

# Sports injuries and risk factors for table tennis among nonprofessional collegiate athletes

## A cross-sectional study

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### Abstract

Despite the increasing popularity of table tennis worldwide, few studies have focused on table tennis injuries.

This study aimed to investigate the injury profiles, including the injury rate, types, locations, and risk factors, among nonprofessional collegiate table tennis athletes in Taiwan.

We performed an online investigation among collegiate table tennis athletes of the nonprofessional category in the 2019 National Intercollegiate Athletic Games in Taiwan. Participants provided general information, and data on the characteristics of their play style, training, and injuries were collected. We then categorized these participants into injured and noninjured groups. Injuries were classified as mild, moderate, and severe, based on the time loss in playing table tennis. The risk factors for table tennis-related sports injuries were then identified through between-group comparisons.

In total, 150 participants responded to the questionnaire. The average participant age was 21.3 years. Gender differences existed in age categories, forehand rubber, backhand style of play, and average days of training per week. Over the 6 months before the study, 76 of 150 participants experienced at least one injury. The handedness for play was associated with the occurrence of injury. Factors associated with injury severity included using rubber other than inverted rubber for the forehand and not qualifying for the national round of the team category of the National Intercollegiate Athletic Games.

With a considerably high injury rate among nonprofessional collegiate athletes, further studies are required on table tennis-related injuries. Playing styles such as handedness and type of rubber used might be associated with the injury. The lower limb was the most common site of injury. These results may provide insights into trainers and coaches for further measures on injury prevention.

**Abbreviation:** NIAG = National Intercollegiate Athletic Games.

**Keywords:** epicondylitis, injury, ligament, sprain, table tennis, tendinopathy

## 1. Introduction

With the increasing popularity of table tennis globally, the number of people playing table tennis has grown considerably,

and an increasing number of schools have established table tennis teams or clubs. Despite the increased popularity of the sport, table tennis receives less attention in sports research. Previous table tennis-related studies focused on kinematics and biomechanics knowledge on various topics, such as differences related to the various types of racket strokes and services,<sup>[1–6]</sup> psychological effects during a match,<sup>[7,8]</sup> and comparison of past and present match analysis methods<sup>[9–11]</sup> to improve sport performance. Little is known regarding the sports injuries caused by table tennis.

A recent review indicated the dearth of epidemiological knowledge regarding table tennis-related injuries.<sup>[12]</sup> Two descriptive epidemiology studies reported a low incidence of injury among elite table tennis athletes (i.e., <5.2% of athletes) during the Summer Olympics Games.<sup>[13,14]</sup> By comparison, Sun and Zhang<sup>[15]</sup> reported that 67.2% of Chinese college table tennis athletes have experienced injuries. The rate was particularly high among male players (i.e., 83.9%); players playing with the “penhold single loop style” had the highest number of injuries among all playing styles. Kondrič et al<sup>[16]</sup> provided epidemiological data for top Slovenian racket sport players and reported that most of the injuries among top-ranking table tennis players occurred at the shoulder (20% of the reported injuries) followed by the hip and the spine (15% each), the ankle (13%), and the wrist (11%). Although the risk factors for table tennis injuries have not been explored, player characteristics and behaviors, such as age, sex, skill, use of protective equipment, playing position, and game strategies, have been proposed.<sup>[17,18]</sup>

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The National Intercollegiate Athletic Games (NIAG) is the most prestigious college-level tournament in Taiwan. The NIAG consist of open and nonprofessional categories for elite and nonprofessional athletes, respectively. Unlike elite athletes, nonprofessional athletes are less likely to undergo formal training where any incorrect stroke or posture would be corrected immediately. Meanwhile, they may not receive consistent monitoring of conditions by medical staff. Moreover, these players may have insufficient knowledge regarding source-of-injury prevention and management, which can cause a delay in medical treatment, thus affecting the recovery time and performance level after return to sports. These issues may render nonprofessional athletes vulnerable to sports injuries.

