

An Investigation of Knee Injury Prevalence and Its Mechanism among Iranian Professional Karatekas

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Original Article

Abstract

Introduction: The knee joint is one of the most frequent points of injuries among karatekas. This study aimed to investigate the prevalence and mechanisms of knee injuries in Iranian professional karatekas.

Materials and Methods: 390 kumite-style karatekas who participated in the national team were nominated as subjects in the current study. The sports background information, knee injury profile, and how these injuries affect the subjects' ability and limitation in daily and sports activities were recorded using the Knee Outcome Survey (KOS) questionnaire. Descriptive statistics [95% confidence interval (CI) and standard deviation (SD)] were used to describe the data. In addition, the Pearson correlation test was used to determine the relationship between subscales related to the abilities and limitations in daily and sports activities and their self-reported scores.

Results: 73% of karatekas experienced knee injury, which often occurred during training exercises. The cartilage and meniscus injuries (12.5%) and anterior cruciate ligament (ACL) injuries (9.5%) had the highest prevalence, and the predominant mechanism was hitting the opponent with the foot, abrupt rotation, and landing. The correlation coefficient of the subscale of athlete's ability in daily and sports activities with self-reported scores was $r = 0.761$ ($P < 0.001$) and $r = 0.782$ ($P < 0.001$), respectively. The knee-related quality of life scale in karatekas was also in the range of 95% CI: 21.8-43.0.

Conclusion: The present study adds new findings about the knee injury profile of karatekas to the research literature. Therefore, its output can be considered as the input of future studies as a practical factor to prevent injury among karatekas.

Keywords: Knee; Knee outcome survey questionnaire; Karate; Quality of life

Citation: Letafatkar A, Naserpour H. **An Investigation of Knee Injury Prevalence and Its Mechanism among Iranian Professional Karatekas.** *J Res Rehabil Sci* 2022; 17: 145-52.

Received: 09.11.2021

Accepted: 19.12.2021

Published: 05.01.2022

Introduction

Participating in physical activities and sports is a global priority due to its numerous benefits, including improving public health, resistance to non-communicable diseases, and enhancing physical, mental, social, and economic fitness indicators (1). Eastern martial arts are widely practiced worldwide due to their physical and mental benefits (2). Karate,

one of the world's most common Olympic martial sports, has attracted public attention in recent decades due to its medal-winning performances in Iran (3, 4). Karate involves two types of competitions, kata (form) and kumite (combat). Karate (kumite) involves a two-person Olympic-style fighting match with active movements and maximum intensity (3, 5).

Participating in sports has inherent injury risks,

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with karatekas experiencing the most injuries in the trunk and neck (40%), knee (32%), upper limb (16%), and trunk alone (12%) according to past studies (3, 5-7). In taekwondo (57%) and judo (39%), the lower limb is the most common site of injury (8) due to factors like wrong techniques, fatigue, and equipment used. The nature of karate causes damage to the lower limbs due to overwork from repeated kicks, jumps, and landings (10). According to karate experts, jumping and landing are essential strategies that require coordination between the upper and lower limbs to absorb forces (6). Improper landing following a jump is a common cause of lower limb injuries (11) such as sprains, cartilage injuries, stress fractures, patellar tendinopathy, patellofemoral pain syndrome (PFPS), and anterior cruciate ligament (ACL) rupture (12-16).

Effective injury prevention strategies are essential to reduce treatment costs and athlete injury incidence as social assets (4, 17). Prevention is necessary and justifiable before treatment due to the high prevalence of injuries and the multifaceted complications they cause (18). Identifying the more damaged points (4, 19) before taking a proactive approach to injury prevention in karate is necessary. The characteristics of karate injuries are unique, and identifying the injury profile is the first step toward prevention programs. Therefore, this study investigated the prevalence and mechanism of knee injuries in professional Iranian male karatekas.

Materials and Methods

This study followed the ethical standards of the Declaration of Helsinki (20) and was approved by the Research Ethics Committee of Sport Sciences Research Institute under the number IR.SSRI.REC.1400.1070. The "materials and methods" section adhered to Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines (21). 390 male karatekas (kumite) with an average age of 24 ± 3 years, an average weight of 63 ± 12 kg, and an average height of 1.7 ± 0.1 meters who participated in the national competitions in Shiraz, Iran, participated in the present research. Before the data collection, the executive committee informed the sports team heads about the research objectives. The athletes were provided with additional explanations by the researcher, and they

completed the written paper-and-pencil self-report study in about ten minutes. The researchers were available to clear any ambiguities or questions.

