding was not possible due to the nature of the training intervention and the requirements of the experimental protocol. Participants played two SSCGs of 4 minutes on the same pitch size of 46m x 33m with individual playing area values of 150m2 for GK+5v5+GK and 189m2 for GK+4v4+GK. The session was conducted on a football pitch equipped with 7-a-side or junior-sized goalposts (6m × 2m). Prior to completing the task, every player performed a ten-minute warm-up consistent with their regular training routines. Three-minute rest intervals interspersed each game, and players were encouraged to rehydrate. The offside rules were not applied in this training. Participants completed each SSCGs on separate days, with standardised warm-up and recovery periods, to minimise fatigue effects. This protocol was implemented prior to the club's regular weekday training sessions. The training task included four support players, one coach, and one assistant coach positioned around the playing area to supply replacement balls whenever the ball went out of play, thereby maintaining continuity during the session. Minimal encouragement and only essential instructions were provided by the coach and players. To maintain collective ball possession and

accommodate the reduced pitch size, goalkeepers were instructed not to perform long kicks or long passes.

Data analysis

The normality of the distribution of the data was determined using the Shapiro–Wilk test before analysis. A two-way mixed-design ANOVA was conducted to identify the effects of the game format and game phase on TW, TL and TSA as well as potential interaction effects between the two factors. Partial eta square was presented as a measure of effect size and statistical significance was set at $p < .05$. The data was analysed using the IBM® SPSS® Statistics Version 26.0 for Windows (IBM Corp., Armonk, NY, USA).

Results

Table 1 reports the means (± SD) of the TW, TL and TSA for the attacking and defending teams in both SSCGs formats. In general, the attacking teams presented lower values of TW and greater values of TL and TSA than the defending teams. In addition, the GK+5v5+GK format tended to present greater values of TL and TSA than the GK+4v4+GK format.

Table 1. Mean and standard deviation [95% Confidence Interval] data during attacking and defending between the game formats.

Phase	Metric	Formats	
		GK+4v4+GK	GK+5v5+GK
Attacking	Team Width (m)	13.11 ± 3.09 [11.83, 14.39]	13.14 ± 3.88 [11.54, 14.74]
	Team Length (m)	14.29 ± 3.15 [12.99, 15.59]	15.60 ± 3.56 [14.13, 17.07]
	Team Surface Area (m2)	86.51 ± 23.74 [76.71, 96.31]	112.75 ± 49.56 [92.29, 133.21]
Defending	Team Width (m)	16.01 ± 4.62 [14.10, 17.92]	14.69 ± 4.54 [12.82, 16.56]
	Team Length (m)	14.01 ± 3.84 [12.43, 15.59]	15.97 ± 3.34 [14.59, 17.35]
	Team Surface Area (m2)	113.10 ± 48.27 [93.17, 133.03]	131.87 ± 64.95 [105.06, 158.68]

Table 2 shows the results of the two-way mixed-design ANOVA. A significant main effect of game phase was found, $F(1,96) = 7.441$, $p = .008$, partial $\eta^2 = .072$, for TW, showing differences between attacking and defending phases, but not for format, $F(1,96) = 0.631$, $p = .429$, partial $\eta^2 = .007$, nor for format × game phase interaction, $F(1,96) = 0.681$, $p = .411$, partial $\eta^2 = .007$.

Table 2. Results of the two-way mixed-design ANOVA examining the effects of game format and game phase on team width, team length, and team surface area.

Variable	Effect	F(1,96)	p	Partial η^2
Team Width	Format	0.631	.429	.007
	Phase	7.441	.008*	.072
	Format × Phase	0.681	.411	.007
Team Length	Format	5.534	.021*	.055
	Phase	0.005	.947	< .001
	Format × Phase	0.218	.642	.002
Team Surface Area	Format	5.291	.024*	.052
	Phase	5.458	.022*	.054
	Format × Phase	0.146	.703	.002

Note. significant level at $p < .05$*. Effect sizes are reported as partial eta squared (η^2).

A significant main effect of format was found, $F(1,96) = 5.534$, $p = .021$, partial $\eta^2 = .055$, for TL, showing differences between the two SSCGs formats, but not for game phase, $F(1,96) = 0.005$, $p = .947$, partial $\eta^2 < .001$, nor for format × game phase interaction, $F(1,96) = 0.218$, $p = .642$, partial $\eta^2 = .002$. For TSA, significant main effects were found for both format, $F(1,96) = 5.291$, $p = .024$, partial $\eta^2 = .052$, and game

phase, $F(1,96) = 5.458$, $p = .022$, partial $\eta^2 = .054$, but not for their interaction, $F(1,96) = 0.146$, $p = .703$, partial $\eta^2 = .002$.

