

Injuries in elite Taekwondo Poomsae athletes

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Poomsae is the only non-contact and no opponent form of Taekwondo. The purpose of this descriptive study was to determine the type and rate of injuries in elite Canadian Poomsae athletes. Strain and joint dysfunction were the most common types of injuries in Poomsae. Lower limb and back were the most common area of injury in females and males respectively. Females with a lower rank in experience level (DAN ≤ 3) were more likely to suffer from chronic overuse injuries compared to their male counterparts, who reported more acute injuries. Athletes ≤ 40 years of age were more prone to acute injuries compared to athletes over 40. As result of reflection on this study a Poomsae Injury Report Form was developed.

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KEY WORDS: Taekwondo, Poomsae, injury, acute, overuse

Poomsae est la seule forme de Taekwondo contre un adversaire imaginaire. Le but de cette étude descriptive était de déterminer le genre et la fréquence de blessures chez les athlètes canadiens de Poomsae de haut niveau. Le claquage et le dysfonctionnement articulaire étaient les genres de blessures les plus courants dans le Poomsae. Les blessures des membres inférieurs et du dos étaient les plus fréquentes respectivement chez les athlètes féminins et masculins. Les athlètes féminins ayant un niveau d'expérience (DAN ≤ 3) inférieur étaient plus susceptibles de souffrir de blessures chroniques dues à un surentraînement que leurs homologues masculins qui, eux, ont signalé des blessures plus graves. Les athlètes âgés de moins de 40 ans étaient plus prédisposés à des blessures graves que les athlètes de plus de 40 ans. Les résultats de cette étude ont permis de préparer un formulaire de rapport sur les blessures dans le Poomsae.

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MOTS CLÉS : Taekwondo, Poomsae, blessure, grave, surentraînement

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Introduction

Since the establishment of Taekwondo (TKD) as a full medal sport in the 2000 Summer Olympic games, there has been an increase in the level of participation with over 80 million athletes worldwide.¹ To successfully compete in the Olympics and tournaments, the focus of training is sparring (Olympic style) TKD. However, in recent years many experienced athletes have started to participate in the training of the mind by focusing on the “unity of the pose” or Poomsae. Poomsae is the only non-contact form of training in TKD.

In 2000, Poomsae was established and warranted as an accepted form of competitive sport by the World Taekwondo Federation since it involves skill, technique and physical exertion. It is practiced for many purposes including self-defence training, preparation for full contact sparring and training toward promotions testing.² Poomsae consists of 13 defined patterns of movement, which are repeated over and over in practice.³ Average training is six days a week and a maximum of four hours and 40 minutes of training per day.⁴ As a result of this intense training, there is a probability of injury in these athletes. Most literature on Taekwondo injuries focuses on sparring (Olympic style).^{1,5-7} The literature regarding the prevalence of chronic overuse injuries (COI) in Poomsae athletes worldwide is sparse. Chronic overuse injuries are injuries that result from repetitive overloading of a tissue (bone, muscles, tendons, etc.) which causes micro damage to the tissue without providing ample time to heal.^{2,8} Chronic overuse injuries may cause early fatigue, soreness, prolonged pain, psychological exhaustion, reduced physical function, loss of playing time, and dropping out of sport.^{2,8} A study of South Korean Poomsae athletes revealed a prevalence rate of COI of 71% while a similar study conducted in Alberta, Canada reported a 73% rate.^{2,9} In these athletes, the lower body was more prone to overuse injuries than the upper body, the knee joint and hamstrings were most prevalent, and a strain type injury the most common.²

Any type of injury can prevent an athlete from reaching the podium. In a retrospective case-series, Kazemi¹⁰ examined 75 sparring TKD athletes over a 10-year period to determine if there was a relationship between past injuries, present injuries, injuries during competition and success (defined as the acquisition of medals during competition). Kazemi reported that when an additional

injury occurred during competition, the sparring TKD athlete was 88% ($p = 0.039$) less likely to win a medal.¹⁰ It was further suggested that prevention, correct diagnosis, and immediate therapeutic intervention are important in elite TKD athletes.¹⁰ Thus, it might also be beneficial for coaches and health care practitioners to understand the types of injuries that Poomsae athletes may encounter during training and competition to minimize any downtime and ensure success. Therefore, the purpose of this study was to investigate the type and characteristics of injuries (including location, severity, age of the athlete, and mechanism of injury during training or in competition), which occurred among Canadian elite Poomsae athletes.

