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Winning patterns under special conditions in elite men's padel players

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Abstract

Official elite padel competitions are typically held under similar conditions, including the surface and the rule allowing two serves to start the rally. What happens when the competition is played under special constraints? This study aimed to describe the temporal structure, number of shots per point, percentage of serve in, percentage of winners and errors, and the distribution of points won by the serving and returning team in elite men's padel played under modified conditions (single-serve rule, clay court surface, and golden point), and to compare these performance indicators between winning and losing pairs. Nine matches from the 2024 Argentinian Padel Tour team competition were analysed, totalling 1250 points (inter-observer K ~0.963, intra-observer K ~0.983). Success in elite men's padel relies on offensive efficiency and rapid resolution capacity, with differences in rally duration and effective length ($p < 0.05$) between match-losing and winning pairs, especially when they play as receiver (95% CI losers: 12.99–13.87 vs 95% CI winners: 9.89–11.73). Whilst serve appeared not to affect error probability directly (95% CI OR: 0.795–1.243), its contribution increased when the effect was adjusted for the final match score, with a decrease in error rate to 42.3% (95% CI OR: 0.437–0.764). Winning pairs are distinguished by adopting an aggressive mindset and managing risk primarily during the opening moments of the point, when error probability is at its peak. Coaches should implement game situations that reward aggressiveness from the return, seeking to transform defence into attack before the tenth shot, as this is where matches are effectively decided.

Keywords

Constraints-led approach, ecological dynamics, performance analysis, racquet sports, risk management

Reviewers: Corrado Lupo (University of Turin, Italy)

Introduction

Padel is a doubles racket sport played on an enclosed court, blending key aspects of tennis and squash. A few years after it was invented in Mexico in 1969 by Enrique Corcuera, the first padel boom occurred in Argentina, followed by a second in Spain.[1] In recent years, it has undergone remarkable global growth, marked by the emergence of official international circuits, the consolidation of national federations, and a surge in media visibility.[2,3] Alongside this institutional development, private leagues and tournaments have also emerged, including the Pro Padel League and the Argentinian Padel Tour—the latter, which serves as the focus of the present study.

This surge in popularity has sparked growing scientific interest in understanding the technical-tactical, physical, physiological, and psychological demands of padel.[4–7] These investigations have described the game by short-duration, high-intensity actions, frequent accelerations and decelerations, multidirectional movements, and repetitive stroke execution within a confined playing environment.[8] Also, players are required to repeatedly perform rotational strokes, overhead actions, lateral displacements, and rapid

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changes of direction, often under time constraints and in unpredictable situations. Such demands may increase the risk of overuse injuries, particularly at the shoulder, elbow, lumbar spine, and lower extremities, while simultaneously requiring high levels of neuromuscular coordination and movement efficiency.[9]

Biomechanics and kinesiology provide essential theoretical and methodological frameworks for analysing sport-specific movement patterns. Biomechanical analysis enables the examination of kinematic variables (e.g., joint angles and angular velocities), kinetic parameters (e.g., joint moments and ground reaction forces), and spatiotemporal characteristics associated with technical execution. Complementarily, kinesiology focuses on integrating the anatomical, neuromuscular, and functional aspects of human movement, offering insights into muscle activation patterns, intersegmental coordination, and motor control strategies.[10,11] Furthermore, understanding the kinesiological demands of padel, combined with match analysis, may inform evidence-based training strategies.

Match analysis—currently the most extensively researched domain in padel[12–14] —focuses on extracting objective data from players' spontaneous behaviour in real competitive contexts. This approach provides valuable insights for designing more effective game strategies, tailoring specific training sessions, and delivering precise feedback to enhance decision-making processes.[15,16]

Previous studies have shown that in professional padel, a typical padel point lasts between 12.2 and 14.8 s and includes an average of 8.8 to 11 shots.[17,18] Although the rules allow up to 20 s between points,[19] professional players often do not use the full time available.[20,21] Importantly, every rally begins with a serve—typically a first serve, used in nearly 90% of cases[22]—and ends either with a winner or an error. In men's professional padel, rallies tend to conclude more frequently with errors than with winners, with approximate proportions of 63.1% and 36.9%, respectively.[23]