Overall, these findings suggest that specific task constraints were associated with different patterns of team behaviour. The game phase was associated with differences in TW, whereas the game format was associated with differences in TL. When looking at TSA, both the format and the game phase was related with differences in TSA. There was no interaction effect between the game format and game phase, meaning the combination of these two factors did not cause any extra changes across the tactical variables. For practical implications, these findings suggest that coaches may wish to use different SSCGs formats to target specific tactical objectives, with large formats associated with team expansion and smaller formats associated with a more compact defensive structure and closer interpersonal coordination.

Discussion

Different formats of SSCGs training and practice in team sport have gained attention recently, with numerous studies reporting improvements in physiological and technical/tactical parameters of participants (Clemente et al., 2023; Sarmento et al., 2018). This study aimed at advancing understanding of the influence of SSCGs in team tactical by providing information about adaptations of collective team behaviours displayed by the players in different formats of SSCGs. We sought to examine changes of numbers of player and game phases on team dynamics of SSCGs by analysing team spatial dispersion measures.

In general, this report supported our initial expectations that different SSCGs formats can lead to different team tactical behaviours. Similar to previous findings, players in both formats adjusted their behavioural patterns during play to achieve their goals tactical objectives (i.e. scoring or defending goal) (Clemente et al., 2023). In other words, there are changes in interpersonal distances between the formats during attacking and defending situations. Our result suggested that, when one player was added into the team while the pitch dimensions remain the same, the TSA or covering area generally higher. This finding suggest that during play the team covering area significantly larger by open-up or increase the distances between the players when they have extra players. In addition, while there are no changes in TW for both formats, however, the TL results evidenced that with an extra player it shows that a more stretch or depth playing shape was discovered, which might be seen as a tactical to approach the goals more quickly by playing elongated or longitudinally style of play in the goal-to-goal direction. This may be due that the players tend to adjust their positioned to play closer relative to each other towards opponent goal zone to explore goal scoring opportunity while area per player stays unchanged (Clemente et al., 2023; Folgado et al., 2012). Therefore, it appears that for both formats, the team react differently during play, exhibiting different tactical behaviours.

Greater TL and TSA were observed in the GK+5v5+GK format, suggesting that players adopted a more expanded spatial organisation despite the reduced relative playing area per player. However, although descriptive statistics indicated higher TL and TSA values in this format, the absence of a significant interaction between game format and game phase suggests that these differences should not be interpreted as evidence that game phase modified the effect of playing format. Perhaps the number of available interpersonal coordination opportunities was increased in the larger format, while team compactness was also sufficiently high, and so players expanded in the longitudinal direction without hindering the maintenance of collective organisation. This interpretation is in line with the ecological dynamics perspective in which collective behaviours are regulated by affordances, or information-based opportunities for action, that emerge from continuously changing informational constraints rather than by pre-formed and instructed patterns of movement (Araújo et al., 2023; Davids et al., 2013). The present findings are consistent with those reported by Azli et al. (2015), who demonstrated that changes the relative area per player during SSCGs was associated with the emergent team behaviours and collective spatial organisation. Similar to the current study, changes in task constraints altered how players coordinated their positioning and movement patterns to achieve performance goals. These results support manipulating player density to constraints the emergence of collective tactical behaviours during football SSCGs.

According to Clemente et al. (2023), larger pitches corresponded with higher stretch index values and a larger team surface area, while smaller pitches were associated with more compact spatial organisation and the greatest number of tackles, duels, and ball recoveries during SSCGs. This is indicative of the continuous adaptation is indicative to player spatial organisation and inter-individual coordination as a consequence of manipulating these task constraints, as players perceive and act upon affordances within the environment.

From an ecological dynamics perspective, these findings suggest that these players were able to keep meaningful collective behaviours despite a reduction in playing space for each team. They were synchronised by perceiving affordances that they could represent as a result of their interactions with other players and the game environment, instead of rigidly respecting any positional play (Laakso et al., 2022). This tactical knowledge was displayed in their paths and relative positioning on the field, and could change by a modification in the informational constraint (for instance, defenders' position, position of the goal, and ball path) (Davids et al., 2013). Borges et al. (2024) showed that teams have a more stable engagement in space as players get older and mature. Player density on the pitch and pitch size are able to impact players' synchronisation, for instance, Folgado et al. (2018) found that by constraining the length of a pitch, longitudinal displacements are also constrained, and players remain closer to each other. These results suggest that players in this age group are able to coordinate themselves and maintain collective behaviours even with a large decrease in playing space. Since passing actions were not quantified in this study, inference that team spatial organisation could impact type of passes performed is just speculation.