Methods

This study was a longitudinal retrospective study of Poomsae injuries sustained by the Canadian National Taekwondo team over a three-year period at the World Poomsae Competition. Every member of the national team completed a general medical fitness form including their names, age, and any past or current injuries prior to participation in the competitions. These provided the general information for all athletes to the team doctor (a chiropractor). Each injured athlete who subsequently presented to the team doctor filled out the personal information section (including name, age, sex, address, phone number, weight, height and TKD rank) on an Injury Report Form (IRF).¹⁰ The team doctor completed the rest of the patient history (past history, location, radiation, character and intensity, mechanism of injury, ability to continue the match), physical examination, diagnosis and severity rating, recommendations, treatment rendered, follow-up and discharge instruction sections of the IRF. No validity and reliability information for the IRF is available. Data were then extracted from the injury forms and analyzed. The team doctor, who was also the primary investigator (PI), was the only individual with access to the IRFs. To ensure confidentiality, each athlete's IRF was numbered and any identifying information was removed for the purpose of this study.

The outcome measures utilized in this study include number of athletes, number of reported injuries, number of athlete exposures, age of athlete, injury rates, TKD experience level (black belt degree, also known as DAN), location of body part injured, injury type, injury mechan-

Table 1.
Injured athletes' characteristics.

Variables	Female, (n=13) mean (±SD)	Male, (n=6) mean (±SD)	Total, (n=19) mean (±SD)
All Injured Participants (n=19)			
Age (Year)	40.1 (±14.0)	27 (±10.4)	34.7 (±13.4)
TKD level (Dan)	3.3 (±1.5)	4.2 (±2.1)	3.6 (±1.7)
Participants with COI (n=11)			
Age (Year)	45.3 (±13.5)	30.3 (±11.7)	39.8 (±14.5)
TKD level (Dan)	3.4 (±1.5)	4.8 (±2.5)	3.9 (±1.9)
Participants with Acute injuries (n=8)			
Age (Year)	34 (±13.1)	20.5 (±0.7)	30.6 (±12.7)
TKD level (Dan)	3.2 (±1.7)	3 (±0.0)	3.1 (±1.5)
SD= Standard Deviation; TKD level (DAN) = black belt degree; COI = Chronic Overuse Injury,			

ism, injury severity, and the point in time when the injury occurred (training or in competition).

The software program “STATA” version 10 was used to analyze the data. Descriptive statistics were used to describe the sample population in terms of anthropomorphic factors such as population number, number of males and females, age range and mean age average, as well as experience level expressed as a belt level. Means were used to describe the outcome measures listed above. No inferential statistics were performed due to small sample size. The Research Ethic Board of the Canadian Memorial Chiropractic College approved this study.

Definitions

Sprains were defined based on a grading system. Grade 1 sprain constituted a slight stretching and some damage to the fibers (fibrils) of the ligament; Grade 2 sprain included partial tearing of the ligament; and Grade 3 sprain was a complete tear of the ligament.¹¹

Joint dysfunction as defined by the World Health Organization¹² is: “a lesion or dysfunction in a joint or motion segment in which alignment, movement integrity and/or physiological function are altered, although contact between joint surfaces remains intact. It is essentially a functional entity, which may influence biomechanical and neural integrity”.

Chain dysfunctions are defined as asymmetries of joint position or movement that are detected by functional tests.¹³

Results

Study Participant Demographics

There were a total of 34 athletes (16 females) who competed over a three-year period at the World Poomsae Competition included in this set of data. Overall, the mean age of the athletes was 34.7 years (SD = 13.4), ranging from 14 to 59 years. A total of 19 athletes (injury rate of 59%) reported injuries during the 3-year period. However, when injured athletes were stratified into COI and acute injuries subgroupings, a difference in characteristics was noted (Table 1).

