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Section II – Exercise Physiology and Sports Medicine

Incidence of Upper Body Injuries in the Top 100 Female Players of the International Padel Federation Ranking

by
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Padel has experienced rapid worldwide growth and increasing professionalization, yet scientific evidence on injuries in elite female players remains scarce. This study aimed to (i) determine the incidence of upper body injuries among the top 100 female players in the International Padel Federation ranking; (ii) examine associations between the injury incidence and racquet or player characteristics; (iii) describe the type and the anatomical location of injuries; and (iv) analyze seasonal injury distribution. An ex post facto design was used to evaluate upper body injuries requiring medical treatment or causing time-loss from training or competition. Of the 100 top-ranked players contacted, 80 consented to participate and completed an electronic survey. Descriptive statistics and inferential analyses were conducted. A total of 58 upper body injuries were reported, corresponding to an incidence rate of 0.81 injuries per 1000 hours of padel or physical training. Injury occurrence was not significantly associated with racquet characteristics or players' attributes ($p > 0.05$). Tendinous injuries were most common (49.1%), followed by muscular injuries (33.3%) ($p < 0.001$). The elbow was the most frequently affected site (26.3%), followed by the shoulder (24.6%) and the wrist (24.6%). Injuries occurred most frequently in winter (45.6%) and spring (29.8%) ($p < 0.001$). Upper body injuries are common in elite female padel players and may compromise performance and career longevity. These findings may inform injury prevention strategies for coaches, physical trainers, physiotherapists, and athletes.

Keywords: *racket sport; performance; health; prevalence; women; damage*

Introduction

Padel has rapidly emerged as one of the world's fastest-growing sports, with over 30 million players across 140 countries (International Padel Federation, 2024). This dynamic, doubles-only racket sport demands intricate team coordination and constant tactical adaptation. Played on a 20×10 m enclosed court surrounded by glass and mesh walls, padel introduces unique gameplay variability influenced by the surface, altitude, and weather conditions (Escudero-Tena et al., 2025).

The professional circuit has expanded globally, with elite athletes competing across continents and attracting large audiences through high-intensity rallies and sophisticated technical-tactical play (Ungureanu et al., 2024). The sport's professionalization has also improved the visibility of female athletes, supported by growing prize parity—an essential milestone for gender equity in sport (Meier et al., 2021). In addition, several differences between men's and women's padel have been reported that may be related to injury risk. Match duration is typically longer in women's padel (Torres-Luque et al., 2015), and rallies average 10–11 strokes, corresponding to a pace of 0.73–0.78 strokes per second. Recent analyses confirmed sex-related differences in the rally pace, with 0.80 strokes per second in men and 0.73–0.75 in women (Martín-Miguel et al., 2024). Professional players usually perform 10–40 different technical actions per match, mainly involving lobs, volleys, groundstrokes, bandejas, smashes, and wall

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strokes (Martín-Miguel et al., 2024). Women's padel is characterized by a greater use of lobs and more frequent net exchanges (Escudero Tena et al., 2024), whereas men's padel tends to involve more decisive strokes (Conde Ripoll et al., 2025) and shorter exchanges. These sex-related variations in temporal structure, technical execution, and tactical patterns may contribute to distinct injury mechanisms and risks in female athletes (Martín-Miguel et al., 2023). Therefore, female padel players may require tailored preventive and therapeutic approaches, reinforcing the need for sex-specific epidemiological research.

Yet, despite the pursuit of peak performance, injury remains a persistent challenge (Romero-Morales et al., 2024). Injuries may erode athlete confidence, impair performance, and, in severe cases, lead to forced absences (Palau et al., 2024), deselection (Guevara et al., 2024), or even premature career termination (Ristolainen et al., 2012). Their impact extends beyond individual health, influencing team success and financial sustainability (Cumps et al., 2008).