Questionnaire of demographic information and sports background: It included demographic characteristics such as height, weight, age, sports history, number of training sessions per week, days and hours of training, duration of exercise, and warm-up methods.

Knee Injury Profile Questionnaire: This scale included information on injury history, injured leg (dominant or non-dominant), mechanism of injury, time of injury, treatment, and type of care after injury. The injury rate was calculated by dividing the injuries by 1000 hours of sports activity.

The Knee Outcome Survey (KOS): It is a widely used self-report questionnaire to evaluate knee joint disability and measure knee disorders in daily activities and sports, including meniscus, ligament, cartilage lesions, PFPS, knee dislocation, or osteoarthritis for both athletes and elderly people (23-28). The KOS questionnaire uses five subscales to measure pain and symptoms in daily life and activities [activities of daily living (ADL)], pain and symptoms in sports activities [Sports Activity Scale (SAS)], and knee-related quality of life scale which evaluates quality of life (QOL). This questionnaire includes 42 five-point Likert scale questions ranging from 0 to 4 (no symptoms to severe problems/disability). Raw scores were converted to a 0-100 scale for each subscale (24). The KOS questionnaire was translated into Farsi, and its validity and reliability were confirmed for ADL (0.97 and 0.78, respectively) and SAS (0.97 and 0.97) subscales (18, 25, 28).

Karate athletes rated their knee performance during daily activities and sports using the visual analog scale (VAS) score from 0 (severe problem) to 100 (no problem), showing motor awareness (18).

The data were entered into Excel 2010 and SPSS software (version 25, IBM Corporation, Armonk, NY, USA). Any questionnaire data with over 20% missing values were removed. Descriptive statistics were used for single-choice questions and confidence intervals (CIs) at the 95% level for continuous variables. Pearson's correlation coefficient (a significance level of 0.05) was used to identify correlations between KOS subscales during ADL and SAS with individual scoring and self-report scales in the SPSS.

Results

The study included 520 karatekas, with 73.6% having one or more knee injuries. 130 participants declined to participate. The average age was 24 (95% CI: 7.10-23.24), weight was 63 kg (95% CI: 8.20-61.64), and height was 172 cm (95% CI: 171-173).

The information obtained from the sports background of the subjects showed that 98 people (25%) were active at the national level and other people (292 people, 75%) at the club level, of which 272 people (70%) were active for more than five years, 113 people (29%) had between 3 and 5 years of experience in karate, and about 1% less than 3 years. About three-quarters of the athletes (294 people) practiced karate more than three days a week; 263 people (67%) practiced between 1 and 2 hours per session. The duration of warm-up was less than 30 minutes in 360 people (92%). Warm-up exercises include stretching, running, and combat exercises in 164 people (42%), a combination of stretching and combat exercises in 33 people (8.5%), and a combination of stretching and running in 65 people (16.7%); martial training alone was observed in 67 people (17.2%), running alone in 33 people (8.5%), and stretching alone in 28 people (7.2%).

Participants' knee injury profile: 324 unique knee injuries were reported in 12286 sports activities, resulting in a recorded injury incidence rate of 26.37 per 1000 hours of competition training. Figure 1 shows the flow chart of study participants. The analyses presented in this section included karate practitioners with a history of injury, and other uninjured participants were excluded from the frequency distribution of the data. The results of the knee injury questionnaire showed that the most injuries in athletes with a history of injuries were recorded in the dominant leg [dominant leg: 36% (n = 103), non-dominant leg: 33% (n = 95), and both legs: 31% (n = 89)] and occurred during training (68%, n = 195), competition (19%, n = 55), and both (13%, n = 37).

The essential mechanisms of injury reported by the participants included kicking the opponent with the foot (35.5%, 102 people), sudden turning (22%, 63 people), hitting the opponent's leg (20%, 58 people), landing from jumping (13%, 37 people), sudden stop (5%, 14 people), and falling (4.5%, 13 people).

Among athletes, the most common injuries were cartilage and meniscus injuries (12.5%), ACL injuries (9.5%), medial knee ligament injuries (2%), posterior cruciate ligament (PCL) injuries (1.5%), and external knee ligament injuries (1.5%). Patellar dislocation had the lowest prevalence at 0.1%.

