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The Prevalence of Musculoskeletal Injuries in Karate in South Africa: An Exploratory Study

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Abstract

This study describes the incidence, prevalence, severity, body region of injuries, and treatment preferences in South African karate practitioners. A cross-sectional survey was distributed to an estimated 200 karateka across various dojos and styles. The anonymous questionnaire included the International Physical Activity Questionnaire, with additional questions on BMI, training quality, karate style, and injury location. The response rate was 73% (n=146). Shotokan was the most practised style (57%, n=83). Most participants were 1st dan (26%, n=38), trained for 10-14 years (29%, n=42), twice weekly (36%, n=53), for 1 hour per session (63%, n=92). Acute injuries were most common (60%, n=112), occurring during training (64%, n=128), with 86% (n=126) sustaining 1-9 injuries. The right knee was most frequently injured (9%, n=52), often from kicks (33%, n=88). Physiotherapists were the preferred treatment (27%, n=67), with minimal performance impact (42%). Injury prevalence is high among South African karateka, particularly in Shotokan, affecting the right knee, lower limbs, and face. However, most injuries are minor, supporting karate's safety as a semi-contact sport. Protective measures for high-risk areas could further reduce injury rates.

Keywords: sport; martial arts; athletic injuries; karate; musculoskeletal injuries; injury prevalence

1. Introduction

Martial arts forms are practised by approximately 100 million people around the world [1] and those who take part are a distinct category of athletes who practise the art of self-defence. A trained martial artist aims to be proficient at defending, striking, and avoiding techniques.

Previous studies[2] have indicated that the majority of martial artists do not suffer from acute traumatic injuries, especially beginner-level and less-experienced martial artists, who are often not allowed to participate in full-contact events, which limits the risk of injuries. Martial artists who practise karate (karateka), train to a high level of athleticism and combat, but are required to practise a significant amount of repetitive movements[2].

Competitive karate is generally related to a considerably high injury rate, but evidence suggests that these are primarily minor injuries, with the prevalence of severe injuries being rare [3]. The most common areas of injury are the hands, while participants of other forms of martial arts have more injuries to their shoulders and upper arms, and are more likely to have chronic upper extremity conditions [4].

Karate is a Japanese word translated to English as 'empty hand', and originated in Okinawa, where it was initially developed as a covert fighting style that employed the hands and feet [3]. Modern-day karate has various different styles, with the most common being Goju-Ryu, Shito-Ryu, Shotokan, and Kyokushin [5].

Goju-Ryu emphasizes blocking techniques, and Shotokan kata (fighting sequences), and both demonstrate a right-sided bias to punching and kicking techniques [6] and injuries to the right side of the body would be expected to be more common. Previous studies have demonstrated that

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Shotokan injury rates are lower than other types of martial arts, including taekwondo, aikido, kung fu, Judo, tai chi and jujitsu [7,8].

Physical injuries may result from the body abruptly receiving an intolerable amount of energy [9]. This can be tissue damage due to exposure to certain amounts of energy which exceed the threshold tolerance of body tissue in humans. The two main causative factors to injuries are either the accumulation of micro-traumatic lesions (caused by repetitive mechanical motion), or injury resulting from a single excessive force or load to the body, which the body cannot withstand or adjust to and resulting in an injury [9].

Musculoskeletal injury in martial arts does not have a standard definition. For the purposes of this study, the definition of musculoskeletal injury is any injury resulting from karate training and/or competition, sustained on impact or over time [10]. Injuries in this form of activity are almost inevitable, as the impact involved in the techniques may surpass the body's mechanical tissue strength [11]. Adding to this idea, karate-specific injuries may result in muscle contusions and milder types of local injuries. Serious injuries such as fractures, muscle and tendon strains, and ligament sprains are more prevalent in sporting codes such as football, wrestling, weight lifting, Taekwondo, Judo, and volleyball [12]. One in five karateka may sustain an injury in a tournament karate match, and one in four during karate training, with approximately 23% of karateka sustaining severe injuries during increased training for tournaments [7].

