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Original Article

Physical, physiological, and tactical responses of U-15 and U-17 soccer players to numerically balanced and unbalanced small-sided games

EDUARDO DE PAULA AMORIM BORGES[1], GIBSON MOREIRA PRAÇA[2], DANILLO SILVEIRA TROMBIERO[3], JURACY DA SILVA GUIMARÃES[4], CARLOS ALEXANDRE VIEIRA[5], LORENZO LAPORTA[6], HENRIQUE DE OLIVERIA CASTRO[7], CLAUDIO ANDRE BARBOSA DE LIRA[8], THIAGO JOSÉ LEONARDI[9], GUSTAVO DE CONTI TEIXEIRA COSTA[10]

[1,3,4,5,8,10]Center for Advanced Study and Research in Sports, Federal University of Goiás, BRAZIL
[2]Center for Studies in Cognition and Action, Federal University of Minas Gerais, BRAZIL
[6]Center for Studies in Performance and Sports Analysis, Federal University of Santa Maria, BRAZIL
[7]Study and Research Group in Physical Education and Sports, Federal University of Mato Grosso, BRAZIL
[9]Laboratory for Multidisciplinary Studies in Sports, Federal University of Rio Grande do Sul, BRAZIL

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Abstract:
Small-sided games (SSGs) are commonly employed to simulate game-specific scenarios, emphasizing the importance of incorporating numerical equality and imbalance to mirror real match dynamics. This study evaluated the physical, physiological, and tactical responses of U-15 and U-17 soccer players during SSGs with numerical balance and numerical superiority in the offensive phase. The sample included 28 male athletes, with 14 from each age group participating in official competitions based on the national schedule. The SSGs were organized in 5v5 and 5v5+2 configurations, with each session consisting of four 6-minute bouts interspersed with 3-minute recovery periods. The sessions alternated between formats, with the first 6-minute period conducted as 5v5, followed by 5v5+2, and so on. On the second day of data collection, the order was reversed. The results indicated differences in the factor age group for distances covered at speeds of 7.20 to 14.29 km/h [$F(1,74)=4.965$, $p=0.029$, $\eta^2=0.06$] and 14.30 to 19.69 km/h [$F(1,74)=13.323$, $p<0.0001$, $\eta^2=0.15$], average heart rate (HRavg) [$F(1,74)=13.292$, $p<0.0001$, $\eta^2=0.15$], maximum heart rate (HRmax) [$F(1,74)=4.844$, $p=0.031$, $\eta^2=0.06$], spatial exploration index (SEI) [$F(1,74)=134.061$, $p<0.0001$, $\eta^2=0.64$], depth [$F(1,74)=93.341$, $p<0.0001$, $\eta^2=0.56$], width [$F(1,74)=7.830$, $p=0.007$, $\eta^2=0.10$], and length per width ratio [$F(1,14)=46.095$, $p<0.001$, $\eta^2=0.77$]. Moreover, considering SEI, there was an interaction between the age group and SSG format [$F(1,74)=4.736$, $p=0.033$, $\eta^2=0.06$], with U-17 players presenting higher SEI compared to U-15 ($p<0.001$). Additionally, SEI was higher in U-17 compared to U-15 in the 5v5+2 ($p<0.001$) and in 5v5 ($p<0.001$) SSGs. Thus, it is observed that numerically unbalanced games did not alter physical, physiological, and tactical responses. On the other hand, differences were noted based on the age group, with older athletes covering greater distances and exploring the game space more.
Key Words: **performance; match analysis; Influence of floaters; numerical superiority; GPS devices.**

Introduction

Soccer is a team sport characterized by variability and unpredictability in game situations (Galatti et al., 2017). Consequently, for compelling gameplay, players need to master the technique and tactical principles for decision-making in problem situations inherent to the game (Araújo et al., 2017; Johnson, 2006; Praça, Morales, Moreira, et al., 2017). Therefore, training sessions must be systematized according to the practice context to enhance athletes' physical and tactical performance, maintaining the specificity of the intended physical, physiological, technical, or tactical response (Clemente et al., 2023; Martín-García et al., 2020; Praça, Morales, & Greco, 2017). In this perspective, Small-Sided Games (SSGs) emerge as a pedagogical tool capable of optimizing performance by facilitating the interaction of physical, physiological, technical, and tactical responses in the training process (Travassos et al., 2014).