Therefore, we performed this observational survey on nonprofessional athletes who participated in the table tennis group of 2019 NIAG. We adopted a cross-sectional design for this observational study to preliminarily explore the potential risk factors. A comprehensive investigation of training conditions, style of play, and injury profiles was conducted via online questionnaire, to identify the injury rate and potential risk factors for injuries. We hypothesize that gender, style of play, and training volume may be associated with table tennis injuries.

## 2. Methods

### 2.1. Study design

This cross-sectional study was conducted during the 2019 NIAG table tennis tournament (recruitment period, September 2019–January 2020). A total of 300 players were randomly selected from the 2019 NIAG participant handbook, which listed all the players of the games. Selected players were contacted by email, telephone, or social media to respond to an online questionnaire. Relevant information was then collected. Ethical approval was obtained from the joint institutional review board of Taipei Medical University (N201908041).

### 2.2. Participants

The NIAG consists of the nonprofessional and professional (open) categories. Only those athletes who participated in the nonprofessional category of the 2019 NIAG were included in this study. Professional athletes are not allowed to participate in the nonprofessional category. According to the rules of the NIAG, athletes were ineligible for the nonprofessional category if they were students at a sports-related department of a university or tertiary institution; had participated in recognized international tournaments, held an international rank, or attained a position among the top 8 rankings in any local competition deemed to be of elite level by the Ministry of Education; and were national team athletes.

Participants who qualified for the 2019 NIAG nonprofessional category are listed in the participant handbook. The NIAG is divided into the preliminary and national rounds. For the team category, the top 15 schools from the preliminary round and the NIAG host school qualify for the national round. For the individual category, the top 32 singles players and top 16 doubles pairs qualify for the national round. The overall tournament results were obtained from the Taiwan national database of student-athletes.

### 2.3. Questionnaire

The main issues of interest include the injury rate, factors that contribute to injury, and the most common types of injury. The

structured questionnaire consisted of 5 sections: general information, years of play and style of play, training volume and conditions, injury history, and Kinesio taping and protective equipment use. In the questionnaire, the reported training volume was measured as the usual training volume before the injury occurred if the participant experienced injury. Participants were asked to indicate whether they had experienced any sports-related injury over the past 6 months, and if yes, whether there was any loss of sporting time.

The questionnaire was distributed to 20 members of the table tennis team of Taipei Medical University to test the viability of the questionnaire. The questionnaire was then revised on the basis of feedback obtained from the team members. The finalized questionnaire was presented as an online survey on Google Forms. The weblink of the questionnaire was sent to the selected athletes through Facebook or email by members of the research team.

### 2.4. Statistical analysis

We determined that a randomly selected sample of 300 players (approximately one-third of total players) was practical concerning the reachability by our research team. Because all the variables were categorical, descriptive statistics are presented as *n* (and %) values. A chi-square test was used to compare the differences in these variables between the 2 groups. A two-tailed *P* value of  $<.05$  was considered significant. Data analysis was performed using SPSS 20.0 software (SPSS, Chicago, IL, USA).

Based on the questionnaire responses, participants were classified into injured and noninjured groups. For patients who had experienced injuries, the injuries were classified as mild, moderate, and severe. Mild injury was defined as injury that caused no sporting time loss; moderate injury, sporting time loss of 1 month or less; severe injury, sporting time loss of over 1 month. Because of the limited number of participants with severe injuries, the moderate and severe subgroups were combined in subsequent analyses. To identify risk factors of injury, comparisons between participants who reported no injury and those who reported injuries were performed. To identify risk factors of injury severity, comparisons between participants categorized as mild injury and moderate-to-severe injury were performed.

