

Manipulating net height in volleyball small-sided games: effects on professional female athletes' tactical-technical performance

Manipulação da altura da rede em jogos reduzidos no voleibol: efeitos no desempenho técnico-tático de atletas profissionais femininas

Manipulación de la altura de la red en juegos reducidos en voleibol: efectos en el rendimiento técnico-tático de atletas femininas profesionales

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Keywords:

Small-games;
Elite athletes;
Net height;
Team sport.

ABSTRACT

This study investigated the effects of manipulating the net height in 4 vs. 4 small-sided games on the tactical-technical performance of professional female volleyball athletes. Eight professional female athletes participated in this study, playing 4 vs. 4 small-sided games at three net heights: 2.15 m, 2.24 m, and 2.33 m. The technical-tactical actions (Specific Performance per Action, Specific Performance per Component, and General Performance) were analyzed through the IAD-VB. Results indicated that the lower net height favored the complex 0 actions ($p=0.034$; $V=0.329$), while the higher net height favored setting ($p=0.001$; $V=0.449$), attack ($p=0.038$; $V=0.325$), and defense ($p<0.001$; $V=0.731$) action structuring. Additionally, the net height was associated with the decision-making component ($p=0.011$; $V=0.368$), suggesting that this specific manipulation may affect the complexity of the decision-making process in the game setting.

Palavras-chave:

Pequenos jogos;
Atletas de elite;
Altura da rede;
Esporte coletivo.

RESUMO

Esse estudo objetivou investigar os efeitos da manipulação da altura da rede em jogos reduzidos de 4 x 4 no desempenho técnico-tático de atletas profissionais femininas de voleibol. Participaram oito atletas femininas profissionais, que jogaram 4 x 4 em três alturas de rede: 2,15 m, 2,24 m e 2,33 m. As ações técnico-táticas (Desempenho Específico por Ação, Desempenho Específico por Componente e Desempenho Geral) foram analisadas através do IAD-VB. Os resultados indicaram que a menor altura favoreceu as ações do complexo 0 ($p=0.034$; $V=0.329$), enquanto a maior altura da rede favoreceu o levantamento ($p=0.001$; $V=0.449$), ataque ($p=0.038$; $V=0.325$), e estruturação das ações defensivas ($p<0.001$; $V=0.731$). Adicionalmente, a altura da rede foi associada ao componente de tomada de decisão ($p=0.011$; $V=0.368$), sugerindo que esta manipulação específica pode afetar a complexidade do processo de tomada de decisão no cenário de jogo.

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Palabras-clave:

Pequeños juegos;
Atletas de elite;
Altura de la red;
Deporte colectivo.

RESUMEN

Este estudio tuvo como objetivo investigar los efectos de la manipulación de la altura de la red en juegos reducidos de 4 vs. 4 sobre el rendimiento táctico-técnico de atletas profesionales de voleibol femenino. Participaron ocho atletas femeninas profesionales, que jugaron 4 vs. 4 en tres alturas de red: 2,15 m, 2,24 m y 2,33 m. Las acciones técnico-tácticas (Rendimiento Específico por Acción, Rendimiento Específico por Componente y Rendimiento General) fueron analizadas mediante el IAD-VB. Los resultados indicaron que la menor altura favoreció las acciones del complejo 0 ($p=0.034$; $V=0.329$), mientras que la mayor altura de la red favoreció la distribución ($p=0.001$; $V=0.449$), ataque ($p=0.038$; $V=0.325$) y la estructuración defensiva ($p<0.001$; $V=0.731$). Además, la altura de la red se asoció con el componente de toma de decisión ($p=0.011$; $V=0.368$), lo que sugiere que esta manipulación específica puede afectar la complejidad del proceso de toma de decisión en el escenario del juego.