In this scenario, SSGs can represent specific situations from the formal game context, providing opportunities for players' physical, physiological, technical, and tactical actions based on their positions on the field (Martín-García et al., 2020; Praça et al., 2022; Silva et al., 2016; Silva et al., 2015). Despite being played under numerical equality between the teams, there are noticeable moments in which duels occur under numerical unbalance (Hill-Haas et al., 2010). For example, a recent study indicated that the ability of a team to keep numerical superiority near the ball is critical to winning matches. Therefore, when employing SSGs, it is essential to create scenarios with numerical equality and numerical imbalance, aligning the SSG configuration with the reality of the game (Hill-Haas et al., 2010). Research in this area indicates that physical response is lower in situations with numerical superiority due to reduced individual workload, stemming from a lesser need

Corresponding Author: GUSTAVO DE CONTI TEIXEIRA COSTA, Email: conti02@ufg.br

to run or actively engage in the game (Praça et al., 2015, 2018). Physiological responses related to maximum heart rate (HRmax) and average heart rate (HRavg) are also lowered in situations of numerical superiority (Praça et al., 2018; Sanchez-Sanchez et al., 2017). Tactical responses differ in SSGs with numerical superiority, reflecting adjustments in players' tactical behavior for each game context, with more offensive tactical actions both with and without the ball compared to the numerical equality configuration (Padilha et al., 2017; Moniz et al., 2020; Silva et al., 2015). Furthermore, there are higher values of width and length and the length per width ratio (LPWratio) in numerical superiority situations (Praça, Morales, Moreira, et al., 2017). Manipulating game conditions promotes greater exploratory behavior in numerically unbalanced conditions than in numerically equal conditions, with variations observed among youth age groups (Canton et al., 2019). Overall, it is expected that adopting numerical superiority will decrease physical responses while inducing a game with greater spatial occupation in width and depth. However, the available literature on this topic has addressed this issue from a fragmented point of view, considering only a few performance dimensions (e.g., only tactical or physical responses). This fragmented approach hinders the possibility of fully understanding the impact of manipulating numerical balance during SSGs on players' responses and indicates further investigation. Given that responses to training with small-sided games in different numerical relations are multifactorial, the existence of study designs that simultaneously address tactical, physical, and physiological responses is justified.

Beyond the differences arising from the type of SSG configuration, variations in responses to SSGs based on age are apparent (López-Fernández et al., 2020). Analysis of physical responses indicates that small-sided games with numerical superiority result in decreased distance covered and peak speed compared to formal games (Lozano et al., 2020). Previous findings suggest that older athletes exhibit a greater physical response than younger athletes in terms of total distance covered and distances covered at higher speeds (Correa et al., 2019; Coutinho et al., 2022; Lemes et al., 2020; Rábano-Muñoz et al., 2019). Regarding physiological responses, no maximum heart rate (HRmax) difference was observed when comparing numerical equality and numerical superiority games in under-14 athletes (Correa et al., 2019). Conversely, in older teams, such as the under-17 category, an increase in HRmax was noted in numerically equal SSGs (Köklü & Alemdaroğlu, 2016), with older teams displaying lower values for both HRmax and average heart rate (HRavg) than younger teams (López-Fernández et al., 2020). Concerning tactical responses, it is evident that these are age-dependent, as older players exhibit higher values for length and width indices in numerically balanced contexts (Praça, Rochael, et al., 2022). Furthermore, older athletes demonstrate greater spatial occupation and distance from centroids than younger athletes (Clemente et al., 2020). Therefore, it is anticipated that athletes of different ages will react differently to SSGs with numerical inferiority and superiority, with older athletes showing a greater physical response and a game characterized by increased spatial occupation in width and length. However, to our knowledge, no previous study has simultaneously addressed the impact of manipulating the numerical equality during SSGs in different age groups. Also, there is a gap in understanding the impact of age on players' responses to SSG from a multidimensional point of view.

