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Padel related injuries: prevalence and characteristics in chilean amateur players – a cross sectional analytic study

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Abstract

Background Padel is a rapidly growing racket sport worldwide. As its popularity increases, there is a need to better understand padel-related injuries. This study aimed to determine the prevalence and characteristics of injuries in amateur padel players.

Methods A Cross-sectional analytical study was conducted in padel players in southern Chile, aged 18 years or older who competed in amateur padel leagues. Data were collected through an online self-report survey between August 2023 and December 2023. Socio-demographic characteristics and padel-related injuries in the previous six months were requested.

Results A sample of 364 amateurs padel players (age 37.4 ± 9.2 years, 63% male) was included. A padel-related injury occurred in 196 participants (53.8%) in the previous six months. No significant differences in injury prevalence were found when comparing by sex (female 53.7%, $n=73$ vs male 53.9%, $n=123$), age (under 36 years 53.2%, $n=99$ vs 36 years or older 54.5%, $n=97$) and competitive level (beginner 53.1%, $n=43$ vs intermediate 53.8%, $n=107$ vs advanced 54.8, $n=46$). The ankle–foot region was the most commonly injured anatomical region followed by the elbow-forearm and shoulder-upper arm, and most injuries occurred in tendons and muscles. Serious injuries (i.e., absence > 4 weeks) occurred most frequently in advanced players. Participants over 36 years were more likely to be injured in training than competition. Significant differences existed between gradual and sudden onset of injury for elbow-forearm (85.7% gradual onset), wrist-hand (81.8% for gradual onset) and ankle–foot (64.7% sudden onset). Regarding injured tissue, gradual injury onset was significantly higher in tendons (77.1%), while sudden onset was more common in ligaments (70%). No significant differences existed for sociodemographic and padel variables when compared by the presence or absence of injury.

Conclusions The prevalence of padel-related injuries was high and injury prevalence according to sex, age and competitive level was similar between groups.

Highlights

Prevalence of padel-related injuries is 53.8%

Padel-related injuries was similar among sex, age and competitive level

Most common injury location was the ankle–foot, followed by the elbow-forearm and shoulder-upper arm

Tendon and muscle were the most commonly injured tissue

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Keywords Epidemiology, Injury, Musculoskeletal injuries, Padel

Background

Padel is a racket sport created in the 1960 s, which has gained great popularity worldwide. This sport is characterized by a high physical demand including short and fast movements with a large number of changes of direction, sprints and repetitive movements when hitting the ball [1]. This high demand could expose players to an inherent risk injury related to their practice [2]. These demands and injury risk may vary depending on the sex, age or level of competition of the players [1, 3].

Prevalences between 40% and 78,8% of at least one injury in the previous year have been reported and an injury prevalence of between 60% and 94.9% during a participants' whole sporting career [2, 4]. This wide range of injury prevalence is mainly due to differences in age, sex or level of participation. Castillo-Lozano & Casuso-Holgado [5] suggest that older players have a higher prevalence of injuries; while other studies found no relationship between age and injury [6, 7]. An injury incidence of 2.75/1000 h of training and 8.44/1000 games played are reported, with a higher incidence in men (2.67/player) compared to women (2.01/player) [6, 8]. The most frequently injured anatomical regions are the elbow, followed by the shoulder, ankle and lower back [2]. In the majority of studies, the tissue most commonly affected was the tendon although not all studies provided this information. Other commonly affected tissues were muscular and ligamentous [2, 9]. The high prevalence of tendon injury is due to the reporting of epicondylalgia as the most frequent disorder in several studies [9]. In professionals, more advanced players tend to suffer more injuries in general, specifically to muscle tissue, while less advanced players suffer fewer injuries and tendon injuries are more frequent [10]. In the case of amateur padel players, injury frequency for level of participation requires further investigation.

However, all this evidence should be considered cautiously. A recent mapping review concluded that the evidence generated in recent years related to padel, whether in amateur or professional padel players, comes mainly from the Spanish population and a limited group of authors [11]. Therefore, despite the developing evidence available reported in systematic and exploratory reviews, there is still a need to expand the demographic population of padel players studied [12]. Furthermore, with the growing popularity of padel worldwide and the associated health benefits it is important to increase our understanding of injury to maximize participation. The aim of this study was to determine injury prevalence with consideration of the distribution of musculoskeletal injuries in amateur padel players which could subsequently inform injury prevention and rehabilitation programs [13].