INTRODUCTION

Small-sided games (SSGs) are considered effective pedagogical tools in athletic development. This methodology requires athletes to adapt to modified contexts set by the coach, characterized by implementation in more compact spaces, increased action frequency, and greater interaction among athletes (Clemente, 2023). Consequently, SSGs promote the enhancement of physical, technical, and tactical abilities, coupled with high motivational levels (Clemente et al., 2021).

The volleyball game consists of various complexes (0- service, I - side out, II - break, III – transition of the break, IV – attack cover, V – freeball/downball), that characterize different moments of the game (Loureiro et al., 2017). Allied with the importance of analyzing the tactical systems employed by teams and the coach's decisions and instructions, the technical elements players use are also commonly studied parameters in volleyball (Rodríguez-Ruiz et al., 2011).

From an early stage of development, SSGs have been employed in training settings to maximize the efficiency of decision-making (DM) tasks related to the athletes' technical and tactical performance (Rodrigues et al., 2022). In this sense, SSGs in volleyball may implement game conditioning strategies that involve altering various variables, including: i) number of players on the field; ii) area configuration; iii) scoring method; iv) allowed actions; v) tactical strategies; vi) net height, among others (Clemente, 2023; Palao et al., 2024). Regarding this last condition, the net height should be determined according to the athletes' skills, age, and characteristics. Considering the importance of vertical jump and its impact on volleyball performance (Villalon-Gasch et al., 2022), manipulating the net height may be an effective way to adjust the game context, since increasing the net height also increases the likelihood of intercepting the ball, as players have more time to read its trajectory (Palao et al., 2024). Indeed, Palao et al. (2024) demonstrated that decreasing the net height resulted in less effective reception but more effective serving in a study that investigated the impact of reducing

net height, court size, and limiting the serve in youth volleyball players.

In terms of developing technical-tactical actions, previous investigations suggest that SSGs are more effective than instructional pedagogical approaches (Clemente et al., 2021). Considering the development of technical-tactical aspects, previous research indicates that using SSGs as a strategy to reduce the playing area favors technical development, while increasing the playing area promotes DM and effectiveness in actions (Rodrigues et al., 2022). Rodrigues et al. (2022) compared the tactical-technical behavior of volleyball players based on the manipulation of court size in small-sided games, indicating that players' behaviors are contingent on the game configurations. They found that modifications in tactical-technical behavior arise from the game ecology.

Manipulation of net height, court size, and restriction of serving actions in SSGs was capable of altering the dynamics of the game, bringing them closer to later stages of gameplay development in U14 volleyball players (Palao et al., 2024). Thus, literature has shown that constraints applied in SSGs imply the promotion of distinct technical and tactical behaviors (Castro et al., 2022a).

Even though previous research extensively highlights the positive impact of pedagogical approaches using SSG methodology on volleyball performance enhancement, there remains uncertainty regarding the actual effects of this training methodology on manipulating specific game variables. Despite the studies conducted on the influence of net height constraints on technical and tactical actions in volleyball, little is known about this effect on professional and adult teams. Therefore, the objective of this study is to verify the effects of applying 4 vs. 4 SSGs with the manipulation of the net height on the tactical-technical performance of professional female volleyball athletes.

METHOD**STUDY DESIGN**

This study employed a descriptive cross-sectional study design to verify the effects of manipulating the

net height in 4 vs. 4 games on the tactical and technical performance of female volleyball players. The research was conducted in a single day, during a specific stage of the season. All the games were played over one day, lasted one set of 15 points and players had a 10-minute rest interval before each small game. Each athlete played a game at each of the net heights. All athletes played on the lowest net, then on the official net, and finally on the highest net, following the same initial order of the teams' games at each net height. The initial order of the teams' games was defined by draw. The games adopted the official rules of the FIVB. The games were conducted under specific temperature and environmental conditions. Furthermore, the game sessions were all held in the morning, the athletes' training turn and to ensure uniformity across the games. All games were recorded and videos were subsequently evaluated.