In South Africa, there is limited information regarding karate injury prevalence and risk factors. We, therefore, aimed to examine anthropometric information, activity levels, training details, style of karate, and expertise levels of South African karateka to determine the factors that are related to injuries.

2. Materials and Methods

This study was a descriptive cross-sectional design, with participants from various dojos (karate schools) and various karate styles (Goju-Ryu, Shito-Ryu and Shotokan) in South Africa.

The survey utilized Google Forms to collect responses, including an electronic information letter and consent form. The information letter stated the study's objectives, the primary researchers' contact details, and the confidentiality of the data. Respondents had to complete a consent form to confirm their participation. The anonymous nature of the questionnaire allowed respondents to withdraw from the study before submitting the questionnaire. Inclusion criteria were 18 years and older, five years or longer of karate training experience, and brown belt level or higher. The survey was open from 9 November 2023 until 13 February 2024.

The questionnaires were sent to 50 dojo heads, and a predicted response rate of 5 participants per dojo was anticipated, with a proposed sample size of 200.

The survey questions were adapted from previous studies related to martial art injuries [1,2,13–15]which included questions on participant demographics, karate information, and karate injuries, with a pilot study being conducted prior to circulation to the various dojos.

The questionnaire was composed of 30 questions involving four sub-sections. Section A focused on demographics, such as their age, height, weight, BMI and gender [1,2,15]). Section B was pre-set questions from the short questionnaire from IPAQ (2002)[16]. Section C was the participants' specific karate information [1,2,15] to determine the quantity of training and style of karate and Section D related to the participants' injuries [2,13,15,17] to determine where musculoskeletal injuries most commonly occur, and which healthcare provider was consulted.

Descriptive statistical analysis was performed using SPSS (version 21.0.0.1; SPSS Inc., Chicago, USA), including calculating counts, percentages, means and standard deviations (SD) and medians, with the assistance of the University of Johannesburg Statistical Consultation Services. Crosstabulations were used to identify the associations between variables related to BMI, amount of training, style of karate and the body region of injury.

The research was approved by the Faculty of Health Sciences Research Ethics Committee (REC), University of Johannesburg (REC-2342-2023). The research participants remained anonymous, no

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identifying data was collected, and there was no ability to trace back determined responses from individual participants. There were no direct benefits to the participant. No conflict of interest was held by anyone involved in this study. The extracted data were labelled using identification numbers and stored on the University of Johannesburg's password-protected server.

3. Results

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

3.1. Demographic Data

The survey yielded 146 responses and therefore had a 73% response rate (95% CI [66.9, 79.2]; n=200), with a margin of error of ±6.15 percentage points. As indicated in Table 1, the sex of participants indicated 70%(n=102) were male, and the majority were between 18 and 34 years. BMI calculations (from height and weight) indicated the majority were classified as "normal weight" between 18.5 and 24.99kg/m^2 (42%, n=61).

Table 1. Demographic data, indicating age, height, weight and calculated BMI.

Age (years)	**% (n)**
18-24	34(50)
25-34	22(32)
35-44	12(18)
45-54	18(27)
55-64	10(15)
≥65	3(4)
Sex	
Male	70(102)
Female	30(44)
Height (cm)	
130-139	1(1)
140-149	2(3)
150-159	8(12)
160-169	26(38)
170-179	38(55)
>179	25(37)
Weight (kg)	
45-54	7(10)
55-64	14(20)
65-74	25(37)
75-84	18(27)
85-94	18(26)
>94	18(26)
BMI (kg/cm^2)	
<18.50	1(2)
18.50-24.99	42(61)
25.00-29.99	37(54)
30.00-34.99	14(20)
35.00-39.99	4(6)
≥40.00	2(3)

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3.2. Training Information

The predominant style was Shotokan with 57%(n=83), and the majority were 1st dan black belt belts (26%, n=38), and the highest level was 8th dan (1%, n=2). Years of training ranged from 10-14 years in 29% (n=42) to 34 years or longer (12%, n=18). The most common training frequency within a week was 2 days per week (36%, n=53) and the least was 7 days per week (1%, n=1). Most participants' training session durations were 31-60 minutes (63%, n=92), with only 1% (n=2) indicating less than 30 minutes and 3% (n=4) indicating longer than 120 minutes. The majority (84%, n=123) did not participate in other forms of martial arts. (Table 2).