In this context, it is evident that athletes' responses are influenced by age and the type of SSG configuration (Barnabé et al., 2016; Machado et al., 2019), prompting the recommendation to modify game settings and alter players' action possibilities during play (Silva et al., 2016). This is crucial as the demands are specific to the task context and the intended physical, physiological, and tactical responses (Clemente et al., 2015; Travassos et al., 2014). Despite increased studies analyzing tactical behaviors through SSGs (Praça et al., 2020), little is known about the formats with unbalanced teams in different football age groups, a situation common in formal games (Praça et al., 2018). Furthermore, most studies examining situations of numerical superiority in SSGs have utilized a small number of players (e.g., 3v3), justifying the need for new studies in broader game formats (e.g., 5v5). Therefore, considering that training through SSGs closely aligns with the practice context and that physical, physiological, and tactical responses in unbalanced situations are inherent to the age group, there is a need to expand knowledge in this area. This study aimed to compare field football players' physical, physiological, and tactical responses between U-15 and U-17 age groups through SSGs played with numerical equality and numerical superiority in the offensive phase. It is hypothesized that older athletes will exhibit greater physical and physiological responses and a tactical behavior characterized by a game with increased spatial occupation in width and depth compared to younger athletes. Additionally, SSGs with numerical superiority are expected to result in lower physical and physiological responses than games with numerical equality, and games with numerical superiority will lead to greater spatial occupation in width and depth compared to games with numerical equality.

Material & methods

Participants

The study involved the participation of 28 male soccer athletes divided into two age groups: U-15 and U-17. The U-15 group comprised 14 athletes with an average body weight of 68.4 kg, 8.49% body fat, and an average height of 1.72 meters. In contrast, the U-17 category included another 14 athletes with an average body weight of 69.8 kg, 7.95% body fat, and an average height of 1.79 meters. These athletes are members of a team that competes in national championships in Brazil. The players included in the study were officially registered

with the team, and selection criteria prioritized those who regularly participated in regional and national competitions, engaging in five weekly training sessions with one official game per week. Goalkeepers participated in data collection but were not evaluated. Athletes with injuries preventing their participation in the research at the time of data collection were excluded from the study.

All participants and their legal guardians were fully informed about the research and procedures and provided written consent to participate. The study received approval from the Federal University of Goiás Ethics Committee, CAAE: 65290217.2.00000.5083.

Procedures

For data collection, the team coaches divided the 14 athletes from each age group into two groups of seven athletes with similar performance levels. This division was based on the coaching staff's subjective evaluation and the players' positions, aiming to generate balanced matchups, as recommended in the literature (Folgado, Duarte, et al., 2014). Each team consisted of two defenders (center-back or full-back), two midfielders (defensive midfielder or midfielder), one forward (center-forward), and two wildcards. The wildcards were positioned at the ends of the central line of the field, actively participating in the game only during the offensive phase and only in the numerical superiority condition. With this configuration, the teams played in the 5v5 and 5v5+2 formats.

The teams faced each other in both SSG configurations with four bouts of 6 minutes and a 3-minute interval between game periods. On the first day of data collection, the teams alternated between game configurations, meaning the first period of 6 minutes in the 5v5, followed by the second period of 6 minutes in the 5v5+2 SSG, and so forth. On the second day of data collection, the order was reversed, and the teams played the first period of 6 minutes in the 5v5+2 configuration, followed by the second period of 6 minutes in the 5v5 SSG, and so forth. All players participated in both configurations on both days, with no team composition or matchup changes. During data collection, players were instructed to maintain a regular diet, and water consumption was allowed ad libitum during the intervals between SSGs. Each session began with a standardized 5-minute warm-up consisting of ball-free movements, progressive sprints with accelerations, and changes of direction. Two referees were positioned on the field's sides throughout the SSGs to observe the game and enforce offside and game rules when necessary. In offside situations, the defending team was awarded a free kick. All SSGs were played on a 44 × 33 m natural grass field. Additional balls were placed around the field to ensure a quick game restart when the ball went out of play. Coaches and researchers provided no verbal encouragement or tactical instructions to the players.

Dependent variables

Physical responses

Physical data were recorded using a 10 Hz GPS device (Polar, Team Pro, Kempele, Finland). Each player wore a chest strap with the device attached, and the validity and reliability of the device were reported in a previous study (Köklü & Alemdaroğlu, 2016; Praça, Andrade et al., 2021; Praça, Andrade et al., 2022). All players used the same GPS unit during the data collection sessions. The GPS was activated at the beginning of the warm-up to facilitate satellite identification and reduce data loss. Variables related to physical demands included total distance covered and distance covered at speeds of 3.0 – 7.19 km/h, 7.20 – 14.29 km/h, and 14.30 – 19.69 km/h, as per a previous study (Praça et al., 2018).