Prevalence rate of injuries: COI vs. acute injuries

Of the 34 athletes who participated in this study, 19 had sustained injuries. Of those, 11 athletes reported symptoms associated with COI and eight athletes reported symptoms that were acute in nature. The total prevalence rate of injury was 56%, with females experiencing more injuries than males.

The total prevalence rate of COI and acute injuries was 32% (n =11) and 24% (n=8) respectively. A high-

Table 2.
Prevalence of COI and acute injury by gender, age and experience among all athletes.

Contents	Female n (%)	Male n (%)	Total n (%)
Total participants (athletes)	16	18	34
Total participants (athletes) injured	13	6	19
Total prevalence rate of athletes injured (%)	81.25%	33.33%	55.88%
CI	62.13-100.37	11.55-55.11	39.19-72.57
Prevalence rate of athletes injured \leq 40 years old	6 (46.2%)	5 (83.3%)	11 (57.9%)
Prevalence rate of athletes injured $>$ 40 years old	7 (53.8%)	1 (16.7%)	8 (42.1%)
Prevalence rate of athletes injured TKD \leq 3	5 (38.5%)	3 (50.0%)	8 (42.1%)
Prevalence rate of athletes injured TKD $>$ 3	8 (61.5%)	3 (50.0%)	11 (57.9%)
Total COI (athletes)	7	4	11
Total prevalence rate of COI (%)	43.75%	22.22%	32.35%
CI	19.44-68.06	3.01-41.43	16.63-48.07
Prevalence rate of COI \leq 40 years old	2 (28.6%)	3 (75.0%)	5 (45.5%)
Prevalence rate of COI $>$ 40 years old	5 (71.4%)	1 (25.0%)	6 (54.5%)
Prevalence rate of COI DAN \leq 3	3 (42.9%)	1 (25.0%)	4 (36.4%)
Prevalence rate of COI DAN $>$ 3	4 (57.1%)	3 (75.0%)	7 (63.6%)
Total acute injuries (athletes)	6	2	8
Total prevalence rate of acute injuries (%)	37.5%	7.14%	23.53%
CI	13.78-61.22	-4.76-19.04	9.27-37.79
Prevalence rate of acute injuries \leq 40 years old	4 (66.7%)	2 (100.0%)	6 (0.75%)
Prevalence rate of acute injuries $>$ 40 years old	2 (33.3%)	0 (0.0%)	2 (0.25%)
Prevalence rate of acute injuries DAN \leq 3	2 (33.3%)	2 (100.0%)	4 (50.0%)
Prevalence rate of acute injuries DAN $>$ 3	4 (66.7%)	0 (0.0%)	4 (50.0%)
CI: Confidence interval at 95%, COI: Chronic overuse injury.			

er prevalence rate of COI and acute injuries is also observed in females compared to their male counterparts (44% (n=7) vs. 22% (n=4) and 38% (n=6) vs. 7% (n=2), respectively).

To consider age and injury types and rates, athletes were divided into two subgroups: age (under 40 or over 40) and experience levels (DAN under 3 or DAN over 3). Injured athletes who were under 40 years of age and who had more black belt experience (DAN over 3) had a slightly higher injury rate (57.9%, n=11) than athletes who

were over 40 and who had less experience (DAN under 3) (42.1%, n=8). Athletes 40 and under were more prone to acute injuries compared to athletes over 40 (75%, n=6) vs. 25% (n=2)) (See Table 2).

A total of 29 COIs were observed in 11 athletes; only 1 athlete was diagnosed with a single COI, 2 athletes with 2 COIs, 6 athletes with 3 COIs and 2 athletes with over 3 COIs. Female athletes presented a higher frequency of multiple COIs than male athletes. Within the group of athletes with COIs, those with 3 COIs were more prevalent

Table 3.

Injured body regions by gender in all injured athletes (n = 19), COI (n = 9), acute (n = 8) and both (n = 2).