## 3. Results

Approximately 900 players participated the nonprofessional table tennis group in the 2019 NIAG. A total of 300 athletes were randomly selected from the NIAG participant handbook, and 150 responded to the questionnaire (67 men and 83 women). The basic participant information is presented in Table 1. The average age was 21.3 years. The majority of participants had  $<5$  years of table tennis experience (70.7%), were right-handed (91.3%), used the shakehand grip (94%), and used inverted rubber for the forehand (88.7%) and backhand (77.6%). In total, 75 athletes played singles and doubles each, with no overlap. Female athletes tended to be younger ( $<20$  years,  $P=.039$ ), use rubber other than inverted rubber for the forehand ( $P=.020$ ), use a defensive style in the backhand stroke ( $P=.001$ ), and spend fewer days per week ( $<3$  days per week,  $P=.001$ ) in training than male athletes.

The injury characteristics are presented in Table 2. In total, 76 athletes (37 men and 39 women) had at least 1 injury over the 6 months. Regarding the severity of injury, 49 were mild, 20 were moderate, and 5 were severe. In total, 94.6% of injury cases were

**Table 1****Basic information of participants (n = 150).**

Variable	Total	Male	Female	P value
Age				.039
≤20	52 (34.7%)	17 (25.4%)	35 (42.2%)	
>20	98 (65.3%)	50 (74.6%)	48 (57.8%)	
Years of play				.21
0–5	44 (29.3%)	16 (23.9%)	28 (33.7%)	
>5	106 (70.7%)	51 (76.1%)	55 (66.3%)	
Right or left-handed				.249
Right	137 (91.3%)	59 (88.1%)	78 (94.0%)	
Left	13 (8.7%)	8 (11.9%)	5 (6.0%)	
Racket grip				.514
Shakehand	141 (94.0%)	62 (92.5%)	79 (95.2%)	
Penhold	9 (6.0%)	5 (7.5%)	4 (4.8%)	
Forehand rubber				.020
Inverted rubber	133 (88.7%)	64 (95.5%)	69 (83.1%)	
Pimpled rubber, anti-spin rubber, or others	17 (11.3%)	3 (4.5%)	14 (16.9%)	
Backhand rubber				.128
Inverted rubber	114 (76.0%)	55 (82.1%)	59 (71.1%)	
Pimpled rubber, anti-spin rubber, or others	36 (24.0%)	12 (17.9%)	24 (28.9%)	
Forehand style of play				.129
Offensive	146 (97.3%)	67 (100%)	79 (95.2%)	
Defensive	4 (2.7%)	0	4 (4.8%)	
Backhand style of play				.001
Offensive	62 (41.3%)	38 (56.7%)	23 (27.7%)	
Defensive	88 (58.7%)	29 (43.3%)	60 (72.3%)	
Singles or doubles				.324
Singles	75 (50.0%)	37 (55.2%)	38 (45.8%)	
Doubles	75 (50.0%)	30 (44.8%)	45 (54.2%)	
Average days of training per week				.001
1–3	121 (80.7%)	46 (68.7%)	75 (90.4%)	
>3	29 (19.3%)	21 (31.3%)	8 (9.6%)	
Average hours of training per session				1
0–3	139 (92.7%)	62 (92.5%)	77 (92.8%)	
>3	11 (7.3%)	5 (7.5%)	6 (7.2%)	
Average hours of training per week				.277
0–9	117 (82.4%)	51 (78.5%)	66 (85.7%)	
>9	25 (17.6%)	14 (21.5%)	11 (14.3%)	
Increased training 2 weeks before major competitions				.136
Yes	137 (91.3%)	59 (88.1%)	79 (95.2%)	
No	13 (8.7%)	8 (11.9%)	4 (4.8%)	
One-to-one training				.285
Yes	27 (18.0%)	15 (22.4%)	12 (14.5%)	
No	123 (82.0%)	52 (77.6%)	71 (85.5%)	
Coach supervision during team training				1
Yes	108 (73.5%)	48 (73.8%)	59 (72.0%)	
No	39 (26.5%)	17 (26.2%)	23 (28.0%)	
Warm up before training				.279
Yes	106 (70.7%)	51 (76.1%)	55 (66.3%)	
No	44 (29.3%)	16 (23.9%)	28 (33.7%)	
Cool down after training				1
Yes	42 (28.0%)	19 (28.4%)	24 (28.9%)	
No	108 (72.0%)	48 (71.6%)	59 (71.1%)	

nontraumatic (no direct contusion), such as strains or sprains. Soft tissue injury was the most common (91.9%). Lower extremity injuries were the most common (67.1%), followed by upper extremity injuries (56.6%) (see supplementary file for details, <http://links.lww.com/MD2/A762>). No significant gender differences were observed in the characteristics of injuries.