With regards to the game phases, we observed similar patterns of TW and TSA with both formats open up their spaces or the distances between the player by stretching laterally during attacking situations when numbers of player were manipulated. This means that the defenders showed greater variability of movement and tended to change their TW more often and deeply in order to defend their goal. Our findings in line with Frencken et al. (2011), that the attackers' surface area is large, and defenders are small during attacking situation in order to break or destabilize the defending team symmetry to create goal scoring opportunity.

The findings further demonstrated that the values of the TSA during attacking were higher than those of the defending team in both formats. This finding suggests that the attacking team sought opportunities to score by occupying more space than the defending team (Silva et al., 2015). From the ecological dynamics point of view, these facts may reflect the ongoing perception–action coupling resulting from the interaction of players from the same team, opponents, and the environment (Araújo et al., 2006). The adaptations to the actions of the attackers and defenders as evidence of their capacity to attune to space and time to achieve the objectives of the team. According to Duarte, Araújo, Freire, et al. (2012), to destabilise or break the symmetry of the defenders organisation attackers have to coordinate their actions by expanding the space and creating possibilities to penetrate in the scoring zones, the defenders have to contract the space to successfully defend the most dangerous zones in front of the goal. By perceiving continuously informational variables like the displacement of the teammates and the disposition of the opponents and the available space, they co-regulate their actions. Araújo et al. (2023) found that higher values might indicate a more exploratory behaviour in the search for affordances and coordination solutions between the involved players. Reinforcing this interpretation, Folgado et al. (2018) discovered that football teams were more synchronised and stable in spatial engagement

The findings may be of relevance to Under-14 players, who are going through important developments in tactical awareness and collective coordination, and for whom player density may associates with the development of age-appropriate tactical behaviours through exposure to different spatial and interpersonal constraints. Although we found significant differences, the effect sizes were low or moderate, so the magnitude of the observed changes in collective behaviour is not high. To promote larger length expansion, coaches can use the GK+5v5+GK formation, while the GK+4v4+GK formation would be more suitable when promoting an organised defensive contraction. However, there are some limitations that should be considered when analysing and interpreting these results. The sample was composed only by Under-14 category players belonging to only one football club, which could limit the extrapolation of the results. While 100 possession sequences were analysed, observations were derived from the same players, therefore the possession sequences cannot be considered wholly independent

statistical units and there may be concern about raising the possibility of pseudo-replication. Data analysis techniques such as multilevel or mixed-effects modelling that directly incorporate repeated measures nested within players/teams should be considered in future. Only two SSCGs formats were used, and collective tactical behaviour was assessed based only on GPS positional variables. Additionally, the fact that this is a quasi-experimental study does not allow us to establish causality relationships. Future research on a larger number of manipulated task constraints, as well as a combination of positional data with technical and physical variables, could contribute to a greater understanding of the self-organised collective mechanisms that explain collective behaviour in football SSCGs.

Conclusions

In conclusion, the findings suggest that difference player density may be associated with changes in collective tactical behaviour among Under-14 football players. SSCGs with less space were associated with more spatially constrained teams, which display more variability in formation changes and covered area. On the other hand, greater space was related to greater team expansion and increase TSA. However, because this exploratory study involved one club and a quasi-experimental design, further research involving larger and more diverse samples is required before broader recommendations can be made. These results support practitioners in understanding what kind of tactical behaviours emerge from changing the relative space per player during training sessions, which could help coaches when planning training interventions for the development of tactical and collective behaviours.

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References

Aguiar, M., Botelho, G., Lago, C., Macas, V., & Sampaio, J. (2012). A review on the effects of soccer small-sided games. *J Hum Kinet*, *33*, 103-113. https://doi.org/10.2478/v10078-012-0049-x

Araújo, D., Brito, H., & Carrilho, D. (2023). Team decision-making behavior: An ecological dynamics approach. *Asian Journal of Sport and Exercise Psychology*, *3*(1), 24-29. https://doi.org/10.1016/j.ajsep.2022.09.005

Araújo, D., Davids, K., & Hristovski, R. (2006). The ecological dynamics of decision making in sport. *Psychology of Sport and Exercise*, *7*(6), 653-676. https://doi.org/10.1016/j.psychsport.2006.07.002