Across all levels, padel injuries have been estimated at 3 per 1000 training hours and 8 per 1000 match hours (Dahmen et al., 2023). Career-long injury prevalence ranges from 60% to 95%, while recent (8–12 months) prevalence spans 40% to 72% (Dahmen et al., 2023). The elbow—particularly due to lateral epicondylitis—is the most frequently affected joint (Castillo-Lozano and Casuso-Holgado, 2017). Among professionals, 65% of injuries are mild, 19% moderate, and 16% severe, with competition representing the most common setting (Valério et al., 2022), However, these figures—mainly drawn from previous studies, such as Valério et al. (2022) on the Brazilian circuit—may not reflect current demands of the Premier Padel Tour.

Despite the sport's rapid growth, studies focusing exclusively on elite female padel players remain scarce. Addressing this gap aligns with broader priorities in sports science (Anderson et al., 2023), and is crucial to developing targeted injury prevention strategies. To our knowledge, this is the first study to investigate upper-body injuries in this population.

Therefore, the aims of this study were: i) to determine the incidence of upper-body injuries among the top 100 women in the International Padel Federation ranking; ii) to examine the injury incidence according to the racquet and players' characteristics; iii) to identify the type and the anatomical location of injuries; and iv) to analyze injury distribution across seasons.

Methods

Participants

The target population comprised the top 100 female athletes in the International Padel Federation ranking, with no additional exclusion criteria. Eighty players agreed to participate (age: 27.23 ± 6.96 years; body height: 167.83 ± 5.81 cm; body mass: 62.58 ± 6.37 kg). All participants provided written informed consent. The study complied with the Declaration of Helsinki and was approved by the Ethics Committee of the University of Extremadura, Cáceres, Spain (protocol code: 166/2023; approval date: 14 February 2024). Confidentiality and privacy were ensured. Non-participating players cited time constraints and personal reasons.

Design and Procedures

This study employed an ex post facto design
within an associative strategy framework (Ato et al., 2013), aiming to explore functional relationships between variables through group comparisons. Historical data were used to retrospectively examine prior events, justifying its classification as an ex post facto study.

Based on instruments used in previous studies (Muñoz et al., 2022), a panel of researchers—PhDs in sport science with peer-reviewed publications in the field—developed a tailored questionnaire. The questionnaire was designed by a team of four researchers specialized in sports medicine and padel research. The process involved two rounds of expert review and pilot testing with three professional players before final approval. The final version was administered via Google Forms in July 2024. Data were collected retrospectively, covering injuries sustained over the previous 12 months in training and/or competition. Participation was voluntary, and no researcher was present during questionnaire completion. Players were contacted via email communication, the survey was self-administered online, and data collection occurred during the competition season.

Measures

The following variables were defined based on previous epidemiological research in racket sports (Muñoz et al., 2022):

- Injury: a differentiation was made between the players who suffered an injury from those who were not injured. Any incidence requiring health treatment of any type, or causing absence from training or match play was considered an injury.

- Racquet shape: categorised as round, teardrop, or diamond.

- Racquet weight: categorised into ≤350 g, 351–370 g, and 371–390 g.

- Rubber consistency (year-round): whether players used the same or different rubber throughout the year.

- Rubber type (seasonal): categorised as soft, intermediate, hard, or non-specified (if unanswered), for both winter and summer.

- Composition of the padel racket: fiberglass and carbon fiber categories were established. In addition, the category "unknown" was included in case players did not know the composition of their padel racket.

- Original overgrip removal: whether players removed the original overgrip or not.

- Number of overgrips: categorised as none, one, or two (excluding the original grip).

- Racquet replacement frequency: categorised as every 2 weeks, monthly, every 2 months, or every >2 months.

- Hand dominance of the player: left-handed or right-handed.

- Side of play: left side, right side, or both (depending on the match).

- Ranking tier: top 50 or 51st–100th in the FIP ranking.

- Weekly training volume: categorised as 10–15 h/week, 16–20 h/week, or >20 h/week, including padel and fitness.

- Injury type: categorised as tendon, muscle, ligament, or bone injury.

- Injury location: categorised as the shoulder, the elbow, the wrist, the forearm, or between the elbow and the shoulder.