Body region	Female n (%)	Male n (%)	Total n (%)
All injured athletes			
Upper body part	6 (32%)	1 (5%)	7 (37%)
Lower body part	4 (21%)	3 (16%)	7 (37%)
Upper and Lower body part	3 (16%)	2 (11%)	5 (26%)
Total	13 (68%)	6 (32%)	19 (100%)
Total COI athletes			
Upper body part	3 (33%)	1 (11%)	4 (44%)
Lower body part	2 (22%)	2 (22%)	4 (44%)
Upper and Lower body part	0 (0%)	1 (11%)	1 (11%)
Total	5 (56%)	4 (44%)	9 (100%)
Total acute athletes			
Upper body part	3 (38%)	0 (0%)	3 (38%)
Lower body part	2 (25%)	1 (13%)	3 (38%)
Upper and Lower body part	1 (13%)	1 (13%)	2 (25%)
Total	6 (75%)	2 (25%)	8 (100%)
Total of acute & COI			
Upper body part	0 (0%)	0 (0%)	0 (0%)
Lower body part	0 (0%)	0 (0%)	0 (0%)
Upper and Lower body part	2 (100%)	0 (0%)	2 (100%)
Total	2 (1)	0 (0)	2 (1)
COI: Chronic overuse injury.			

(n = 6; female = 3, male = 3) than those with 1, 2 or more than 3 COIs.

Prevalence of COI vs. Acute injuries by body region (Table 3)

The prevalence of COI and acute injuries by body part was considered in three categories; upper body parts defined as cervical, thoracic, upper limbs and anything above the umbilicus; lower body parts defined as low back, pelvis, lower limbs or anything that is below the umbilicus and; both upper body part and lower body part. The analysis revealed that when examining all injured athletes there were an equal number of injuries in the upper body (37%, n=7) and the lower body (37%, n=7). Similarly, COI athletes and acute injured athletes also reported equal injuries in the upper (44% (n=4) and 38% (n=3), respectively) and lower body (44% (n=4) and 38% (n=3), respectively) (upper = 38% (n=3), lower = 38% (n=3)).

There was no difference between females and males (Table 4) when comparing the rate of COI. The rate of acute injury in female vs. male athletes divided into age and level of experience subgroups (≤ 40 or > 40 years old and TKD (≤ 3 or > 3). However, males with a TKD ≤ 3 were most likely to have an acute injury. Interestingly, only females (n=2) reported both acute and chronic injuries in both upper and lower body parts.

Chronic overuse injuries were categorized by 5 specific body parts (neck, back, upper limb, pelvis and lower limb) and compared (Table 5). The lower limb was the most injured area with females (58%, 19 injuries) being affected twice as often as their male counterparts (29%, 5 injuries). Back injuries were considered the second highest injured region, with males (59%, 10 injuries) being affected almost 3 times more than females (21%, 7 injuries).

Table 4.
Injured body regions in female and male athletes.

Body region	≤ 40 years old n (%)	>40 years old n (%)	TKD ≤ 3 n (%)	TKD > 3 n (%)
FEMALE				
Total of all injured female athletes				
Upper body part	3 (23%)	3 (23%)	3 (23%)	3 (23%)
Lower body part	1 (7%)	3 (23%)	1 (7%)	3 (23%)
Upper and Lower body part	2 (15%)	1 (7%)	1 (7%)	2 (15%)
Total	6 (46%)	7 (54%)	5 (38%)	8 (62%)
Injured body Regions of COI in females (n=7)				
Upper body part	2 (29%)	2 (29%)	2 (29%)	2 (29%)
Lower body part	0 (0%)	3 (43%)	1 (2%)	2 (29%)
Upper and Lower body part	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	2 (29%)	5 (71%)	3 (43%)	4 (57%)
Injured body Regions of acute injuries (n = 6)				
Upper body part	2 (33%)	0 (0%)	0 (0%)	2 (33%)
Lower body part	1 (17%)	1 (17%)	2 (33%)	0 (0%)
Upper and Lower body part	1 (17%)	1 (17%)	1 (17%)	1 (17%)
Total	4 (67%)	2 (33%)	1 (17%)	1 (17%)
MALE				
Total of all injured male athletes				
Upper body part	1 (17%)	0 (0%)	0 (0%)	1 (17%)
Lower body part	2 (33%)	1 (17%)	2 (33%)	1 (17%)
Upper and Lower body part	2 (33%)	0 (0%)	1 (17%)	1 (17%)
Total	5 (83%)	1 (17%)	3 (5%)	3 (5%)
Injured body Regions of COI (n=4)				
Upper body part	1 (25%)	0 (0%)	0 (0%)	1 (25%)
Lower body part	1 (25%)	1 (25%)	1 (25%)	1 (25%)
Upper and Lower body part	1 (25%)	0 (0%)	0 (0%)	1 (25%)
Total	3 (75%)	1 (25%)	1 (25%)	3 (75%)
Injured body Regions of acute injuries (n=2)				
Upper body part	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Lower body part	1 (5%)	0 (0%)	1 (5%)	0 (0%)
Upper and Lower body part	1 (5%)	0 (0%)	1 (5%)	0 (0%)
Total	2 (100%)	0 (0%)	2 (100%)	0 (0%)
COI: Chronic overuse injuries				

