Time-out impact on performance and scoring dynamics in boys' youth volleyball

Impacto del tiempo muerto en el rendimiento y la dinámica de puntuación en el voleibol juvenil masculino

Authors

Carlos López-Serrano [1]
Juan José Molina Martín [1]

[1] Technical University of Madrid, c/ Martín Fierro 7, 28040 Madrid, (Spain)

Corresponding author:
López-Serrano Carlos
carlos.lopezs@upm.es

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Abstract

Introduction: The present research measures the effectiveness of time-outs in junior male volleyball and their impact on performance and score dynamics.
Objective: The study evaluated the relationship between time-outs and contextual variables like point difference, match status, and opponent level.
Methodology: A total of 1090 time-outs across 511 sets from 144 matches in the first provincial division of the Madrid Volleyball Federation were analyzed.
Results: Findings show that 63.3% of time-outs are requested when the team is trailing. Although 50.28% of time-outs result in winning the next point, their impact is more significant over the following three-point sequence, with 23.37% of cases yielding two points. Multinomial logistic regression revealed that factors such as the set period and opponent level significantly affect time-out requests.
Conclusions: Dynamic visualization with interactive dashboards helped identify patterns and optimize tactical decision-making. These findings emphasize the importance of strategic time-out management to enhance performance during critical moments of play.

Keywords

Dashboard; game rhythm; performance; strategies; tactical pause.

Resumen

Introducción: La presente investigación mide la eficacia de los tiempos muertos en el voleibol juvenil masculino y su impacto en el rendimiento y la dinámica del marcador.
Objetivo: El estudio evaluó la relación entre los tiempos muertos y variables contextuales como la diferencia de puntos, el estado del partido y el nivel del rival.
Metodología: Se analizaron un total de 1090 tiempos muertos a lo largo de 511 sets de 144 partidos de la primera división provincial de la Federación Madrileña de Voleibol.
Resultados: Los resultados muestran que el 63,3% de los tiempos muertos se solicitan cuando el equipo va perdiendo. Aunque el 50,28% de los tiempos muertos permiten ganar el siguiente punto, su impacto es más significativo en la siguiente secuencia de tres puntos, con un 23,37% de casos en los que se consiguen dos puntos. La regresión logística multinomial reveló que factores como el periodo establecido y el nivel del adversario afectan significativamente a las solicitudes de tiempo muerto.
Conclusiones: La visualización dinámica con paneles interactivos ayudó a identificar patrones y optimizar la toma de decisiones tácticas. Estos resultados ponen de relieve la importancia de la gestión estratégica de los tiempos muertos para mejorar el rendimiento en los momentos críticos del partido

Palabras clave

Panel de control; ritmo de juego; rendimiento; estrategias; pausa táctica.

Introduction

The role of the coach in team sports is vital in determining the development and outcome of a match. Among the various tools available, time-outs stand out for their ability to create a brief period of direct intervention with the players. These breaks not only facilitate strategic and tactical adjustments, but also interrupt the opponent's momentum and help stabilize the team's performance (Fernández-Echeverría et al., 2013; García-Tormo et al., 2003). In sports such as basketball and handball, studies have shown that time-outs are more frequently requested when teams are at a disadvantage, aiming to stop negative runs and change a game's direction (Ortega et al., 2010; Zetou et al., 2008).

Research in volleyball points to the strategic use of time-outs with implications for scoreboard dynamics. For example, Moreno et al. (2005) and Sampaio et al. (2013) show that such time-outs can affect the points that immediately follow them and sometimes turn around the course of a set. However, not all time-outs work uniformly and may depend on some contextual variables, such as the period set, the score difference, and the opposition level (Abreu et al., 2017; Jetzke & Winter, 2022; Palao et al., 2021). Research from the current studies revealed that coaches often call a time-out at critical moments of the game, especially when the team is behind by a few points, looking to break the opponent's momentum and take back control (Den Hartigh & Gernigon, 2018; Kozar et al., 1993).

The use of time-outs can serve both tactical and psychological purposes. Zetou et al. (2008) highlight that coaches use these time-outs not only to adjust game strategies, but also to motivate players and alleviate internal team tensions. Moreover, studies in team sports such as basketball indicate that time-outs can be tools to turn around tactical patterns and provide specific instructions to stabilize team performance (Ortega et al., 2007; Rodriguez, 2000; Steeger et al., 2021; Swann et al., 2016). Momentum, seen as the psychological force that drives or impedes performance, is also affected: a time-out can disrupt an opponent's positive momentum or help overcome a negative momentum within one's own team (Den Hartigh & Gernigon, 2018). However, the coach's intervention must be precise and pertinent, as its excessive use may decrease its effectiveness (Miller, 2005).