PARTICIPANTS

The study was approved by the Ethics and Research Committee of the University (number 6.430.163). A convenience sampling strategy was used, and participants were eight Brazilian professional female athletes (average age of 22.63 ± 7.22 years; average experience of 4.50 ± 2.32 years) from a volleyball team that competed in the 2023 Superliga C (equivalent to the third division of Brazil's National Volleyball Championship). The players have competitive experience at national level and were regularly engaged in six weekly training sessions, each lasting 2 hours. The participants in this study were classified at tier 3 of the Participants Classification Framework, indicating their competitive level within the sport (McKay et al., 2022). The inclusion criteria were: (i) carrying out all procedures described in the study; (ii) carrying out systematic volleyball training at least three times a week for a minimum period of one year; and (iii) participating in championships for their respective club at the state, national and/or international level. Volunteers who did not meet any of the inclusion criteria would be automatically excluded from the study. However, there was no exclusion.

PROCEDURE

The head coach was responsible for dividing the teams, aiming to achieve technical-tactical balance. The 4 vs. 4 games were played with three net heights: 2.15 m, 2.24 m, and 2.33 m. These heights were chosen following the criteria: 2.15 m was used because it is the lowest height among the female volleyball categories (9 cm lower than the official senior women's height); 2.24 m was used as it is the official height for women's senior volleyball; and 2.33 m is 9 cm higher than the official height for women's senior volleyball. During data collection, there was no technical or tactical instruction for the participants, only verbal encouragement with the aim of motivation.

To analyze technical-tactical performance during the matches, the Instrument for Technical-Tactical

Performance Assessment in Volleyball (IAD-VB) (Collet et al., 2010) was used. IAD-VB included the individual assessment of players in real-match situations, related to specific actions (serve, reception, setting, attack, blocking, and defense) and technical-tactical performance components (technical: adjustment and efficiency; tactical: DM and effectiveness). With the application of the IAD-VB, the player's levels of Specific Performance per Action (SPA) and Specific Performance per Component (SPC) are established, according to equations proposed by the instrument, which considers the number of technical-tactical actions carried out by the player and their respective evaluations. The General Performance (GP) was determined by calculating the arithmetic mean of the specific performance in each action. The players' performance level corresponds to the percentage result obtained through the proposed equations, and is classified as inadequate (0 to 33.3%), intermediate (33.4 to 66.6%), or adequate (66.7 to 100%), as proposed by the IAD-VB.

The official games were recorded using a videocamera Sony® Handycam NP-BX1 Full HD, positioned at the back of the court at a height of 3.5 meters, and analyzed by three volleyball specialists (senior team head coaches with over 10 years of volleyball experience) experienced in the IAD-VB assessment, according to the SPA, SPC, and GP, to evaluate the performances of the athletes. The within and between-observer reliability were 0.80 and 0.85, respectively, obtained through Cohen's Kappa, extensively adopted for measuring observers' agreement in observational instruments (Castro et al., 2022b).

STATISTICAL ANALYSIS

The collected data were transformed into percentage values, according to the three IAD-VB categories, and descriptive and inferential statistical resources were used in their analysis. The association between the height of the volleyball net and the level of technical-tactical performance of the athletes investigated was analyzed using the Chi-square test of Independence. The Adjusted Residual values from the analysis were used as references to establish associations between the variables, with significance being reported for values above 1.96 or below -1.96. Cramer's V was calculated as the effect size for the Chi-square tests, classified as small (0.05), medium (0.15), or large (0.25), following Cohen's (1988) guidelines considering the analyses' degrees of freedom (4). Statistical significance was set at 5% ($p < 0.05$). Analyses were performed using the SPSS software (SPSS Version 21.0 for Windows, SPSS Inc., Chicago, IL, USA).

RESULTS

The analysis of the athletes' technical-tactical performance for each action evaluated is presented in Table 1. Associations were verified between SPA and net height in serving ($p=0.034$; $V=0.329$), setting ($p=0.001$;

Table 1. Association between SPA and net height.