When comparing match outcomes, the evidence consistently shows that winning teams outperform their opponents in several key areas. They win more total points and break points,[24] play more winners[25] and make fewer unforced errors.[26] Their effectiveness is particularly notable during extended rallies lasting more than 11 s, as well as in minimising errors during the critical first four seconds of play.[27] Additionally, winning pairs tend to play more aggressively, proactive padel—characterised by a higher frequency of no-bounce shots,[28] and an increased number of winners executed through volleys and smashes.[29,30] Their dominance is further reflected in their success at the net, where they secure a greater proportion of points.[31]

From a theoretical standpoint, the ecological dynamics framework posits that sports performance emerges through the continuous interaction between the athlete and a dynamic environment, shaped by individual, task, and environmental constraints.[32] In this context, manipulations such as playing on clay, using a one-serve rule, and introducing golden points act as task and environmental constraints that can reorganise affordances, influence decision-making, and shape performance behaviours due to different biomechanics and kinesiology demands.[33] Previous studies on golden point reported changes in game dynamics, such as an increase in the number of games per set,[34] a higher frequency of break[8] and a greater parity, particularly in women's padel.[35] Furthermore, significant differences have been observed between winning and losing pairs, especially in the number of golden points won while receiving.[24] Consequently, the golden point has emerged as a crucial factor in influencing match outcomes. Recently, Martin-Miguel and colleagues observed a higher prevalence of shots in golden points, suggesting a low-risk tactical approach.[36]

To date, no studies have been conducted on the clay court in padel. However, in other racket sports, such as tennis, the court surface significantly modulates the external physical demands and tactical outcomes of professional match play. Systematic review data indicate that clay courts elicit the longest rally durations, compared with the significantly shorter exchanges observed on hard and grass courts. This temporal extension on clay correlates with a higher volume of strokes per rally. Furthermore, while first-serve speeds remain relatively stable across surfaces, the serve's effectiveness is attenuated on clay, where receivers win a higher percentage of return games compared to the high-efficiency service outcomes characteristic of grass-court play.[37]

Understanding how these constraints affect technical-tactical behaviour offers valuable insights into representative training design and performance optimisation.

Therefore, the aims of this study were twofold: (i) to describe the temporal structure, number of shots per point, percentage of serve in play, point-ending effectiveness (percentage of winners and errors), and the serving and point efficiency in elite men's padel matches played under modified conditions—namely, a single-serve rule, clay court surface, and the use of golden points; and (ii) to compare a subset of these performance indicators—specifically those related to shot outcomes, point resolution and percentage of serve in—between winning and losing pairs. We hypothesised the following: (1) winning players win more overall points than losing players; (2) winning players win more points when they serve than losing players do when they serve; (3) winning players make more winners and fewer errors than losing players.

Methods

Research design

The present observational research follows an empirical methodology with a descriptive approach, characterised by a nomothetic, punctual, and multidimensional framework.[34]

Table 1. Inter-observer and intra-observer reliability.

Study variables	*Inter-observer K*	*Intra-observer*
Rally duration	0.94	0.98
Rest in between points	0.94	0.96
Shots per point	0.98	1.00
Effective shots per point	0.95	0.98
Serve in percentage	1.00	1.00
Last shot effectiveness	1.00	1.00
Serving efficiency	0.94	0.96
Point efficiency	0.95	0.98

Sample

The data were collected from the nine matches of the 2024 Argentinian Padel Tour team competition, which represented 100% of the study sample and encompassed 1250 points. Two teams competed over three consecutive days in the first-ever competition held on an outdoor clay court. The tournament was held in Buenos Aires, Argentina. A total of 12 elite Argentinian male players participated in these nine matches. All procedures were conducted in accordance with the ethical standards in sport and exercise science research, the local Ethics Commission, and following approval from the Bioethics Committee of the University of Extremadura (reference 157/2022).

Study variables

The following variables were analysed and classified by their core category and level of openness, where the core category represents the variable's central thematic dimension, and the level of transparency indicates the extent to which it allows variation.[35]

Rally length (s): duration of each point, defined as the time elapsed from a booming serve to the last shot.

Rest in-between points (s): duration of the time between one point and the one immediately after. The time between games, including the time before the first point of each game, was not considered.

Shots per point: count of strokes played in a point, spanning from the service to the last stroke, whether the previous stroke is a winner or an error.