Atan, S. A., Azli, M. S., Jakiwa, J., & Rustam, S. (2023). Relationship between match running performance and physical capacity in Malaysia young soccer player. *Sport Mont*, *21*(1), 55-59. https://doi.org/10.26773/smj.230209

Azli, M., Davids, K., Duarte, R., Araújo, D., Button, C., & Shield, A. (2015). Changing the ratio of area per player during small-sided soccer games shapes performance. In T. Favero, B. Drust, & B. Dawson (Eds.), *International Research in Science and Soccer II* (1st ed., pp. 3-9). Routledge. https://doi.org/10.4324/9781315686745

Borges, E. d. P. A., Praça, G. M., Figueiredo, L. S., Vieira, C. A., & Costa, G. D. C. T. (2022). Promoting tactical-technical actions during small-sided soccer games: A narrative review on constraints' manipulation within ecological teaching models (Promoción de acciones técnico-tácticas durante partidos de fútbol reducidos: una revisión narrativa s. *Retos*, *45*, 566-575. https://doi.org/10.47197/retos.v45i0.91723

Borges, E. D. P. A., Praça, G. M., Trombiero, D. S., Guimarães, J. D. S., Vieira, C. A., Laporta, L., Castro, H. D. O., De Lira, C. A. B., Leonardi, T. J., & Costa, G. D. C. T. (2024). Physical, physiological, and tactical responses of U-15 and U-17 soccer players to numerically balanced and unbalanced small-sided games. *Journal of Physical Education and Sport*, *24*(9), 1129-1137. https://doi.org/10.7752/jpes.2024.09237

Clemente, F., Praça, G. M., Aquino, R., Castillo, D., Raya-González, J., Rico-González, M., Afonso, J., Sarmento, H., Silva, A. F., & Silva, R. (2023). Effects of pitch size on soccer players' physiological, physical, technical, and tactical responses during small-sided games: a meta-analytical comparison. *Biology of Sport*, *40*(1), 111-147. https://doi.org/10.5114/biolsport.2023.110748

Coutts, A. J., & Duffield, R. (2010). Validity and reliability of GPS devices for measuring movement demands of team sports. *Journal of Science and Medicine in Sport*, *13*(1), 133-135. https://doi.org/10.1016/j.jsams.2008.09.015

Davids, K., Araujo, D., Correia, V., & Vilar, L. (2013). How Small-Sided and Conditioned Games Enhance Acquisition of Movement and Decision-Making Skills. *Exerc Sport Sci Rev*, *41*(3), 154-161. https://doi.org/10.1097/JES.0b013e318292f3ec

Davids, K., Araújo, D., & Shuttleworth, R. (2005). Applications of dynamical systems theory to football. In T. Reilly, J. Cabri, & D. Araújo (Eds.), *Science and Football V: The Proceedings of the Fifth World Congress on Sports Science and Football* (1st ed., Vol. 22, pp. 537). Routledge. https://doi.org/10.4324/9780203412992

Davies, K., Rudd, J., Davids, K., & Lewis, C. (2023). Using principles of nonlinear pedagogy to develop soccer skills. In M. Duncan, M. Noon, & A. Seabra (Eds.), *Science and Practice of Youth Soccer*. Routledge. https://doi.org/10.4324/9781032665238

Duarte, R., Araújo, D., Correia, V., & Davids, K. (2012). Sports teams as superorganisms: Implications of sociobiological models of behaviour for research and practice in team sports performance analysis. *Sports Medicine*, *42*(8), 633-642. https://doi.org/10.1007/BF03262285

Duarte, R., Araújo, D., Fernandes, O., Fonseca, C., Correia, V., Gazimba, V., Travassos, B., Esteves, P., Vilar, L., & Lopes, J. (2010). Capturing complex human behaviors in representative sports contexts with a single camera. *Medicina (Kaunas)*, *46*(6), 408-414. https://doi.org/10.3390/medicina46060057

Duarte, R., Araújo, D., Folgado, H., Esteves, P., Marques, P., & Davids, K. (2013). Capturing complex, non-linear team behaviours during competitive football performance. *Journal of systems science and complexity*, *26*(1), 62-72. https://doi.org/10.1007/s11424-013-2290-3

Duarte, R., Araújo, D., Freire, L., Folgado, H., Fernandes, O., & Davids, K. (2012). Intra-and inter-group coordination patterns reveal collective behaviors of football players near the scoring zone. *Human Movement Science*, *31*(6), 1639-1651. https://doi.org/10.1016/j.humov.2012.03.001