Table 2. Karate training information, including style, level, years of training, average duration of training sessions, days trained per week, and participation in other martial arts.

Karate style	**%(n)**
Shotokan	57(83)
Goju-Ryu	29(43)
Shito-Ryu	9(13)
Kyokushin	5(7)
Belt level	
Brown	14(20)
Junior Black	5(7)
Cadet Black	1(1)
Black 1st Dan	26(38)
Black 2nd Dan	19(28)
Black 3rd Dan	13(19)
Black 4th Dan	9(13)
Black 5th Dan	6(9)
Black 6th Dan	5(8)
Black 7th Dan	1(1)
Black 8th Dan	1(2)
Years of training	
5-9	23(33)
10-14	29(42)
15-19	11(16)
20-24	13(19)
25-29	7(10)
30-34	5(8)
>34	12(18)
Average duration of training session	
1-30	1(2)
31-60	63(92)
61-90	18(26)
91-120	15(22)
>120	3(4)
Days trained per week	
1 day	5(7)
2 days	36(53)
3 days	27(40)
4 days	15(22)
5 days	12(17)
6 days	4(6)
7 days	1(1)
Participate in other forms of martial arts	

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No	84(123)
Yes	23(16)

3.3. Injury Information

As presented in Table 3, the majority of injuries (64%, n=128) occurred during training, with 36% (n=73) occurring during competition, and were more likely to be acute (60%, n=112), with 1-9 total injuries sustained in 86%(n=126) of participants. Neck and mid-back injuries were the least likely to occur (1%, n=8), with the most common sustaining injuries to the right knee (9%, n=52) and face/head (8%, n=51). These injuries were more likely to occur as a result of a kick in 33% (n=88), and only 1% (n=2) reported injury from a submission grip, with 23% (n=62) being sustained over time. Those that sustained injuries consulted physiotherapists 27%(n=67) most commonly. Twenty-two per cent (n=32) reported they were not able to train for 1-3 months, and only 1% (n=2) of participants indicated they were unable to train for longer than 1 year after an injury. The majority (42%, n=61) of those who sustained an injury indicated that their performance was only mildly affected, and 12% (n=18) that their performance was not affected at all by their injuries.

Table 3. Participants' injury information related to period, total injuries, region, mechanism, and duration unable to train.

The period when sustained injury	**%(n)**
Competition	128(64)
Training	73(36)
Acute or chronic injury	
Acute	60(112)
Chronic	40(75)
Total injuries sustained	
1-9	86(126)
10-19	8(12)
20-29	5(7)
30-39	0(1)
≥40	1(1)
Region of injury	
Face/ Head	8(51)
Jaw	4(26)
Neck	1(8)
Chest	3(20)
Abdomen	3(18)
Mid-back	1(8)
Low back	4(26)
Right sided injury	
Shoulder	5(34)
Upper arm	1(5)
Elbow	1(9)
Forearm	1(9)
Wrist	3(20)
Hand	4(25)
Hip	3(17)
Buttock	1(4)
Thigh	3(18)
Knee	9(52)
Lower leg	2(14)
Ankle	5(33)

