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Musculoskeletal Injuries in Table Tennis during Competition: A Systematic Review

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ABSTRACT

The study aimed to investigate the incidence of musculoskeletal injuries among table tennis players and identify their associated risk factors. We conducted a literature search in online databases using relevant search terms related to "table tennis" and "injury". To compare the rate of injuries according to player-related variables, we extracted information on sex, level of games, circumstances of injury, and duration of sport absence after injury. Furthermore, we calculated the odds ratios based on the number of injuries according to variables. Eight articles included 873 professional table tennis players, revealing an overall musculoskeletal injury rate of 3.6 % (31 musculoskeletal injuries). The incidence was 10.0 injuries per 1,000 playing hours (range, 0–27.0). The rate of musculoskeletal injuries for female and male players were 3.2 % and 3.8 %, respectively, and those for Summer Olympic Games, Asian Games, and domestic national games was 4.8 %, 15.4 %, and 0 %, respectively. More than half (52 %) of injuries occurred during training, and most injuries (64 %) were of a nature that did not cause time loss. This review provides valuable information about the incidence of musculoskeletal injuries in table tennis competitions. However, owing to the limitations of this study in identifying injury-related risk factors, future studies analyzing comprehensive variables are required.

Introduction

Musculoskeletal injuries (MSKIs) are injuries that can affect muscles, bones, and joints and are commonly encountered in sports practice [1, 2]. MSKIs are one of the most common health-related injuries in athletes that results in economic costs, diminished performance, and even withdrawal from competitions [3].

Table tennis, also known as ping-pong, is a racket sport played regularly by over 300 million people globally with at least 40 million federated players [4]. It may be used for physical education, recreation, and therapeutic modality for various diseases [5, 6]. Furthermore, table tennis attracts participants of diverse ages, ranging from young athletes to older competitors [5, 6]. However, it is a complex sport that requires quick reflexes, rapid decision-

making, and intricate upper extremity rotations involving the wrist, elbow, and shoulder, as well as trunk rotation and lower limb mobility with constant knee flexion [7, 8]. Therefore, it is believed that table tennis players are susceptible to MSKIs.

In the process of establishing an injury prevention strategy, knowledge of the risk factors associated MSKIs is important. Previous systematic reviews have evaluated the risk factors for MSKIs in other sports disciplines [9]. Although a descriptive study on MSKIs among high-performance players has been published [10], no studies have provided a comprehensive dataset on MSKIs in table tennis during competition. Therefore, this study aimed to evaluate the characteristics of MSKIs in table tennis during competition and identify the risk factors by comparing MSKI rates according to player related variables.

Materials and Methods

Search strategy

This study was conducted according to the preferred reporting items for systematic reviews and meta-analysis guidelines [11]. On December 7, 2021, we conducted a literature search in online databases (PubMed, Embase, Web of Science) using different related search terms as presented in ▶ **Table 1**.

Inclusion and exclusion criteria

The inclusion criteria included: (1) studies on MSKIs that occurred in table tennis; (2) studies that defined injuries as new or recurring musculoskeletal complaints, concussions, or other medical conditions (injuries) incurred in a competition or training requiring medical attention, regardless of the resulting absence from competition or training [12]; and (3) studies written in English.

The exclusion criteria were as follows: 1) studies on non-MSKIs, diseases, or other health problems in table tennis; 2) case reports; and 3) review articles. However, for review articles, although they were not directly included in the analysis, we added original articles cited within some review articles for our analysis.

Data extraction and data analysis

We initially screened the results from the search string above based on a review of the abstract or full text of each article, excluding studies that were irrelevant. We obtained the full-text portable document format of the remaining articles and reviewed them accordingly.

To compare the prevalence of MSKIs according to player-related characteristics, we extracted information on sex, level of games, circumstances of injury, and time loss from sport after injury as player-related variables. For risk factor analysis, we classified each characteristic into subcategories. We classified the level of games attended by players in each original article as Summer Olympic Games, Asian Games, and domestic national games. Moreover, we classified the circumstances of injury as the training or competition periods.

Statistical analysis

We calculated the odds ratio using the number of MSKIs according to player-related variables. Data were analyzed using IBM SPSS ver. 20.0 (IBM Corp., Armonk, NY, USA), and a p-value <0.05 was statistically significant.

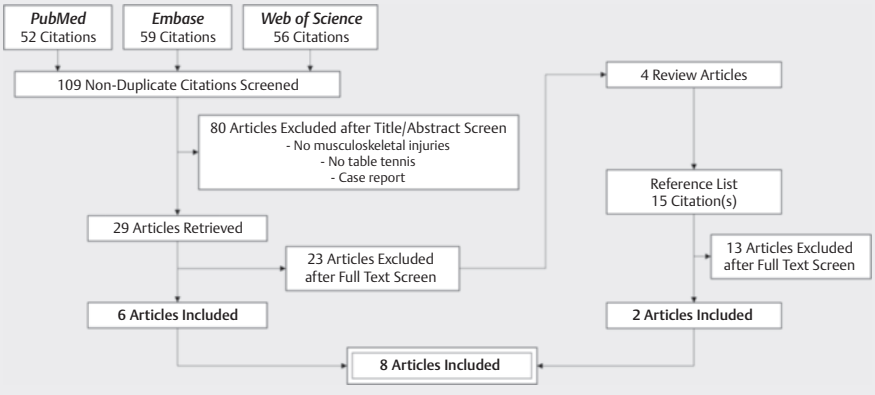
▶ **Table 1** Search strategy items and details

Database	Search terms
PubMed	((table tennis) OR (table tennis [MeSH Terms])) AND ((injury) OR (injury[MeSH Terms]) OR (trauma) OR (trauma [MeSH Terms]))
Embase	('table tennis' OR 'table tennis': ti, ab, kw) AND (injury OR injury: ti, ab, kw OR trauma OR trauma: ti, ab, kw)
Web of Science	(ALL = (table tennis) OR TS = (table tennis)) AND (ALL = (injury) OR TS = (injury) OR ALL = (trauma) OR TS = (trauma))

Results

Flowchart of the study selection process

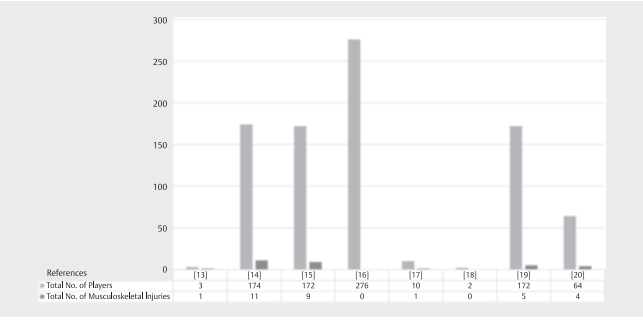
▶ **Fig. 1** shows the literature search, collection, exclusion, and inclusion process. We included eight studies [13–20] in the final analysis; the authors' names, journal, year of publication, study population size, level of games attended by players, and observation period for each study are summarized in ▶ **Table 2**.



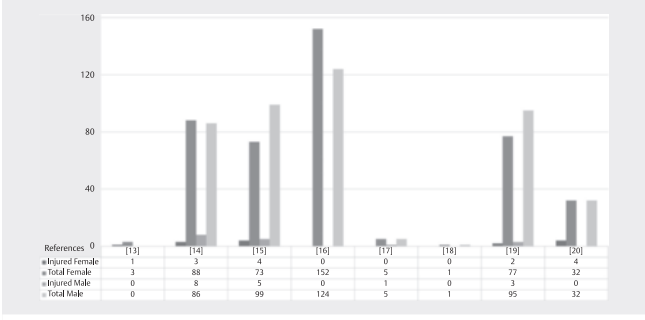
▶ **Fig. 1** Flowchart of the study selection process.

▶ **Table 2** Main features of the included studies

Authors	Journal (Year of publication)	No. of study population (Total / male / female)	Level of games which players attended	Observational period (days)
A Hamid et al. [13]	Sains Malaysiana (2016)	3 / 0 / 3	Asian Games	26
Engebretsen et al. [14]	Br J Sports Med (2013)	174 / 86 /88	Summer Olympic Games	17
Junge et al. [15]	Am J Sports Med (2009)	172 / 99 / 73	Summer Olympic Games	16
Laoruengthana et al. [16]	J Med Assoc Thai (2009)	276 / 124 / 152	Thailand National Games	11
Lhee et al. [17]	BMJ Open Sport Exerc Med (2021)	10 / 5 / 5	Asian Games	16
Nabhan et al. [18]	Br J Sports Med (2016)	2 / 1 / 1	Youth Summer Olympic Games	13
Soligard et al. [19]	Br J Sports Med (2017)	172 / 95 / 77	Summer Olympic Games	17
Steffen et al. [20]	Br J Sports Med (2020)	64 / 32 / 32	Youth Summer Olympic Games	13



▶ **Fig. 2** Total number of table tennis players enrolled in each study and total number of musculoskeletal injuries in that study.