The effectiveness of time-outs is a topic of great interest in sports literature. According to the findings of Garcia-Tormo et al. (2003), in youth volleyball, most of the time-outs called succeed in breaking the opposing team's streak in the next play(s). However, studies also suggest that the impact of time-outs may vary depending on the score. When called with a minimal point differential, time-outs tend to be more effective, as they allow the team to regain control and adjust their performance (Gomez et al., 2014; Zetou et al., 2008).

This study looks to contribute new information to the scientific field by analyzing the effectiveness of time-outs in volleyball and their impact on team performance and game dynamics. Unlike previous research, this work focuses on contextual variables such as the difference in the score and the competitive load of the set. In addition, the use of dashboards and dynamic visualizations represents a great contribution to deepening on the analyses, revealing trends and patterns that are difficult to detect manually. Understanding the constant flow of sports data requires a shift in approach and the use of interactive graphics capable of providing more personalized and accurate information (Casals & Daunis-I-Estadella, 2022; Morales et al., 2024), allowing coaches and players to gain meaningful insights (Araújo et al., 2021; Morán-Pedroso et al., 2024). Finally, these visualizations synthesize relevant information, presenting it in an understandable way (López-Serrano et al., 2023), optimizing strategic decisions at critical moments and improving game management at the youth and professional level.

To understand the effect of time-outs on volleyball, it is necessary to interpret them in terms of their influence on team performance and on the development and progress of the game. This means that, in any particular context, a result can be characterized as effective only in conjunction with a score count and all subsequent point sequences. In relation to the optimization of decision-making processes by coaches during competition, the results can give solid recommendations for making use of time-outs in a way that influences the outcome of sets and matches. (Abreu et al., 2017; Moreno et al., 2005). In this regard, the present research aims to measure the effectiveness of time-outs in boys' youth volleyball and their impact on performance and scoring dynamics.

Method

This study followed a quantitative research design, specifically employing a correlational and explanatory approach to analyze the influence of time-outs in volleyball matches. The study was conducted through a systematic collection and statistical analysis of data extracted from official match records.

Participants and Sample

A total of 1090 time-outs were analyzed, played in 511 sets, corresponding to 144 matches of the first provincial division in the cadet and juvenile male categories, during the 23-24 season. The distribution was 72 matches in each category. In the cadet category, there were 259 time-outs called by the home team and 242 by the visiting team. In the youth category, 287 time-outs were requested by the home team, while 302 were requested by the visiting team. All the information was obtained from the public data available in the web repositories of the Madrid Volleyball Federation. However, it was not possible to collect all the matches from these leagues, as many of them were discarded due to lack of information or data on the official website. Therefore, only 54.55% of the total matches from these leagues could be collected. The research protocol received full approval from the Research Ethics Committee of the Technical University of Madrid (Spain).

Variables

The fixed descriptor variables used in the following study were:

a) Category: cadet or juvenile

b) SET: indicates the set number.

c) WinSet (WS): identifies whether the lead team won/lost the full set.

d) Period Set (PS): Following Lopez-Serrano et al. (2022) divides each set into 3 periods according to the score. 1st period of the set (1stP) between 0 to 9 points, 2nd period of the set (2ndP) between point 10 to 19 points, and 3rd period of the set (3rdP) which includes from point 20. The intervals for the 5th set are: 0-4; 5-9; more than 10, respectively.

e) Time-out (TO): determines the order in which each time-out was called in each set. used both in plural and singular form

f) Opposition Level (OL): which determines the differences in level between the competing teams, categorised into five levels (López-Serrano et al., 2022).

g) Competitive Load of the set (CL): indicating if the set is of attenuated load, when the set is not decisive in the victory of the match; or high competitive load when the set is decisive in the outcome of the match (López-Serrano et al., 2022).

h) Coach Timeout Request (CRT): indicates the team that requested the timeout (home or away)

i) Requesting Team Score Difference (RTS): indicates the score points the same team that requested the time-out at the time each time-out was called.

j) Opponent Team Score (OTS): indicates the score points carried by the same opposing team that did not request the time-out.

k) Score difference (SD): indicates the points difference between the teams at the time the time-out was requested. A positive value indicates that the team calling the time-out is winning, while a negative value indicates that the team is losing.

l) Next point result (NPR): indicates whether the same team that called the time-out won or lost the next point played after the time-out.