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Foot	4(27)
Left sided injury	
Shoulder	5(28)
Upper arm	1(6)
Elbow	1(6)
Forearm	1(8)
Wrist	2(13)
Hand	3(17)
Hip	2(10)
Buttock	1(1)
Thigh	2(14)
Knee	5(31)
Lower leg	2(12)
Ankle	5(28)
Foot	4(24)
Technique resulting in injury	
Strike	29(77)
Kick	33(88)
Take down	14(36)
Submission grip	1(2)
Over time	23(62)
Duration unable to train	
1 - 2 days	12(18)
1 week	18(26)
2 weeks	13(19)
3 weeks	8(11)
1 month	12(18)
1 - 3 months	22(32)
3 - 6 months	10(14)
6 months - 1 year	(4)6
≥1 year	(1)2
Healthcare practitioner attended	
Physiotherapist and/ or Biokineticist	27(67)
I treated myself (e.g., Rest, Ice, Tapping, Medication)	25(62)
General practitioner (GP)	20(49)
Orthopaedic surgeon	15(37)
Received no treatment	8(20)
Chiropractor	5(12)
Other	1(3)

Statistical analysis of karate style to the region of injury demonstrated statistically significant results in relation to Shotokan style and right wrist (p=0.03), right (p=0.01) and left (p=0.04) lower leg injuries and left foot (p=0.01) injuries.

No statistically significant results were determined in relation to BMI classification and injury, with “normal weight” showing statistically significant results for low back (p=0.01) and left ankle (p=0.03) injuries.

4. Discussion

This study described the incidence, severity, mechanism and body region of injuries in South African karateka, and considered factors such as BMI, karate style, and the duration/frequency of training periods that may have an influence.

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Aligned to outcomes previously presented by other authors [8,18], Shotokan was the predominant style of karate (57%). Previous studies [14] have also found similar results in relation to 1st dan black belt being the highest participant rank, which is likely a consequence of the age category, and the fact that each successive rank level requires a longer period of training, and more karateka are likely to stop training before reaching the more advanced levels. Although some studies have found an association between the years of training and the prevalence of injuries [15,17], our findings in South African karateka did not appear to show this trend. In addition, while previous studies have indicated that higher BMI values increase the risk of athletic injury [19], no correlation was found, and karateka with "normal" BMI figures are more likely to sustain injuries. This finding should be considered within the context of karate, where the intensity of training is related to personal motivation and fitness, and therefore, those with higher BMI values may not be as prone to injury related to the decreased intensity. Therefore, training intensity and biomechanical factors may play a more critical role than body composition alone.

4.1. Duration and Frequency of Training

The majority of South African karateka train two days per week, for 31-60 minutes per session. This calculates to an average of two hours of training per week, which is less than the previous studies in other regions [8,13,14]. Given that the majority of participants were between the ages of 18 and 24, this may in fact be considered a low activity level, [20] and would have an impact on the frequency of injuries due to less training than in previous studies.

4.2. Type of Training Related to Injury Occurrence

As was found in previous studies [1,13], the majority of injuries are likely to occur during normal training, and not during competitions. Given the time periods related to training, the proportion of training time related to competition supports this concept. A large number of karate practitioners may also not necessarily compete in competitions, and this would also have an impact on the results [21,22].

4.3. Acute or Chronic Nature of Injuries

South African karate follows a similar trend to other regions [23], and the majority of injuries were not associated with repetitive training, but more in terms of a specific incident, which is anticipated given the high speed of techniques being performed and received in combat sports. However, there were still a high number of chronic injuries, which would be expected given the repetitive nature of karate training, which may impact training efficacy over time as it can lead to alterations in range of motion and muscle activation and result in these injuries [24].

4.4. Total Injury Prevalence

The current study has a high prevalence (86%) of 1-9 injuries sustained during the karate training, when compared to previous findings in karate (37.3%), judo (56%) and kung-fu (38.9%) [1,12]. In many cases, martial arts injuries are poorly reported, as less significant injuries may not be remembered [8]. Being a contact sport, injuries are somewhat expected, and a 'no injury' category for answers may have allowed for a different reporting. The injury rate across participants may also be considered low, due to a semi-contact approach being applied in karate training [5] and full-contact karate would, in all likelihood, have a different finding [17].