Action	Net height	Technical-tactical performance level			χ^2	<i>p</i>	V
		Inad. (%) [AR]	Interm. (%) [AR]	Adeq. (%) [AR]			
Serving	2.15 m	14.29 [-2.1]	28.57 [-0.5]	57.14 [2.2]	10.403	0.034	0.329
	2.24 m	25.00 [1.1]	25.00 [-1.4]	50.00 [0.4]			
	2.33 m	25.00 [1.1]	37.50 [1.9]	37.50 [-2.6]			
Reception	2.15 m	25.00 [-1.1]	37.50 [1.1]	37.50 [0]	6.696	0.153	0.264
	2.24 m	37.50 [2.2]	25.00 [-2.2]	37.50 [0]			
	2.33 m	25.00 [-1.1]	37.50 [1.1]	37.50 [0]			
Setting	2.15 m	25.00 [1.3]	12.50 [-3.5]	62.50 [2]	19.423	0.001	0.449
	2.24 m	25.00 [0]	25.00 [1.3]	50.00 [-1]			
	2.33 m	12.50 [-2.5]	37.50 [3.5]	50.00 [-1]			
Attack	2.15 m	14.28 [-2.1]	42.86 [2]	42.86 [-0.1]	10.164	0.038	0.325
	2.24 m	25.00 [1.1]	37.50 [0.6]	37.50 [-1.5]			
	2.33 m	25.00 [1.1]	25.00 [-2.6]	50.00 [1.6]			
Blocking	2.15 m	28.57 [0.3]	42.86 [-1.7]	28.57 [1.7]	7.239	0.124	0.274
	2.24 m	28.57 [0.3]	57.14 [1.7]	14.29 [-2.4]			
	2.33 m	25.00 [-0.7]	50.00 [0]	25.00 [0.7]			
Defense	2.15 m	14.28 [-2.7]	42.86 [1.2]	42.86 [1.2]	51.429	<0.001	0.731
	2.24 m	42.86 [1.2]	42.86 [5.5]	14.28 [-6]			
	2.33 m	14.29 [-2.7]	28.57 [-2.4]	57.14 [4.8]			

Note: SPA = Specific Performance per Action; Inad. = Inadequate; Interm. = Intermediate; Adeq. = Adequate; AR = Adjusted Residual; χ^2 = Chi-square; *p* = *p* value; V = Cramer's V.

V=0.449), attack (*p*=0.038; V=0.325), and defense (*p*<0.001; V=0.731).

Considering the serving actions, the 2.15 m net height presented a lower proportion of actions with inadequate technical-tactical performance (14.29%) and a higher proportion of actions at an adequate level (57.14%) compared to expected. At the net height of 2.33 m, lower proportions of serving actions at an adequate technical-tactical level (37.50%) were reported compared to expected.

In the setting actions, in turn, a lower proportion of actions with intermediate technical-tactical performance (12.50%) and a higher proportion of actions at an adequate level (62.50%) were found at the 2.15 m net height, compared to expected proportions. At the 2.24 m net height, lower proportions of inadequate technical-tactical level (12.50) and a higher proportion of intermediate level (37.50%) setting actions were observed in relation to expected.

Considering the attack actions, the 2.15 m net height showed a lower proportion of inadequate technical-tactical performance (14.28%) and a higher proportion of intermediate level (42.86%) actions compared to expected. At the 2.33 m net height, a lower proportion of intermediate technical-tactical attack actions (25.00%) were reported compared to expected.

Regarding defense actions, a lower proportion of inadequate technical-tactical performance (14.28%) was observed at the 2.15 m net height compared to expected. At 2.24 m, a higher proportion of actions with

intermediate technical-tactical performance (42.86%) were found compared to expected. Still considering defense actions, the 2.35 m net height showed a lower proportion of actions with inadequate (14.29%) and intermediate (28.57%) technical-tactical performance, in addition to a higher proportion of actions at an adequate level (57.14%) compared to expected.

