

Technical performance and aerobic fitness in Padel amateurs players with different practice levels Rendimiento técnico y condición aeróbica en jugadores aficionados de pádel con diferentes niveles de práctica

*, ** Pedro Cabral Mendes, *, ** Ricardo Gomes, ***, ** Guilherme Estáquio Furtado, **** José Amoroso, *
Samuel Lemos, *, ** Gonçalo Dias, *, ** Rui Mendes

* Polytechnic Institute of Coimbra (Portugal), ** University of Coimbra (Portugal), *** Polytechnic Institute of Guarda (Portugal),
**** Polytechnic Institute of Leiria (Portugal)

Abstract. The aim of this study is to compare the precision of low and high-level padel players in a closed task and its relationships with the heart rate responses to the exercise. A sample of 49 male players of two practice levels (age, 36.73 ± 1.50) was selected to participate in this study. Technical performance was analysed through the Groundstroke Padel Accuracy Test (GPA) and heart rate during and after the task was monitored. There were no statistically significant differences in the GPA test, but even so the results showed a heart rate recovery at 60 and 120 sec were significantly higher for the high-level group [HRR1, $U = 189$, $p = 0,026$, $d = 0,32$ (moderate effect); HRR2, $U = 186,50$, $p = 0,023$, $d = 0,32$ (moderate effect)]. We conclude that it would be relevant to measure other product variables in order to make this field test (GPA) even more effective in the evaluation the real technical level of padel players. Additionally, high-level players recuperate faster after the effort, which appear to indicate that they may be better aerobically prepared.

Keywords: Padel, Groundstroke Padel Accuracy test, heart rate, precision, agility.

Resumen. El objetivo de este estudio es comparar la precisión de jugadores de pádel de bajo y alto nivel en una tarea cerrada y su relación con las respuestas de la frecuencia cardíaca al ejercicio. Se seleccionó una muestra de 49 jugadores masculinos de dos niveles de práctica (edad, $36,73 \pm 1,50$) para participar en este estudio. El rendimiento técnico se analizó a través del Groundstroke Padel Accuracy Test (GPA) y se monitorizó la frecuencia cardíaca durante y después de la tarea. No hubo diferencias estadísticamente significativas en el test de GPA, pero aun así los resultados mostraron una recuperación de la frecuencia cardíaca a los 60 y 120 segundos significativamente mayor para el grupo de nivel alto [HRR1, $U = 189$, $p = 0,026$, $d = 0,32$ (efecto moderado); HRR2, $U = 186,50$, $p = 0,023$, $d = 0,32$ (efecto moderado)]. Concluimos que sería relevante medir otras variables del producto para hacer aún más efectivo este test de campo (GPA) en la evaluación del nivel técnico real de los jugadores de pádel. Además, los jugadores de alto nivel se recuperan más rápido después del esfuerzo, lo que parece indicar que pueden estar mejor preparados aeróbicamente.
Palabras clave: Pádel, Valoración de la precisión del golpeo (GPA), frecuencia cardíaca, precisión, agilidad.

Introduction

Padel is a modern racket sport played on a 10x20 meters court that was created in the 1970s (De Marco, Nicastro, & Patti, 2017; Sánchez-Alcaraz, 2013). With growing interest in the recent years, Padel has now become one of the most popular sports in Spain with over four million regular participants and it is rapidly spreading around the world and this popularity has spread to Portugal (Courel-Ibáñez, Sánchez-Alcaraz, Benítez, & Echeagaray, 2017; Muñoz, Toro-Román, Vergara, Romero, et al., 2022). This is a cooperative sport, where two players share the same play space against another double team that is positioned across a net (Claver, Santandreu, & Martin, 2021). The playing space is surrounded by walls, mostly of glass and metal mesh on the sides, reaching 3 metres in height (International Padel Federation, 2017), which gives this sport the unique characteristic of enabling the ball to rebound on the side and

back walls, resulting in a fast paced game with more frequent actions without any increased physical intensity, compared to similar racket sports (Zabala, Badiola, Bidaurrezaga, Vargas, & Granados, 2016).

