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Article

Influence of Playing Site and Weekly Training Frequency on Physical Performance in Elite Padel Players

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Abstract

Background/Objectives: The physical and physiological characteristics of padel players are essential for appropriate training load prescription; however, this area remains underexplored. Therefore, this study aimed to analyse physical and physiological differences in male padel players according to playing side and weekly training frequency. **Methods:** Fourteen high-level male players competing in professional circuits or top-level regional competitions participated in this cross-sectional study. **Results:** Vertical jump performance differed significantly between the countermovement jump (CMJ) and the Abalakov jump (ABK) ($p < 0.001$), with lower values in the CMJ (40.98 cm) compared with the ABK (46.96 cm). Isometric handgrip strength showed significant inter-limb differences ($p < 0.001$), with greater force in the dominant hand (49.08 kg) than in the non-dominant hand (44.22 kg). Mean completion time in the agility T-test was 10.40 s (95% CI: 10.06–10.74 s). The Yo-Yo Intermittent Recovery Test showed a mean distance of 404.28 m, corresponding to an estimated VO_2max of 50.79 $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$. Playing side significantly affected Yo-Yo performance and estimated VO_2max ($p = 0.036$), with higher values in left-side players. Although no significant differences were found in handgrip strength according to playing side, both dominant and non-dominant hands showed large effect sizes ($d = -0.93$ and -0.88 , respectively), with low coefficients of variation, particularly in right-side players. Weekly training frequency did not significantly influence any variable ($p > 0.05$), showing trivial to small effect sizes. **Conclusions:** These findings help characterise the physical and physiological profile of high-level padel players and provide practical reference values to support training prescription and performance monitoring.

Keywords: racket sports; high-level athletes; strength; vertical jump; maximum oxygen consumption; agility

1. Introduction

Padel is a racket sport played in doubles on an enclosed 20 × 10 m court and is currently experiencing substantial worldwide growth [1]. Over the past decade, both its popularity and federated participation have increased markedly [2], driven by its competitive accessibility and high technical–tactical complexity [3]. In parallel with this expansion, the sport has evolved from a tactical perspective [4], leading to increased physical demands in modern padel [5]. Nevertheless, despite growing scientific interest and the practical relevance of these demands, research focusing on physical and physiological parameters remains limited when compared with the extensive literature addressing performance-related indicators [6].

From a physical and physiological standpoint, padel is characterized as a high-intensity intermittent sport, with an approximate stroke frequency of $0.78 \text{ shots}\cdot\text{s}^{-1}$ [7], involving the alternation of short- and medium-duration efforts (5–20 s) with intermittent recovery periods. These demands are associated with blood lactate concentrations ranging from 2.40 to $3.38 \text{ mmol}\cdot\text{L}^{-1}$ [8], as well as a mean oxygen uptake of approximately $24 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$, corresponding to $\sim 43.7\%$ of $\text{VO}_{2\text{max}}$ [9]. However, the available evidence shows considerable heterogeneity, likely due to the limited number of studies and the diversity of the samples analysed. In this regard, $\text{VO}_{2\text{max}}$ values of $51.15 \pm 5.73 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ have been reported in amateur players [10], whereas higher values of $55.43 \pm 7.04 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ have been observed in professional players [11]. Regarding neuromuscular responses, competition does not appear to induce substantial levels of fatigue, as variables such as jump height and handgrip strength [12] generally do not show significant post-match declines. This limited and heterogeneous body of evidence highlights the need for further investigation of the physical and physiological characteristics of padel players, not only to accurately describe their demands, but also to establish reference values that facilitate training optimisation and the individualisation of interventions based on variables such as weekly training frequency or playing side.