Differences between injured and noninjured athletes in terms of the characteristics of training, playing style, and performance in

the 2019 NIAAG are displayed in Table 3. Athletes who experienced injuries over the 6 months before the study tended to be right-handed ( $P = .045$ ) and use Kinesio taping ( $P = .022$ ) or protective equipment, such as a wrist guard and a patella strap ( $P = .005$ ) to manage the injuries.

The differences between participants with mild and moderate-to-severe injuries in terms of the characteristics of training, playing style, and performance in NIAAG are displayed in Table 4.

**Table 2****Characteristics of injury.**

Variable	Total injured cases (n = 76)	Male injured cases (n = 37)	Female injured cases (n = 39)	P value
Type of injury*—soft tissue injury				.424
Yes	68 (91.9%)	32 (88.9%)	36 (94.7%)	
No	6 (8.1%)	4 (11.1%)	2 (5.3%)	
Type of injury*—trauma				.051
Yes	4 (5.4%)	4 (11.1%)	0	
No	70 (94.6%)	32 (88.9%)	38 (100%)	
Regions of injury—lower limb				.808
Yes	51 (67.1%)	24 (64.9%)	27 (69.2%)	
No	25 (32.9%)	13 (35.1%)	12 (30.8%)	
Regions of injury—upper limb				1
Yes	43 (56.6%)	21 (56.8%)	22 (56.4%)	
No	33 (43.4%)	16 (43.2%)	17 (43.6%)	
Regions of injury—trunk				.342
Yes	28 (36.8%)	16 (43.2%)	12 (30.8%)	
No	48 (63.2%)	21 (56.8%)	27 (69.2%)	
Regions of injury—head and neck				.671
Yes	5 (6.6%)	3 (8.1%)	2 (5.1%)	
No	71 (93.4%)	34 (91.9%)	37 (94.9%)	
Treatment after injury				1
Yes	36 (47.4%)	18 (48.6%)	18 (48.2%)	
No	40 (52.6%)	19 (51.4%)	21 (51.8%)	

\* Two participants did not indicate the type of injury.

**Table 3****Differences between participants with and without injury experience over the 6 months before the study.**

Variable	Injured (n = 76)	Noninjured (n = 74)	P value
Gender			.33
Male	37 (48.7%)	30 (40.5%)	
Female	39 (51.3%)	44 (59.5%)	
Age			1
≤20	26 (34.2%)	26 (35.1%)	
>20	50 (65.8%)	48 (64.9%)	
Years of play			.108
0–5	27 (35.5%)	17 (23.0%)	
>5	49 (64.5%)	57 (77.0%)	
Right-handed or left-handed			.045
Right	73 (96.1%)	64 (86.5%)	
Left	3 (3.9%)	10 (13.5%)	
Racket Grip			1
Shakehand	71 (93.4%)	70 (94.6%)	
Penhold	5 (6.6%)	4 (5.4%)	
Forehand rubber			.206
Inverted rubber	70 (92.1%)	63 (85.1%)	
Pimpled rubber, antispin rubber, or others	6 (7.9%)	11 (14.9%)	
Backhand rubber			.849
Inverted rubber	57 (75.0%)	57 (77.0%)	
Pimpled rubber, antispin rubber, or others	19 (25.0%)	17 (23.0%)	
Forehand style of play			1
Offensive	74 (97.4%)	72 (97.3%)	
Defensive	2 (2.6%)	2 (2.7%)	
Backhand style of play			.622
Offensive	33 (43.4%)	29 (39.2%)	
Defensive	43 (56.6%)	45 (60.8%)	
Singles or doubles			1
Singles	38 (50.0%)	37 (50.0%)	
Doubles	38 (50.0%)	37 (50.0%)	
Average days of training per week			.098
1–3	57 (75.0%)	64 (86.5%)	
>3	19 (25.0%)	10 (13.5%)	