Physiological responses

This study recorded heart rate (HR) using heart rate monitors (Polar®, FT1, Kempele, Finland) compatible with the GPS interface during the SSGs. Both maximum heart rate (HRmax) and average heart rate (HRavg) were recorded. HRmax was determined to be the highest HR value recorded during the SSGs, while HRavg was calculated to be the mean of all HR values recorded during each session.

Tactical responses

Positional data were recorded using a 10 Hz GPS device (Polar, Team Pro, Kempele, Finland). The analysis of tactical response was conducted through the following parameters: a) Spatial Exploration Index (SEI) (m), defined as the average difference between the mean position and the actual position of each player at every moment of the game. It indicates how exploratory the player's behavior was, with higher SEI values suggesting more exploratory behavior, while lower values indicate more positional behavior; b) Depth (m) and Width (m), determined by the distance between the farthest players in length and the players farthest to the right and left in width; c) Stretch Index (m), defined as the average difference between the mean position and the actual position of each player at every moment of the game, illustrating the dispersion of players from the geometric center. Higher values indicate greater dispersion, and d) Width/Depth Ratio (ua) indicates the preferred displacement axis of a team on the field. Values greater than 1ua indicate a more lengthwise positioning, while values below 1ua indicate a wider positioning.

Data processing and statistical analysis

Player positional data were recorded using GPS units and processed in MATLAB R2010a (The MathWorks Inc., Natick, MA, USA). Each player's latitude and longitude data were synchronized and converted into meters using the Universal Transverse Mercator (UTM) coordinate system. The data were smoothed using a second-order Butterworth filter with a 10 Hz cutoff frequency. After converting positional data into meters, a

rotation matrix was calculated for each small-sided game with the field vertices' positions, aligning the field length with the x-axis and the width with the y-axis. Subsequently, the rotation matrix was applied to the players' positional data to align it with the field reference. The GPS devices were activated at the beginning of the warm-up to facilitate satellite identification and reduce data loss. After the match, the data were downloaded and analyzed using the online Polar Team Pro software. It is noted that the weather was sunny throughout the data collection, enhancing GPS accuracy.

Descriptive data were presented as mean, standard deviation, maximum, and minimum values. Two-way repeated-measures ANOVA was employed to assess positional, physical, and physiological variables, with Bonferroni post-hoc analysis used to identify differences between age groups and SSG configurations. Additionally, the effect size was calculated using partial eta-squared (η^2 partial), interpreted as follows according to Cohen [29]: η^2 partial < 0.06 - small effect, 0.06 < η^2 partial < 0.14 - moderate effect, η^2 partial > 0.14 – large effect. All statistical analyses were conducted using the Statistical Package for the Social Sciences (SPSS - Version 20.0 for Windows, SPSS Inc., Chicago, IL, USA), and the significance level was set at 5%.

Results

Physical responses

The results regarding physical responses are presented in Table 1. Considering the total distance covered, there was no difference between age groups [$F(1,74)=0.002$, $p=0.963$, $\eta^2=0.00$], SSGs [$F(1,74)=0.326$, $p=0.570$, $\eta^2=0.00$], or interaction between the factors [$F(1,74)=0.239$, $p=0.626$, $\eta^2=0.00$]. Analyzing the distance covered at speeds from 3.00 to 7.19 km/h, no difference was observed between age groups [$F(1,74)=2.247$, $p=0.138$, $\eta^2=0.03$], SSGs [$F(1,74)=1.417$, $p=0.238$, $\eta^2=0.02$], or interaction between the factors [$F(1,74)=1.866$, $p=0.176$, $\eta^2=0.03$]. Considering the distance covered at speeds from 7.20 to 14.29 km/h, a difference was observed between age groups [$F(1,74)=4.965$, $p=0.029$, $\eta^2=0.06$], with no difference between the SSGs [$F(1,74)=0.007$, $p=0.933$, $\eta^2=0.01$] or interaction between the factors [$F(1,74)=0.0553$, $p=0.459$, $\eta^2=0.01$]. Bonferroni's post-hoc analysis showed that the U-15 group covered a greater distance at speeds from 7.20 to 14.29 km/h compared to the U-17 group ($p=0.029$). Analyzing the distance covered at speeds from 14.30 to 19.69 km/h, there was a difference between age groups [$F(1,74)=13.323$, $p<0.0001$, $\eta^2=0.15$], with no difference between the SSGs [$F(1,74)=3.666$, $p=0.059$, $\eta^2=0.05$] or interaction between the factors [$F(1,74)=0.746$, $p=0.390$, $\eta^2=0.01$]. Bonferroni's post-hoc analysis showed that the U-17 group covered a greater distance at speeds from 14.30 to 19.69 km/h compared to the U-15 group ($p<0.001$). Considering the distance covered at speeds from 19.70 to 25.09 km/h, there was no difference between age groups [$F(1,74)=0.743$, $p=0.391$, $\eta^2=0.01$], SSGs [$F(1,74)=3.474$, $p=0.066$, $\eta^2=0.05$], and no interaction between the factors [$F(1,74)=1.819$, $p=0.182$, $\eta^2=0.02$].