Table 5.
Chronic overuse injuries by anatomical body regions a total of 50 injuries.

Body parts	Female n (%)	Male n (%)	Total injuries n (%)
Neck (cervical)	5 (15%)	1 (6%)	6 (12%)
Back (cervicothoracic, thoracic & lumbar)	7 (21%)	10 (59%)	17 (34%)
Upper limb (shoulder, arm, etc.)	0 (0%)	0 (0%)	0 (0%)
Pelvis (SI & hip)	2 (6%)	1 (6%)	3 (6%)
Lower limb (leg, thigh, knee, calf, toe)	19 (58%)	5 (29%)	26 (52%)
n= number of injuries.			

Table 6.
Types of reported injury (n=50) comparing gender, age and TKD experience level.

Injury Type	Female n (%)	Male n (%)	Age ≤ 40 n (%)	Age > 40 n (%)	TKD ≤ 3 n (%)	TKD > 3 n (%)	Total
Sprain (Grade I & II)	1 (2%)	0 (0%)	0 (0%)	1 (2%)	0 (0%)	1 (2%)	1
Strain	10 (30%)	9 (30%)	11 (22%)	8 (14%)	12 (24%)	7 (14%)	19
Joint dysfunction	10 (20%)	7 (14%)	11 (22%)	6 (12%)	6 (12%)	11 (22%)	17
Myofasciopathy	3 (4%)	0 (0%)	3 (6%)	0 (0%)	0 (0%)	3 (6%)	3
Chain Dysfunction	2 (4%)	0 (0%)	2 (4%)	0 (0%)	0 (0%)	2 (4%)	2
OA	1 (2%)	0 (0%)	1 (2%)	0 (0%)	1 (2%)	0 (0%)	1
SICK scapula	1 (2%)	0 (0%)	1 (2%)	0 (0%)	0 (0%)	1 (2%)	1
Tissue irritation/ dysfunction	1(2%)	1 (2%)	2 (4%)	0 (0%)	1 (2%)	1 (2%)	2
Osgood-Schlatter	0 (0%)	2 (4%)	2 (4%)	0 (0%)	2 (4%)	0 (0%)	2
ACL deficiency	2 (2%)	0 (0%)	0 (0%)	2 (4%)	2 (4%)	0 (0%)	2
Total	31 (60%)	19 (40%)	33 (66%)	17 (34%)	24 (48%)	26 (52%)	50
TKD = Taekwondo							

Past history of injuries

Eleven out of 34 athletes experienced more than one injury in the past 3 years with a total of 50 injuries in this population. The most common types of injury were strain (42%, 19 injuries) and joint dysfunction (34%, 17 injuries). Sprains were rarely observed.

Overall, the injury rate was higher for females (60%, 31 injuries) and those who were 40 year-old or younger (66%, 33 injuries). There was no notable difference when

comparing the levels of experience or between strains and joint dysfunction.