(continued)

**Table 3**  
(continued).

Variable	Injured (n = 76)	Noninjured (n = 74)	P value
Average hours of training per session			.209
0–3	68 (89.5%)	71 (95.9%)	
>3	8 (10.5%)	3 (4.1%)	
Average hours of training per week			.077
0–9	55 (76.4%)	62 (88.6%)	
>9	17 (23.6%)	8 (11.4%)	
Increased training 2 weeks before major competitions			.561
Yes	71 (93.4%)	67 (90.5%)	
No	5 (6.6%)	7 (9.5%)	
One-to-one training			1
Yes	14 (18.4%)	13 (17.6%)	
No	62 (81.6%)	61 (82.4%)	
Coach supervision during team training			.853
Yes	54 (74.0%)	53 (71.6%)	
No	19 (26.0%)	21 (28.4%)	
Warm-up before training			.105
Yes	59 (77.6%)	48 (64.9%)	
No	17 (22.4%)	26 (35.1%)	
Cool-down after training			.473
Yes	24 (31.6%)	19 (25.7%)	
No	52 (68.4%)	55 (74.3%)	
Physical activities in addition to table tennis			.323
Yes	34 (44.7%)	27 (36.5%)	
No	42 (55.3%)	47 (63.5%)	
Use of Kinesio taping			.022
Yes	30 (39.5%)	16 (21.6%)	
No	46 (60.5%)	58 (78.4%)	
Use of protective equipment			.005
Yes	28 (36.8%)	12 (16.2%)	
No	48 (63.2%)	62 (83.8%)	
Qualified for 2019 NIAG nationals?			.870
Yes	42 (55.3%)	39 (52.7%)	
No	34 (44.7%)	35 (47.3%)	
Top 8 in 2019 NIAG nationals?			1
Yes	12 (28.6%)	11 (28.2%)	
No	30 (71.4%)	28 (71.8%)	

Participants who experienced moderate-to-severe injury used noninverted rubber for the forehand ( $P = .042$ ) more commonly compared with participants who experienced mild injury. The results of the analysis of the association between body location and severity of injury are displayed in Table 5; no significant association was identified.

#### 4. Discussion

This study provided information regarding the injury profiles of nonprofessional collegiate table tennis athletes who participated in the 2019 NIAG, and explored potential risk factors associated with the injuries. Gender differences were observed in the categories of age, forehand rubber, backhand style of play, and average days of training per week. In total, 76 of 150 participants experienced at least one injury over the past 6 months, which indicates a high sports-related injury rate. The handedness for play was associated with the occurrence of injury, and athletes tended to use Kinesio taping and protective equipment to manage the injuries. Among participants who experienced injuries, injury severity was associated with the use of noninverted rubber for the forehand stroke.

This study shows a high injury rate; 50.7% of participants experienced at least one sports-related injury over the past 6 months. Although the majority of injury cases was mild, there were still 33.8% of injured athletes who needed to pause training. Such a high injury rate should draw attention to trainers and coaches for implementation of measures for injury prevention. Sun and Zhang<sup>[15]</sup> previously reported a high proportion (i.e., 67.2%) of Chinese collegiate table tennis athletes who had experienced injuries; however, they did not describe how they had defined the injury rate. The level of athletes was also unclear. By comparison, 2 previous studies indicated a low injury rate (i.e., 0–3%, and 5%) among elite table tennis athletes who took participated in the 2008 and 2016 Olympic games.<sup>[13,14]</sup> However, it should be noted that the injury rate reported in those 2 studies was the incidence during a short period of the Olympic tournament, which might account for a low injury rate. Accordingly, care should be taken to not completely attribute the difference in injury rates between the abovementioned studies to the level of professionalism.