With regard to playing side, previous literature has reported relevant differences primarily from a technical–tactical perspective. In terms of playing volume, left-side players are more involved in match play, performing a greater total number of strokes [13,14]. Concerning stroke type and court location, left-side players execute a higher number of strokes in intermediate court areas [15,16] and at the net [16], whereas right-side players perform more smashes from both net and baseline positions [15]. From the baseline, no significant differences have been observed in the number of lobs; however, left-side players tend to execute more parallel shots, while right-side players perform more cross-court shots [17]. In addition, right-side players show a higher frequency of bajadas [18] and back wall shots [19]. In net and mid-court zones, right-side players perform a greater number of volleys [13], whereas left-side players execute more smashes, including both winners and unforced errors [20,21]. Collectively, these patterns suggest that right-side players tend to prioritise rally continuity, while left-side players assume a more offensive role [22,23]. This evidence indicates that playing side substantially influences technical–tactical behaviour and may also affect the physical demands imposed on players.

From a physical perspective, previous studies have shown that right-side players exhibit greater jump height in countermovement jump (CMJ) and squat jump (SJ) tests, whereas left-side players present higher muscle mass and maximal strength (one-repetition maximum) in exercises such as the squat and leg curl [24]. When competition-related demands have been analysed, left-side players have been shown to perform a greater number of accelerations and decelerations per hour compared with right-side players [25], as well as a greater post-match increase in handgrip strength [26]. From a physiological standpoint, competition does not appear to significantly affect cytokine responses [27], nor biochemical markers such as serum creatinine, urea, and creatine kinase (CK), or urinary parameters including specific gravity and erythrocyte count [28]. Although some evidence suggests slight differences according to playing side [24], the limited and heterogeneous nature of the available data restricts meaningful comparisons across studies, particularly when considering sex-related differences. This limitation highlights the need to generate further evidence on physical fitness and physiological parameters in padel according to playing side.

Overall, the existing literature underscores the need to further investigate the physical and physiological characteristics of padel players, given the limited research currently available in this area [8]. Moreover, differences associated with playing side, together with potential disparities in workload, may result in distinct physical and physiological adaptations. Weekly training frequency may further modulate these adaptations, particularly in high-level players. Therefore, the aim of the present study was to analyse physical and physiological differences in male padel players according to playing side and weekly training frequency. It was hypothesised that, due to the tactical demands and greater playing involvement of left-side players, they would exhibit superior physical values. As a secondary hypothesis, it was proposed that padel practice alone would be insufficient to induce

significant physical adaptations in high-level players, with such adaptations being largely dependent on the inclusion of complementary physical training.

2. Materials and Methods

2.1. Study Design

This study employed a cross-sectional, observational design to analyse differences in physical performance among padel players according to playing side and weekly training frequency. Data collection was conducted in May under controlled environmental conditions (mean temperature: 15.2 °C; relative humidity: 42%). Prior to participation, all players were informed about the study aims and procedures and provided written informed consent in accordance with the Declaration of Helsinki [29]. The study protocol was approved by the Ethics Committee (University of Extremadura 166//2023). To minimise the influence of residual fatigue on performance outcomes, all assessments were conducted following a standardised testing order: (i) anthropometric measurements; (ii) vertical jump performance assessed using the countermovement jump (CMJ) and Abalakov tests; (iii) isometric handgrip strength; (iv) agility assessed using the T-test; and (v) intermittent endurance evaluated using the Yo-Yo test.

2.2. Participants

The sample comprised 14 high-level male padel players, aged 18–34 years, who were actively competing in professional circuits or top-level regional federated competitions. Players were excluded if they had sustained an injury within the three months preceding data collection or were not at full physical capacity at the time of testing. Participants were contacted by telephone to schedule the testing sessions. Based on their habitual playing role in competition, players were classified according to playing side, resulting in two groups: left-side players ($n = 7$; age: 25.14 ± 5.01 years; height: 1.82 ± 0.05 m; body mass: 78.86 ± 4.98 kg; weekly training volume: 11.50 ± 3.84 h) and right-side players ($n = 7$; age: 20.86 ± 2.04 years; height: 1.77 ± 0.05 m; body mass: 73.00 ± 5.26 kg; weekly training volume: 12.86 ± 3.81 h).

2.3. Procedures

The study was conducted across two separate Mondays, one week apart, with both sessions starting at 9:00 a.m. The first session was dedicated to familiarisation with the testing procedures, while the second session corresponded to definitive data collection. All assessments were performed during a period in which none of the participants had competed during the preceding weekend, thereby minimising the influence of residual fatigue and ensuring homogeneous testing conditions. In addition, testing was conducted during the competitive season to avoid potential performance fluctuations associated with preseason or end-of-season phases.

Upon arrival at the testing facility, participants completed a descriptive questionnaire and underwent an anthropometric assessment. Body mass was measured using a bioelectrical impedance scale (Tanita B-601; Tanita Corp., Tokyo, Japan), total height was measured, and subsequently the length of the lower limbs was measured from the iliac crest. Participants then completed a standardised 10-minute warm-up, after which the following physical performance tests were administered.

Vertical Jump Performance: Vertical jump height was assessed using the My Jump Lab 3 application [30], which has been previously validated for this purpose. Two jump conditions were evaluated: the countermovement jump (CMJ), initiated from an upright standing position followed by a rapid downward movement immediately preceding the concentric propulsion phase until take-off [31], and the Abalakov jump (ABK), performed using the same technique but allowing arm swing to generate additional impulse [32]. Each jump condition was performed three times, with 20 s of rest between attempts. The mean value of the three trials was used for analysis. A 1-minute recovery

period was allowed between jump types, and 2 minutes of rest were provided between the final CMJ attempt and the first ABK attempt.

Isometric Handgrip Strength: Isometric handgrip strength was assessed using a Takei handgrip dynamometer (Takei, Tokyo, Japan), a device widely used in sport science research [33]. Following established protocols [34], participants stood upright with feet shoulder-width apart, the testing arm fully extended alongside the body, and the grip held in a neutral position. Three maximal attempts were performed with each hand, and the mean value was retained for analysis. A 1-minute rest period was allowed between attempts, and 2 minutes of rest were provided between testing hands.

T-Test: Test used to evaluate the agility and change-of-direction speed, following the protocol described by Hernández-Davó et al. [35]. A central cone was placed 10 m from the timing gates, with two additional cones positioned 5 m to each side of the central cone. On the starting signal, participants sprinted forward through the timing gates (Witty System, Microgate, Bolzano, Italy) and touched the central cone with the right hand. They then performed a 5 m lateral shuffle to the left to touch the left cone with the left hand, followed by a 10 m lateral shuffle to the right to touch the right cone with the right hand. Subsequently, participants shuffled laterally 5 m back to the central cone, executed a 180° turn, and sprinted forward 10 m to complete the test. Each participant performed three trials, with 2 minutes of passive recovery between trials. The best time was used for statistical analysis.

Yo-Yo Intermittent Recovery Test: Test used to assess the Intermittent endurance capacity, which has previously been applied in padel players [36]. The protocol described by Bangsbo et al. [37] was followed, with a maximum test duration of 15 minutes. The initial running speed was set at 13 km·h⁻¹ and increased progressively according to audio signals. The test consisted of repeated shuttle runs over a 20 m distance, marked by two cones, combined with a 5 m active recovery zone indicated by a third cone. Each cycle comprised a 20 m out-and-back run (40 m) followed by an out-and-back active recovery run (10 m), for a total distance of 50 m per cycle. The test was terminated when the participant failed to reach the running zone within the required time on two consecutive occasions. Maximal oxygen uptake (VO₂max) was estimated from the total distance covered using the following equation: VO₂max (ml/kg/min) = YoYo IR2 distance (m) × 0,0136 + 45.3 [37].