Discussion

Type of injuries

Strains (38%) and joint dysfunctions (34%) were the most prevalent injuries among those athletes who sustained injuries in our study (Table 6). Koh and Kwak⁴

also found that strains were the most common form of injury in Poomsae athletes. However, instead of a joint dysfunction, they found dislocation to be the third most common form of injury. In contrast to Poomsae, sparring seems to display a different trend with regards to the type of injury experienced by the athletes. Kazemi *et al.*¹⁴ analyzed Taekwondo injuries retrospectively over nine years and found a total of 2164 acute injuries were reported; about half (50.2 %) were contusions whereas 12.7 % were sprains. Contusions were reported to be the most prevalent type of injury in contact (33.3% of all reported injuries) and semi-contact (71.4% of all reported injuries) Wushu athletes.¹⁵ A literature review compiled by Pieter *et al.*¹ on injuries in Taekwondo also found that contusions (42.7% in men and 64.7% in women) were the most common type of injuries. A meta-analysis completed by Lystad *et al.*⁷ analyzed the most frequent type of injury arising from sparring TKD. The most common type of injury was contusion (36 per 1000 athlete-exposures) and the least common was dislocation (0.6 per athlete-exposures).⁷

Comparing different martial art styles, Zetaruk *et al.*¹⁶ found a significant difference in the occurrences of contusions between karate and sparring TKD, with only 17% of Shotokan karate students sustaining bruises compared with 43% of sparring TKD students. Furthermore, they found that those who trained in tai chi had low injury rates¹⁶, similar to Poomsae athletes of the current study. In addition, Tai chi practitioners do not sustain multiple injuries compared to other styles of martial arts such as Taekwondo, aikido, Kung Fu and Shotokan karate.¹⁶

Injury rate for COI and acute injuries

In our study, the total prevalence rate of injured athletes (combined COI and acute) was 56% and the prevalence rate of COI alone was 32% and acute 24% (Table 2). Our data contradicts the findings in the study by Koh² and Song and Shin⁹, which reported a high prevalence rate of COIs in Poomsae athletes (73% and 71%, respectively). Injury rates and risk of sustaining multiple injuries in athletes who practice Tai Chi are extremely low compared to the other styles of martial arts presented in a study by Zetaruk *et al.*¹⁶ The only similarity that exists between Tai Chi and Poomsae injuries is that the most prevalent injury was muscle strain.

Gender and type of injury

Kazemi and Pieter¹⁷ compared genders in sparring TKD athletes and found that contusion was the most common type of injury in which females experienced more injuries than males (81% vs. 33%).

Female athletes we studied were more likely to suffer from chronic overuse injuries; they showed a 22% higher injury rate than males. This finding was similar to that found in the study by Koh.² In our study, female athletes reported a higher frequency of multiple COIs than male athletes (25% vs. 11%), whereas Koh² reported that female athletes had a lower frequency of multiple COI than male athletes (25% vs. 75%). The non-contact form of Wushu is very similar to Poomsae. Although documentation of injuries in Wushu competitions is not readily available, Blijid *et al.*¹⁵ reported that female semi-contact Wushu athletes had a higher incidence of injury compared to their male counterparts. This finding is similar to that found in Poomsae athletes, but in the forms (non-contact Wushu) competition, no injuries were reported.

The most common type of injury among men was sprain followed by joint dysfunction during national sparring Taekwondo championships.¹⁷ Our study did not find any gender difference with regards to strain injuries.

Age and Taekwondo Experience Level (DAN)

The mean age of Poomsae athletes with COIs observed in this study was slightly higher (Table 1) than the mean age of competitors with COI from a recent study by Koh (40 years vs. 35 years, respectively).² Koh and Kwak⁴ showed a trend (statistically insignificant) of high injury rate in older Poomsae athletes. Our study revealed no difference in chronic overuse injuries in younger and older athletes (five of 11 athletes with COI were ≤ 40 and six were > 40) (Table 2). Athletes 40 and under were more prone to acute injuries compared to athletes over 40. Koh² found that athletes over the age of 30 had a slightly higher frequency of acute injury than those under 30. This difference maybe due to the difference in classification of older athletes in our study (40 years of age) versus that in Koh² (30 years of age).