There was no association between SPA and the net height for reception (*p*=0.153; V=0.264) and blocking (*p*=0.124; V=0.274).

The analysis of the athletes' technical-tactical performance for each of the IAD-VB components is presented in Table 2. An association was verified between the SPC and the net height for the DM component (*p*=0.011; V=0.368). For this component, a lower proportion of actions with inadequate technical-tactical performance (31.58%) compared to expected was observed at the net height of 2.15 m. At the 2.24 m net height, lower proportions of actions at an adequate technical-tactical performance level (23.68%) were reported in relation to expected. Still considering the DM component, a lower proportion of intermediate technical-tactical performance (16.67%) was reported compared to expected at the 2.33 m net height.

There was no association between SPC and net height for adjustment (*p*=0.732; V=0.145), efficiency (*p*=0.221; V=0.244), and effectiveness (*p*=0.196; V=0.251).

The analysis of the athletes' general technical-tactical performance is presented in Table 3. An association was verified between the GP and the net height (*p*<0.001;

Table 2. Association between SPC and net height.

Component	Net height	Technical-tactical performance level			χ^2	<i>p</i>	V
		Inad. (%) [AR]	Interm. (%) [AR]	Adeq. (%) [AR]			
Adjustment	2.15 m	14.28 [0.4]	19.05 [-1]	66.67 [0.6]	2.019	0.732	0.145
	2.24 m	11.11 [-0.8]	26.67 [1.3]	62.22 [-0.6]			
	2.33 m	14.29 [0.4]	21.43 [-0.3]	64.28 [0]			
Efficiency	2.15 m	18.61 [-0.1]	30.23 [-0.1]	51.16 [0.8]	5.717	0.221	0.244
	2.24 m	14.64 [-1.3]	41.46 [2.1]	43.90 [-1]			
	2.33 m	23.26 [1.4]	27.90 [-1.4]	48.84 [0.2]			
Decision-making	2.15 m	31.58 [-2.2]	31.58 [1.1]	36.84 [1.2]	13.066	0.011	0.368
	2.24 m	42.11 [0.5]	34.21 [1.8]	23.68 [-2.2]			
	2.33 m	47.22 [1.7]	16.67 [-3]	36.11 [1]			
Effectiveness	2.15 m	26.32 [0.7]	36.84 [-0.4]	36.84 [-0.2]	6.047	0.196	0.251
	2.24 m	25.58 [0.5]	44.19 [1.5]	30.23 [-1.9]			
	2.33 m	19.51 [-1.2]	34.15 [-1.1]	46.34 [2.2]			

Note: SPC = Specific Performance per Component; Inad. = Inadequate; Interm. = Intermediate; Adeq. = Adequate; AR = Adjusted Residual; χ^2 = Chi-square; *p* = *p* value; V = Cramer's V.

Table 3. Association between GP and net height.

Net height	Technical-tactical performance level			χ^2	<i>p</i>	V
	Inad. (%) [AR]	Interm. (%) [AR]	Adeq. (%) [AR]			
2.15 m	25.00 [1.3]	62.50 [2]	12.50 [-3.5]	67.500	<0.001	0.838
2.24 m	12.50 [-2.5]	75.00 [5.1]	12.50 [-3.5]			
2.33 m	25.00 [1.3]	25.00 [-7.2]	50.00 [7.1]			

Note: GP = General Performance; Inad. = Inadequate; Interm. = Intermediate; Adeq. = Adequate; AR = Adjusted Residual; χ^2 = Chi-square; *p* = *p* value; V = Cramer's V.