- Season of injury: autumn (from 22 September), winter (from 21 December), spring (from 20 March), summer (from 21 June), or DK/NA (does not know/no answer).

- Individual exposure: estimated weekly time the player spent on training or competing, multiplied by 50 weeks. This accounted for a two-week holiday period, subtracted from the 52 weeks in a year.

- Total exposure: sum of individual exposure across participants.

- Injury incidence: calculated as (Σ injuries / Σ exposure hours) × 1000.

- Injury prevalence: proportion of injured players relative to the full sample: (Σ injured athletes / N participants) × 100.

Statistical Analysis

Descriptive statistics (frequencies, percentages, 95% confidence intervals) were calculated. For inferential analysis, Chi-square goodness-of-fit tests were conducted to assess whether certain categorical variables (e.g., injury type, seasonal distribution) deviated significantly from expected uniform distributions. Additionally, contingency tables were developed using the Pearson's Chi-square test or the Fisher's exact test (as appropriate) to assess associations between variables. Association strength was measured using Cramer's V (Vc) (Field, 2018), interpreted per Crewson as small (<0.10), low (0.10–0.29), moderate (0.30–0.49), or high (>0.50) (Crewson, 2006). Corrected Standardised Residuals (CSR) were used to identify over- or under-represented cells (CSR > |1.96|) (Field, 2018). Statistical significance was set at $p < 0.05$. All analyses were performed using IBM SPSS Statistics (version 27.0; IBM Corp, Armonk, NY).

Results

Of the 80 participants, 43 sustained at least one upper-body injury during the 12-month study period, representing prevalence of 53.7%. Among these, 29 players reported one injury (67.44%), 13 players reported two injuries (30.23%), and one player reported three injuries (2.33%). Total exposure was 71,875 h, with a mean individual exposure of 898.4 h. The overall injury incidence was 0.81 injuries per 1000 h of exposure (95% CI: 0.60–1.02).

Association with Equipment and Players' Characteristics

Injury occurrence was not significantly associated with padel racquet characteristics—shape, weight, rubber type across the year, rubber type in summer or winter, racquet composition,

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original overgrip removal, number of overgrips, or racquet replacement frequency.

Similarly, no significant associations were found between injury occurrence and players' characteristics—FIP ranking tier, dominant hand, side of play, or weekly training hours (Table 1).

Injury Type and the Anatomical Location

No significant association was observed between the injury type and the anatomical location ($p = 0.334$) (Table 2). Most injuries were located at the elbow (26.3%), the shoulder (24.6%), and the wrist (24.6%) (Figure 1).

The distribution of injury types differed significantly from uniformity ($\chi^2 = 25.172$, df = 3, $p < 0.001$). Tendinous (49.1%) and muscular injuries (33.3%) were overrepresented (residuals: 13.5 and 4.5, respectively), while ligamentous (8.8%) and bone injuries (8.8%) were underrepresented (residuals: −8.5 and −9.5, respectively) (Table 3).

Seasonal Distribution

Injury distribution across seasons also deviated significantly from uniformity ($\chi^2 = 32.345$, df = 4, $p < 0.001$). Most injuries occurred in winter (45.6%) and spring (29.8%), with fewer injuries reported in summer (10.5%) and autumn (3.5%). "Don't know/no answer" responses represented 10.5% (Figure 2). Residuals indicated overrepresentation in winter (14.4) and spring (5.4), and underrepresentation in summer (−4.6), autumn (−8.6), and DK/NA (−6.6).

No significant association was found between the season and the injury type ($\chi^2 = 8.750$, df = 12, $p = 0.724$, Vc = 0.226), or between the season and the injury location ($\chi^2 = 16.453$, df = 16, $p = 0.422$, Vc = 0.269) (Table 4).

Discussion

This study aimed to: (i) determine the incidence of upper-body injuries in the top 100 female players of the International Padel Federation ranking; (ii) examine associations between the injury incidence and the racquet or players' characteristics; (iii) describe injury types and anatomical locations; and (iv) analyze seasonal injury distribution. To our knowledge, this is the first study to assess upper-body injuries in such a highly ranked and representative cohort of professional female padel players. Previous studies have either focused on retired athletes during matches (Pérez et al., 2023) or included broader categories of participants, limiting their scope.