4.5. Body Region of Sustained Injuries

The findings of our study are consistent with previous studies in relation to the high injury rate to the face and knees [3,9–11,13–15,25]. The face and head, knees and ankles are the most likely regions to sustain an injury, with a higher incidence on the right side of the body. The risk of injury to the face may be expected to be higher, as this is often a specific target for striking, followed by the

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upper and lower limbs, rather than the trunk and abdomen. Limb injuries may also occur as a result of defensive techniques [13] from opponents. The right side is much more likely to sustain an injury, as most people are right-handed and would use their dominant side more frequently for attacking and defensive techniques [26]. We found statistically significant associations with Shotokan karate in terms of injuries to the right wrist (p=0.03), right lower leg (p=0.01), left lower leg (p=0.04), and left foot (p=0.01), which may be a result of the higher number of those doing this style, as opposed to being more likely to result in injury.

4.6. Strike Type in Relation to Injury

Injuries associated to strike type in our study differed in relation to previous studies [11,13] in other regions, with the majority being sustained from kicks (33%), followed by strikes (29%), whereas the previous studies found kicks were more likely to cause an injury, although Macan et al.[5] indicated that strikes caused the majority of injuries in all age groups.

Our study had a difference of less than 10% between strike and kick injuries, whereas the previous studies showed a much larger difference. This may be due to the sample size of the study not being as large as these studies, resulting in a disproportionate kicking predominance.

4.7. Time Period for Recovery Post-Injury

In this study, the longest time karateka were unable to train due to an injury was between 1-3 months (22%), followed by only one week (18%). In Shotokan karate specifically, it has been reported that 30% of karateka require time off from training following sustained injuries [8].

With regard to the severity of injuries, the majority of injuries are considered as minor and do not have a significant impact to the point of not being able to train, which is consistent with previous research [3,5,8,14]. In general terms, severe injuries are considered rare [3] and therefore, the time periods for recovery would be expected to remain low.

4.8. Healthcare Professional Involved and Injury Treatment

Similar to previous studies [12,14], the most common health care professional consulted after an injury was a physiotherapist or biokineticist, and the majority attended some level of care as opposed to self-treatment. Given the conservative nature of these professions and the low incidence of severe injuries, these would be considered appropriate results.

4.9. Effect of Injury on Performance

Our study suggests that in the majority of cases, injuries have little effect on performance. Injured athletes commonly continue to train, and this can result in a mild injury becoming more severe, which may ultimately require more time off from training [14].

Despite the high injury rate, the low severity and minimal impact on performance reinforce South Africa's karate classification as a safe martial art, particularly given its semi-contact nature in training [27].

4.10. Limitations

Limitations of this study relate to the fact that injury recall bias may affect the reporting, as no specific time period was included in the questionnaire. As indicated previously, a category for "no-injury" should be considered, as the values requested assume an injury had occurred, and this may have resulted in increased incidence within our study.

5. Conclusions

This study examined injury patterns among South African karateka, revealing that Shotokan practitioners face a higher risk of injuries to the right wrist, lower legs, and left foot, likely due to

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technical demands and right-sided dominance. Unlike previous studies, no significant links were found between injuries and BMI or years of training, suggesting that training intensity and biomechanics play a greater role. Most injuries were acute, occurring during training rather than competition, with the face and knees being the most vulnerable, consistent with global trends.

While injury prevalence (86%) was higher than in judo or kung fu, the majority were minor, requiring less than three months of recovery. Strikingly, kicks (33%) and strikes (29%) caused injuries at nearly equal rates, differing from prior research and possibly reflecting regional training differences. Despite the high frequency, the low severity of injuries supports karate's classification as a safe sport, particularly given its semi-contact training approach.

These findings underscore the need for targeted injury prevention, especially in Shotokan dojos, focusing on protective measures for high-risk areas. Future studies should explore long-term injury trends and the effectiveness of preventive strategies to further enhance safety without compromising karate's accessibility and appeal.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of The University of Johannesburg (protocol code REC-2341-2023 on 25 October 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest.

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