Physiologically, it is an intermittent sport, with short rest intervals and ball changes (rallies) throughout players (Castillo-Rodríguez, Alvero-Cruz, Hernández-Mendo, & Fernández-García, 2014), with a total game duration that may vary between 60 and 180 minutes (Muñoz, et al, 2022) and a total individual distance covered of about 2900 metres (Llín, Guzmán, Llana, et al., 2021). Players hit the ball with a frequency of once, per second (Sánchez-Alcaraz, Courel-Ibáñez, & Cañas, 2017). Playing time in Padel tends to be shorter than rest time, with the average duration of points being approximately 11.62 seconds (s) for men and 18.65s for women (Sánchez-Alcaraz et al., 2017). In line with what has been described, as the end of the set approaches, there is a tendency for the rest time to increase, within the regulatory time set for the sport (Marín, Fernández, Pérez, et al., 2016).

This sport is also characterised by a maximum court speed of 15.4 kilometres per hour (km/h) and a total covered distance of approximately 80% at low speeds (<6km/h). It should be noted that only 0.7% of the total distance covered by the players, occurs at high speeds (>12km/h) and with a Heart Rate between 123 to 150 bpm (Amieba & Salinero Martín, 2013). Furthermore, the duration of a point changes with age, gender and player level, where greater performance levels tend to be associated with longer point duration (Marín, et al., 2016).

Recent studies have analysed point duration and attack. In total, 40% of unforced errors, were committed, in the first 4s of the rally (ball exchange), more than 50% of points were won between the 5th and 11th sec, and 30% of forced errors occurred after the 11th second of the rally (Sánchez-Alcaraz et al., 2017). These authors also added that the ability to score in long rallies, that is, longer than 11s and not to commit unforced errors in the first 4s contributed considerably to success. Previously, this same research group showed that higher level players obtained better accuracy results in each of the beats they performed (Sánchez-Alcaraz, Courel-Ibáñez, & Cañas, 2016). The authors also verified that the type of effort involved during the game, even in points with a relatively long duration (at least 30s), did not cause enough fatigue to decrease the players' performance.

In line with what has been described, Padel requires a well-developed aerobic component, combined with good agility levels, acceleration, deceleration, displacement and various changes of direction, in order to allow the player to move quickly on the court, during one to two hours of play (Amieba & Salinero, 2013). It is worth highlighting the relevance of a good cardiorespiratory fitness in the player's intermittent recovery capacity (Martínez, Moreno, & Verdú, 2017). A better Heart Rate Reserve has an influence in this sport, and is therefore a differentiating factor between low and high-level Padel players (Courel-Ibáñez, & Herrera-Gálvez, 2020).

Furthermore, padel has a very own game dynamics, where technical, spatial and efficacy indicators assume particular importance in the player performance (Courel-Ibáñez, Muñoz, & Alcaraz Martínez, 2019). According to some specialist researchers, there are three styles of play: i) net, ii) middle or transition and iii) baseline. In the specific case of the middle or transition game, stroke type is characterised by a greater use of the volley, the forehand and the *bandeja* (Sánchez-Alcaraz et al., 2016). In the net game (offensive zone) the predominance is the volley and in the baseline game (defensive zone) the use of lobs, forehand hits and wall shots are frequent (Courel-Ibáñez, & Herrera-Gálvez, 2020).

This study aims to bring scientific knowledge to this fast-growing sport that can help improve the training process, based on the assumptions described above. Compared to the other training factors such as technical, tactical, mental/psychological, physical and social, the physical component tends to be the most studied, especially in anthropometric dimensions and muscle strength (Castillo-Rodríguez et al., 2014; Courel-Ibáñez & Herrera-Gálvez, 2020; Martínez-Rodríguez, Collado, & Vicente-Salar, 2015; Müller, Goulart, & Del Vecchio, 2019; Muñoz, Toro-román, Grijota, et al., 2021). To our knowledge, this is the first study that has analysed the performance of Portuguese Padel players. Thus, the present work aims to analyse and compare the precision, heart rate and heart rate recovery during the Groundstroke Padel Accuracy (GPA) test between low and high-level Portuguese amateurs Padel players.

Material and Methods

Study design

This is a cross-sectional study with a convenience sample selected from a list of practitioners registered in the Portuguese Padel Federation (FPP) and originating from clubs in the Coimbra and Leiria area (Portugal). Data were collected in two clubs and took place in April and May 2021.

Criteria of sample selection

Participants in this study met the following criteria: a) adult players; b) male; c) registered with the Portuguese Padel Federation; d) Participation in at least 5 FPP tournaments.

A sample of 49 male adult players with ages between 18 years and 55 years (36.73 ± 1.50) participated in the study. The participants had a competitive level ranging between M1 and M4 according to the classifications/categories adopted by the Portuguese Padel Federation. All players were ranked nationally, with M1 players ranking between 1st and 64th position. M2 players were between 65th and 250th, M3 between 251st and 500th, M4 players between 501st and 800th, and M5's were below the 801st national position. The national ranks are weekly updated and exclusively use the official Portuguese Padel Federation events played in the last year (FPP, 2022). The players' competitive level was classified in two groups according to their competitive level achieve in local competitions, following criteria described in previous studies (Courel-Ibáñez & Herrera-Gálvez, 2020; Muñoz et al., 2021) : 3rd and 4th category (low-level players, n = 25), and 1st and 2nd category (high-level players, n = 24). Table 1 presents the sample characteristics.

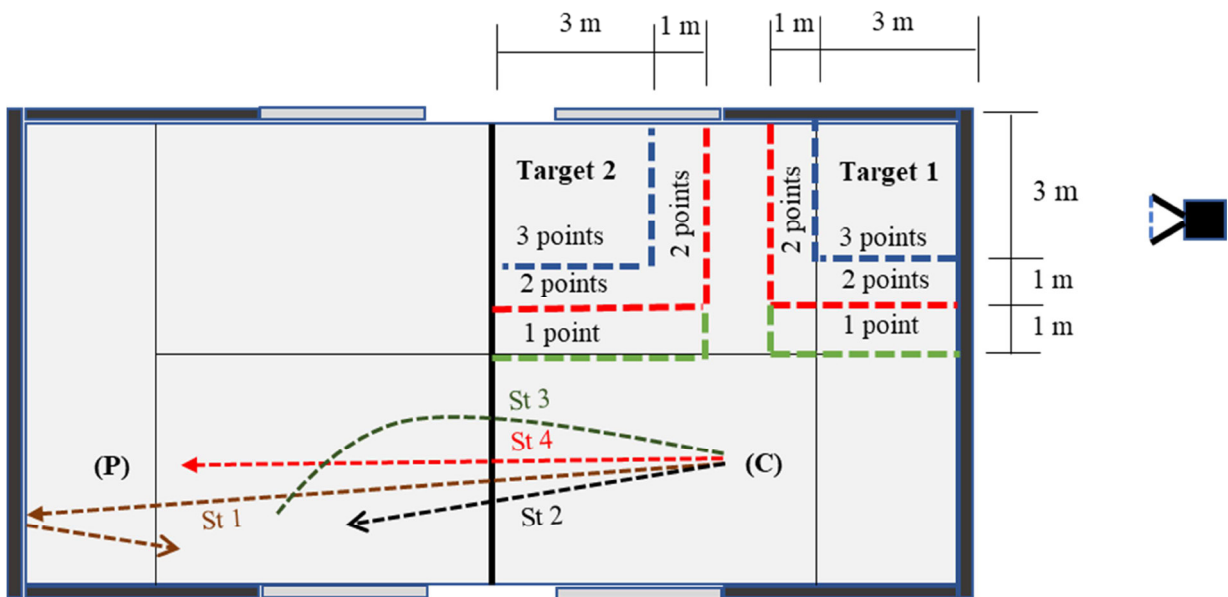


Figure 1. Dimension and placement of target zones for GPA test. The coach throws in the following order: stroke 1 (st 1): forehand hit after ball bouncing off the wall; st 2: forehand volley (near the net); st 3: "bandeja" (approximately aligned with the 3-iron) and st 4: forehand shot, slightly behind the service line. Score: blue delimited target zone – three points; red delimited target zone – two points; and green delimited target zone – one point (adapted from Sánchez-Alcaraz et al., 2016, p. 326).

Table 1
Characteristics of the padel players

	High Level n=24 (M \pm SD)	Low Level n=25 (M \pm SD)
Age (years)	36.04 \pm 2.13	37.04 \pm 2.15
Height (cm)	176.50 \pm 1.18	177.28 \pm 1.23
Body mass (kg)	78.33 \pm 2.36	80.64 \pm 2.00
BMI (Kg/m ²)	25.01 \pm 0.59	25.54 \pm 0.65
Practice Experience (years)	3.44 \pm 0.27	2.40 \pm 0.27

Ethical procedures

All players were national and registered in the Portuguese Padel Federation. They were previously informed about the characteristics of the study, and signed an informed consent, legitimating their participation in the study. Confidentiality, anonymity and the exclusive use of the data collected only for the present study were guaranteed. The study was conducted in accordance with the Helsinki Declaration and the Oviedo Convention and was unanimously approved by the Ethics Committee of the Polytechnic Institute of Coimbra (Nº 23_CEIPC_2021).

Experimental setup

Prior to the test day, the participants were informed: 1) to not consume any alcoholic or caffeinated beverages in the 24h prior to the test; 2) to not undergo through any strenuous physical activity (competitive play) in the day before the test; 3) to not take any heavy meal within 2 hours before the test.

During test day, participants were measured, weighed and BMI upon arrival, according to the standard

recommendations (Lohman, Roache, Martorell, Roche, & Martorell, 1992). Body mass and height were measured using standardized guidelines with an electronic scale (Tanita SC 330) and a stadiometer (SAGE Type). Body mass index (BMI) was calculated as body mass (kg) divided by height² (m).

The Groundstroke padel accuracy test (GPA) was applied to assess players' accuracy level in each beat (Sánchez-Alcaraz et al., 2016). This test intends to evaluate the technical performance (accuracy) in a sequence of 4 hits without opposition. The player was required to perform accurately a cyclical sequence of 4 different beats in various positions on the court, during 8 series of 30 seconds, with 20 seconds of rest between series. The 4 strokes were performed in the following chronological order: stroke 1: ball after bouncing off the glass; stroke 2: volley (near the net); stroke 3: tray (approximately aligned with the 3-iron) and stroke 4: direct hit, slightly behind the service line (Sánchez-Alcaraz et al., 2016). To maintain uniformity and keep task reliability, a professional Padel Coach with more than 10 years of experience served the balls for the participants.

Heart Rate (HR) values were also recorded during the whole duration of the test, and Heart Rate Recovery was measured 60 (HRR1) and 120 (HRR2) seconds after the end of the test with a Polar H10 heart rate monitor [Polar, 2019]. The GPA test was filmed with a GoPro Hero 8 camera at 60 FPS for later video analysis and classification.

Statistical Analysis

Normality assumptions were assessed through Shapiro-Wilk test, with a further symmetry analysis when normality was not verified (Pestana, & Gageiro, 2005). To analyse bivariate and linear associations between the quantitative variables, the spearman (s) correlation coefficient was used, for a significance level of 5%. Mann-Whitney U test was used to compare low and high-level groups in the variables selected. Regarding the magnitude of the coefficients found, the following classification was adopted (Hopkins, Marshall, Batterham, & Hanin, 2009): 1) values below 0.20: indicate very low linear associations; 2) values between 0.20 and 0.39: point to low linear associations; 3) values between 0.4 and 0.69: associations are considered moderate; 4) values between 0.7 and 0.89: consider the associations as high and; 5) 0.9 and 1 indicate very high associations). This analysis was performed using the IBM program SPSS (version 25) for a significance level of 5%.

Results

As presented in Table 1, the players' competitive level was classified in two groups according to their competitive level achieved in local competitions: 3rd and 4th category (low-level players, n = 25), and 1st and 2nd category (high-level players, n = 24). Both groups showed a similar age and body composition values. As expected, the high-level players were more experienced than the low-level ones.

The comparison of the GPA performance and heart rate response to exercise is shown in Table 2. Both groups performed similarly in the GPA test, with no statistically significant differences being found for any of the variables analysed. Regarding the heart rate, both groups achieved relatively similar values for the last 30 seconds of the test. However, the heart rate recovery values at 60 and 120 seconds were significantly higher for the high-level group [HRR1, U = 189, p = 0.026, d = 0.32 (moderate effect); HRR2, U = 186.50, p = 0.023 d = 0.32 (moderate effect)].

Table 2
Padel players performance and heart rate responses

	High Level	Low-Level	Mann-Whitney U test
			p-value
GPA accuracy			
GPA total score	184.54 ± 7.24	180.08 ± 9.06	0.575
GPA total shots	112.9 ± 1.89	109.89 ± 2.87	0.401
GPA average Score	1.63 ± 0.06	1.63 ± 0.06	0.674
GPA wall score	47.67 ± 2.94	47.72 ± 2.74	0.889
GPA volley score	46.9 ± 2.23	45.24 ± 3.39	0.357
GPA Over-head score	42.25 ± 1.92	44.28 ± 2.10	0.515
GPA direct score	43.08 ± 1.88	42.48 ± 2.71	0.802
Heart Rate (bpm)			
Hrex	160.96 ± 3.32	153.80 ± 3.80	0.082
HRR1	35.33 ± 2.82	22.68 ± 3.50	0.026*
HRR2	50.21 ± 2.75	39.60 ± 3.32	0.023*

Hrex = heart rate after exercise; HRR1 = heart rate recovery values at 60; HRR2 = heart rate recovery values at 120 seconds

Correlation analysis found associations between HRR1 ($\rho = 0.584, p = 0.003$), HRR2 ($\rho = 0.63, p = 0.001$), and GPA score for the high level-group. This correlation was not evident for the low-level group (HRR1, $\rho = 0.06, p=0.777$; HRR2, $\rho = 0.184, p=0.379$).

Table 3
Correlations between heart rate values and GPA Total Score

	Low Level	High-level
	GPA Total Score	GPA Total Score
Hrex	0.174 (p=0.414)	-0.001 (p=0.997)
HRR1	0.584 (p=0.003)*	0.060 (p=0.777)
HRR2	0.630 (p=0.001)*	0.184 (p=0.379)

Hrex = heart rate after exercise; HRR1 = heart rate recovery values at 60; HRR2 = heart rate recovery values at 120 seconds

Discussion

An analysis on the sample characteristics shows that there were no evident anthropometric differences between the two groups. These result are in line with a previous study (Courel-Ibáñez, & Herrera-Gálvez, 2020) and are somewhat contrary to what has been recently found, where anthropometric differences between low-level and high-level players were found (Muñoz et al, 2022). Our average age was substantially higher to that of the players participating in the referred studies and this should be considered. Nonetheless, it appears that there is some undefinition as to the anthropometric characteristics of Padel players of different levels, which further studies should address.

As it is highlighted by Sánchez-Alcaraz, Martínez-Gallego, Llana et al (2021) and Courel-Ibáñez, Sánchez-Alcaraz, García, Echegaray (2017), it is evident that a growing number of amateur middle-aged practitioners between 35 and 55 years of age are being drawn to this sport. Our convenience sample confirms this tendency. However, this may cause a decrease in the players' performance and somewhat depict only the recreational group of players, rather than the elite and sub-elite national or international players. Further studies should aim to analyse these variables in more elite levels.

Regarding GPA performance, both groups performed very similarly, despite the high-level players performing an average of 3 more shots per test, which was statistically insignificant. The absence of significant differences between the low-level and high-level group for the GPA performance test, both in the global score and in each stroke type contradicts what was reported by Courel-Ibáñez and Herrera-Gálvez (2020). It is important to refer that our study had a substantially larger sample than the one carried out by the aforementioned authors.

The fact that the GPA does not include any decision making by the player, partially deprives it of the desirable

representativeness of the task or even ecological validity (Araújo, 2009). The 4 stroke sequence, as it is previously known by the players, ends up «simplifying» their motor action and does not encompass other equally relevant shots, such as the backhand, backhand volley or the wall backhand shot. The test score, considering only the accuracy of the shots may be reductive and not very precise when trying to evaluate the real level of players' performance. The bounce height and ball speed are relevant variables to measure the level of play and they are not taken into account in this test. It is noteworthy that Sánchez-Alcaraz et al (2016) had already warned about the need to measure the speed of the ball in the different strokes. As highlighted by Menayo et al (2008) there is a strong relationship between speed and accuracy in racket sports (Calvo, 2008).

This problem of task representativity in tests that aim to analytically assess technical gestures also occurs in the ITN On Court Assessment for Tennis, for example. This test has been developed to assist National Associations to cater more fully to the recreational players that do not play competitively on a regular basis. Though, the ITF recognises some of the limitations of any non-competition-based assessment in Tennis (for example, the static feeding, only assessing strokes in a closed situation, only certain strokes being assessed) (Olcucu, & Vatansever, 2015).

Similarly to what was reported by Courel-Ibáñez and Herrera-Gálvez (2020), also in this study it was possible to find associations between HRR1 and HRR2 and technical performance (GPA Score) in the high-level group. In other words, aerobic fitness seems to assume some relevance in sport performance in padel. This fact is assumed by Amieba and Salinero (2013) and Carbonell et al (2017) who corroborate the importance of a good aerobic fitness for the recovery between points (Amieba & Salinero, 2013; Martínez et al., 2017). In line with what has been described, Ziemann, Sledziewska, Grzywacz, Gibson, and Wierzba (2011) equally reinforce the relevance of aerobic fitness in sports performance in tennis. Even amateur padel tennis players with a higher competitive level do not present higher physical fitness, but present longer practice time (Müller, & Vecchio, 2018).

Conclusions

The GPA is a field test that is easy to apply in training as it recreates, both on a physical level and on a technical and tactical level, the typical actions that occur in padel. However, this test did not allow to differentiate the accuracy level of high-level players from low level players. Due to the recency of this sport in Portugal, the ranking may not reflect the effective technical performance of the

padel players. On the other hand, as this test measures only the accuracy of a few strokes, the resulting evaluation may not correspond to the real technical level of the players. As previously mentioned, we suggest the use of other variables, such as the speed and the height of the bounce of the ball on the court. The high-level players showed a higher recovery capacity after the effort (HHR1 and HHR2) and this may indicate a higher aerobic fitness of these players. In line with what has been reported by previous studies using the GPA (Courel-Ibáñez & Herrera-Gálvez, 2020; Sánchez-Alcaraz et al., 2016), this test allowed to simulate the physical demands of a Padel game. The results of this manuscript provided worthy information to improve the design of more specific field tests and training sessions for padel players depending on their level of game.

The main limitation of this study lies in the sample characteristics. As this is a relatively recent sport in Portugal, the participants in the study were mostly over 35 years of age. The time of practice in the sport did not differ, in a substantial way, from the high-level group to the low-level group, possibly due to the recency of this sport. On the other hand, a larger sample would allow a greater generalization of the results. Additionally, as the GPA test does not measure bounce height and ball speed of each stroke, makes the evaluation of the padel player's technical performance less reliable. It would be equally relevant to analyse the backhand shots previously referred, which require greater precision and are more difficult.

Future research should relate the GPA performance with the Game Performance Assessment Instrument, applying it Padel (see in more detail in Mitchell et al., 2006; Oslin, Mitchell, & Griffin, 1998), analysing and comparing high-level players (M1 and M2), intermediate level players (M3 and M4) and beginners (without ranking) in order to infer whether the three groups of players differ in decision making in different phases of the game (defensive, transition and attack), as well as in the level of execution of some strokes.

Acknowledgment

The authors are grateful for the availability of the Star Padel club in Coimbra, CETL, Ultra padel club, and XXL, both from Leiria, the coach David del Barrio and all the participants in the study.

Reference

- Amieba, C., & Salinero, J. J. (2013). Overview of paddle competition and its physiological demands. *Agon*, 3(2), 60–67. Retrieved from <https://dialnet.unirioja.es/servlet/articulo?codigo=4727170&info=resumen&idioma=SPA>

- Araújo, D. (2009). O desenvolvimento da competência táctica no desporto: o papel dos constrangimentos no comportamento decisional. *Motriz*, 15(3), 537-540.
- Calvo, G. (2008). En Jugadores De Perfeccionamiento, 16–30.
- Castillo-Rodríguez, A., Alvero-Cruz, J. R., Hernández-Mendo, A., & Fernández-García, J. C. (2014). Physical and physiological responses in Paddle Tennis competition. *International Journal of Performance Analysis in Sport*, 14(2), 524–534. <https://doi.org/10.1080/24748668.2014.11868740>
- Claver, E. L., Santandreu, C. S., & Torrents Martin, C. (2021). Pádel: una mirada compleja, dinámica y no lineal en la iniciación deportiva y el entrenamiento. *Retos*, 41, 354-361.
- Courel-Ibáñez, J., & Herrera-Gálvez, J. J. (2020). Fitness testing in padel: Performance differences according to players' competitive level. *Science and Sports*, 35(1), e11–e19. <https://doi.org/10.1016/j.scispo.2019.05.009>
- Courel-Ibáñez, J., Sánchez-Alcaraz, B.J., and Muñoz, D. (2019). Exploring game dynamics in padel: implications for assessment and training. *Journal of Strength and Conditioning Research*, 33,7, 1971-1977. <https://doi.org/10.1519/JSC.0000000000002126>.
- Courel Ibáñez, J., Sánchez-Alcaraz Martínez, B. J., Benítez, S. G., & Echegaray, M. (2017). Evolución del pádel en España en función del género y edad de los practicantes. *Cultura, Ciencia y Deporte*, 12(34), 39–46. <https://doi.org/10.12800/ccd.v12i34.830>
- De Marco, J. C., Nicastro, O., & Patti, D. (2017). La historia del paddle (pádel). *Federación Internacional de Pádel*. Recuperado Julhlo, 6, 2021 de https://www.padelvip.com/wp-content/uploads/2017/08/2017_Historia-del-Padel_foto.pdf
- Federação Portuguesa de Padel (2022). Regulamento Geral. Recuperado Agosto, 5, 2022, de <https://tiesports.s3.amazonaws.com/clubs/46074/document-images/0fc25ecf-8cfa-48fc-ade6-065bf4fd73d1.pdf>
- Hopkins, W. G., Marshall, S. W., Batterham, A. M., & Hanin, J. (2009). Progressive statistics for studies in sports medicine and exercise science. *Medicine and Science in Sports and Exercise*, 41(1), 3–13. <https://doi.org/10.1249/MSS.0b013e31818cb278>
- International Padel Federation. (2017). Regulations of the padel game. Retrieved from <https://www.worldpadeltour.com/media-content/2016/03/REGULATIONS-OF-THE-GAME-OF-PADEL-FIP-2017.pdf?fbclid=IwAR2Li49lhvOaygiu7c-J7TSY9igT4cvDcLjUdLs7IWEZabIB2PizbBzYUbe>
- Zabala, L., Gil, S., Badiola, A., I Bidaurrezaga, L., Vargas, A., & Granados, C. (2016). Características físicas y antropométricas, y análisis de juego en jugadores de pádel de elite. *Búsqueda*, 3(16), 33-40. <https://doi.org/10.21892/01239813.164>
- Llín, J. R., Guzmán, J., Llana, S., Vuckovic, G., Muñoz, D., & Sánchez-Alcaraz, B. J. (2021). Análisis de la distancia recorrida en pádel en función del nivel de juego y el número de puntos por partido. *Retos*, 39, 205-209.
- Lohman, T. J. G., Roache, A. F., Martorell, R., Roche, A. F., & Martorell, R. (1992). *Anthropometric Standardization Reference Manual*. *Medicine & Science in Sports & Exercise* (Vol. 24). <https://doi.org/10.1249/00005768-199208000-00020>
- Marín, D. M., Fernández, A. G., Pérez, F. J. G., García, J. D., Sánchez, I. B., & Jiménez, J. M. (2016). Influencia de la duración del set sobre variables temporales de juego en pádel. *Apunts. Educación Física y Deportes*, (123), 69–75. [https://doi.org/10.5672/apunts.2014-0983.es.\(2016/1\).123.08](https://doi.org/10.5672/apunts.2014-0983.es.(2016/1).123.08)