Effective shots per point: count of strokes played in a point, spanning from the service to the last stroke, excluding cases in which the previous stroke results in an error.[36]

Serve in percentage: percentage of the times in which the serve was put into play. According to the rules of this special competition, there was only one opportunity to make the serve in. This differs from official padel tournaments, where, according to the rules, there are two opportunities to make the serve in, as in tennis.

Last shot effectiveness: winner or error. A winner is an action in which a player wins the point with a direct shot, while a mistake is an action in which the player loses the point, regardless of the difficulty of the ball.

Serving efficiency: a distinction was made between points won by the serving players or points won by the returning players.

Point efficiency: a distinction was made between points won by the winning players and points won by the losing players.

Procedures

The observer, an MSc student in Sports Sciences and a certified padel coach with over three years of experience, observed the matches and recorded the study variables using an *ad hoc* instrument. After the collection process, an intra-observer reliability analysis was conducted to verify the collected data. The observer reanalysed a random sample of 3 matches to ensure sufficient relevant data, as it is typical to reanalyse around 10–20% of the study sample.[37] The mean intra-observer reliability was 0.98 (see Table 1), considered almost perfect.[38] Another observer, a PhD in Sports Sciences and certified padel coach with over 10 years of experience, also analysed the same random sample of 3 matches to calculate the average inter-observer reliability, which was 0.95 (see Table 1).[38]

Statistical analysis

A descriptive analysis was performed, including frequencies, percentages, means, and standard deviations for the variables under study. An inferential analysis was then conducted to develop contingency tables and use the Chi-square (χ^2) test to assess the association between variables. Odds Ratio (OR) and their 95% confidence intervals (CI) were estimated by a series of binomial logistic regressions to predict the OR of the last shot error probability. The significance level was set at $p < 0.05$, and the statistical analysis was performed using SAS (version 9.4) for Windows.

Results

Nine matches were analysed, totalling 1250 points. 21.28% of points were played at the third set and 40% at the second set ($\chi^2 = 290.7$, $p < 0.001$). Independent of the set number, more than 60% of points were played within the first six games, and just 15.52% were played after the 10th game ($\chi^2 = 264.6$, $p > 0.001$). Table 2 shows the descriptive statistics of the main variables. The server's frequency was higher than the receiver's, resulting in a corresponding discrepancy in match winner or loser ($\chi^2 = 93.08$, $p < 0.001$). The percentage of error did not vary between the matches ($\chi^2_{(8)} = 4.01$, $p = 0.856$) or set ($\chi^2_{(2)} = 0.85$, $p = 0.655$) but reported significant differences between games of server ($\chi^2_{(12)} = 72.55$, $p < 0.001$) and receiver ($\chi^2_{(12)} = 30.11$, $p < 0.001$). The point pace, computed as the rally length–to–duration ratio, was

Table 2. Descriptive performance.

Rally duration (s)	
Mean	9.82
SD	6.94
Rally rest (s)	
Mean	12.37
SD	6.84
Rally length (shots)	
Mean	7.34
SD	5.18
Effective rally length (shots)	
Mean	6.82
SD	5.23
Serve (%)	
Server	81.12
Returner	18.88
Score (%)	
Winner	77.76
Loser	22.24
Last shot (%)	
Error	52.67
Point	47.33
Point won by (%)	
Winner	54.08
Loser	45.92

0.75, which decreased to 0.69 in effective rally length, while the rally duration-to-rest ratio was 0.79.

Table 3 compares match-winning and match-losing pairs and their statistical differences when stratified by serve condition. All the main parameters were affected by the match results, and the losing pair exhibited longer rally lengths and greater rally rest durations. However, when the match results were stratified by serve, significant differences in duration and length were observed only in the receiver, with the winner exhibiting shorter times and fewer shots.

Table 4 presents the logistic regression results predicting the OR of the last-shot error probability. Except for model five, the serve did not affect the error rate probability, with similar curves on rally duration (Figure 1, model 2), rally length (Figure 1, model 3), and effective rally length (Figure 1, model 4), but players at serve showed lower error rate as the rally duration and length increased. When the final score-adjusted results are considered, both serve and effective rally length affect the error probability, with a reduced risk ranging from 23.4% to 56.3% for players at serve.