m) Three-point outcome (TPO): indicates the sequence of points won in the three points following the time-out. win3next (W3p), won the next three points, lost3next (L3p), lost all three, win2p (W2p), won two points, winning the first one, lostnext&2p (L22p), lost two points, starting with the first one, lostnext&win2p (W21p), won 2 points, but lost the first one and winnext&lost2p (L21p), lost 2 points, but won the first one.

n) Match status (MS): Indicates the match status for the team that called the time-out (winning, losing, or tied).

o) Trend before timeout (TBT) – indicates what the three-point trend was before each time-out (Tout). -3= Lost 3 points before Time-out, -2= Lost 2 points before Time-out, -1= Lost 1 point before Time-out, 3= Won 3 points before Time-out, 2= Won 2 points before Time-out, 1= Won 1 point before Time-out.

p) Trend after timeout (TAT) – Indicates the trend in the three points following a timeout (TO). It takes the same values as the previous variable (TBT) but for the points after the TO.

Data analysis

A chi-square test of independence was performed to analyze the relationship between match status (MS) and each time-out (Tout), evaluating their association in different contextual categories such as: Category, WS, OL, SET, CL, CRT, MS, PD, NPR and TPO. In addition, the effectiveness of each Tout was examined through NPR and TPO. To interpret the strength of association, Cramér's coefficient (Vc) was used. A related-samples t-test was also applied to compare the trend of the three items before (TBT) and after (TAT) the time-out, assessing their impact on the score. A multinomial logistic regression model was used to analyze the factors affecting the probability of asking for time-outs. The predictor variables included were SD, OL, WS, PS and NPR. Model fit was evaluated, and Odds Ratios (OR) were calculated to understand the influence of each variable.

The Bonferroni test was also applied to verify normality, and the Kruskal-Wallis test was used to evaluate the standard deviations (SD) of the Requested time-outs. Post hoc Mann-Whitney comparisons, adjusted with Bonferroni, were performed to identify significant differences between each time-out. Additionally, an interactive dashboard was created in Microsoft PowerBI to visualize the data, allowing to dynamically explore trends in time-out requests in real time.

Finally, a cluster analysis was used to establish the OL variable, classified into 3 competitive levels (Marcelino et al., 2011). In relation to the logistic regressions, their correct diagnosis was verified, and all tests were performed using SPSS v.26 statistical package (IBM Corp., Armank, NY, USA). Significance was set at $p < 0.05$.

Results

Table 1 shows a strong association between the requested time-outs and the state of the match ($\chi2$ (6) = 479.62; $p < 0.001$; Vc = 0.469). Additionally, Cramér's V value (Vc = 0.486) indicates a moderate relationship.

Table 1. Match status at the time each timeout is called

	Losing		Winning		Tied		Total	
Time out	n	%	n	%	n	%	n	%
1stT	450	91.28%	26	5.27%	17	3.45%	493	100.00%
2ndT	203	55.46%	17	4.64%	146	39.89%	366	100.00%
3rnT	31	18.45%	0	0.00%	137	81.55%	168	100.00%
4thT	6	9.52%	0	0.00%	57	90.48%	63	100.00%
Total	690	63.30%	43	3.94%	357	32.75%	1090	100.00%

It is observed that 63.30% of the time-outs are requested when the team is losing, compared to 32.75% during a tie and 3.94% when winning. The first time-out is mostly called when at a disadvantage (91.28%), whereas for the third and fourth time-outs, their request predominantly occurs in a tie situation (81.55% and 90.48%, respectively), showing a shift in trend as time-outs progress. Table 2 presents the effectiveness of the time-outs, measured by the outcome of the point immediately following (won/lost) after the time-out, as well as by the results of the three subsequent points following the requested time-out.

The effectiveness of timeouts is shown in Table 2, measured by the outcome of the next point (won/lost) following the timeout, as well as by the results of the three subsequent points after the requested timeout.

Table 2. Effectiveness measured by the result of the point after the time-out and the following three points

Effectiveness		Time out (TO)	1stTO	2ndTO	3rdTO	4thTO	Total TO
Next point result (NPR)	Won	n	247	182	83	36	548
		%	50.10%	49.73%	49.40%	57.14%	50.28%
	Lost	n	246	184	85	27	542
		%	49.90%	50.27%	50.60%	42.86%	49.72%
Three-point outcome (TPO)	W3p	n	42	30	8	5	85
		%	8.54%	8.26%	5.06%	8.06%	7.91%
	W2p	n	115	80	42	16	253
		%	23.37%	22.04%	26.58%	25.81%	23.53%
	L21p	n	89	70	29	14	202
		%	18.09%	19.28%	18.35%	22.58%	18.79%
	W22p	n	48	49	30	8	135
		%	9.76%	13.50%	18.99%	12.90%	12.56%
	L22p	n	139	103	40	14	296
		%	28.25%	28.37%	25.32%	22.58%	27.53%
	L3p	n	59	31	9	5	104
		%	11.99%	8.54%	5.70%	8.06%	9.67%

Note. W3 - Won the next 3 points; W2p = Won the next 2 points after winning the first one; L21p = Lost two points, winning only the first one; W22p = Won the next two points, but lost the first one; L22p = Lost 2 points, including the first one; L3p = Lost the next three points.