2.4. Statistical Analysis

Results are presented as mean ± standard deviation. Data were assessed for normality and homogeneity of variance using the Shapiro–Wilk and Levene’s tests, respectively. Paired-samples t-tests were used to compare vertical jump height and isometric strength. Independent-samples Student’s t-tests were applied to compare players based on playing side and weekly training frequency for variables with normal distribution and equal variances. A one-tailed t-test was used to test the hypothesis that right-side players present lower values than left-side players, and that players with higher weekly training frequency show higher values than those with lower frequency. Effect sizes for pairwise differences were calculated using Cohen’s *d*, with the following qualitative interpretation: *d* < 0.1 (no effect), 0.2–0.5 (small effect), 0.5–0.7 (intermediate effect), and 0.8–≥1.0 (large effect) [38]. All statistical analyses were conducted using JASP for Windows (version 0.19, Amsterdam, The Netherlands). Statistical significance was set at *p* < 0.05.

3. Results

Table 1 presents the physical performance characteristics of the players. Vertical jump performance differed significantly between the CMJ and the ABK (*df* = 13, *t* = -10.148; *p* < 0.001; Cohen’s *d* = 0.160), with lower values observed in the CMJ (mean: 40.98 cm; 25th percentile: 36.54 cm; 75th percentile: 44.55 cm) compared with the ABK (mean: 46.96 cm; 25th percentile: 41.16 cm; 75th percentile: 51.67 cm). Isometric handgrip strength also showed significant inter-limb differences (*df* = 13, *t* = 7.304; *p* < 0.001; Cohen’s *d* = 0.230), with greater force production in the dominant hand (mean: 49.08 kg; 25th percentile: 47.32 kg; 75th percentile: 52.35 kg) compared with the non-dominant hand (mean: 44.22 kg; 25th percentile: 43.20 kg; 75th percentile: 47.47 kg). T-test yielded a mean completion

time of 10.40 s, with a 95% confidence interval ranging from 10.06 to 10.74 s. Yo-Yo test showed a mean distance of 404.28 m, corresponding to an estimated mean VO_2max of $50.79 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$. The 95% confidence intervals ranged from 347.32 to 461.25 m for distance and from 50.02 to 51.57 $\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ for VO_2max .

Table 1. Descriptive analysis of the physical variables.

Variable	Mean	Std. Deviation	95% Confidence Interval		Percentile		
			Upper	Lower	25th	50th	75th
CMJ (cm)	40.98	6.40	37.29	44.68	36.54	42.32	44.55
Abalakov (cm)	46.96	7.49	42.63	51.29	41.16	47.45	51.67
Dominant Handgrip (kg)	49.08	4.49	46.49	51.67	47.32	50.45	52.35
Non-dominant Handgrip (kg)	44.22	5.09	41.28	47.17	43.20	45.65	47.47
T-test (sec)	10.40	0.59	10.06	10.74	10.18	10.38	10.64
YoYo (m)	404.28	98.66	347.32	461.25	330.00	390.00	455.00
VO_2max (ml/kg/min)	50.79	1.34	50.02	51.57	49.78	50.60	51.48

Playing side exerted a significant effect on Yo-Yo test performance and estimated VO_2max ($t = -1.978$; $df = 12$; $p = 0.036$; Cohen's $d = -1.057$) (Table 2), being higher in left-side players. Although no statistically significant differences were detected for handgrip strength variables, both dominant and non-dominant handgrip strength exhibited large effect sizes ($d = -0.93$ and -0.88 , respectively), together with low coefficients of variation, particularly among right-side players.

Table 2. Comparative analysis according to the side of play.

Variable	Group	Mean	Std. Deviation	SE	Coefficient of variation	p	Cohen's d
CMJ (cm)	Right	38.85	6.29	2.379	0.162	0.113	-0.681
	Left	43.12	6.22	2.352	0.144		
Abalakov (cm)	Right	44.74	7.54	2.851	0.169	0.142	-0.599
	Left	49.19	7.30	2.761	0.149		
Dominant Handgrip (kg)	Right	47.14	4.87	1.841	0.103	0.054	-0.931
	Left	51.02	3.33	1.261	0.065		
Non-dominant Handgrip (kg)	Right	42.11	6.22	2.354	0.148	0.062	-0.883
	Left	46.34	2.65	1.005	0.057		
T-test (sec)	Right	10.45	0.75	0.283	0.072	0.611	0.154
	Left	10.36	0.43	0.164	0.042		
YoYo (m)	Right	357.14	67.75	25.608	0.190	0.036	-1.057
	Left	451.42	106.36	40.204	0.236		
VO_2max (ml/kg/min)	Right	50.15	0.92	0.348	0.018	0.036	-1.057
	Left	51.43	1.44	0.547	0.028		

Note. For all tests, the alternative hypothesis specifies that group Right is less than group Left. SD: Standard deviation; SE: Standard error; p: signification; bold letter: $p < 0.05$.

Weekly training frequency (Table 3) revealed no statistically significant differences between the high-load and low-load groups for any of the analyzed performance variables ($p > 0.05$). Specifically, trivial to small effect sizes were observed for CMJ ($p = 0.443$; $d = 0.078$), ABK ($p = 0.442$; $d = 0.08$), maximal handgrip strength ($p = 0.478$; $d = 0.031$), normalized handgrip strength ($p = 0.441$; $d = 0.081$), Yo-Yo test performance ($p = 0.601$; $d = -0.14$), and estimated VO_2max ($p = 0.601$; $d = -0.14$), indicating minimal practical differences between training-load groups. In contrast, T-test demonstrated a small effect size despite the absence of statistical significance ($p = 0.198$; $d = 0.47$). The low-load group

achieved faster times (10.26 ± 0.38 s) compared with the high-load group (10.54 ± 0.75 s) and also displayed a substantially lower coefficient of variation (CV = 0.037 vs. 0.071).

Table 3. Comparative analysis according to the side of play.

	Group	Mean	Std. Deviation	SE	Coefficient of variation	P	Cohen's d
CMJ (cm)	High-load	41.24	6.89	2.608	0.167	0.443	0.078
	Low-load	40.73	6.41	2.426	0.158		
Abalakov (cm)	High-load	47.27	6.70	2.535	0.142	0.442	0.080
	Low-load	46.65	8.75	3.308	0.188		
Dominant Handgrip (kg)	High-load	49.15	3.88	1.467	0.079	0.478	0.031
	Low-load	49.01	5.34	2.021	0.109		
Non-dominant Handgrip (kg)	High-load	44.44	5.67	2.146	0.128	0.441	0.081
	Low-load	44.01	4.89	1.849	0.111		
T-test (sec)	High-load	10.54	0.75	0.284	0.071	0.198	0.470
	Low-load	10.26	0.38	0.144	0.037		
YoYo (m)	High-load	397.14	95.51	36.103	0.241	0.601	-0.140
	Low-load	411.42	108.84	41.140	0.265		
VO ₂ max (ml/kg/min)	High-load	50.70	1.29	0.491	0.026	0.601	-0.140
	Low-load	50.89	1.48	0.560	0.029		

Note. For all tests, the alternative hypothesis specifies that group High-load is greater than group Low-load. SD: Standard deviation; SE: Standard error; p: signification.

4. Discussion

The aim of the present study was to analyse physical and physiological differences in male padel players according to playing side and weekly training frequency. The main findings indicate that: (i) players displayed significantly lower vertical jump performance in the CMJ compared with the ABK (40.98 vs. 46.96 cm), while isometric handgrip strength was greater in the dominant than in the non-dominant hand (49.08 vs. 44.22 kg); additionally, mean values obtained in the T-test (10.40 s), Yo-Yo test (404.28 m), and estimated VO₂max (50.79 ml·kg⁻¹·min⁻¹) characterize the change-of-direction ability and aerobic capacity of high-level padel players; (ii) playing side significantly influenced Yo-Yo test performance and VO₂max, with higher values observed in left-side players, whereas no statistically significant differences were detected for handgrip strength despite large effect sizes and low variability; and (iii) weekly training frequency did not result in statistically significant differences in any physical variable, although agility performance showed a small effect size, favouring the low-load group.