Our study shows that a higher proportion of female athletes used noninverted rubber for the forehand than male athletes (Table 1). This may be attributed to the difference in the general

**Table 4**  
**Potential factors related to the severity of injury.**

Variable	Mild (n=49)	Moderate to severe (n=25)	P value
Gender			1
Male	25 (51.0%)	12 (48.0%)	
Female	24 (49.0%)	13 (52.0%)	
Age			.201
≤20	20 (40.8%)	6 (24.0%)	
>20	29 (59.2%)	19 (76.0%)	
Years of play			.61
0–5	16 (32.7%)	10 (40.0%)	
>5	33 (67.3%)	15 (60.0%)	
Right-handed or left-handed			.546
Right	46 (93.9%)	25 (100%)	
Left	3 (6.1%)	0	
Racket grip			1
Shakehand	46 (93.9%)	24 (96.0%)	
Penhold	3 (6.1%)	1 (4.0%)	
Forehand rubber			.042
Inverted rubber	48 (98.0%)	21 (84.0%)	
Pimpled rubber or others	1 (2.0%)	4 (16.0%)	
Backhand rubber			.582
Inverted rubber	36 (73.5%)	20 (80.0%)	
Pimpled rubber or others	13 (26.5%)	5 (20.0%)	
Forehand style of play			.546
Offensive	47 (95.9%)	25 (100%)	
Defensive	2 (4.1%)	0	
Backhand style of play			.627
Attack	23 (46.9%)	10 (40.0%)	
Defensive	26 (63.4%)	15 (60.0%)	
Singles or doubles			.326
Singles	22 (44.9%)	15 (60.0%)	
Doubles	27 (55.1%)	10 (40.0%)	
Average days of training per week			1
1–3	36 (73.5%)	19 (76.0%)	
>3	13 (26.5%)	6 (24.0%)	
Average hours of training per session			.110
0–3	46 (93.9%)	20 (80.0%)	
>3	3 (6.1%)	5 (20.0%)	
Average hours of training per week			1
0–9	35 (76.1%)	19 (76.0%)	
>9	11 (23.9%)	6 (24.0%)	
Increased training 2 weeks before major competitions			1
Yes	46 (93.9%)	23 (92.0%)	
No	3 (6.1%)	2 (8.0%)	
One-to-one training			.059
Yes	6 (12.2%)	8 (32.0%)	
No	43 (87.8%)	17 (68.0%)	
Coach supervision during team training			.265
Yes	33 (70.2%)	20 (83.3%)	
No	14 (29.8%)	4 (16.7%)	
Warm-up before training			.306
Yes	38 (77.6%)	20 (80.0%)	
No	11 (22.4%)	5 (20.0%)	
Cool down after training			.306
Yes	18 (36.7%)	6 (24.0%)	
No	31 (63.3%)	19 (76.0%)	
Physical activities in addition to table tennis			.805
Yes	21 (42.9%)	12 (48.0%)	
No	28 (57.1%)	13 (52.0%)	
Use of Kinesio taping			.458
Yes	17 (34.7%)	11 (44.0%)	
No	32 (65.3%)	14 (56.0%)	
Use of protective equipment			.458
Yes	17 (34.7%)	11 (44.0%)	
No	32 (65.3%)	14 (56.0%)	
Qualified for 2019 NIAG nationals?			.472
Yes	28 (57.1%)	12 (48.0%)	
No	21 (42.9%)	13 (52.0%)	
Top 8 in 2019 NIAG nationals?			.124
Yes	10 (35.7%)	1 (8.3%)	
No	18 (64.3%)	11 (91.7%)	

Note: 2 of the 76 injured participants did not indicate the severity of the injury.