Methods

A cross-sectional-analytical study was utilized involving amateur padel players between August 2023 and December 2023. The sampling was non-probabilistic and consecutive (i.e., people who met the selection criteria during the recruitment period were included in the research). Participants were contacted and invited to participate through social networks or directly in different amateur padel competitions. This study was approved by the Ethics Committee of the Universidad de las Americas (CEC_FP_2023016) and was conducted in accordance with the Declaration of Helsinki [14].

Participants

Inclusion criteria specified that participants were 18 years of age or older and competed in amateur paddle leagues in southern Chile (i.e., not receive any payment for their participation). Exclusion criteria included participation in professional competitions. All participants provided informed consent prior to commencing the study. Data was stored anonymously and on a secure server with a unique number assigned to each participant to ensure anonymity.

Measurements

All data was collected through a self-report survey, created by the authors (see supplementary material), on the QuestionPro® platform. This self-report survey was created to collect information on factors previously identified as related to injuries in padel players (e.g., padel equipment, padel training and musculoskeletal injuries due to padel practice) [2, 10, 15]. Prior to its application in the study, a pilot test was conducted in 15 padel players (who did not participate in the final study) to assess its comprehension and applicability. A link to the survey was shared via e-mail (information provided by organizers of amateur competitions). The following socio-demographic characteristics were recorded: age, sex, mass (kg) and height (m). Body Mass Index (BMI) was calculated by mass/m^2.

Padel practice

Information was obtained regarding the practice of padel such as hand used to hold the racket, shape and type of racket used, shoe type, padel playing experience, competition level and training characteristics such as weekly frequency and practice duration, other physical/sports activities participated in and their characteristics.

Padel-related injuries

Information was requested regarding musculoskeletal injuries resulting from padel in the previous six months. Padel-related injury was defined as 'any accident or physical problem occurring while playing padel or directly resulting from padel' [5, 8, 16]. Participants who reported having an injury were asked: i) how and in what context the injury occurred? ii) when it occurred? iii) whether it prevented them from training or participating in a competition? iv) whether there was a diagnosis by a medical professional or if it was self-reported? v) whether it required treatment? and; vi) what was the anatomical region injured? This type of self-reporting has shown good consistency with reports of medical diagnoses therefore supporting their use in epidemiological musculoskeletal injury studies [17].

Statistical analysis

All analyses were performed using SPSS version 25 statistical software (Armonk, New York: USA: IBM Corp). The distribution of continuous variables (age, mass, height and BMI) was evaluated using the Shapiro–Wilk test and Q–Q plots, obtaining a normal distribution. Therefore, these variables are presented as means and standard deviations. Qualitative variables are presented as absolute and relative frequencies.

Demographic and padel variables were compared according to the presence or absence of padel-related injury. In accordance with the recommendations of the STROBE-SIIS consensus, injuries and their characteristics were analyzed according to sex, age and competitive level [18]. For age comparison, this variable was discretized according to the median (36 years old). The level of play in padel competitions is classified according to different categories. At the extremes of the categories, it is reported that, novices are classified as category 'seventh' if they are men and as category 'D', if they are women. In contrast, the most experienced players are classified as category 'first' for men and category 'A' for women. The competitive level was established by grouping the various categories of play. Thus, three competitive levels were established: i) beginner, comprising categories sixth and seventh for men and, D for women ii) intermediate, comprising categories third, fourth and fifth for men and, C for women and iii) advanced, comprising categories first and second for men and, A and B for women.

For the comparison of quantitative variables, the Student's t-test was used, while for qualitative variables the Chi-square test was used. If the chi-square test was significant, corrected residuals (z-value) were calculated [19] and were considered significant when the z-value was less than/greater than ± 1.96. A p-value of < 0.05 was considered statistically significant.

Results

The sample was composed of 364 players (mean age 37.4 ± 9.2 years), 63% of whom were male ($n = 228$). The demographic and sports characteristics according to the presence of injury of the sample are described in Tables 1 and 2, respectively. Of the total sample, 53.8% ($n = 196$) reported having suffered a padel-related injury in the previous six months. With respect to the duration since the injury, 62.3% of the participants reported suffering padel-related injury three months ago or less. Regarding reporting by sex, 53.7% ($n = 73$) of females and 53.9% ($n = 123$) of males reported an injury in the previous six months. Under 36 years of age, 53.2% ($n = 99$) reported an injury versus 54.5% ($n = 97$) of participants aged 36 years and older. In terms of competitive level, 53.1% ($n = 43$) of beginners, 53.8% ($n = 107$) of intermediate and 54.8% ($n = 46$) of advanced participants reported an injury in the previous six months. No significant differences were found between sociodemographic variables and padel when compared by the presence or absence of padel-related injury (see Tables 1 and 2).