Injury Prevalence and the Incidence

Over the past 12 months, 53.7% of players sustained at least one upper-body injury, with an incidence of 0.81 injuries per 1000 h of exposure. These values are slightly lower than those previously reported, founding a 67.7% injury prevalence among Brazilian first- and second-tier players. In this study, injuries involved both upper and lower body segments (Valério et al., 2022). Similarly, another study found a 65.6% injury rate among a mixed group of amateur, semi-professional, and professional players, although only 34.9% were upper-body injuries (García-Fernández et al., 2019). A recent systematic review estimated an incidence of 3 injuries per 1000 h of padel training across all body regions (Dahmen et al., 2023). The relatively lower incidence observed in the present study may reflect the protective effect of elite-level preparation, including superior technical execution, tailored physical conditioning, and regular access to medical and physiotherapy support. This aligns with the "training-injury prevention paradox", whereby high training loads, when well-planned and supported, can enhance resilience and reduce the injury risk (Gabbett, 2016). Furthermore, recent findings in racket sports confirm that combined technical and conditioning-based training enhances aerobic capacity, agility, and load management (Morais et al., 2025), which may indirectly contribute to injury protection in elite padel players.

Table 1. Incidence of injuries according to the racquet and players' characteristics in the women's top 100 of the International Padel Federation

Variables	Categories	Injury						
		No			Yes			
		n	%	CSR	n	%	CSR	*p*
Padel racquet shape	Diamond	12	32.4	1.4	8	18.6	−1.4	0.346
	Tear	16	43.2	−0.5	21	48.8	0.5	
	Round	9	24.3	−0.8	14	32.6	0.8	
Padel racquet weight	≤ 350 g	1	2.7	−0.9	3	7.0	0.9	0.127
	351–370 g	34	91.9	1.1	36	83.7	−1.1	
	371–390 g	2	2.7	−0.7	4	9.3	0.7	
Type of rubber during the year	Same	35	94.6	1.0	38	88.4	−1.0	0.442
	Different	2	5.4	−1.0	5	11.6	1.0	
Type of rubber (summer)	Soft	1	2.7	−1.2	4	9.3	1.2	0.388
	Hard	13	35.1	0.5	13	30.2	−0.5	
	Intermediate	10	27.0	1.2	7	16.3	−1.2	
	Non-specific	13	35.1	−0.8	19	44.2	0.8	
Type of rubber (winter)	Soft	3	8.1	−0.5	5	11.6	0.5	0.652
	Hard	13	35.1	1.2	10	23.3	−1.2	
	Intermediate	8	21.6	0.1	9	20.9	−0.1	
	Non-specific	13	35.1	−0.8	19	44.2	0.8	
Padel racquet composition	Fiber carbon	20	54.1	−2.1	33	76.7	2.1	0.056
	Fiberglass	1	2.7	−0.5	2	4.7	0.5	
	Unknown	16	43.2	2.4	8	18.6	−2.4	
Removal of the original overgrips	No	24	64.9	−0.2	29	67.4	0.2	0.817
	Yes	13	35.1	0.2	14	32.6	−0.2	
Number of overgrips	0	9	24.3	1.8	4	9.3	−1.8	0.192
	1	25	67.6	−1.4	35	81.4	1.4	
	2	3	8.1	−0.2	4	9.3	0.2	
Padel racquet change	Every 2 weeks	3	8.1	1.2	1	2.3	−1.2	0.425
	Every month	10	27.0	0.6	9	20.9	−0.6	
	Every two months	11	29.7	−1.3	19	44.2	1.3	
	Every more than two months	13	35.1	0.2	14	32.6	−0.2	
FIP Ranking	1–50	26	70.3	1.3	24	55.8	−1.3	0.425
	51–100	11	29.7	−1.3	19	44.2	1.3	
Hand dominance	Right-handed	33	89.2	−0.6	40	93.0	0.6	0.698
	Left-handed	4	10.8	0.6	3	7.0	−0.6	
Playing side	Left	16	43.2	−0.5	21	48.8	0.5	0.880
	Right	17	45.9	0.4	18	41.9	−0.4	
	Both	4	10.8	0.2	4	9.3	−0.2	
Weekly hours of training (padel and fitness)	10–15 hours/week	7	18.9	0.0	8	18.6	0.0	0.802
	16–20 hours/week	22	59.5	0.5	23	53.5	−0.5	
	> 20 hours/week	8	21.6	−0.6	12	27.9	0.6	

n = frequency; % = percentage; CSR = corrected standard residuals; g = grams

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Table 2. The type of injury and its anatomic location in the women's top 100 of the International Padel Federation.

Anatomic location	Ligamentous			Muscular			Bone			Tendinous			*p*
	n	%	CSR	n	%	CSR	n	%	CSR	n	%	CSR	
Forearm	1	20.0	0.3	6	31.6	2.3	0	0.0	−1.0	2	7.1	−1.8	0.334
Elbow	1	20.0	−0.3	3	15.8	−1.3	2	40.0	0.7	9	32.1	1.0	
Shoulder	1	20.0	−0.2	4	21.1	−0.4	0	0.0	−1.3	9	32.1	1.3	
Wrist	2	40.0	0.8	4	21.1	−0.4	3	60.0	1.9	5	17.9	−1.2	
Between the elbow and the shoulder	0	0.0	−0.7	2	10.5	0.3	0	0.0	−0.7	3	10.7	0.5	

n = frequency; % = percentage; CSR = corrected standard residuals

Table 3. Type of injury in the women's top 100 of the International Padel Federation.

Type of injury	Injuries		Injury incidence	95% CI	
	n	%	n/1000 h	n/1000 h	*p*
Tendinous	28	49.1	0.39	0.26–0.52	0.001
Muscular	19	33.3	0.26	0.15–0.38	
Ligamentous	5	8.8	0.08	0.02–0.15	
Bone	5	8.8	0.07	0.01–0.13	

n: frequency; %: percentage; CI: Confidence Interval

Table 4. Type of injury and its anatomic location according to the season of the year.

Variables	Categories	Season of the year														
		Autumn			Winter			Spring			Summer			DK/NA		
		n	%	CSR	n	%	CSR	N	%	CSR	n	%	CSR	n	%	CSR
Type	Ligamentous	0	0.0	−0.4	4	15.4	1.6	1	5.9	−0.5	0	0.0	−0.9	0	0.0	−0.7
	Muscular	1	50.0	0.5	7	26.9	−0.9	7	41.2	0.8	2	28.6	−0.3	2	40.0	0.3
	Bone	0	0.0	−0.4	1	3.8	−1.2	2	11.8	0.5	2	28.6	2.0	0	0.0	−0.7
	Tendinous	1	50.0	0.0	14	53.8	0.7	7	41.2	−0.8	3	42.9	−0.4	3	60.0	0.5
Anatomic location	Forearm	0	0.0	−0.6	5	19.2	0.7	2	11.8	−0.5	1	14.3	−0.1	1	20.0	0.3
	Elbow	0	0.0	−0.9	7	26.9	0.1	4	23.5	−0.3	2	28.6	0.1	2	40.0	0.7
	Shoulder	1	50.0	0.9	9	34.6	1.6	3	17.6	−0.8	0	0.0	−1.6	1	20.0	−0.2
	Wrist	0	0.0	−0.8	5	19.2	−0.9	6	35.3	1.2	3	42.9	1.2	0	0.0	−1.3
	Between the elbow and the shoulder	1	50.0	2.1	0	0.0	−2.1	2	11.8	0.5	1	14.3	0.6	1	20.0	0.9

n = frequency; % = percentage; CSR = corrected standard residuals; DK = indicates does not know / NA = no answer

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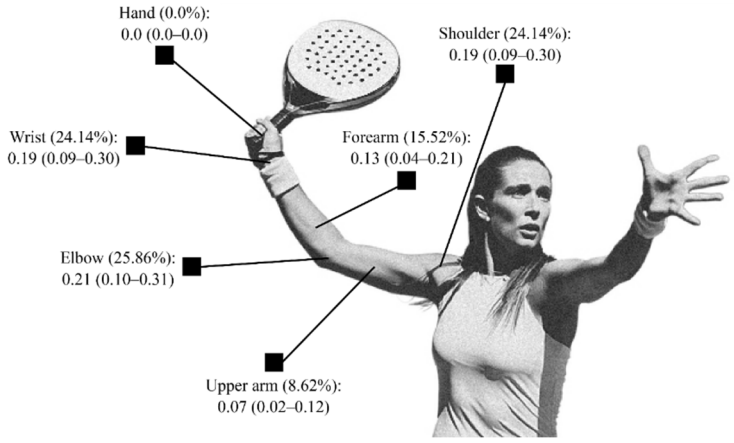


Figure 1. Injury frequency and the incidence for each anatomic location of the upper limbs. Data are presented as frequency to the total of injuries in percentage, and the injury incidence is reported as number per 1000 h (95% Confidence Interval).

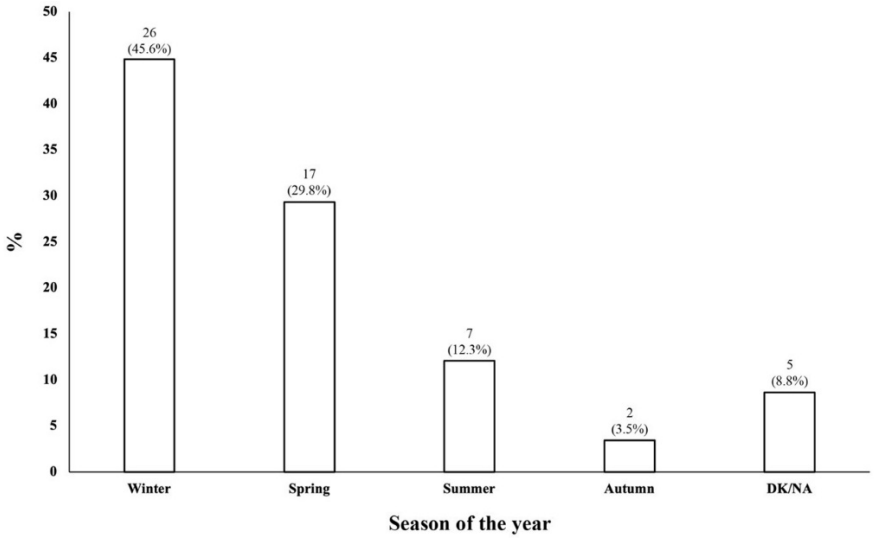


Figure 2. Injuries by season of the year. Data are presented as the number of injuries and the relative frequency to the total of injuries in percentage.
DK/NA indicates does not know or no answer

Lack of Association with Equipment or Players' Characteristics

The injury incidence was not significantly associated with racquet characteristics (shape, weight, rubber, composition, overgrip use) or players' factors (dominant hand, side of play, training volume, or ranking tier). This contrasts with findings from previous studies reporting that heavier racquets and higher weekly workloads increase upper-limb injury risk in amateur players and coaches (Muñoz et al., 2022). These discrepancies may reflect the greater technical proficiency and training periodization typical of professional players, as well as more informed equipment selection practices.

Injury Types and Anatomical Locations

The elbow (26.3%), the shoulder (24.6%) and the wrist (24.6%) were the most affected regions, with tendinous (49.1%) and muscular injuries (33.3%) being most frequent. A previous study identified the upper limbs (61%) as the most affected area (Valério et al., 2022). Other authors observed that the elbow was the most affected joint (García-Fernández et al., 2019) and that muscular injuries were typical in the shoulder and the arm, ligamentous injuries were typical in the elbow and in the wrist, and bone injuries were typical in the hand (Muñoz et al., 2022). Tendinous and muscular injuries have consistently been highlighted as predominant in amateur padel (García-Fernández et al., 2019; Muñoz et al., 2022), with the shoulder and the elbow being especially vulnerable (Castillo-Lozano and Casuso-Holgado, 2015).

The high incidence of elbow and shoulder injuries is consistent with the sport's technical-tactical and biomechanical demands (Sellitto et al., 2024). Padel is characterized by a high volume of overhead and volley strokes (Lupo et al., 2018), with a strong unilateral load that may predispose players to conditions such as lateral epicondylitis (Demeco et al., 2022; Tagliafico et al., 2023). Overuse is a common mechanism of injury in this population (García-Fernández et al., 2019; García-Giménez et al., 2022), and this could be the cause of the injuries in professional athletes given the high amount of competition matches throughout the year. Importantly, sex-specific differences in technical-tactical patterns have been reported: women's padel is characterized by more frequent lobs (Lupo et al., 2018) and longer rallies (Torres-Luque et al., 2015), which result in a greater volume of overhead strokes such as the bandeja (Conde-Ripoll et al., 2025), whereas men's padel involves more powerful smashes and shorter rallies (Conde-Ripoll et al., 2025). These differences may increase the cumulative overhead load in female players and partly explain the predominance of shoulder and elbow injuries observed in this study. Studies in overhead athletes also report decreased internal rotation, altered external/internal rotation strength ratios, and increased humeral head retroversion, all of which contribute to the upper-limb injury risk (Tooth et al., 2020).

Seasonal Trends

The injury incidence peaked during winter (45.6%) and spring (29.8%). Winter coincides with the pre-season and the start of the competitive calendar, a period typically marked by increased training volume and intensity. This spike in load—both internal and external—may account for the rise in injuries (Gabbett, 2016). Additionally, the early-season tournaments in the Premier Padel circuit often involve intercontinental travel, exposing players to jet lag and travel-related fatigue, both of which may impair performance and elevate injury risk (Fowler et al., 2015). In addition, cold weather could be a potential contributing factor, especially when players do not warm up properly (Edouard et al., 2024).

Strengths, Limitations and Future Studies

A key strength of this study is its high participation rate from the top 100 ranked female padel players, offering unprecedented insight into injury trends in elite women's padel. However, some
limitations must be acknowledged. Injury data were self-reported via an online questionnaire, which may introduce recall bias or underreporting. Additionally, the study did not differentiate between injuries sustained during training and those occurring during competition.

Future research should expand to include injuries affecting the entire body and incorporate objective injury verification methods. Given known sex-based differences in injury patterns (Hardaker et al., 2024), equivalent studies in elite male padel players are also warranted to generate a more comprehensive injury profile for the sport.

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Clinical Implications

Upper-body injuries can compromise both performance and players' availability in elite padel, emphasizing the need for targeted prevention strategies. Effective measures may include:

- education for players, coaches, and families about injury risk (Brown et al., 2018),
- regular musculoskeletal screenings to proactively identify and address vulnerabilities (Šiupšinskas et al., 2019),
- biomechanical assessments of stroke technique (Wood et al., 2023),
- evidence-based equipment selection (Elliott et al., 2005),
- sport-specific strength and conditioning programs.

Despite padel's rapid growth, such injury prevention protocols remain underdeveloped. This study provides foundational data to support the design of structured prevention programs tailored to the sport's unique physical and technical demands.

The findings are relevant for a wide range of professionals, including researchers, coaches, strength and conditioning specialists, physiotherapists, and sports medicine practitioners.

Conclusions

Among the top 100 female players in the International Padel Federation ranking, 53.7% sustained at least one upper-body injury over the past year, with an incidence of 0.81 injuries per 1,000 h of padel or physical training. The injury incidence was not influenced by racquet characteristics or players' attributes. Tendinous injuries were the most common, followed by muscular injuries, with the elbow, the shoulder, and the wrist being the most affected anatomical sites. Injury frequency peaked in winter and spring. These findings highlight the need for targeted injury prevention strategies in elite female padel, particularly during high-load periods and for upper-limb overuse pathologies.

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