The athletes involved in our study were elite athletes participating at a World level, which is the highest level of competition in Poomsae. In the existing literature^{2,4,9} on Poomsae injuries, the level of competition was at a club or provincial level; therefore, the differences seen be-

tween results may be attributed to experience level (elite vs. non-elite athletes).

Body regions affected due to COI

We found the lower limbs to be the most affected by chronic overuse injuries which was similar to other studies.^{4,5,7,11,13} Back injuries were the second most occurring type of injury, which were more prevalent among males than females. Although most studies did not present results that were similar, many did not seek to make a comparison. Kazemi *et al.*¹⁰ found that injuries to the spine (neck, upper back, low back and coccyx) were the third most often injured body region in males in a nine year longitudinal study of sparring TKD athletes.

When comparing different regions of the body in chronic overuse injuries and acute injuries, the upper and lower body regions were the dominant injured body parts. We did not find any relationship between gender and age and type of injury in poomsae athletes in contrast to Kazemi *et al.*¹⁰ reporting a trend for increased injuries in athletes over 35 years of age in sparring TKD. We found the lower extremity to have the most commonly acutely injured region (38%) which compares favourably with Zetaruk *et al.*¹⁶ (38.9%). Zetaruk *et al.*¹⁶ also reported the lower extremity (35.9%) to be the most affected body part in Kung Fu.

Koh and Kwak⁴ noted that female athletes had a higher prevalence of COIs compared to their counterparts, however, our data did not show any significant differences between female and male recorded COIs. This may be due to our small sample size.

We found very few injuries that actually occurred immediately during training. Very few Poomsae training injuries occurred during the training activity, but rather developed over time in response to long hours of training leading eventually to chronic overuse injuries. One study showed chronic overuse injuries in 71% of Poomsae athletes in South Korea.⁴ An additional study conducted by Koh², showed that 73% of Poomsae athletes from Alberta, Canada reported chronic overuse injuries symptoms. Koh² also noted that female athletes and those who practiced more than 3 times a week had a higher prevalence of chronic overuse injuries compared to their counterparts. In Poomsae, the lower body was more prone to overuse injuries than the upper body; the dominant areas of injur-

ies were the knee joint and hamstrings, where strain was the most common type of injury.

Limitations

There are a number of limitations to this study. One limitation was the small sample size and therefore, the result needs to be used with caution and the conclusions may be limited to this pool and may not necessarily be considered generalizable to other populations. We cannot discount that a single clinician examined and diagnosed the injuries and it is possible that another clinician may have had different findings or diagnoses. Future studies in Poomsae injury should include various nations and investigate the injury rates during competitions with larger sample size.

The Injury Report Form (IRF)¹⁰, which was used for recording the injuries in this study was originally designed for recording injuries in sparring athletes. Upon conducting this study and realizing the limitations and shortcomings of the Injury Report Form used, the principle author created a Poomsae specific Injury Report Form. (See Appendix)

Severity of injury has been considered to be one of the main factors that affect an athlete's participation and performance. Unfortunately, there is a paucity of recording and defining severe injuries in Taekwondo studies. To the authors' knowledge only three studies have defined severity of injuries in Taekwondo.¹⁷⁻¹⁹ Sherrill²⁰ graded injury severity on a scale of 0–10 based on time lost from full participation. Injuries of grade three or less (time lost: < 1 day) accounted for 74%, while the remaining 26% were grade four injuries (time lost: 2–7 days). No injuries were reported to result in more than one week of time lost from full participation. Koh and De Freitas¹⁸ classified injury severity as mild (no time lost or restriction to participation), moderate (some disruption, less than full participation) or severe (discontinued participation and/or referral to a hospital). The injury rates per 1000 Athlete Exposures (AEs) of mild, moderate, and severe injuries were reported to be 56.0, 26.5, and 25.5, respectively. Lystad *et al.*¹⁹ recommended categorizing severity of injury: "The number of days that have elapsed from the date of injury to the date of the player's return to full participation in training and match play". They grouped the injuries as slight (0–1 days), minimal (2–3 days), mild (4–7 days), moderate (8–28 days), severe (> 28 days), "career-ending", and "non-fatal catastrophic injuries".¹⁹

6	Unsurvivable
5	Critical impaired LOC, altered GCS in cervical spine
4	Requires immediate transfer: opened/unstable fracture/dislocations
3	Requires assessment 24hrs: minor fractures/dislocations
2	Requires non-urgent follow up: sprains/strains
1	Minor treatment completed at scene: mild contusion, scratches

Figure 1. *Severity Score*.²⁰
 Legend: LOC=Loss of Consciousness;
 GCS=Glasgow Coma Scale.