Discussion

The main objective of this study was to examine the game dynamics of elite men's padel under unconventional environmental and task constraints, specifically the single-serve rule, the golden-point system, and clay-court surfaces. Beyond a fundamental spatiotemporal characterisation of

Table 3. Comparisons between match-losing and match-winning pairs, and match-losing and match-winning pairs stratified by serve.

	Match-losing pair		Match-winning pair		Kruskal-Wallis		Server		Kruskal-Wallis for server		Receiver		Kruskal-Wallis for receiver	
	(n = 574)		(n = 676)		[match losing vs winning pair]		losing pair (n = 466)	winning pair (n = 548)	[match losing vs winning pair]		losing pair (n = 108)	winning pair (n = 128)	[match losing vs winning pair]	
Variable	Mean	SD	Mean	SD	$\chi2_{(1)}$	p-value	Mean ± SD	Mean ± SD	$\chi2_{(1)}$	p-value	Mean ± SD	Mean ± SD	$\chi2_{(1)}$	p-value
rally duration (s)	10.25	7.04	9.45	6.84	5.32	0.021*	9.51 ± 6.59	9.13 ± 6.92	2.64	0.104	13.43 ± 7.99	10.81 ± 6.32	6.06	0.014*
rally rest (s)	12.94	6.67	11.87	6.95	13.59	<0.001*	12.32 ± 5.19	11.48 ± 7.33	16.38	<0.001*	15.47 ± 10.46	13.63 ± 4.47	0.2	0.654
rally length	7.64	5.29	7.08	5.08	4.94	0.026*	7.23 ± 5.08	6.95 ± 5.18	2.47	0.116	9.38 ± 5.85	7.65 ± 4.58	4.98	0.026*
effective rally length	7.14	5.37	6.56	5.09	4.66	0.031*	6.62 ± 5.12	6.30 ± 5.18	2.56	0.11	9.38 ± 5.85	7.65 ± 4.58	4.98	0.026*

Table 4. Logistic regression model for predicting the probability of error at a point.

Model 1	OR	95% CI		Wald $\chi 2_{(1)}$	p-value
serve	0.994	0.795	1.243	0.003	0.959
Model 2	OR	95% CI		Wald $\chi 2_{(1)}$	p-value
rally duration	0.959	0.943	0.976	21.63	<0.001*
serve	0.997	0.795	1.249	0.001	0.976
Model 3	OR	95% CI		Wald $\chi 2_{(1)}$	p-value
rally length	0.974	0.953	0.995	5.6	0.018*
serve	0.995	0.795	1.244	0.002	0.995
Model 4	OR	95% CI		Wald $\chi 2_{(1)}$	p-value
effective rally length	0.936	0.914	0.958	30.49	<0.001*
serve	0.993	0.792	1.246	0.003	0.953
Model 5 (adj. by match score)	OR	95% CI		Wald $\chi 2_{(1)}$	p-value
effective rally length	0.957	0.932	0.983	10.4	0.001*
serve	0.577	0.437	0.764	14.88	0.001*