The characteristics of the participants who reported a padel-related injury according to sex, age and competitive level, is reported in Table 3. The context in which the injury occurred, training or competition, was found to be significantly different regarding age, with those over 36 years being more likely to be injured in during training. A diagnosis of injury by a medical professional was more common in players participating at a higher level (intermediate and advanced). The highest injury frequency was found in the lower limb (46.7%, $n = 86$) and upper limb (42.4%, $n = 78$). The anatomical regions with the highest frequency of injury were ankle–foot (18.5%, $n = 34$), shoulder-upper arm (15.2%, $n = 28$), elbow-forearm (15.2%, $n = 28$) and knee (13.6%, $n = 25$). Pre-padel musculoskeletal injury was more frequent in younger participants, i.e. aged 36 years or younger. Additionally, we performed an exploratory analysis in participants who reported a padel-related injury of the association between padel-related injury onset (sudden or gradual) and anatomical region and injured tissue using the chi-square test. Regarding the anatomical

Table 1 Demographic characteristics according to presence of padel-related injury

	Padel-related injury *n* = 196 (53.8%)	Non-injured *n* = 168 (46.2%)	*p*-value	Total *n* = 364
Sex[a]			0.96	
Female	73 (37.2)	63 (37.5)		136 (37.4)
Male	123 (62.8)	105 (62.5)		228 (62.6)
Age (years)[b]	37.4 ± 8.7	37.4 ± 9.7	0.96	37.4 ± 9.2
Mass (kg)[b]	78.1 ± 15.4	76.8 ± 13.9	0.4	77.5 ± 14.7
Height (cm)[b]	170.8 ± 8.6	171.8 ± 7.8	0.27	171.3 ± 8.3
BMI (kg/m^2)[b]	26.6 ± 3.9	25.9 ± 3.6	0.08	26.3 ± 3.7
Nutritional status[a]			0.71	
Underweight (< 18.5)	2 (1.0)	1 (0.6)		3 (0.8) 142
Normal weight (< 25)	73 (37.2)	69 (41.1)		(39.0) 158
Overweight (< 30)	85 (43.4)	73 (43.5)		(43.4)
Mild obesity (< 35)	32 (16.3)	24 (14.3)		56 (15.4)
Medium obesity (< 40)	4 (2.0)	1 (0.6)		5 (1.4)
In addition to padel. do you participate any other physical activity or sport?[a]			0.22	
Yes	121 (61.7)	114 (67.9)		235 (64.6)
Gym	39 (32.2)	41 (36.0)		80 (34.0)
Running	10 (8.3)	9 (7.9)		19 (8.1)
Cycling	6 (5.0)	5 (4.4)		11 (4.7)
CrossFit	4 (3.3)	9 (7.9)		13 (5.5)
Racket sport	6 (5.0)	10 (8.8)		16 (6.8)
Contact sport	22 (18.2)	17 (14.9)		39 (16.6)
Individual sport	5 (4.1)	1 (0.9)		6 (2.6)
Other	29 (24.0)	22 (19.3)		51 (21.7)
Hours/week				
1	14 (11.6)	18 (15.8)		32 (13.6)
2	38 (31.4)	38 (33.3)		76 (32.3)
3	30 (24.8)	26 (22.8)		56 (23.8)
4	13 (10.7)	17 (14.9)		30 (12.8)
5	11 (9.1)	4 (3.5)		15 (6.4)
6 or more	15 (12.4)	11 (9.6)		26 (11.1)
No	75 (38.3)	54 (32.1)		129 (35.4)
Before you started padel. did you participate in any sport or recreational physical activity? [a]			0.32	
Yes	163 (83.2)	146 (86.9)		309 (84.9)
No	33 (16.8)	22 (13.1)		55 (15.1)

N number, *kg* kilograms, *cm* centimeters, *m* meter

[a] Data shown in absolute frequency (percentage). Chi-square test showed no significant differences in any characteristics between padel-related injury and non-injured

[b] Data show in mean ± standard deviation. Student's t-test showed no significant differences in any characteristics between padel-related injury and non-injured

region the analysis demonstrated significant differences ($p = 0.001$), specifically in elbow-forearm (85.7% gradual vs 14.3% sudden), wrist-hand (81.8% gradual vs 18.2% sudden) and ankle–foot (35,3% gradual vs 64.7% sudden). Regarding injured tissue, we found significant differences ($p = 0.002$), in particular in tendon (77.1% gradual vs 22.9% sudden) and ligament (30% gradual vs 70% sudden).

Discussion

The aim of this study was to determine the prevalence of injuries and their characteristics in amateurs padel players in southern Chile. Injury prevalence was 53.8%, which is similar to other European and Latin American reports which range from 40% and 78,8% [2, 4]. The definition of injury used varies between researchers and requires consideration. Studies by Muñoz et al. [20] and Valério et al.

Table 2 Padel characteristics according to the presence of padel-related injury

	Padel-related injury ***n*** **= 196 (53.8%)**	**Non-injured** ***n*** **= 168 (46.2%)**	***p*-value**	**Total** ***n*** **= 364**
Playing Hand			0.53	
Right	182 (92.9)	153 (91.1)		335 (92.0)
Left	14 (7.1)	15 (8.9)		29 (8.0)
Racket Shape			0.78	
Diamond	63 (32.1)	48 (28.6)		111 (30.5)
Teardrop	64 (32.7)	61 (36.3)		125 (34.3)
Round	61 (31.1)	50 (29.8)		111 (30.5)
Unknown	8 (4.1)	9 (5.4)		17 (4.7)
Racket Type			0.57	
Control	57 (29.1)	49 (29.2)		106 (29.1)
Power	56 (28.6)	40 (23.8)		96 (26.4)
Versatile	76 (38.8)	69 (41.1)		145 (39.8)
Unknown	7 (3.6)	10 (6.0)		17 (4.7)
Shoe Type			0.16	
Specialized	178 (90.8)	146 (86.9)		324 (89.0)
Running	15 (7.7)	18 (10.7)		33 (9.1)
Unknown	2 (1.0)	0 (0.0)		2 (0.5)
Other	1 (0.5)	4 (2.4)		5 (1.4)
Playing Time (experience)			0.41	
0–6 months	28 (14.3)	17 (10.1)		45 (12.4)
6 months to 1 year	42 (21.4)	40 (23.8)		82 (22.5)
1 to 2 years	73 (37.2)	67 (39.9)		140 (38.5)
2 to 4 years	39 (19.9)	26 (15.5)		65 (17.9)
More than 5 years	14 (7.1)	18 (10.7)		32 (8.8)
Level of competition			0.98	
Beginner	43 (21.9)	38 (22.6)		81 (22.3)
Intermediate	107 (54.6)	92 (54.8)		199 (54.7)
Advanced	46 (23.5)	38 (22.6)		84 (23.1)
Matches per/week			0.43	
1	29 (14.8)	22 (13.1)		51 (14.0)
2	63 (32.1)	60 (35.7)		123 (33.8)
3	57 (29.1)	49 (29.2)		106 (29.1)
4	29 (14.8)	19 (11.3)		48 (13.2)
5	15 (7.7)	10 (6.0)		25 (6.9)
6 or more	3 (1.5)	8 (4.8)		11 (3.0)
Formal padel training			0.39	
Yes	81 (41.3)	62 (36.9)		143 (39.3)
Frequency				
1 d/week	18 (22.2)	19 (30.6)		37 (25.9)
2 d/week	27 (33.3)	21 (33.9)		48 (33.6)
3 d/week	17 (21.0)	15 (24.2)		32 (22.4)
4 d/week	15 (18.5)	5 (8.1)		20 (14.0)
5 d/week	4 (4.9)	2 (3.2)		6 (4.2)
Hours/week				
1	13 (16.0)	13 (21.0)		26 (18.2)
2 to 3	28 (34.6)	27 (43.5)		55 (38.5)
4 to 5	28 (34.6)	14 (22.6)		42 (29.4)
6 to 7	9 (11.1)	5 (8.1)		14 (9.8)
8 to 9	2 (2.5)	2 (3.2)		4 (2.8)
10 or more	1 (1.2)	1 (1.6)		2 (1.4)
No	115 (58.7)	106 (63.1)		221 (60.7)

Data shown in absolute frequency (percentage). Chi-square test showed no significant differences in any characteristics between padel-related injury and non-injured

Table 3 Padel-related injury characteristics according to sex, age and competitive level

		Injured						
		Sex		**Age**		**Level**		
	Total	**Woman**	**Man**	**< 36 years**	**> 36 years**	**Beginner**	**Intermediate**	**Advanced**
Onset								
Sudden	85 (43.8)	31 (43.1)	54 (44.3)	40 (40.8)	45 (46.9)	23 (53.5)	46 (43.4)	16 (35.6)
Gradual	109 (56.2)	41 (56.9)	68 (55.7)	58 (59.2)	51 (53.1)	20 (46.5)	60 (56.6)	29 (64.4)
		p = 0.87		*p = 0.4*		*p = 0.24*		
Context (sudden onset participants only)								
Training	43 (52.4)	19 (63.3)	24 (46.2)	**15 (39.5)**	**28 (63.6)**	16 (69.6)	20 (44.4)	7 (50.0)
Competing	39 (47.6)	11 (36.7)	28 (53.8)	**23 (60.5)**	**16 (36.4)**	7 (30.7)	25 (55.6)	7 (50.0)
		p = 0.13		***p = 0.029***		*p = 0.14*		
Did it prevent you from training or participating in a competition?								
Yes	116 (60.7)	41 (57.7)	75 (62.5)	55 (57.3)	61 (64.2)	30 (71.4)	60 (57.1)	26 (59.1)
at the moment	8 (7)	1 (2.4)	7 (9.5)	4 (7.4)	4 (6.6)	**2 (6.7)**	**5 (8.5)**	**1 (3.8)**
between 1 and 6 days	27 (23.5)	10 (24.4)	17 (23)	13 (24.1)	14 (23)	**11 (36.7)**	**14 (23.7)**	**2 (7.7)**
between 1 and 4 weeks	38 (33)	12 (31.7)	25 (33.8)	19 (35.2)	19 (31.1)	**7 (23.3)**	**23 (39)**	**8 (30.8)**
more than 4 weeks	42 (36.5)	17 (41.5)	25 (33.8)	18 (33.3)	24 (39.3)	**10 (33.3)**	**17 (28.8)**	**15 (57.7)**
No	75 (39.3)	30 (42.3)	45 (37.5)	41 (42.7)	34 (35.8)	12 (28.6)	45 (42.9)	18 (40.9)
		p = 0.52		*p = 0.33*		*p = 0.27*		
Medical diagnosis								
Yes	104 (55)	38 (53.5)	66 (55.9)	52 (54.7)	52 (55.3)	**20 (47.6)**	**51 (49.5)**	**33 (75.0)**
No	85 (45)	33 (46.5)	52 (44.1)	43 (45.3)	42 (44.7)	**22 (52.4)**	**52 (50.5)**	**11 (25.0)**
		p = 0.75		*p = 0.94*		***p = 0.01***		
Did you require treatment?								
Yes	117 (62.2)	48 (67.6)	69 (59.0)	58 (61.7)	59 (62.8)	**19 (45.2)**	**67 (65.0)**	**31 (72.1)**
No	71 (37.8)	23 (32.4)	48 (41.0)	36 (38.3)	35 (37.2)	**23 (54.8)**	**36 (35.0)**	**12 (27.9)**
		p = 0.28		*p = 0.88*		***p = 0.026***		
Anatomical region								
Neck	1 (0.5)	0 (0.0)	1 (0.9)	1 (1.1)	0 (0.0)	0 (0.0)	1 (1.0)	0 (0.0)
Thoracic spine	2 (1.1)	2 (2.9)	0 (0.0)	0 (0.0)	2 (2.2)	1 (2.4)	0 (0.0)	1 (2.3)
Lumbosacral spine	11 (6)	2 (2.9)	9 (7.8)	7 (7.7)	4 (4.3)	2 (4.8)	6 (6.1)	3 (7.0)
Shoulder-upper arm	28 (15.2)	9 (13.0)	19 (16.5)	15 (16.5)	13 (14.0)	9 (21.4)	14 (14.1)	5 (11.6)
Elbow-forearm	28 (15.2)	12 (17.4)	16 (13.9)	11 (12.1)	17 (18.3)	7 (16.7)	19 (19.2)	2 (4.7)
Wrist-hand	22 (12)	11 (15.9)	11 (9.6)	14 (15.4)	8 (8.6)	5 (11.9)	10 (10.1)	7 (16.3)
Hip-groin	2 (1.1)	2 (2.9)	0 (0.0)	0 (0.0)	2 (2.2)	1 (2.4)	1 (1.0)	0 (0.0)
Knee	25 (13.6)	8 (11.6)	17 (14.8)	13 (14.3)	12 (12.9)	4 (9.5)	12 (12.1)	9 (20.9)
Ankle–foot	34 (18.5)	15 (21.7)	19 (16.5)	15 (16.5)	19 (20.4)	5 (11.9)	18 (18.2)	11 (25.6)
Anterior thigh	7 (3.8)	2 (2.9)	5 (4.3)	3 (3.3)	4 (4.4)	2 (4.8)	5 (5.1)	0 (0.0)
Posterior thigh	4 (2.2)	0 (0.0)	4 (3.5)	1 (1.1)	3 (3.2)	0 (0.0)	4 (4.0)	0 (0.0)
Lower leg	14 (7.6)	4 (5.8)	10 (8.7)	7 (7.7)	7 (7.5)	4 (9.5)	8 (8.1)	2 (4.7)
Other	6 (3.3)	2 (2.9)	4 (3.5)	4 (4.4)	2 (2.2)	2 (4.8)	1 (1.0)	3 (7.0)
		p = 0.23		*p = 0.51*		*p = 0.37*		
Injured tissue								
Muscle	48 (26.1)	15 (21.7)	33 (28.7)	22 (24.2)	26 (28.0)	**16 (38.1)**	**30 (30.3)**	**2 (4.7)**
Tendon	48 (26.1)	22 (31.9)	26 (22.6)	22 (24.2)	26 (28.0)	**8 (19.0)**	**26 (26.3)**	**14 (32.6)**
Ligament	30 (16.3)	9 (13)	21 (18.3)	16 (17.6)	14 (15.1)	**6 (14.3)**	**16 (16.2)**	**8 (18.6)**
Joint	14 (7.6)	6 (8.7)	8 (7.0)	4 (4.4)	10 (10.8)	**4 (9.5)**	**6 (6.1)**	**4 (9.3)**
Bone	5 (2.7)	0 (0.0)	5 (4.3)	3 (3.3)	2 (2.2)	**1 (2.4)**	**2 (2.0)**	**2 (4.7)**
Nervous system	5 (2.7)	1 (1.4)	4 (3.5)	4 (4.4)	1 (1.1)	**1 (2.4)**	**0 (0.0)**	**4 (9.3)**
Unknown	28 (15.2)	12 (17.4)	16 (13.9)	17 (18.7)	11 (11.8)	**5 (11.9)**	**16 (16.2)**	**7 (16.3)**

Table 3 (continued)

		Injured						
		Sex		Age		Level		
	Total	Woman	Man	< 36 years	> 36 years	Beginner	Intermediate	Advanced
Other	6 (3.3)	4 (5.8)	2 (1.7)	3 (3.3)	3 (3.2)	**1 (2.4)**	**3 (3.0)**	**2 (4.7)**
		p = 0.23		*p = 0.57*		***p = 0.045***		
Pre-padel musculoskeletal injury								
Yes	56 (33.9)	19 (30.6)	37 (35.9)	**39 (42.9)**	**20 (21.5)**	30 (37.5)	58 (30.5)	27 (34.2)
No	109 (66.1)	43 (69.4)	66 (64.1)	**52 (57.1)**	**73 (78.5)**	50 (62.5)	132 (69.5)	52 (65.8)
		p = 0.49		***p = 0.002***		*p = 0.68*		

Data shown in absolute frequency (percentage). Statistically significant data, i.e. *p*-value < 0.05 in the chi-square test, are highlighted in bold

[21] did not provide an injury definition while Castillo-Lozano and Casuso-Holgado [16] and Priego Quesada et al. [7] used the same definition as our study. Studies by Castillo-Lozano and Casuso-Holgado [5] and García–Fernández et al. [8], associate the concept of injury with the search for medical help/support (emergency or treatment) or to the absence of sports practice (competition or training). Furthermore, in these studies different sports injury instruments were used to record injury data and therefore should be considered in any comparison.

It is important to note that, differences in injury definition have a major impact on the reporting of injury prevalence or incidence [22]. Thus, the incidence is often high when the injury is described as 'all complaints' or 'problems' as athletes may record injuries that are not associated with their sport, for instance, gym, running or other racket sports injuries [6, 23]. Therefore, the need for uniformity in injury definition is recommended.

Padel-related injury prevalence by sex, age and competitive level

The prevalence of padel-related injuries according to sex, age and competitive level was similar between groups.

In the analysis of frequency or type of injury according to sex no significant differences existed. In general, there is a consensus of a the higher injury rate in women in comparison to men (especially at the knees) in team and court sports due to anatomical, neuromuscular and hormonal differences [24]. However, in padel, the evidence regarding the comparison of injuries by sex is contradictory. For example, Sánchez Alcaraz-Martínez et al. [15], and our study, reported no differences by sex in the number or type of injuries in federated players in Spain, however there was a difference in the location with a higher prevalence in the upper limb in women than in men. Pérez et al. [10] in a study of 36 participants, highlighted the higher prevalence of injuries in women × 1000 matches (15.10) than men (10.50), while [6] in a study of 274 padel players reported a higher prevalence in men (2.67 injuries/player) than women (2.01 injuries/players). Comparison should consider the different injury reporting methodologies that are employed (i.e., self-administered surveys developed by authors vs standardized injury reporting instruments) and varying sample sizes and playing level.

We did not find any differences by age in the reported injury frequency. One previous study specifically addressed the age factor and injury prevalence, finding that injury frequency increases with age, with a reported prevalence of 86.7% in senior players (55–67 years) versus 60% in junior players (14–20 years) [5]. Sánchez Alcaraz-Martínez et al. [15] reported significant differences in the injured tissue according to age, with those under 35 years of age having more tendon injuries. In contrast, Priego Quesada et al. [7] and Augustsson & Lundin [6], whose sample was similar to ours in terms of age homogeneity, found no relationship between age and frequency or type of injury. Regarding whether injury occurs in training or competition, a significant difference existed with those over 36 years being more likely to be injured during training (63.6% training vs 36.4% competition). It is possible that players within this age range may be subject to a reduction in physical fitness that reduces their ability to cope with the demands of training. Therefore, in order to prevent injuries, there might be a requirement to ensure that players have a sufficient level of physical fitness via specific strength and conditioning programs that prepare players for the demands of padel. Another consideration, which has not been addressed by previous studies, is that pre-padel musculoskeletal injury was more prevalent in younger participants (42.9% in 36 years or younger vs 21.5% in over 36 years). This may indicate that young participants who had a musculoskeletal injury prior to starting padel are more likely to have a padel-related injury than older participants. However, this requires further investigation via future longitudinal studies.

Regarding differences by level of competition, our data indicates that participants with padel-related injuries at the beginner (38.1%) and intermediate (30.3%) levels have a higher frequency of muscle injuries than the advanced (4.7%) level which could highlight the necessity for strength and conditioning programs to reduce injury risk. Advanced padel players who have their training or competitions interrupted by musculoskeletal injuries report less frequent periods of one to six days (3.8%), but more frequently report interruptions exceeding four weeks (57.7%). This highlights the greater physical demand at this level of competition, suggesting a prevalence of severe injuries in this group of players. There is a paucity of evidence addressing the level of competition of amateur padel players, however a previous study, found that lower categories, third and fourth (intermediate in our study), had a higher frequency of ligament and tendon-type injuries [15]. As potentially different competitive levels require different levels of physical preparation and practice could influence results, more studies should include this variable in their analysis. This is further supported by Pérez et al. [10] who concluded that the level (i.e., ranking) impacts on the type and frequency of injuries and by Valério et al. [21] who found significant differences between competition levels and injury moment. Amateur players have different motives behind playing padel which include health benefits, entertainment and social factors and this could also influence whether they seek medical attention for an injury, and it is observed that the diagnosis of injury is less frequent in players participating at a beginner level. Beginners are likely to have less experience of injury and may not act accordingly to prevent an increase in the severity of injury and this could be considered in future research.

Anatomical region

The most common anatomical injury location region was the ankle–foot (18.5%) followed by the elbow-forearm (15.2%) and shoulder-upper arm (15.2%). Our data shows a similar frequency between the upper (42.4%) and lower limbs (46.7%). This finding is similar to that of Valério et al. [21] in 62 Brazilian padel players described as professional or aspiring professionals who reported the highest injury prevalence in shoulder-elbows, mainly due to an overuse mechanism of injury and also in 60 active padel players injuries whose injuries were mainly located at the elbow [5]. Augustsson & Lundin [6] reported 571 overuse injuries in 274 padel players with most located at the knee followed by the elbow, lower back, foot and lower leg. Tagliafico et al. [25] in a study of 800 padel players reported a higher prevalence in the lower limb, specifically the knee. The low prevalence of low back pain (6%) in our study contrasts with two other studies that reported 16%– 27.5% [6, 15]. Differences in the distribution in these anatomical regions could be related to the different characteristics of the populations assessed. Approaches that specifically target these commonly injured regions might be a consideration for injury prevention via programs that improve the players physical attributes such as muscle strength, endurance and flexibility.

Injury tissue

Consistent with other studies, our data shows muscle (26.1%) and tendons (26.1%) were the most common injury tissue [6, 15, 21, 25].

For muscle injuries, the onset of injury, namely sudden (50%) or gradual (50%), demonstrated no differences. In tendons, a gradual onset (77.1%) of injury was more frequent than sudden onset (22.9%) and could be related to overuse injuries, such as tendinopathies. In ligaments a sudden onset (70%) was more frequent than gradual onset (30%), which could potentially be due to the presence of traumatic injuries such as a sprain.

Tendon injuries are often related to a repetitive overuse mechanism of injury that can result in conditions such as tendinopathy and may relate to equipment choices and the influence on ball striking mechanisms. It is possible that the type of unstrung racket in padel may be a factor in elbow and wrist injuries due to how the racket interacts with regulation of the force during the stroke which contrasts with the stringed rackets of tennis where tension is regulated during stroke hitting [8]. It should also be considered that the padel requires repetitive movements, which may exceed the capacity of tendons located in the upper or lower limbs. Injury prevention for tendinopathies should aim to manage loading of regions such as the extensor tendons of the elbow and the achilles tendon so that they have the capacity to cope with the demands of training and competition. This could focus on a combination of strength specific work e.g. calf raises for the achilles tendon and monitoring of playing and training load to reduce the risk of injury developing.

Player's characteristics

The age of the players may support the theory that many players transition to padel later in life often after 30 years and following previous experience with other racket sports such as tennis. For example, the mean age of our study was 37.4 ± 9.2 years, and in Swedish study the mean age was 42.2 ± 9.9 years (males) and 44.8 ± 8.9 years (females) [6]. In a Spanish study the mean age was 38.98 ± 21.85 years [5] while an Italian based study had a mean age of 49 ± 22 years [25]. An exception to this observation was a study in Spain with a mean age of 31.68 years [20].

For our participants, 73.4% reported having two years or less padel experience with 76.9% playing 3 matches or less per week and 60.7% not doing any formal training, while Augustsson & Lundin [6] in Sweden where padel is relatively new, reported that players had a playing experience of 2 to 3 years and the majority (> 50%) trained more than eight times per month. Reflecting the longer padel history in Spain the mean playing experience of 7.65 years is higher than our population [5].

Approximately 60% of the amateur padel players participating in our study were overweight or obese (i.e., BMI >25). The presence of overweight players reflects the amateur status of our population, in contrast to professional players. No other studies of amateur padel players report this feature in its participants. In our population, the data demonstrated no association between overweight or obesity participants and the presence of padel-related injury. However, studies in other sports have concluded that the presence of overweight or obese participants increases the risk of injury [26, 27]. Therefore, intervention to improve physical fitness and reduce the weight of these players may be beneficial and to improve our understanding of this theme we recommend further research.

Padel equipment

In our study, no statistically significant differences were found between injured and non-injured participants according to the shape and racket type. In contrast, Thomas et al. [4] identified that the round shape of the padel racket could be a risk factor for developing musculoskeletal injuries while Muñoz et al. [20] reported that a racket weighing more than 350 g increases injury risk. Therefore, further research is needed regarding equipment and its possible impact on the occurrence of padel-related injuries.

Our study is not without limitations. Data were collected using a self-report survey, therefore self-report bias must be considered. For example, recall bias regarding an injury and its characteristics or lack of understanding of the questions asked. However, an attempt was made to limit these factors by using a time period limited to six months prior to survey application and by conducting a pilot assessment of the survey. Another possible limitation is the sample was limited to the south of Chile whose population may present different characteristics from the rest of the country and other countries. In the south of Chile padel is very popular and, remembering the exploratory nature of this study, this location represents a valid starting point to generate epidemiological information regarding injuries derived from padel, at a national level. The strengths of our study include: i) the number of participants, making it one of the larger padel studies, ii) the use of an injury definition, which allowed us to investigate whether injuries were specifically derived from padel which is important considering that the vast majority of these participants practice other sports (more than 60% in our population) and iii) the percentage of females (37.4%), as other studies present a lower percentage, therefore not allowing the extrapolation of the data (e.g., Muñoz et al. [20] 15.5% females and Thomas et al. [4] 26% females).

Future studies should address the definition of padel-related injury and reach consensus with athletes, medical teams and researchers in order to have a clear and common definition [18, 28]. There should also be further consideration of sex differences in injury prevalence and type and investigation of the relationship between equipment choices and injury such as the weight of the racket, number of overgrips and racket material composition. These were not within the remit of the current study; however future research would potentially allow greater consideration of equipment factors.

The information provided by our study is important for coaches and the health care team of padel players, as it establishes the basis for understanding of the possible complications of padel practice and for generating efficient strategies to prevent padel-related injuries.

Conclusions

The prevalence of padel-related injuries in amateur players was 53.8% and prevalence was similar between groups regardless of sex, age and competitive level. The most common anatomical region was the ankle–foot followed by the elbow-forearm and shoulder-upper arm, and tendons and muscles were the most commonly injured tissue.

Supplementary Information

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Supplementary Material 1.

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Authors' contributions
All authors (H. B-A., R. G-B., R. A. & C. B-S.) have made significant contributions to the conception and design of the study, the acquisition, analysis, and interpretation of data, as well as drafting the manuscript or making substantial revisions. They have approved the final version of the manuscript and agree to be personally accountable for their individual contributions.

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Data availability
The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Declarations

Ethics approval and consent to participate
Informed consent was obtained from all subjects involved in the study. This study was approved by the Ethics Committee of the Universidad de las Americas (CEC_FP_2023016) and was conducted in accordance with the Declaration of Helsinki (World Medical Association, 2013).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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