- Martinez-Rodriguez, A., Collado, E. R., & Vicente-Salar, N. (2015). Estudio de la composición corporal de jugadores adultos de pádel y tenis. *Nutricion Hospitalaria*, 31(3), 1294–1301. <https://doi.org/10.3305/nh.2015.31.3.8004>
- Martínez, J. A. C., Moreno, J. F., & Verdú, N. P. (2017). Analysis of heart rate in amateur female padel. *Retos*, 2041(32), 204–207.
- Mitchell, S. A., Oslin, J. L., & Griffin, L. L. (2006). Teaching sport concepts and skills: A tactical games approach (2nd ed.). Champaign, IL: Human Kinetics.
- Müller, C. B., Goulart, C., & Del Vecchio, F. B. (2019). Acute effects of caffeine consumption on performance in specific test paddle. *Revista Brasileira de Ciências Do Esporte*, 41(1), 26–33. <https://doi.org/10.1016/j.rbce.2018.07.002>
- Müller, C. B., & Vecchio, F. B. Del. (2018). Physical fitness of amateur paddle tennis players: Comparisons between different competitive levels. *Motricidade*, 14(4), 42–51. <https://doi.org/10.6063/motricidade.14602>
- Muñoz, D., Toro-Román, V., Vergara, I., Romero, A., Fuente, A. I., F. O., & Sánchez-alcaraz, B. J. (2022). Análisis del punto de oro y su relación con el rendimiento en jugadores profesionales de pádel masculino y femenino. *Retos*, 45, 275-281.
- Muñoz, D., Toro-Román, V., Grijota, F. J., Courel-Ibáñez, J., Sánchez-Pay, A., & Sánchez-Alcaraz, B. J. (2022). Análisis antropométrico y de somatotipo en jugadores de pádel en función de su nivel de juego *Retos*, 41, 285-290.
- Olcucu, B., & Vatansever, S. (2015) Correlation Between Physical Fitness and International Tennis Number (ITN) Levels Among Children Tennis Players. *The Anthropologist*, 21(1-2), 137-142. <https://doi.org/10.1080/09720073.2015.11891803>
- Oslin, J., Mitchell, S., & Griffin, L. (1998). The Game Performance Assessment Instrument (GPAI): Development and preliminary validation. *Journal of Teaching in Physical Education*, 2, 213–243.
- Pestana, M. H., & Gageiro, J. N. (2005). *Análise de dados para ciências sociais – A complementaridade do SPSS* (5th ed.). Lisboa: Edições Sílabo, Lda.
- Sánchez-Alcaraz, B. J., Martínez-Gallego, R., Llana, S., Vučković, G., Muñoz, D., Courel-Ibáñez, J., Sánchez-Pay, A., Ramón-Llín, J. (2021). Ball Impact Position in Recreational Male Padel Players: Implications for Training and Injury Management. *International Journal of Environmental Research and Public Health*, 18, 435. doi: 10.3390/ijerph18020435.
- Sánchez-Alcaraz, B. J., Courel-Ibáñez, J., & Cañas, J. (2016). Valoración de la precisión del golpeo en jugadores de pádel en función de su nivel de juego. [Groundstroke accuracy assessment in padel players according to their level of play.]. *RICYDE. Revista Internacional de Ciencias Del Deporte / The International Journal of Sport Science*, 12(45), 324–333. <https://doi.org/10.5232/ricyde2016.04507>
- Sánchez-Alcaraz, B. J. (2013). Historia Del Pádel. *Materiales Para La Historia Del Deporte*, 11, 57–60.
- Sánchez-Alcaraz, B. J., Courel-Ibáñez, J., & Cañas, J. (2017). Estructura temporal, movimientos en pista y acciones de juego en pádel: revisión sistemática (Temporal structure, court movements and game actions in padel: a systematic review). *Retos*, 2041(33), 308–312. <https://doi.org/10.47197/retos.v0i33.55025>
- Ziemann, E., Sledziewska, E., Grzywacz, T., Gibson, A.L., & Wierzbza, T.H. (2011). Body composition and physical capacity of elite adolescent female tennis players. *Georgian Medical News*, 196-197,19-27.