Table 1. Physical responses observed in the two experimental conditions by the two age groups

	U-15		**U-17**	
	5v5 X ± SD	**5v5+2 X ± SD**	**5v5 X ± SD**	**5v5+2 X ± SD**
Total distance (m)	577 ± 89	576 ± 73	579 ± 56	567 ± 61
Distance at 3,00 - 7,19 km/h (m)	244 ± 34	258 ± 25	259 ± 29*	259 ± 31
Distance at 7,20 - 14,29 km/h (m)	245 ± 81	234 ± 74	210 ± 61*	217 ± 59
Distance at 14,30 - 19,69 km/h (m)	50 ± 24	45 ± 25	66 ± 24	55 ± 25
Distance at 19,70 - 25,09 km/h (m)	10 ± 11	9 ± 9	14 ± 12†	8 ± 9

(*) $p<0,05$, different from U-15. (†) $p<0,05$, different from 5v5+2.

Physiological responses

The results regarding physiological responses are presented in Table 2. The analysis of the data showed that considering the average heart rate (HRavg), there was a difference in the age group factor [$F(1,74)=13.292$, $p<0.001$, $\eta^2=0.15$], with no differences between the SSG formats [$F(1,74)=0.051$, $p=0.821$, $\eta^2=0.01$], and no interaction between factors [$F(1,74)=3.428$, $p=0.068$, $\eta^2=0.04$]. Bonferroni's post-hoc analysis showed that the U-15 group had a higher HRavg than the U-17 group ($p<0.001$).

Analyzing the maximum heart rate (HRmax), there was a difference in the age group factor [$F(1,74)=4.844$, $p=0.031$, $\eta^2=0.06$], with no difference in the SSG configuration factor [$F(1,74)=0.025$, $p=0.874$, $\eta^2=0.00$], and no interaction of factors [$F(1,74)=0.031$, $p=0.861$, $\eta^2=0.00$]. Bonferroni's post-hoc analysis showed that the U-15 group had a higher HRmax than the U-17 group ($p=0.031$).

Table 2. Physiological responses observed in the two experimental conditions by the two age groups

	U-15		U-17	
	5v5 X ± SD	5v5+2 X ± SD	5v5 X ± SD	5v5+2 X ± SD
HRavg (bpm)	171 ± 12	167 ± 12	161 ± 16*	163 ± 13
HRmax (bpm)	191 ± 13	191 ± 14	187 ± 17	187 ± 15

(*) p<0,05, different from U-15.

Tactical responses

The results regarding tactical responses are presented in Table 3. The analysis of the data showed that in the spatial exploration index (SEI), there was a difference between age groups [F(1,74)=134.061, p<0.001, η^2=0.64] and interaction between the factors [F(1,74)=4.736, p=0.033, η^2=0.06]. However, there was no difference between the SSGs [F(1,74)=0.004, p=0.949, η^2=0.00]. Bonferroni's posthoc analysis showed that the U-17 group had a higher IEE when compared to the U-15 group (p<0.001), and the IEE was higher in the U-17 group compared to the U-15 group in situations with a wildcard (p<0.001) and numerical equality (p<0.001). Considering the length, the age group factor showed a difference [F(1,74)=93.341, p<0.0001, η^2=0.56], and there was no difference between the SSGs [F(1,74)=2.527, p=0.116, η^2=0.03], and no interaction between the factors [F(1,74)=1.131, p=0.291, η^2=0.02]. Bonferroni's post-hoc analysis showed higher length values in the U-17 group than in the U-15 group (p<0.001). Analyzing the width, there was a difference between age groups [F(1,74)=7.830, p=0.007, η^2=0.10], and there was no between SSGs [F(1,74)=0.077, p=0.782, η^2=0.00], and no interaction between factors [F(1,74)=0.511, p=0.477, η^2=0.01]. Bonferroni post-hoc analysis showed higher width values in the U-15 group than in the U-17 group (p=0.007). Considering the stretching index, there was no difference between age groups [F(1,14)=2.592, p=0.130, η^2=0.16], SSGs [F(1,14)=0.809, p=0.384, η^2=0.06], and no interaction between the factors [F(1,14)=0.001, p=0.977, η^2=0.00]. The analysis of the LPWratio showed a difference between age groups[F(1,14)=46.095, p<0.001, η^2=0.77], and there was no difference between SSGs [F(1,14)=0.459, p=0.509, η^2=0.03], and no interaction between the factors [F(1,14)=0.051, p=0.825, η^2=0.00]. Bonferroni's post-hoc analysis showed that the U-17 group had a higher LPWratio than the U-15 group (p<0.001).

Table 3. Tactical responses observed in the two experimental conditions by the two age groups

	U-15		**U-17**	
	5v5 X ± SD	**5v5+2 X ± SD**	**5v5 X ± SD**	**5v5+2 X ± SD**
SEI (m)	8.33 ± 1.26	7.77 ± 1.17	10.42 ± 1.40*	10.89 ± 1.54*
Length (m)	22.31 ± 4.07	22.08 ± 4.26	30.42 ± 3.75*	28.70 ± 4.47*
Width (m)	22.77 ± 5.94	22.36 ± 6.10	19.13 ± 4.74*	20.03 ± 4.44
Stretching Index (m)	15.97 ± 1.68	15.72 ± 1.58	17.46 ± 2.06	17.16 ± 2.28
LPWratio (ua)	73.42 ± 9.07	75.59 ± 8.76	77.61 ± 23.44*	78.09 ± 17.03

SEI: Spatial Exploration Index; LPWratio: length per width ratio.
(*) p<0,05, different from U-15.

Discussion

Small-sided games (SSGs) are employed in training to optimize performance through task constraints on players and adjust tactical, physiological, and physical responses to the contexts inherent in youth soccer. While there is already knowledge about using SSGs in male soccer training, especially regarding different SSG configurations (Clemente et al., 2021; Sousa et al., 2019), little is known about configurations involving unbalanced play, especially in SSGs beyond 3vs3, extensively investigated in the literature. Thus, this study assessed soccer players' tactical behavior and physiological and physical demands in the U-15 and U-17 age categories using SSGs with numerical equality (5v5) and offensive numerical superiority (5v5+2). The main differences lie in the comparison between age groups, while the protocol type had a negligible effect on the players' tactical, physical, and physiological responses.

The hypothesis that older athletes would exhibit greater physical and physiological responses than younger athletes was confirmed, particularly regarding physical responses. Castellano et al. (2017), who analyzed players in the U-13 and U-14 categories in situations of numerical equality and SSGs with different field sizes, observed that the younger category covered less distance at various speeds than the older category, a result like Lemes et al. (2020). In another study, Rábano-Muñoz et al. (2019) analyzed players in the U-17, U-19, and U-21 categories in situations of numerical superiority. They found that the U-17 category covered shorter total distances and distances at speeds ranging from 7.00 to >18.00 km/h compared to the older categories. Therefore, exposure to systematic training in the sport is assumed to enhance athletes' ability to