**Table 5**  
**Relationship between the region and severity of injuries.**

Region of injury	Mild (n=49)	Moderate to severe (n=25)	P value
Lower limb injury	29 (59.2%)	12 (48.0%)	.460
No lower limb injury	20 (40.8%)	13 (52.0%)	
Upper limb injury	30 (61.2%)	20 (80.0%)	.122
No upper limb injury	19 (38.8%)	5 (20.0%)	
Trunk injury	19 (38.8%)	9 (36.0%)	1
No trunk injury	30 (61.2%)	16 (64.0%)	
Head and neck injury	3 (6.1%)	2 (8.0%)	1
No head/neck injury	46 (93.9%)	23 (92.0%)	

The values represent the total number of patients (% of patients among those with an injury in this region).

style of play. Male athletes generally play with much more spin and power and often hit the ball later using the counter loop technique. In contrast, female athletes tend to play at a controlled speed. The spin and power input by female athletes are generally lower than those of male athletes. Hence, they would usually stand closer to the table and hit the ball earlier to limit the opponent's time to react. This trend has also been noted in tennis.<sup>[19,20]</sup> The use of noninverted rubber is another method to control spin and speed, varying the speed and spin of returning shots to the opponents. Furthermore, in this study, compared with male athletes who tended to use an all-offensive style of play, female athletes generally adopted a defensive strategy for backhand strokes. However, although male and female athletes differ in their style of playing, gender differences were not associated with the occurrence and severity of injuries.

To our knowledge, this is the first study to explore the potential risk factors for table tennis injuries. The finding that handedness was associated with injury occurrence is interesting. It was unclear why right-handed players were more prone to injuries than left-handed players. Further studies are required to confirm the underlying relationship and the mechanism. In addition, we found that the use of rubber other than inverted rubber might be associated with more severe injuries. Inverted rubber is an offensive and the most popular type of rubber. Although the mechanism underlying the association between the rubber type and injury severity is unclear, it is possible that the players and coaches are less familiar with the rubber other than inverted rubber (e.g., pimped rubber), which can potentially lead to improper use, resulting in more severe injuries.

Regarding the site of injury, Kondrič et al<sup>[16]</sup> reported that the most common site of injury was the shoulder girdle among Slovenian elite table tennis players. Ebadi and Günay<sup>[21]</sup> reported that the entire upper limbs and knees were the most common sites of injury for men and women, respectively, among Turkish elite table tennis players. While we reported that the top 4 most common sites of injury (i.e., the ankle, arm, waist, and thigh), shoulder injury was not common. Perhaps the difference between professional and nonprofessional athletes regarding the biomechanical aspect during playing may partially explain the difference in injury sites.

Professional athletes are required to perform quicker shots, and the level of play is much more intense and focused on offensive play than among nonprofessional athletes. These features could contribute to the shoulder, knee, and waist, these being the most common sites of injury among professional athletes. In contrast, nonprofessional athletes are less prepared for the stroke, which increases the likelihood of making decisive

last-minute actions, causing compensatory over-dynamic motions of the upper extremity based on the unstable posture of the trunk and lower extremity. Wang et al<sup>[4]</sup> highlighted that nonprofessional players often have a significantly larger ankle internal rotation, increasing the risk for an ankle sprain, which may explain the comparatively higher injury rate of the ankle among nonprofessional players.

This study has several limitations. First, the sample size was small. It was suggested that to detect moderate-to-strong associations, 20 to 50 cases of injury are needed, whereas small associations would need approximately 200 injured subjects.<sup>[22]</sup> Accordingly, the statistical power in this study might be low. Second, the use of questionnaires might be susceptible to recall bias; and the identification of injury was self-reported without clinical confirmation. Third, this was a cross-sectional study, which cannot determine the causal relationships between the injury and the studied factors. Fourth, the relatively low response rate (i.e., 50%) might have affected the representativeness of the data. Fifth, there were only a few cases of severe injury; therefore, we were unable to analyze solely on this category of injury severity. Finally, the focus on nonprofessional players might limit the extrapolation to all table tennis athletes.

## 5. Conclusion

Considering the high sports injury rate among nonprofessional collegiate athletes, further studies are required to focus on table tennis-related injuries. Playing styles such as handedness and type of rubber used might be associated with table tennis injury. The lower limb was the most common site of injury. These results potentially provide insights to trainers and coaches for further measures in injury prevention.

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