The physical performance values reported in this study provide updated reference data that help to define the physical profile of competitive padel players. Regarding vertical jump performance, the CMJ values observed (~41 cm) exceed those previously reported in professional (~32 cm) [11], amateur (~34.6 cm) [36], female (~24 cm) [11], and youth padel players (26–30 cm) [39–41]. These differences across competitive levels and age groups suggest that neuromuscular performance in padel does not increase linearly with playing level and may be influenced by training background, playing role, or evolving game demands. Consequently, further research is needed to establish contemporary reference values and support the individualization of training strategies.

ABK performance (~46 cm) was lower than values typically reported in sports such as basketball or volleyball [42,43], where arm swing plays a more decisive role due to sport-specific demands. Conversely, ABK values were comparable to those reported in racket sports such as tennis [42], where external load and movement patterns, particularly in doubles formats, are similar to those observed in padel [44]. Notably, when compared with previous studies in professional padel players [11], the

values obtained in the present investigation were higher, supporting the notion that the physical demands of padel may have increased in recent years and reinforcing the need for updated research reflecting the current performance profile of the sport.

Isometric handgrip strength results revealed clear asymmetries between the dominant and non-dominant limbs, which are likely attributable to the unilateral nature of racket use. Such asymmetries have been consistently reported in padel and other racket sports [45,46]. Although functional asymmetries are inherent to unilateral sports and do not necessarily imply an increased injury risk [47], pronounced asymmetries have been associated with a greater likelihood of injury in some contexts [48]. Therefore, monitoring handgrip strength asymmetry remains relevant for injury prevention and compensatory training strategies.

Agility and change-of-direction ability, assessed using the T-test, yielded mean values (~10.40 s) consistent with the multidirectional demands of padel. These results compare favourably with those reported in young tennis players (~10.68 s) [35], volleyball female and basketball male players (~12 s) [49,50], while remaining higher than values observed in elite badminton players (~9.14 s) [51]. Given the high frequency of accelerations, decelerations, and directional changes during padel match play [52], these findings underscore agility as a key physical quality in this sport and support its systematic assessment and targeted development in training programmes.

Performance in the Yo-Yo Intermittent Recovery Test revealed a mean distance of 404.28 m and an estimated VO_2max of $50.79 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$. These values fall within the range previously reported in laboratory-based assessments of padel players ($43.2\text{--}59.4 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$) [9], thereby contributing to the limited body of evidence on aerobic capacity in this sport. From a comparative perspective, the VO_2max observed in padel players can be considered moderate, lower than values reported in badminton, yet higher than those observed in combat sports (e.g., judo or taekwondo) and certain team sports such as rugby or basketball [53]. This aerobic profile appears sufficient to support recovery between points, maintain match intensity, and sustain performance during prolonged rallies.

Regarding playing side, despite the initial hypothesis anticipating greater physical advantages in left-side players, the results demonstrated significant differences only in Yo-Yo test performance and VO_2max , favouring right-side players. No statistically significant differences were observed in jump performance or agility, in agreement with previous studies [54,55], although conflicting findings have been reported elsewhere [24]. These discrepancies may be attributed to differences in competitive level, sample characteristics, or the specific technical-tactical demands associated with each playing position.

Change-of-direction performance did not differ significantly between playing sides, suggesting that agility demands are relatively symmetrical, as both players are exposed to frequent multidirectional movements during match play [24,55]. In contrast, isometric handgrip strength tended to be higher in left-side players, aligning with findings in amateur padel players [55] and partially supporting the proposed hypothesis. This difference may reflect the greater involvement of left-side players in point-ending actions [56], particularly smashes [57], which require higher stroke velocities and force production [58]. Consequently, handgrip strength may reflect specific neuromuscular adaptations linked to the tactical role performed on court.

One of the most novel findings of the present study is the higher VO_2max observed in left-side players, which is consistent with both the initial hypothesis and previous reports favoring this playing position [24]. From a technical-tactical perspective, right-side players tend to be more involved in rally-continuity actions [59], such as the *bandeja* and the backhand volley [23], which may require sustained movements and frequent positional adjustments. However, left-side players appear to be exposed to a greater external load, characterized by a significantly higher number of accelerations and decelerations, along with slightly greater total distance covered during match play [25]. This increased movement volume and mechanical load may impose higher aerobic demands, thereby partially explaining the elevated VO_2max values observed in left-side players. Nevertheless, this interpretation remains speculative and should be confirmed in future studies integrating external

load metrics with physiological responses according to playing side. Overall, these findings suggest that playing side may influence specific physical capacities, with left-side players exhibiting higher VO_2max values, potentially associated with greater overall movement demands despite a lower involvement in rally-continuity actions, together with greater isometric handgrip strength, which may reflect a superior capacity to finish points through offensive strokes such as the smash.

Finally, weekly training frequency did not significantly influence any of the physical capacities assessed. Although higher training volumes are generally associated with improved physical fitness [60], the present findings suggest that padel practice alone may be insufficient to induce meaningful adaptations in strength, power, or aerobic capacity. Given the importance of vertical jump performance and agility for padel success [61,62], these results highlight the need to incorporate complementary physical training, particularly strength-based interventions, into regular practice. In addition to enhancing performance [63], such training may also play a key role in injury prevention [64].

The present study has several limitations that should be considered when interpreting the findings. First, the relatively small sample size limits the generalizability of the results. Consequently, the reported values should be interpreted with caution and may be regarded as preliminary reference data rather than normative benchmarks for padel players.

Second, although all assessment instruments employed have been previously validated, the use of more specific measurement tools, such as force platforms for vertical jump assessment, could have provided additional biomechanical variables (e.g., impulse, peak force, or rate of force development). The inclusion of such measures would allow a more detailed examination of jump strategies and potential inter-individual or positional differences.

In addition, logistical constraints limited the number of assessments performed, restricting the analysis primarily to descriptive data obtained at a single time point. While this approach allowed for the characterization of the players' physical profile, it did not permit the investigation of medium- or long-term adaptations to training or competition. Therefore, future research should aim to include larger samples, adopt longitudinal study designs, and integrate more comprehensive methodologies, such as external load monitoring and advanced neuromuscular assessments, to further elucidate the physical and physiological demands of padel performance.

5. Conclusions

The present study provides relevant evidence regarding the physical characteristics of high-level padel players, as well as potential differences according to playing side and weekly training frequency. The descriptive values obtained for vertical jump performance, with mean heights of 40.98 cm in the CMJ and 46.96 cm in the ABK, appear to be representative of the physical condition of the players analyzed. Furthermore, jump heights below the 25th percentile may indicate a potential physical limitation that could negatively affect competitive performance.

With respect to isometric handgrip strength, a clear asymmetry between the dominant and non-dominant limbs was observed, with higher values in the dominant arm. Although such asymmetry does not necessarily imply an immediate negative impact on performance or injury risk, it represents a relevant characteristic in unilateral sports and should be monitored to prevent excessive muscular imbalances over time.

The agility and change-of-direction performance assessed using the T-test (mean time: 10.40 s) reflects an adequate displacement capacity, consistent with the multidirectional demands of padel. Similarly, the mean distance covered in the Yo-Yo Intermittent Recovery Test (404.28 m), corresponding to an estimated VO_2max of $50.79 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$, indicates a good level of aerobic capacity, likely sufficient to sustain high-intensity efforts during prolonged rallies and maintain performance throughout long-duration matches.

Regarding playing side, left-side players exhibited greater isometric handgrip strength, which may be associated with their tactical role, typically involving a higher proportion of point-ending actions, particularly smashes. In addition, left-side players demonstrated higher VO_2max values,

potentially reflecting greater overall movement demands and exposure to repeated high-intensity actions during match play.

Finally, weekly padel training frequency did not appear to influence the physical and physiological variables assessed. These findings suggest that on-court padel practice alone may be insufficient to elicit meaningful improvements in physical performance. Accordingly, the inclusion of complementary strength and conditioning programs is recommended to optimize performance and reduce the risk of injury in high-level padel players.

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