V=0.838). At the 2.15 m net height, a higher proportion of actions with intermediate technical-tactical performance level (62.50%) and a lower proportion of adequate actions level (12.50%) were found compared to expected. On the other hand, at the 2.24 m net height, lower proportions of inadequate (12.50%) and adequate (12.50%) technical-tactical level actions were reported, in addition to a higher proportion of intermediate (75.00%) in relation to expected. Finally, at the 2.35 m net height, a lower proportion of intermediate technical-tactical performance level (25.00%) and a higher proportion of adequate level (50.00%) were reported compared to expected.

DISCUSSION

The present study aimed to analyze the effects of manipulating the net height (2.15 m, 2.24 m, and 2.33 m) in 4 vs. 4 SSGs on the technical-tactical performance of professional female volleyball players. Overall, results showed that the lower net height favored the serve actions, and the official net height favored intermediate performance in setting and defense actions. On the other hand, higher net height hampered serving actions and favored adequate performance in defense actions.

In addition, the SPC indicated that modifying the net height is only associated with the DM component.

Considering the lower net height (2.15 m), it was observed that complex 0 (serve) was favored, given the negative association with inadequate technical-tactical performance, and the positive association with adequate technical-tactical performance in the serve actions. These results confirm the literature, as they indicate that by lowering the net height and increasing the difference in the ball's hitting height, athletes are able to execute a serve at an angle of incidence that hinders reception by the opposing team (Pawlik and Mroczek, 2023). The women's game is a sustaining game, with more complex II actions (Laporta et al., 2023), a fact confirmed in the results, since the attacks did not result in a direct point, showing a negative association with inadequate and a positive association with intermediate technical-tactical performance.

In the official net height (2.24 m) configuration, associations with defense actions were observed, with a positive association observed for intermediate performance and a negative association observed for adequate defense action performance. In the official net height configuration, complex 0 becomes less effective, facilitating offensive construction, as observed

in the literature (Rocha et al., 2022). Alternatively, one could consider that the SSGs on the conventional net height represent the athletes' actual technical-tactical capabilities. In this sense, as the distribution of teams made it impossible to divide players equally by functional specialization, it is possible that specialization in some technical fundamentals, such as reception and defense, may have influenced the results found since specialists modulate performance and behavior in the match (Rocha et al., 2023).

The 2.33 m net height showed a negative association with adequate serving performance, a positive association with intermediate performance in setting actions, and a positive association with adequate performance and a negative association with inadequate and intermediate performance in defense actions. Thus, increasing the net height influenced technical-tactical behavior in complexes 0 and I. Furthermore, considering the inverse correlation between attack and defense (Cantú-González et al., 2022), the greater net height limited the attack options and hampered its overall performance. This can be attributed to the modifications in technical and tactical behaviors, leading to slower attack times and ultimately facilitating defensive actions (Adin-Marian and Marilena, 2021).

The findings regarding the SPC indicate that modifying the net height is only associated with the DM component. In our experimental context, a lower net height (2.15 m) resulted in a negative association with inadequate performance, suggesting that game decisions that should be avoided became more evident. Thus, it can be inferred that lower net height increases the probability of achieving success in terminal actions (Pawlik and Mroczek, 2023). Nevertheless, the official net height (2.24 m) configuration showed a negative association with adequate DM, and the greater net height (2.33 m) configuration showed a negative association with intermediate DM performance. The results of this study indicate that in female players, an increase in the square footage per player, combined with net heights that are similar to or higher than those in the official game, results in greater difficulties in offensive construction. Furthermore, the manipulation of square footage per player has an impact on tactical and technical behavior (Rocha et al., 2020; Rodrigues et al., 2022).

Regarding the GP, results indicated that the 2.15 m net height showed a negative association with adequate performance and a positive association with intermediate performance. The 2.24 m net height showed a positive association with intermediate performance and a negative association with adequate performance. Moreover, the 2.33 m net height showed a negative association with intermediate performance and a positive association with adequate performance. This is probably due to facilitating the serve, which results in worse conditions for offensive construction (Rocha et al., 2023) while facilitating powerful attacks (Vasileva, 2021). On the other hand, increasing the net height makes the game

less powerful, improving the conditions for offensive and defensive structuring since there is more time available (Adin-Marian and Marilena, 2021), resulting in superior tactical-technical performance.