The most common treatment methods for injuries include self-treatment (45.3%, 130 people), physiotherapy (19.5%, 56 people), and other standard techniques (such as warming and ice packs: 25 people, 8.7%). Out of the 287 athletes, only 5 participants (1.8%) received surgery, whereas 71 (24.7%) did not use any treatment protocol. Almost half of the karate athletes (47.4%, 185 people) resumed their training a week after the injury, and only 11.8% of the athletes (46 people) had a recovery period of more than 21 days before returning to the competition.

Participants' KOS subscales and self-report scores were calculated. ADL and sports activities KOS scores were 89 ± 11 and 91 ± 9 , respectively. Self-reported knee condition scores for ADL and sports activities were 89 ± 11 and 90 ± 10 , respectively. Pearson's correlation coefficients between KOS scores and self-reported scores were $r = 0.761$ ($P < 0.001$) and $r = 0.782$ ($P < 0.001$) for ADL and sports activities, respectively.

The subscales' scores of knee condition symptoms and signs in daily activities (ADL symptoms) and sports (SAS symptoms) were obtained as 95% CI = 1.50-34.49 and 95% CI = 18.60-29.20, respectively. The range of pain subscale scores in daily activities (ADL pain) was also 95% CI = 32.00-1.51, and in sports (SAS pain) was 95% CI = 27.8-38.30. Moreover, the QOL scale related to knees in karate athletes was 95% CI = 21.80-0.43.

Discussion

The present study investigated the prevalence and mechanism of knee injuries in Iranian professional karate practitioners. The study found that 73.6% of participants experienced knee injuries, consistent with Piejko et al. (30) and VencesBrito et al. (31). Both studies identified the lower extremities and knees as common injury sites in karatekas.

The study found that the most common way to injure an opponent in karate was using the foot (35.5%, 102 people).

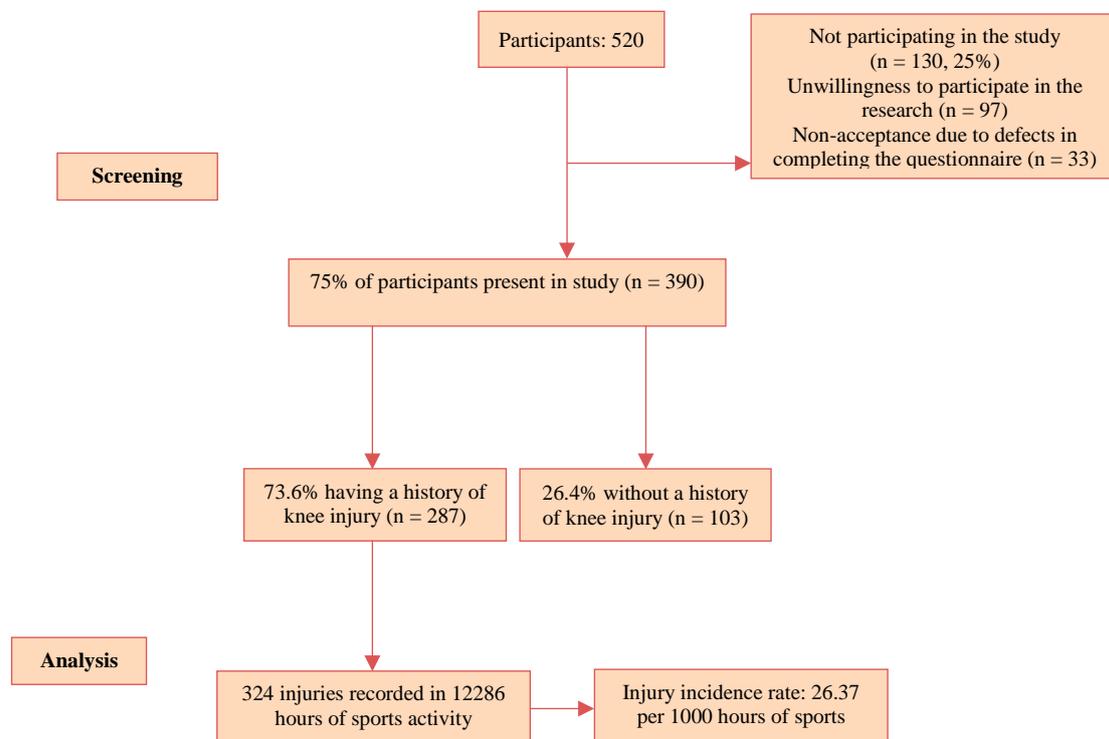


Figure 1. The flow chart of the study

New rules were implemented in 2015 by the World Karate Federation that awarded one point for hand techniques and two or three points for foot techniques. Therefore, athletes are more likely to injure their dominant lower limb due to increased striking ability (5, 32). A quarter of the karatekas competed nationally, and 70% had over five years of experience. This study had higher levels of sports activity history than previous studies (34).