Essafi, S., Brouki, Y., El Machrouh, Y., Khali, C., Barkaoui, M., Eloirdi, A., & Chokri, A. (2026). Integrated training through small-sided games: effects on football players' tactical engagement. A systematic review. *Retos*, *75*, 675-690. https://doi.org/10.47197/retos.v75.118254

Folgado, H., Bravo, J., Pereira, P., & Sampaio, J. (2019). Towards the use of multidimensional performance indicators in football small-sided games: the effects of pitch orientation. *Journal of Sports Sciences*, *37*(9), 1064-1071. https://doi.org/10.1080/02640414.2018.1543834

Folgado, H., Duarte, R., Fernandes, O., & Sampaio, J. (2014). Competing with lower level opponents decreases intra-team movement synchronization and time-motion demands during pre-season soccer matches. *PloS one*, *9*(5), e97145. https://doi.org/10.1371/journal.pone.0097145

Folgado, H., Duarte, R., Marques, P., Gonçalves, B., & Sampaio, J. (2018). Exploring how movement synchronization is related to match outcome in elite professional football. *Science and Medicine in Football*, *2*(2), 101-107. https://doi.org/10.1080/24733938.2018.1431399

Folgado, H., Lemmink, K. A., Frencken, W., & Sampaio, J. (2012). Length, width and centroid distance as measures of teams tactical performance in youth football. *European Journal of Sport Science*, 1-6. https://doi.org/10.1080/17461391.2012.730060

Frencken, W., Lemmink, K., Delleman, N., & Visscher, C. (2011). Oscillations of centroid position and surface area of soccer teams in small-sided games. *European Journal of Sport Science*, *11*(4), 215-223. https://doi.org/10.1080/17461391.2010.499967

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 Med*, *41*(3), 199-220. https://doi.org/10.2165/11539740-000000000-00000

Laakso, T., Davids, K., Luhtanen, P., Liukkonen, J., & Travassos, B. (2022). How football team composition constrains emergent individual and collective tactical behaviours: Effects of player roles in creating different landscapes for shared affordances in small-sided and conditioned games. *International Journal of Sports Science & Coaching*, *17*(2), 346-354. https://doi.org/10.1177/17479541211030076

McGarry, T. (2009). Applied and theoretical perspectives of performance analysis in sport: Scientific issues and challenges. *International Journal of Performance Analysis in Sport*, *9*(1), 128-140. https://doi.org/10.1080/24748668.2009.11868469

McGarry, T., Anderson, D., Wallace, S., Hughes, M., & Franks, I. (2002). Sport competition as a dynamical self-organizing system. *Journal of Sports Sciences*, *20*(10), 771 - 781. https://doi.org/10.1080/026404102320675620

Muhyi, M., Suharti, S., Puspodari, P., Syarif, A., Putro, B. N., Wibawa, J. C., & Ayubi, N. (2025). Physiological mechanisms of increasing maximal oxygen volume through small sided games training: a systematic review. *Retos*, *69*, 1215-1225. https://doi.org/10.47197/retos.v69.116525

Reilly, T., Cabri, J., & Araújo, D. (2005). Small-sided games as an alternative to interval training for soccer players. In T. Reilly, J. Cabri, & D. Araújo (Eds.), *Science and Football V: The Proceedings of the Fifth World Congress on Sports Science and Football* (1st ed., Vol. 22, pp. 559). Routledge. https://doi.org/10.4324/9780203412992

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

Silva, P., Duarte, R., Sampaio, J., Aguiar, P., Davids, K., Araújo, D., & Garganta, J. (2014). Field dimension and skill level constrain team tactical behaviours in small-sided and conditioned games in football. *Journal of Sports Sciences*, *32*(20), 1888-1896. https://doi.org/10.1080/02640414.2014.961950

Silva, P., Esteves, P., Correia, V., Davids, K., Araújo, D., & Garganta, J. (2015). Effects of manipulations of player numbers vs. field dimensions on inter-individual coordination during small-sided games in youth football. *International Journal of Performance Analysis in Sport*, *15*(2), 641-659. https://doi.org/10.1080/24748668.2015.11868821

Sousa, H., Gouveia, É. R., Marques, A., Sarmento, H., Pestana, M., Quintal, T., Lopes, H., & Ihle, A. (2022). The Influence of Small-Sided Football Games with Numerical Variability in External Training Load. *Sustainability*, *14*(2), 1000. https://doi.org/10.3390/su14021000

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