This research has some limitations that must be acknowledged. One of them is related to the number of participants, which may negatively affect the robustness of the statistical analyses and the range of technical and tactical capacity. Certain actions, such as double blocks, are less likely to occur and can potentially impact the results obtained from the instrument. Additionally, the investigation only focused on a 4 vs. 4 SSGs format, disregarding an equal balance due to the functional specialization of the players. Another limitation refers to the selection of players for teams, which was performed by the head coach. Although the literature reports this form of selection, we suggest that team selection carried out according to performance ranking may be more accurate than the head coach's perception. This highlights the need for future research to address these gaps in knowledge and provide a more comprehensive understanding of the subject.

Considering our study, head coaches should consider using the SSGs to evaluate and improve tactical-technical actions. The practice of placing boxes to facilitate attacks over the net during training can be minimized by manipulating the net height, which presents different results related to athletes' behavior. Furthermore, games with a smaller number of athletes, such as 4 vs. 4, can be used as tools to increase athlete participation during training sessions.

CONCLUSION

In summary, our findings indicated that manipulating the net height on a 4 vs. 4 SSGs format impacts tactical-technical performance. While the lower net height favored the complex 0 action, the higher net height favored offensive and defensive structuring. Additionally, the net height was associated with the DM component, suggesting that this specific manipulation may affect the complexity of the DM process in the game setting.

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CONFLICTS OF INTEREST

None.

REFERENCES

- Adin-Marian C, Marilena C. Study on defense efficiency in senior Volleyball teams. *Sci Mov Health* [Internet]. 2021 [cited 2024 Jan 29];21(2, Suppl):244-8. Available from: <https://www.analefefs.ro/anale-fefs/2021/i2-supplement/pe-autori/7.%20COJOCARU%20ADIN-MARIAN,%20COJOCARU%20MARILENA.pdf>