▶ **Fig. 3** Number of injured table tennis players according to sex in each study.

Study participants

Eight articles included 873 table tennis players, with 442 players (50.6 %) being male. Five articles involved 584 players who attended the Summer Olympic Games, including the Youth Olympic Games; 13 players from two articles attended the Asian Games; and 276 players from one article attended the domestic national games.

Overall rate of musculoskeletal injuries

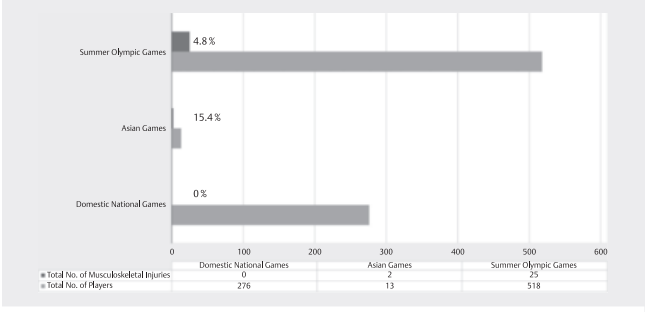
During competition, 31 MSKIs were reported among the 873 professional table tennis players, and the overall rate of MSKIs in table tennis during competition was 3.6 %. ▶ **Fig. 2** shows the number of professional table tennis players enrolled in each study and the total number of MSKIs in each group. The incidence of table tennis-related MSKIs was 10.0 injuries per 1,000 playing hours (range, 0–27.0).

Sex

Eight studies provided data on the sex distribution of players and ▶ **Fig. 3** shows the rate of MSKIs according to the sex reported in each article. Overall, 14 MSKIs occurred in 431 female players, and 17 MSKIs occurred in 442 male players. The rate of MSKIs for female and male players were 3.2 % and 3.8 %, respectively, with no significant difference (p = 0.63).

Level of games

▶ **Fig. 4** shows the rate of MSKIs according to the level of games reported in each article. The rate of MSKIs in each group was 4.8 % (25 injuries/518 players) for the Summer Olympic Games, 15.4 % (2 injuries / 13 players) for the Asian Games, and 0 % (0 injuries/276 players) for the domestic national games. No significant difference between the Summer Olympic Games and Asian Games was observed (p = 0.09).



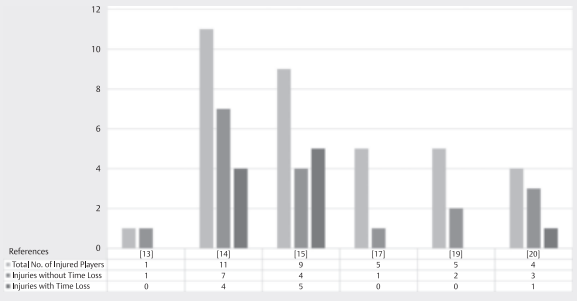
▶ **Fig. 4** Rate of musculoskeletal injuries according to level of games that players attended.

Circumstances of injury

Information on the circumstance of injury was available for 25 (80.6 %) injuries in five studies [13–15, 19, 20]. Of these, 13 (52.0 %) occurred during training, and 12 (48.0 %) during competition.

Time loss from sport after injury

Data on time loss from sport after injury were available for 28 injuries (90.3 %) in six studies [13–15, 17, 19, 20]. ▶ **Fig. 5** shows the rate of MSKIs according to the time loss reported in each article. Of



▶ **Figure 5** Number of musculoskeletal injuries according to time loss from sport after injury.

▶ **Table 3** Risk factors for musculoskeletal injuries in table tennis

Player variables	Compare	Odds ratio	95 % C.I
Male	Female	1.19	0.57–2.45
Asian Games	Summer Olympic Games	3.59	0.75–17.1

the 28 injuries, 18 (64.3 %) were injuries without time loss, and the remaining injuries (35.7 %) were injuries with time loss.

Risk factors for musculoskeletal injuries

▶ **Table 3** presents the odds ratios of MSKIs according to player variables.

Discussion

This systematic review investigated the rate of MSKIs in table tennis during competition. To the best of our knowledge, this is the first review to assess the rate and risk factors of MSKIs among professional table tennis players. We found that 31 MSKIs occurred in 873 professional table tennis players, and the incidence of MSKIs in table tennis during competition was 10.0 injuries per 1,000 player hours. However, no significant risk factors for MSKIs were observed in table tennis during competition.

Kondric et al. [21] evaluated the frequency of sports injuries among top Slovenian racket players and reported that table tennis players experience fewer injuries compared to badminton and tennis players. Abadi et al. [22] conducted a prospective cohort study during professional tennis tournaments in Indonesia under the International Tennis Federation and reported an MSKI incidence rate of 30.8 injuries per 1,000 playing hours. In this study, the incidence rate of MSKIs in table tennis during competition was 10.0 injuries per 1,000 playing hours, suggesting a lower incidence compared to other racquet sports.

The rate of MSKIs in table tennis during competition may vary depending primarily on the definition of the injury, demographic characteristics of study participants, and length of observation [23]. By exploring studies conducted on a group of players with similar performance levels or participating in the same game, a study of non-professional collegiate players reported MSKI rates between 50.7 % and 67.2 %, whereas a study of world-class athletes who participated in the Summer Olympic Games reported rates between 2.9 % and 6.3 % [14, 15, 19, 24, 25]. However, readers should keep in mind that the study on MSKIs in world-class athletes only investigated MSKIs that occurred during the Summer Olympic Games held for a brief period (16–17 days).

No significant differences in the total number of injuries, injury severity, and incidence of injuries between non-professional players and professional athletes were reported [26–28]. In a cross-sectional epidemiological study of beach tennis injuries in 206 elite and recreational players, the incidence of injuries in elite players was less than that in non-ranked players (1.71 vs. 2.04 injuries/1,000 hours play) [26]. Nevertheless, Bahr and Krosshaug [29] reported that the incidence of sports injuries in professional athletes was lower than that in non-professional players. This review was aimed at studies that analyzed MSKIs in professional table tennis athletes during competition. The reason is that studies on non-professional athletes have often investigated injuries under the athletes' own judgment without using the definition of injuries used in this study [12]. Therefore, to analyze the difference in MSKIs between non-professional and professional table tennis players, it is necessary to conduct a prospective study using the same definition of injuries.

A previous study that explored the epidemiology of sports-related injuries in young athletes reported that 59.3 % of injuries occurred during training and 40.7 % during competitions [27]. At the 2012 Summer Olympic Games, a higher injury occurrence was reported during competition than during training [14], whereas an opposite trend was observed during the 2008 Summer Olympic Games [15]. However, the 2016 Summer Olympic Games and the 2018 Youth Summer Olympic Games had the same number of MSKIs during training and competition [19, 20]. Regarding whether the risk of injury differs depending on the circumstance of injury, Kondric et al. [21] suggested that the increase in MSKIs during the competition period was due to increased risk factors, such as the opponent, violation of fair play, and increased motivation.

This study had some limitations. First, this study provided only overall information on MSKIs in table tennis; however, it could not provide information on the cause of the injury, accurate diagnosis, and prevalence information according to the diagnosis. Second, this study could not analyze the incidence of MSKIs according to player age. This is because only four of the eight articles included in the analysis presented the mean age of the entire population, and the above studies did not separately describe the age of the injured player. Finally, we could not extract information on important variables that were expected to be related to the risk of musculoskeletal injury, such as a player's career, athletic style (attacking, defense, forehand stroke, and backhand stroke), usual amount of training, and post-injury history.

However, this study has an advantage of being the first to systematically review MSKIs that occur in professional table tennis players during competition and this systematic review provides a comprehensive understanding of the MSKIs that occur in table tennis during competition.

In conclusion, this systematic review provides valuable information about the MSKIs in table tennis during competition. Because this study could not identify injury-related risk factors, future research that analyzes comprehensive variables is required.

Conflict of Interest

The authors declare that they have no conflict of interest.

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