Regarding the effectiveness of each timeout, a comparison was made to assess whether there was a relationship between the team requesting each timeout and the result of the immediately following point or the sequence of the next three points, considering various contextual situations. No effectiveness was found based on category, winset, opponent level, SET, CL, TO, match status, or PS ($p > 0.05$). However, a significant association was found between the moment when a timeout was requested and the sequence of the subsequent three points, specifically in the first period of the set (0-9 points) ($\chi2$ (5) = 12.445; $p < 0.029$; Vc = 0.313).

Additionally, the paired-samples t-test showed a significant difference between trend before timeout (TBT) and trend after timeout (TAT) ($t = -30.67$, $p<0.001$). These results indicate that time-outs produce a significant change in the scoring sequence, breaking the existing trend in the score at the moment they are requested.

The results of the multinomial logistic regression (Table 3) to identify factors that influence time-outs (Tout) in volleyball matches indicated that the overall model is significant ($\chi2$ (27) = 620; $p < 0.001$). The R^2N test values show that this model moderately explains 29.8% of the variability in the result of the set.

Table 3. Measures of fit of the logistic regression model

					Global Model Test		
Model	Deviance	AIC	BIC	R^2_N	χ^2	gl	p
1	1949	2009	2158	0.298	620	27	< .001

Table 4 presents the results of the multinomial logistic regression, which estimates the probability of requesting time-outs in comparison to the 1st TO based on predictive variables. It was found that the period of the set (PS) significantly influences the request for time-outs, particularly during the 2nd and 3rd periods. Additionally, the score difference (SD) and the opponent's level (OL) also moderately affect the decision to request additional time-outs.

Table 4. Multinomial Logistic Regression Coefficients for the Probability of Requesting Time-Outs.

							95% Confidence Interval	
Time-out	Predictor	Coefficient	SE	Z	p	OR	Lower	Upper
2ndTO – 1stTO	Intercept	-3.751	0.738	-5.081	< .001**	0.024	0.006	0.100
	SD	0.051	0.024	2.133	0.033*	1.052	1.004	1.103
	OL							
	-2low– Equal	-0.369	0.353	-1.046	0.296	0.691	0.346	1.381
	-1low – Equal	-0.394	0.224	-1.754	0.079	0.675	0.435	1.047
	1high – Equal	0.010	0.217	0.046	0.964	1.010	0.660	1.545
	2high – Equal	-0.365	0.382	-0.957	0.339	0.694	0.328	1.467
	WS							
	Win – Lost	-0.024	0.186	-0.127	0.899	0.977	0.678	1.407
	PS							

	2ndP – 1stP	3.195	0.723	4.420	< .001**	24.399	5.918	100.589
	3rdP – 1stP	5.195	0.725	7.168	< .001**	180.293	43.559	746.240
	NPR							
	Won – Lost	-0.14287	0.1649	-0.8664	0.386	0.8669	0.62745	1.198
3rdTO – 1stTO	Intercept	-16.097	0.1832	-87.848	< .001**	0.000	0.000	0.000
	SD	0.22582	0.0316	7.146	< .001**	1.253	1.178	1.333
	OL							
	-2low– Equal	-0.459	0.509	-0.901	0.368	0.632	0.233	1.715
	-1low – Equal	-0.747	0.300	-2.492	0.013*	0.474	0.263	0.853
	1high – Equal	-0.057	0.281	-0.202	0.840	0.945	0.545	1.639
	2high – Equal	-0.716	0.543	-1.318	0.188	0.489	0.168	1.418
	WS							
	Win – Lost	0.023	0.241	0.096	0.924	1.023	0.638	1.640
	PS							
	2ndP – 1stP	14.283	0.186	76.757	< .001**	1.60e+6	1.11e+6	2.30e+6
	3rdP – 1stP	17.424	0.154	113.370	< .001**	3.69e+7	2.73e+7	4.99e+7
	NPR							
	Won – Lost	-0.208	0.221	-0.939	0.348	0.813	0.527	1.253
4thTO – 1stTO	Intercept	-17.213	0.272	-63.181	< .001**	3.35e-8	1.96e-8	5.71e-8
	SD	0.248	0.043	5.818	< .001**	1.281	1.179	1.393
	OL							
	-2low– Equal	-1.713	1.086	-1.578	0.115	0.180	0.021	1.514
	-1low – Equal	-1.073	0.417	-2.571	0.010*	0.342	0.151	0.775
	1high – Equal	-0.041	0.361	-0.113	0.910	0.960	0.473	1.949
	2high – Equal	-15.879	0.000	0.000	< .001**	0.000	0.000	0.000
	WS							
	Win – Lost	0.130	0.322	0.404	0.686	11386.000	0.606	2.139
	PS							
	2ndP – 1stP	13.807	0.358	38.577	< .001**	991795.130	491768.602	2.00e+6
	3rdP – 1stP	17.547	0.235	74.821	< .001**	4.17e+7	2.64e+7	6.61e+7
	NPR							
	Won – Lost	0.086	0.307	0.281	0.779	1.090	0.597	1.989

Note. SD = Point difference at the time-out moment; OL = Opponent level; -2low = opponent two levels below; -1low = opponent one level below; 2high = opponent two levels above; 1high = opponent one level above; Equal = Same level between opponents; WS = Set win; PS = Set period; NPR = Next point result. *p < 0.05. **p < 0.01

In the 2ndTO, the set period is a key factor: during the second period, the likelihood of calling a time-out is 24 times higher ($p < 0.001$, OR = 24.4), and in the 3rd period, this probability increases up to 180 times ($p < .001$, OR = 180.3). Comparing the 3rd period to the 1st, the data show that the probability of requesting a TO in the 2nd period is 1,6 million times higher, and in the 3rd period, up to 38,9 million times higher ($p < 0.001$). Facing a lower-level team reduces this probability ($p = 0.013$, OR = 0.47). These patterns are repeated in the 4thTO, with ORs of 991,785 and 41.7 million in the 2nd and 3rd periods, respectively. Additionally, the SD and the OL also influence the decision to request this 4th TO.

In Table 5 and Figure 5 of the dashboard, the distribution of time-outs according to the point difference between teams when they are called is shown. When the team is losing (negative point difference), the first two time-outs are mainly called, with the second being particularly notable. In contrast, the 3rd and 4th TO are requested in more balanced situations, even if the team is winning. The chi-square analysis reveals a significant association between the point difference and the calling of TO ($\chi 2(72)=409.937$, $p < 0.001$, Vc=0.354), indicating that TO are not called randomly but are based on the score.

Table 5. Timeout request percentage distribution as a function of the opponents' point difference.

SD	Requested time-out sequence								Total	
	1stTO		2ndTO		3rdTO		4thTO			
9	0	0.00%	4	100.00%	0	0.00%	0	0.00%	4	100.00%
8	0	0.00%	2	100.00%	0	0.00%	0	0.00%	2	100.00%
7	1	16.67%	3	50.00%	2	33.33%	0	0.00%	6	100.00%
6	1	11.11%	5	55.56%	3	33.33%	0	0.00%	9	100.00%
5	2	11.11%	10	55.56%	6	33.33%	0	0.00%	18	100.00%
4	4	20.00%	6	30.00%	10	50.00%	0	0.00%	20	100.00%
3	2	7.69%	8	30.77%	11	42.31%	5	19.23%	26	100.00%
2	4	7.41%	26	48.15%	16	29.63%	8	14.81%	54	100.00%
1	13	23.64%	14	25.45%	17	30.91%	11	20.00%	55	100.00%
0	14	21.88%	25	39.06%	10	15.63%	15	23.44%	64	100.00%
-1	31	31.00%	34	34.00%	23	23.00%	12	12.00%	100	100.00%
-2	43	39.45%	32	29.36%	28	25.69%	6	5.50%	109	100.00%
-3	66	62.26%	19	17.92%	16	15.09%	5	4.72%	106	100.00%

-4	109	73.15%	31	20.81%	8	5.37%	1	0.67%	149	100.00%
-5	89	69.53%	30	23.44%	9	7.03%	0	0.00%	128	100.00%
-6	60	58.25%	36	34.95%	7	6.80%	0	0.00%	103	100.00%
-7	28	52.83%	25	47.17%	0	0.00%	0	0.00%	53	100.00%
-8	17	53.13%	13	40.63%	2	6.25%	0	0.00%	32	100.00%
-9	6	27.27%	16	72.73%	0	0.00%	0	0.00%	22	100.00%
-10	2	14.29%	12	85.71%	0	0.00%	0	0.00%	14	100.00%
-11	0	0.00%	7	100.00%	0	0.00%	0	0.00%	7	100.00%
-12	0	0.00%	2	100.00%	0	0.00%	0	0.00%	2	100.00%
-13	1	20.00%	4	80.00%	0	0.00%	0	0.00%	5	100.00%
-14	0	0.00%	1	100.00%	0	0.00%	0	0.00%	1	100.00%
-16	0	0.00%	1	100.00%	0	0.00%	0	0.00%	1	100.00%
Total	493	45.23%	366	33.58%	168	15.41%	63	5.78%	1090	100.00%

Note. 1stTO = First time-out requested; 2ndTO = Second time-out requested; 3rdTO = Third time-out requested; 4thTO = Fourt time-out requested.

Collectively, the results obtained through the Kruskal-Wallis test indicated a significant difference in the point difference between the different time-outs requested ($\chi^2(3)=180.28$; $p < 0.001$). Post hoc tests revealed significant differences between almost all the TO, except between the 3rdTO and 4thTO ($p > 0.05$). Overall, the 1st two TO were associated with a greater point difference compared to the last two TO.

Similarly, the chi-square analysis shows that score differences have a significant association with the request for each TO for any of the contextual situations studied. The results obtained are as follows:

Category:

- Cadet (χ^2 (63) = 252.43; $p < 0.001$; Vc = 0.410)
- Juvenile (χ^2 (69) = 225.344; $p < 0.001$; Vc = 0.357)

WS:

- Win (χ^2 (69) = 255.422; $p < 0.001$; Vc = 0.394)
- Lose (χ^2 (63) = 244.240; $p < 0.001$; Vc = 0.388)

OL:

- 2 lower levels (χ^2 (48) = 72.822; $p < 0.012$; Vc = 0.589)
- 1 lower level (χ^2 (60) = 119.149; $p < 0.001$; Vc = 0.386)
- Equal level (χ^2 (60) = 172.178; $p < 0.001$; Vc = 0.406)
- 1 higher level (χ^2 (60) = 166.719; $p < 0.001$; Vc = 0.402).
- No differences were observed for 2 higher levels ($p > 0.05$).

SET:

- Set 1st - 4th (χ^2 (60) = 181.800; $p < 0.001$; Vc = 0.461; χ^2 (63) = 160.66; $p < 0.001$; Vc = 0.411; χ^2 (63) = 113.406; $p < 0.001$; Vc = 0.364; χ2 (3) =97.746; $p < 0.003$; Vc=0.472)
- No differences were observed for the 5th set ($p > 0.05$).

CL:

- Attenuated (χ^2 (69) = 318.553; $p < 0.001$; Vc = 0.378)
- High (χ^2 (69) = 131.229; $p < 0.001$; Vc = 0.355)

Coach Timeout Request (CRT):

- Home (χ^2 (60) = 206.472; $p < 0.001$; Vc = 0.355)
- Away (χ^2 (72) = 254.944; $p < 0.001$; Vc = 0.395)

Match Status (MS):

- Losing (χ^2 (60) = 313.020; $p < 0.001$; Vc = 0.389)
- Tied (χ^2 (69) = 182.942; $p < 0.001$; Vc = 0.413).

- No differences were observed for winning ($p > 0.05$).

PS:

- 2ndP (χ^2 (51) = 156.483; $p < 0.001$; Vc = 0.360)
- 3stP (χ^2 (72) = 163.237; $p < 0.001$; Vc = 0.312).
- No differences were observed for the 1erP ($p > 0.05$).

NPR:

- Won (χ^2 (69) = 308.019; $p < 0.001$; Vc = 0.356)
- Lost (χ^2 (69) = 243.453; $p < 0.001$; Vc = 0.387)

TPO:

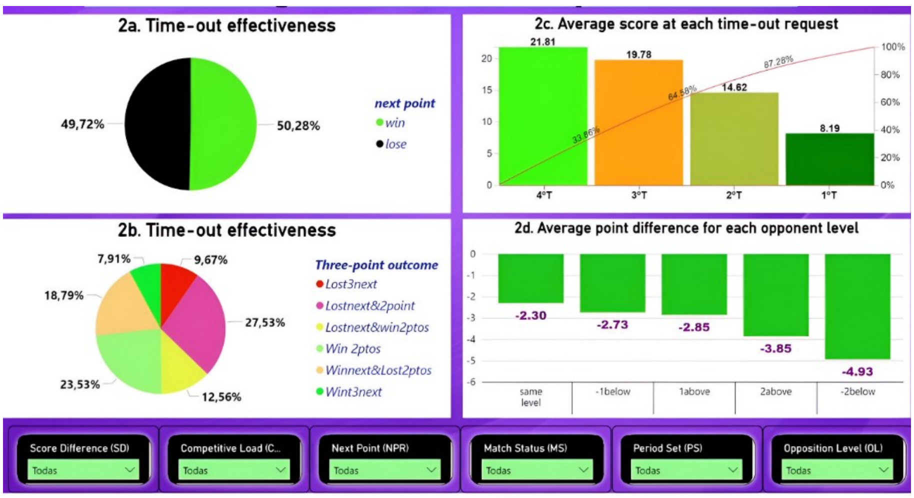
- W3p (χ^2 (48) = 91.929; $p < 0.001$; Vc = 0.600)
- W2p (χ^2 (66) = 133.055; $p < 0.001$; Vc = 0.419)
- L21p (χ^2 (60) = 110.694; $p < 0.001$; Vc = 0.427)
- W22p (χ^2 (54) = 81.817; $p < 0.009$; Vc = 0.449)
- L22p (χ^2 (60) = 141.203; $p < 0.001$; Vc = 0.399)
- L3p (χ^2 (60) = 146.581; $p < 0.001$; Vc = 0.685).

Dynamic data visualization

To explore the trends influencing the request for TO in volleyball, Microsoft PowerBI was used to create an interactive dashboard featuring Figures 1 to 5. This allows for data segmentation and the dynamic observation of the influence of various variables in real-time.

Figure 1 shows that TO are mainly requested when teams are at a disadvantage. In the 1st and 2nd TO, home and away teams have average point differences of -3.87 and -3.18, respectively. This difference decreases in the 3rd TO and becomes almost neutral in the 4thTO.

Figure 1. Time-out report (Show in the dashboard)



Source: Authors' own elaboration

Figure 2 shows that 50.28% of the TOs end up winning the immediate point, while 49.72% end up losing right after. In the next three points, 27.53% of the cases lose two out of the three points that follow, while 23.53% wins two points. TO are requested on average at 8.19, 14.82, 19.78, and 21.81 points, respectively. Towards the end of the set, 33.86% are called between the 2nd and 3rd periods. Additionally, greater point differences (-4.93) are observed against opponents two levels below, and smaller differences (-2.30) are seen against rivals of the same level. In Figure 3, it can be observed that, against opponents of the same level or one level higher, TO are requested with moderate negative point differentials, ranging between -2.26 and -3.79 points. However, in more unequal levels, these differentials increase to -4.18 (two levels higher) and -5.70 (two levels lower). Figure 4 shows the percentage distribution of TO requests based on the point difference, indicating that TO are more frequently requested when the team is at a significant disadvantage on the scoreboard. Finally, Figure 5 presents the sequence of points TPO after each TO, showing that most time-outs do not result in sustained recovery in the score.

Discussion

The aim of the study was to analyse the effectiveness of time-outs in volleyball and their impact on team performance and game development, taking into account the contextual situations that influence them. The findings of this study show how volleyball coaches use TO as a strategic tool to influence the flow of the game, particularly in relation to the score and key moments within a set. TO are more frequently requested when the team is at a disadvantage, accounting for 63.3% of the cases. This trend is even more pronounced in the 1stT, which is called in 91.2% of cases when the team is approximately 4 points behind in the score. This practice reinforces the idea that the 1stTO acts as an emergency intervention aimed at stopping negative momentum and preventing the score difference from increasing (Fernández-Echeverría et al., 2019; Zetou et al., 2008). Den Hartigh and Gernigon (2018) studied how time-outs requested during table tennis matches aim to influence the opponent's "momentum," affecting their psychology and the sequence of points in the match, attempting to 'icing the game' (Goldschmied et al., 2023), thereby seeking a shift in the score dynamics. It was also observed that the first time-out is requested, on average, to 8.19 points, the second at 14.82, the third at 19.78, and the fourth at 21.81. However, the frequency of time-outs decreases towards the end of the set, with only 33.86% called between the second and third periods of the set. This strategy reflects that coaches use time-outs at the beginning of the set to slow down the opponent and, at the same time, reserve time-outs for critical moments at the end of the set, looking to influence the outcome (Kozar et al., 1993).

This trend is supported by our results, which indicate that as TO progress within a set, the 3rd and 4th TO are requested in 81.55% and 90.48% of cases, respectively, when the score is tied. The final time-out is not requested if the team wins (0.00%). This trend is in line with other studies showing how coaches in team sports use TO in advanced stages to consolidate performance and prevent possible downs in the score (Gómez et al., 2014) and reinforce the team's concentration in the decisive phases of the game (Abreu et al., 2017; Rodrigues, 2000). In fact, the request for TO is uncommon when the team is winning (only 3.94% of cases) or if the disadvantage is very high (-8 points or more). This strategy reflects how coaches avoid requesting time-outs at critical moments, maybe to avoid " icing" their players, which could disrupt a favorable momentum, generating repetitive thoughts and self-control wear, factors that affect performance under pressure (Baumeister et al., 1994; Goldschmied et al., 2023). In this way, they aim to maximize the psychological impact of the break.

The multinomial logistic regression results highlight the strategic importance of TO as the set progresses. The probability of requesting a 2nd TO during the 2nd and 3rd periods is 24.4 and 180 times higher, respectively (OR=24.399, p < .001; OR=180.293, p < .001). This pattern underlines the relevance of key moments in the set for influencing the game (Lorenzo et al., 2006; Montero et al., 2005). Point difference (SD) and opponents' level (OL) also have an impact: TO are more frequent against lower-level opponents (OR=0.474, p=0.013), coinciding with the need to stop negative streaks of the opponent (Drikos et al., 2021; Moreno et al., 2005). These results coincide with studies showing that TO are called in adverse situations to break the opponent's rhythm (Fernández-Echeverría et al., 2013; Zetou et al., 2008). Therefore, coaches should use TO strategically at critical moments, as suggested by previous studies (Ortega et al., 2010; Zetou et al., 2008).

An interesting finding is that, although TO do not generally significantly impact the point immediately following (50.28% wins vs. 49.72% losses), they do have a progressive effect on the next three points (TPO). In the 1st TO, the data indicates improved performance: 23.37% winning sequences on two points and 12.56% on three points. This suggests that TO may serve as a progressive adjustment tool, helping the team to adapt and break the opponent's negative streak, rather than as an instant solution (Miller, 2005; Saavedra et al., 2012). On the other hand, the low incidence of losing three-points after a TO (9.67%) suggests that these pauses stabilize the game, although their impact on turning around the overall dynamics is limited. This is due, in part, to the ability of both teams to quickly adjust their strategies and efforts, keeping the score balanced (Sampaio et al., 2010). However, this finding does not minimize the usefulness of TO, but rather highlights the importance of effective tactical management and clear communication from the coach (Gutiérrez-Aguilar et al., 2016; Moreno et al., 2005).

Finally, the chi-square analysis ($\chi^2(72) = 409.937$, $p < 0.001$, Vc=0.354) supports that TO requests significantly depend on the score difference and various contextual variables. For instance, the opponent's level (OL) is crucial, except when they are clearly superior. In such cases, the probability of winning the next point (NPR) drops to 40.98% compared to 59.02%. In addition, the score difference (SD) increases to -4.93 on average, compared to -2.30 at equal level. Competitive load (CL) and match status (MS) are influential, except when the team wins, where few TO are called. Period set (PS) is relevant, less in the 1st set. López-Serrano et al. (2024) showed that the contextual situations that occur at the end of the game have a great impact on the probability of winning. It is precisely in these moments when coaches perceive that the situation is critical or that their team is at a disadvantage, that they tend to request more TO to try to turn around and maintain the hope of winning. Similarly, wins in the NPR and next three-points (TPO) are clearly associated with the request for TO. This shows how coaches adapt their decisions according to the context, highlighting the importance of managing time-outs well to influence the game (Moreno et al., 2005). The ability to evaluate the game and make precise tactical decisions under pressure is crucial to maximize the use of TO (Bar-Eli y Tractinsky, 2000; Moreno et al., 2005).

Conclusions

In conclusion, the results of this study support the utility of time-outs, not only as a tactical pause but also as a fundamental tool to influence the dynamics of the game at critical moments within a set. As previous research has shown, TO help reduce disadvantages and reverse negative scoring trends, showing notable efficacy at the three points immediately following their request. This analysis highlights how boys' youth volleyball coaches adapt the timing of calling TO according to the score difference, the period set, and the opposition's level. In addition, the implementation of interactive dashboards has proven to be an innovative and useful tool, allowing for more in-depth analysis and facilitating the identification of trends to optimize the timing of TO. Among the study's limitations are the dependence on openly data and the exclusion of games with incomplete information, as well as the possible influence of unmeasured subjective factors, such as the coach's experience. In practice, these results help coaches plan time-out management to maximize its effectiveness. Future studies should explore variations between categories and optimize strategies for use in various game situations.

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Authors and translators' details:

Carlos López-Serrano	carlos.lopezs@upm.es	Author
Juan José Molina Martin	juanjose.molina@upm.es	Author
Carlos López-Serrano	carlos.lopezs@upm.es	Translator