- Cantú-González JR, Hueyotl-Zahuantitla F, Castorena-Peña JA, Aguirre-López MA. The attack-block-court defense algorithm: a new volleyball index supported by data science. *Symmetry*. 2022;14(8):1499. <http://doi.org/10.3390/sym14081499>.
- Castro HO, Laporta L, Lima RF, Clemente FM, Afonso J, Silva Aguiar S, et al. Small-sided games in volleyball: a systematic review of the state of the art. *Biol Sport*. 2022a;39(4):995-1010. <http://doi.org/10.5114/biolsport.2022.109960>. PMID:36247946.
- Castro HO, Praça GM, Mesquita IMR, Afonso J, Costa GCT, Moreno MP, et al. The impact of Pendular model on decision-making and tactical-technical performance of U18 male volleyball players. *Int J Sports Sci Coaching*. 2022b;17(4):792-803. <http://doi.org/10.1177/174795412111048586>.
- Clemente FM. Bibliometric analysis of scientific production in small-sided games. *Human Mov*. 2023;24(4):1-17. <http://doi.org/10.5114/hm.2023.132707>.
- Clemente FM, Afonso J, Sarmiento H. Small-sided games: an umbrella review of systematic reviews and meta-analyses. *PLoS One*. 2021;16(2):e0247067. <http://doi.org/10.1371/journal.pone.0247067>. PMID:33577611.
- Cohen J. Statistical power and analysis for the behavioral sciences. 2nd ed. Hillsdale: Lawrence Erlbaum Associates; 1988. p. 79-80.
- Collet C, Nascimento JV, Ramos V, Stefanello JMF. Construção e validação do instrumento de avaliação do desempenho técnico-tático no voleibol. *Rev Bras Cineantropom Desempenho Hum*. 2010;13(1):43-51. <http://doi.org/10.5007/1980-0037.2011v13n1p43>.
- Laporta L, Costa GCT, Fernandes LG, Pastori IA, Rocha ACR, Hileno R, et al. Sequence and efficacy of game complexes in high-level women's volleyball: a novel perspective through Social Network Analysis. *Int J Sports Sci Coaching*. 2023;18(3):867-73. <http://doi.org/10.1177/17479541221087688>.
- Loureiro M, Hurst M, Valongo B, Nikolaidis P, Laporta L, Afonso J. A comprehensive mapping of high-level men's volleyball gameplay through social network analysis: analysing serve, side-out, side-out transition and transition. *Montenegrin J Sports Sci Med*. 2017;6(2):35-41. <http://doi.org/10.26773/mjssm.2017.09.005>.
- McKay AK, Stellingwerff T, Smith ES, Martin DT, Mujika I, Goosey-Tolfrey VL, et al. Defining training and performance caliber: a participant classification framework. *Int J Sports Physiol Perform*. 2022;17(2):317-31. <http://doi.org/10.1123/ijsspp.2021-0451>. PMID:34965513.
- Palao JM, Ureña A, Moreno P, Ortega-Toro E. Effect of changes in the net height, court size, and serve limitations on technical-tactical, physical, and psychological aspects of U-14 female volleyball matches. *Front Psychol*. 2024;14:1341297. <http://doi.org/10.3389/fpsyg.2023.1341297>. PMID:38268810.
- Pawlik D, Mroczek D. Influence of jump height on the game efficiency in elite volleyball players. *Sci Rep*. 2023;13(1):8931. <http://doi.org/10.1038/s41598-023-35729-w>. PMID:37264052.
- Rocha ACR, Laporta L, Andre Barbosa de Lira C, Modenesi H, Figueiredo LS, Costa GDCT. Complex I in male elite volleyball: an interactional analysis according to reception location. *Int J Perform Anal Sport*. 2022;22(1):77-89. <http://doi.org/10.1080/24748668.2021.2003961>.
- Rocha ACR, Laporta L, Rodrigues GP, Lira CAB, Castro HO, Costa GCT. Is it possible for the reception and the player-receiver to influence the offensive construction in volleyball? An ecological vision and Intragame procedural relationships in high-level teams. *Int J Perform Anal Sport*. 2023;23(4):319-33. <http://doi.org/10.1080/24748668.2023.2229204>.
- Rocha A, Freire AB, Silva AB Jr, Martins LR, Maia MP, Mitre GP, et al. How context influences the tactical-technical behavior of learners: the case of volleyball. *Rev Bras Cineantropom Desempenho Hum*. 2020;22:e59461. <http://doi.org/10.1590/1980-0037.2020v22e59461>.
- Rodrigues MCJ, Rocha A, Lira CA, Figueiredo LS, Lima COV, Laporta L, et al. How small-sided games' court dimensions affect tactical-technical behavior in beginner volleyball athletes. *Int J Sports Sci Coaching*. 2022;17(6):1385-95. <http://doi.org/10.1177/17479541211058447>.
- Rodriguez-Ruiz D, Quiroga ME, Miralles JA, Sarmiento S, de Saá Y, García-Manso JM. Study of the technical and tactical variables determining set win or loss in top-level European men's volleyball. *J Quant Anal Sports*. 2011;7(1):1-15. <http://doi.org/10.2202/1559-0410.1281>.
- Vasileva F. Speed, agility and explosive leg power in female junior volleyball players: a comparative study. *Int J Sport Exerc Health Res*. 2021;5(2):55-9. <http://doi.org/10.31254/sportmed.5206>.
- Villalon-Gasch L, Penichet-Tomas A, Sebastia-Amat S, Pueo B, Jimenez-Olmedo JM. Postactivation Performance Enhancement (PAPE) increases vertical jump in elite female volleyball players. *Int J Environ Res Public Health*. 2022;19(1):462. <http://doi.org/10.3390/ijerph19010462>. PMID:35010722.