The study found that over 25% of participants skipped stretching exercises during the warm-up program. Previous research emphasizes the importance of warm-up and flexibility in injury prevention, highlighting the need for stretching in training.

Half of karate injuries occur during preparation, particularly in training sessions. This statistic encompasses over two-thirds of karatekas who dedicate most of their time to preparatory phase training, with three sessions of 1-2 hours per week. These findings align with research by Vences Brito

et al. (31) and Mahdavi Mohtasham and Shahrbanian (18), highlighting the importance of educators focusing on this stage of education.

Despite the aggressive nature of this sport, only 11.8% of participants experienced injuries lasting more than 21 days, and 47.4% resumed training after just one week. These findings are consistent with previous studies reporting lower injury rates in this sport than in others. Self-treatment of knee injuries by athletes can lead to chronic damage and negatively impact health and performance. Without proper injury prevention and rehabilitation, reducing recovery time can cause re-injury (4). It is essential to thoroughly carry out rehabilitation programs during the return to training period to prepare injured athletes for the competition. Increasing activity before recovery can lead to chronic injuries and decreased sports performance (38).

This research showed that cartilage and meniscus injuries (12.5%) and ACL (9.5%) had the highest prevalence of injuries. The usual mechanism of these injuries in repeated sports activities is rotation,

deceleration, and jumping (39), which is one of the most frequent movements in karate (40). These findings will help inform trainers and doctors about the need for a specialized preventive program to reduce the risk of cartilage and ligament injuries during exercise (39).

In addition, the results of the knee function scale and self-reported scores of knee function of karate athletes for subscales of knee condition in ADL and SAS showed a high motor awareness in the knee joint, which was not mentioned in previous research. Skinner and Barrack concluded that the weakness of motor awareness is an influencing factor in knee injuries, especially knee joint destruction diseases (41). Therefore, the information obtained from the present study can be considered as input for future research and an influencing factor for preventing injuries among karatekas.

Finally, ADL limitation was significantly more significant than SAS, and the most common complaint was sitting with bent knees. This appears to be related to meniscal damage, stress on the knee joint, range of motion (ROM) limitation, or a combination of all three factors (42, 43).

Limitations

The research study was limited by the sampling method utilized and voluntary participant data collection, with 25% of karatekas declining to participate, potentially impacting the results. Due to the limited number of female karatekas and the absence of male researchers among the female athletes in the competition, more research is needed to obtain unique data on this group of subjects.

Recommendations

It is recommended that the present research be conducted in different ages and countries and female gender populations to determine how age, race, and gender differences affect the injury profile.

Conclusion

Over 70% of karate practitioners experience knee injuries, with the ACL being the most frequent. These results can aid in designing injury prevention strategies by recommending specialized training programs for karate practitioners.

Acknowledgments

The authors sincerely thank all the participants, the organizers of the competitions, and the Karate Federation who sincerely helped us in this research.

Authors' Contribution

Study design and ideation: Amir Letafatkar, Hamidreza Naserpour

Getting financial resources for the study: Amir Letafatkar

Scientific and executive support of the study: Amir Letafatkar, Hamidreza Naserpour

Data collection: Amir Letafatkar, Hamidreza Naserpour

Analysis and interpretation of the results: Amir Letafatkar, Hamidreza Naserpour

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Manuscript preparation: Amir Letafatkar

Specialized scientific evaluation of the manuscript: Amir Letafatkar, Hamidreza Naserpour

Confirming the final manuscript to be submitted to the journal website: Amir Letafatkar, Hamidreza Naserpour

Maintaining the integrity of the study process from the beginning to the publication, and

responding to the referees' comments: Amir Letafatkar, Hamidreza Naserpour

Funding

The current study was supported by Kharazmi University, Tehran, Iran (thesis code: 16507, ethics code: IR.SSRI.REC.1400.1070).

Conflict of Interest

Authors declare no conflict of interest.

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