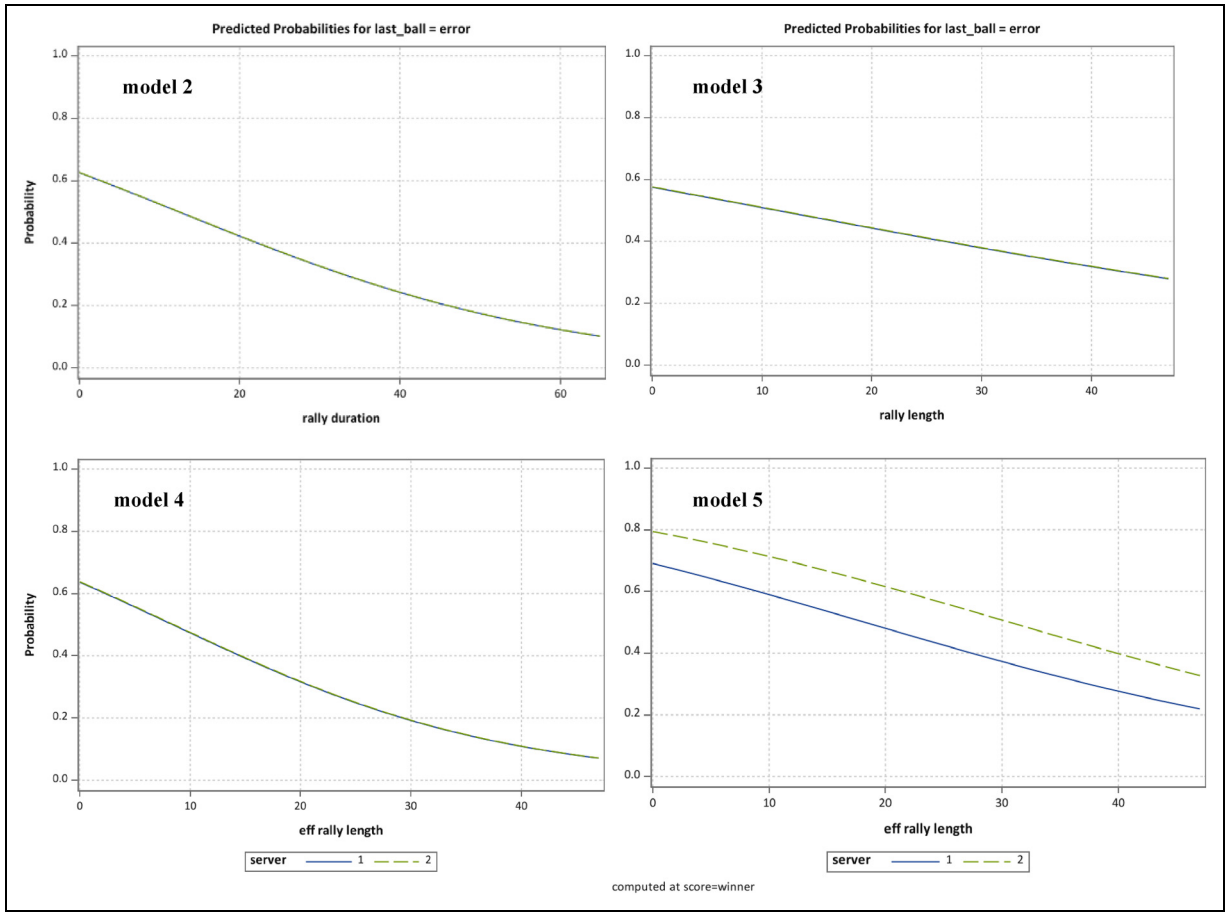

Figure 1. Predicted error probabilities on rally duration, rally length, effective rally length and adjusted effective rally length, considering serve role as server (1) or returner (2).

these conditions, this research sought to elucidate how such modifications influence shot effectiveness and point-resolution strategies, and to provide a comparative analysis of winning and losing pairs. Furthermore, the study aimed to model error probability as a function of rally progression, offering a predictive perspective on performance under these specific competitive restrictions. We found that the leading match indicators, such as rally duration and length, reported different results between winners and losers, and this effect was enhanced when players received. Generally, players who win the match require fewer shots ($\sim$ 0.5 per point) to win the rally. Its justification may

rely on two technical-tactical aspects: a more offensive mindset when players are at the net (in the attack position) or when they reach the net in defense.[29] Mauro and colleagues[39] found that as the point progresses, the probability of winning the point increases for the receiving pair. Independent of match results, we found that players who received had longer rally durations, rest times, and lengths than players at serve, confirming the predicted effect. Considering that wider differences appeared between the match loser and the winner receiver, the defensive contribution mainly affected the match score. Although each additional shot increases the probability of winning the rally by ~ 4%,[39] this advantage persists until the 10th shot, after which the receiving pair may be at a disadvantage, as depicted by parameter differences in Table 4. However, the average rally length and duration differ from those reported by Martin-Miguel and colleagues[18] and Lupo et al.,[40] who reported 12 to 14.8 s and 9.3 to 11 strokes per point, respectively. Although they analysed a different competition, the results referred to 2020 and 2016, and this discrepancy may reflect a shift toward a faster game, as the point pace comparison suggests (0.75 vs. 0.8 and 0.78). Even if match parameters depend on tournament rounds,[24] quicker rallies and game duration require greater attention and specific adaptations in padel training models,[17] especially given that the point pace further decreases if we do not count the serve. Particularly, we can report a work-to-rest ratio of 1:1.26, which, when combined with short strokes (≤ 10 s) repeated for ~ 95 min,[41] could define an alternate metabolic profile of padel,[42] with intensive intervals (heart rate: 135–149.1 b/min). These findings could also have implications for the kinesiological and biomechanical demands of padel. When compared to other racket sports, the physiological and kinesiological demands may vary due to the greater influence of the serve, as seen in tennis and badminton, which require extensive neuromuscular effort and high blood lactate concentrations,[42,43] or table tennis, which requires higher aerobic power and tolerance.[42] However, in padel, the metabolic profile, shot effectiveness, and internal load may shift due to the serve role, last-point rules, and extended rest in key moments.[4,5,18,23–27,31,39,44]

In addition to the time patterns, we hypothesised that serve and game parameters could affect the error probability. We found that the prediction curves (Figure 1) decrease over the stroke duration, independent of time or rally length. Additionally, the serve influenced the error probability only when the effective rally length was considered, and the match score adjusted its effect. The error probability reports the highest value within the first five strokes and decreases by ~4% per additional second, ~2.7% per additional stroke, or ~6.7% per additional effective stroke. This result highlights that players intend to be more offensive and increase the speed of their attacking or defending strokes soon after serving, taking advantage of the opportunity. In fact, if we consider the effective rally length (which does not consider the first ball), the curve represents a steeper decline with a higher error probability value within the first five strokes. Escudero-Tena and colleagues found that the most common errors occur during defence against the wall and volley,[45] especially the backhand.[46]

When considering the winner-pair, the probability of error is 11.55% higher at the receiver than at the server, which could indicate an aggressive mindset from the beginning, even when they cannot benefit from a net position. Although a previous study emphasised that prolonging the point increases the receiver's probability of success, professional players who win seem to exploit each ball to reach the point. Losing pair usually makes more backhand groundstrokes, while winning pairs are involved in more net shots, such as volleys and smashes.[40] Whilst the smash represents the most winning shot in professional male play, men played more than 40% of their shots in the transition zone (mid-court), and unforced errors are the leading cause of point endings.[40,47] At baseline, winning pairs showed a reduced error rate of ~10% compared to losing pairs.[48] The lob represents less than 20% of groundstrokes, limiting this solution to a comfortable game context.[49–51] The losing pair often performs fewer attacking actions than the winners, failing to achieve them by 47% points,[28] whereas the winning pair are more effective in winning strokes.[13,24,52,53] It appears that defence and point construction when switching positions have the most significant influence on defining winners; however, a different study design is needed to demonstrate this.

This study presents many limitations: i) the small sample size; ii) the gender limits the results to only male players; iii) the Argentine championship may report different features compared to other countries. Further worldwide investigations are needed.

Conclusions

This study provides evidence that elite men's padel game dynamics are significantly modulated by specific environmental and task constraints. In conclusion, the present study evidence that, under the constraints of a single-serve rule and clay court surface, success in elite men's padel relies not on consistency during prolonged rallies, but on offensive efficiency and rapid resolution capacity. Winning pairs are distinguished by adopting an immediate, aggressive mindset and managing risk primarily during the opening moments of the point, when error probability is at its peak. In addition, a significant performance factor is the effectiveness of the return; winning pairs are significantly better at neutralising the initial disadvantage and closing the point in less time when acting as receivers, demonstrating a higher capacity to achieve the net position of counter-attack actions more quickly. As players adopt a more aggressive strategy during play, coaches and physical

conditioning trainers should consider identifying key movement patterns, muscular demands, and mechanical stressors that can support the development of targeted strength and conditioning programs, technique refinement protocols, and injury prevention interventions tailored to padel players.

These findings suggest prioritising the design of tasks that simulate the psychological and tactical pressure of having "only one serve," focusing obsessively on decision-making during the first 5 shots of the point. Coaches should implement game situations that reward aggressiveness from the return, seeking to transform defence into attack before the tenth shot, as this is where matches are effectively decided.

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Ethical considerations

All procedures were conducted in accordance with the ethical standards in sport and exercise science research, the local Ethics Commission, and following approval from the Bioethics Committee of the University of Extremadura (reference 157/2022).

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Data availability

Data is freely available at the publisher's webpage.

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