displace during small-sided game tasks. Accordingly, it is recommended that training load planning using this tool should be adjusted based on the athletes' skill level (for example, their age). Interestingly, despite demonstrating a higher physical response, older athletes also exhibited a lower physiological response, indicating that the achieved external load represented a lower internal load on the athletes. A previous study suggested that athletes with higher aerobic power cover greater distances in small-sided games (Lemes et al., 2020). Thus, it is considered that older athletes, besides showing a better physical response, tend to withstand the efforts from small-sided games better. This reinforces the need to plan the use of SSGs considering the age and skill level of the practitioners, challenging the one-size-fits-all approach. From a tactical perspective, it was observed that older athletes exhibited a game more oriented along the length axis, partially confirming the hypothesis of greater spatial occupation. Furthermore, older athletes showed greater spatial exploration than younger athletes, aligning with the hypotheses. Previous studies indicated older athletes had lower LPWratio and length values than younger athletes (Praça, Moreira, et al., 2022), contradicting the current results. However, the earlier study investigated athletes in the U-13 and U-14 categories, a different sample from the current research, and adopted the 3vs3 configuration. Interestingly, age-related differences in spatial occupation occurred in another study only in the 3v3 game, not in the 4v4 (Folgado, Lemmink, et al., 2014). In official games, another study also found no differences in spatial occupation between younger and older athletes (Praça, Moreira, et al., 2021). Thus, it is considered that in games with more players (e.g., 5v5), spatial occupation is less influenced by age, explaining the current results. Furthermore, the increase in length values indicates that older athletes more easily reach the opponent's goal and advantageous positions for scoring, as reported in other game formats in the literature (Praça, Chagas, et al., 2021) and regarding spatial exploration, Praça, Rochael et al. (2022) analyzed players in the U-13 and U-14 categories in situations of numerical superiority and with different field sizes, finding that older players have higher values of spatial exploration, similar to the current study. In another study, Clemente et al. (2020) analyzed players in the U-13, U-15, and U-17 categories under conditions of numerical equality and observed that the tactical response was more exploratory in older athletes. Therefore, being able to explore the playing field seems to represent a skill acquired by athletes throughout the training process. However, the limited number of investigations on the subject in larger game formats (e.g., 5v5) suggests that more research should be conducted to understand the phenomenon (Praça, Chagas et al., 2021).

The players' physical, tactical, and physiological responses did not significantly impact the game configuration. Regarding the influence of numerical superiority when considering the SSG formats of 3v3 and 4v3, Praça et al. (2015, 2018) observed a greater physical response in games with numerical equality compared to games with numerical superiority. It is suggested that adopting small games with a larger area and number of players leads athletes to adopt a more stable game that is less subject to variability in conditions like 3v3, which helps explain the current results. For example, while previous studies indicated tactical differences between games with numerical equality and superiority (Praça et al. 2017; Praça, Moreira, et al., 2022), the current study demonstrated that athletes adopted similar spatial occupation and exploration protocols with numerical equality and superiority. Therefore, the more players there are in the SSG configurations, the less the additional wild card influences the physical response. However, further studies in configurations with more players are recommended to expand the understanding of this behavior. The current study represents advancements in understanding the use of numerical superiority in small-sided game training in soccer. Addressing the issue from a multidimensional point of view, as recommended in the literature, allows for a comprehensive understanding of the effects of these configurations on player behavior (Folgado et al., 2019). For example, the absence of differences in tactical response between games with numerical equality and superiority provides a possible explanation for the lack of difference in physical responses between configurations, which can only be understood through a multidimensional approach. However, limitations need to be considered. Initially, the study considers athletes from only one club. Additionally, it was impossible to adopt objective measures for team composition, as done in previous studies (Praça, Morales, Moreira, et al., 2017).

Conclusions

Based on the results, it was observed that the physical and physiological responses did not change according to the configuration of the SSGs. On the other hand, older athletes presented greater physical performance – total distance and distances in higher speed zones – and a lower physiological response. In addition, the tactical response differed between categories, with the under-17 group presenting more exploratory behavior than the under-15 group, especially with extended field occupation. This factor may have been reflected in the differences found in the physical and physiological responses. Therefore, the results suggest that SSGs should be used for training, considering the individual characteristics of the athletes.

The practical implications reverberate in the possibility of coaches adjusting the SSG configurations to increase their players' performance, taking them to the desired level in the training process defined by the football club. In long-term training, the preparation of sessions should consider the specificity of the athletes, bringing them closer to the desired objectives for each age group. In this scenario, future research should investigate other SSG configurations in different categories and compare the athletes' performance throughout the season.

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