In our opinion this classification is appropriate when one is able to follow the athlete following the injury. However, when the athlete has only been provided care only once during an event, this classification would not be applicable. In our opinion The Abbreviated Injury Scale (AIS, Figure 1) would be more practical for rating severity of injury at presentation to the health care provider.²⁰

This scale was used in Injury Report Form to account for the acute and on field injuries.¹⁰ Grade 6 was not included in Kazemi¹⁰ Injury Form Report. However, Oler *et al.*²² reported one case of a fatal kick to the head that resulted in an occipital skull fracture, bilateral subdural haematomas, contusion of the frontal and temporal lobes, and haemorrhage and herniation of the brainstem. As such, Grade 6 injury is included in the revised Poomsae Injury Report (Appendix) to account for the worst-case scenario.

Furthermore an email address for the athlete and the treating practitioner was added since most communications are through email at this time. Signature of the health practitioner was added under their personal info section since the signature at bottom of the page had been confusing. Competition division was added. RANK was refined by revising it to BELT RANK/COLOUR/DAN for clarification. And finally a simple consent statement on the bottom of the page with athlete and or parent/guardian signature was added. The part on IRF which related

to ability/inability of the sparring athlete to complete the match at which round was removed since it did not relate to Poomsae athletes. The new Poomsae IRF is not validated and future studies should investigate validity and reliability of this tool.

Conclusion

The most prevalent injuries in Poomsae were strain and joint dysfunctions. The lower limb was the most common site of chronic and acute injuries. Furthermore, females were more likely to sustain injuries to their lower limbs than males. Males with a black belt DAN ≤ 3 were most likely to have an acute injury. Females with a lower rank in experience level (DAN) were more likely to suffer from chronic overuse injuries compared to their male counterparts. Athletes 40 years old and younger were more prone to acute injuries compared to athletes over 40. Further investigation of Poomsae injuries in various nationals with larger sample size is recommended. A new injury form for reporting Poomsae injuries was developed, which requires further validity and reliability testing.

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Appendix
Poomsae Injury Report Form.

Date:		Time:	
EVENT:		PLACE:	
NAME:	BIRTHDATE:	AGE:	SEX: M F
ADDRESS:		CITY:	
PROVINCE:	POSTAL CODE:	PHONE:	
HEALTH CARD NO:	WEIGHT:	HEIGHT:	
COMPETITION DIVISION:			
NAME OF TAEKWONDO SCHOOL:		BELT RANK/Colour/Dan:	
TO BE COMPLETED BY MEDICAL PERSONNEL			
NAME:		OCCUPATION:	
CLINIC LOCATION:		PHONE:	
EMAIL:		SIGNATURE:	
Past History: Location: Radiation: Character & Intensity: Mechanism of Injury:		During training During competition Completed Match Yes No	
Front snap Kick Side Kick Round house Kick Crescent kick Punch Block Tripped Collision Other		ALLERGIES:	
Examination Findings:		Severity Score: 6 Unsurvivable 5 Critical impaired LOC, altered GCS in cervical spine 4 Requires immediate transfer: opened/unstable fracture/dislocations 3 Requires assessment 24hrs: minor fractures/dislocations 2 Requires non-urgent follow up: sprains/strains 1 Minor treatment completed at scene	
Diagnosis:		ACUTE CHRONIC OVERUSE	
Recommendations:		FIT TO COMPETE NOT FIT TO COMPETE	
Treatment Rendered:			
Follow-up:			
Discharge Instructions:			

I have been informed of the risks involved and consent to the treatment and recommendations stated above.

Athlete Signature:

Date:

Parent/guardian name:

Signature:

Date: