

Sports injury type and psychological factors affect treatment period and willingness-to-pay

Cross-sectional study

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Abstract

This study aimed to describe the sport injuries of elite collegiate athletes, and to examine the influence of career length, past injuries, and psychological factors on the treatment period and willingness to pay (WTP) for treatment.

A survey was conducted among students of the Department of Physical Education, Korea National Sport University. Results were interpreted through frequency analysis and multiple linear regression analysis.

All students currently in training (n=624, mean age 21 ± 2 years) participated in this study. 12-month prevalence of sports injuries was 56%. The locations of the most common and severe injuries were the knee, ankle, and back. The most frequent types of common injury were sprain, ruptured ligament, and bruising. The location of injuries varied according to the sports discipline. The treatment period was influenced by sports discipline, career length, location, and type of injury, and fear of further injuries. Treatment period was associated with the reason for fear of injuries, and WTP was influenced by fear of further injuries.

Our study suggests that specific management plans for athletes based on disciplines, past injuries, and their emotional responses to previous injuries are required for rehabilitation and return to sports following treatment.

Abbreviations: KNSU = Korea National Sport University, NMQ = Nordic Musculoskeletal Questionnaire, WTP = willingness to pay.

Keywords: athletes, athletic injuries, cost of illness, sports injuries, willingness to pay

1. Introduction

For elite athletes to train and compete at their highest performance levels, it is necessary to understand the epidemiological characteristics as well as the consequences of sports

injuries. Previous studies have provided sufficient evidence showing that elite athletes have higher risks for trauma, as well as higher incidence of overuse injury, than leisure sports athletes, and subsequent injuries also influence their long-term health outcomes.^[1-6] Furthermore, psychological factors such as distress and anxiety influence the rehabilitation and the time to return to play.^[7-9] In this regard, sports injuries, both acute trauma and overuse injuries, are major targets not only in maintaining the short-term condition of the athletes but also in enhancing their long-term physical and psychological health. Effective approaches to injury prevention, treatment, and rehabilitation include specialized and personalized plans by sports discipline to meet the needs of the athletes.^[10]

To date, many studies have been conducted on sports injuries in various sports sectors, focusing on major sports events such as the Olympic Games.^[2,3,6,11,12] On the other hand, as with the study of injuries at major sports events, the study of the ongoing injury and management of elite athletes during training is also important, because it has a significant impact on preventing them from further injuries and prolong their sports career. In addition, there is a need to consider the emotional response of athletes to sports athletes. Previous studies reported that fear was a prominent emotional response at the time of returning to sport,^[13] and also that negative psychological responses in athletes identified the risk of not returning to the athletes preinjury level of sports by 12 months.^[14]

Korea National Sport University (KNSU), the national institution for training sports leaders in Korea, is a very unique institution, with the most number of Olympic medalists from its students or alumni, and more than one-third of all Korean medals in major international games, including the Olympics.^[15] Moreover, it has the most diverse range of sport disciplines,

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including archery, wrestling, badminton, boxing, skating, shooting, swimming, cycling, weightlifting, judo, track and field, gymnastics, taekwondo, fencing, rowing, tennis, canoeing, field hockey, handball, bowling, and golf. However, only small groups of students by sport discipline have been studied with respect to their training and injuries.^[16–19] Therefore, there is a persisting need to examine and compare sport injuries by different sports among the members of this group.

This cross-sectional study was designed to describe the prevalence and types of sport injuries in Korean elite athletes of KNSU, and to examine the influence of career length and the emotional responses to sports injuries on the treatment period and the willingness to pay (WTP) for treatment. The Centers for Disease Control & Prevention in Korea published a report in 2018 on injury prevention which showed that the types and location of injuries as well as safety facilities and preventive strategies for the prevention of sports injuries vary according to sports disciplines.^[20] Furthermore, a previous study by the authors of our study showed that the subjective evaluation by young athletes on the medical services for health promotion, sports injury prevention, and counseling for stress and other psychological problems significantly influenced the WTP for these treatments.^[21,22] Based on the empirical data and the previous study, we hypothesized in this study that the injury location will vary by sports discipline and that the length of treatment period and WTP for the treatment of sports injuries will vary according to past injuries and psychological factors with respect to further injuries, in addition to the sports discipline.

2. Materials and methods

2.1. Study design

A survey of elite athletes in different sports competing at the national or international level was conducted among students currently enrolled in the Department of Physical Education, KNSU, in the second semester (from August to December) of 2017. For this cross-sectional survey, a researcher visited classes or training sessions within the department to provide verbal instructions and questionnaires to the students. All participants were informed about the study through a cover letter and verbal instructions. To ensure compliance and privacy, the instruction stated that all responses will be treated with confidentiality and the data were solely for research purposes. Written informed consent was obtained before participation. All procedures were approved by the Institutional Review Board of Gachon University, Seongnam, Republic of Korea (No. 1044396-201708-HR-127-01) and conducted in accordance with the guidelines issued by the Human Subjects Committee.

2.2. Participants

This study was conducted on all students of the Department of Physical Education, KNSU, who are elite athletes with experiences in training and competition at the national or international level. In KNSU, all elite athletes are enrolled in the Department of Physical Education, which focuses on the cultivation of both elite athletes and sports educators through specialized sports programs. Among the registered educational institutions in Korea, KNSU has the largest number of elite athletes at the national or international level, with a total of 728

students (based on 2017 data, <http://sports1.or.kr/stat/>), according to the Korean Sport & Olympic Committee. Athletes who were in training camps, those who were out of campus for the treatment of injuries, and those whose coach or trainer did not agree to the survey owing to possible distractions to the training were excluded.

2.3. Sports injury survey

The variables in this survey have been selected and designed based on the previous studies as well as expert consultations. An open-questionnaire was sent out to the athletes in KNSU to find out their sports disciplines which were later categorized for statistical analysis based on the consultations from the faculty members and researchers in KNSU. In addition to the survey used in our previous studies,^[21,22] literature on the location of the injury showed a variety of standards for locating the injured body parts.^[23–25] The design of our questionnaire on the injury location was modified based on the standardized Nordic Musculoskeletal Questionnaire (NMQ) which was developed and validated as a tool for evaluating the prevalence of occupational musculoskeletal symptoms.^[24,26,27] Since NMQ was designed for occupational musculoskeletal symptoms, the questionnaire had undergone some modifications to specifically target sports injuries. To investigate the overall injuries of the athletes, sports injury was defined in this study as any type of musculoskeletal symptoms (acute or chronic) caused by sports training or competitions, shown on a diagram of the human body, which was segmented to reflect common sports injury areas.^[28] Furthermore, the types of injury included in our survey was based on previous studies regarding sports injuries during the Olympics and consultations from the sports team doctors, from which the questions were ordered by frequency of the occurrence reported in these studies.^[23,29]

In this structured, forced, multiple or binary choice survey, questions relating to the prevalence of injury focused on lifetime (sports injury at least once in the life) and 12-month injuries. With respect to lifetime injuries, questions identifying the injuries were divided into the most severe sports injury and the most common sports injury that the participant experienced. For both injury experiences, the participants were asked about the location and type of the injuries. To further specify the location of sports injuries, the human body was divided into 16 parts (from the 9 parts of the original NMQ). The types of injuries were categorized into 8 types: bone dislocation, fracture, ruptured ligament, ruptured muscle, sprain, bruises, disc hernia, and others. In addition, the treatment period of the injury, WTP for treatments to return to training 1 week earlier, and the location for which the participants had the greatest fear for further injuries and reasons for such fears were included in the survey. Lastly, psychological factors such as the location for which the participants had the greatest fear for further injuries, and the reasons for such fears were included. Since the athletes participating in this study were elite athletes with recurrent injuries, consultations from the KNSU faculty members and sports team doctors as well as previous studies^[24,25] revealed that the fear for possible injuries might be linked to health care utilization, which was reflected in this survey. Before the participants answered questions on sports injuries, they provided baseline information including demographics such as age and sex, as well as the sports discipline and career length.

2.4. Statistical analysis

The most severe and most common sports injuries by discipline were analyzed. The descriptive statistics of the participants were analyzed using frequency analysis and expressed as means and standard deviations. Data on sports injury were analyzed using frequency analysis, and group means were compared using unpaired *t*-tests for age, sex, and career length. The most common injuries according to the sports discipline were visualized on a diagram of the human body, and the frequency with which the body parts were mentioned as the most commonly injured areas were expressed using a color spectrum. Furthermore, the treatment period and WTP for treatment to return to training 1 week earlier, was analyzed through multiple linear regression analysis, adjusting for the sports discipline, career length, injury location and type, and fear of injuries. In the linear regression analysis, archery was the reference to which the other variables were compared. Missing values were included in the data analysis, and multiple answers were considered equivalent to missing values. All statistical analyses were conducted using R software (ver. 3.4.2, code name “Short Summer”; <http://r-project.org/>). A *P* value of <.05 was considered statistically significant.

3. Results

3.1. General characteristics of elite athletes in KNSU

Among all elite athletes (n=728) in the Department of Physical Education, KNSU, registered in the Korean Sport & Olympic Committee, 624 students (86%) from 23 sports disciplines responded to the survey. The characteristics of all students are shown in Table 1. Of the participants, 30% were female athletes and the largest group among 23 sports disciplines was the track and field group (12%). The largest group in terms of career length was that with a career length of between 6 and 8 years (29%).

3.2. Types and location of sports injuries

An overview of the commonly injured areas, severely injured areas, and concerned areas for injuries is listed in Supplement 1, <http://links.lww.com/MD/F340>. The percentage of injuries in the knee, back, ankle, and shoulders summed up to >60% of all common injuries, severe injuries, and most concerned areas for injuries. On the other hand, the most frequent types of common injury were sprain (21%), ruptured ligament (20%), and bruising (11%), while the most frequent types of severe injury were ruptured ligament (23%), fracture (13%), and sprain (10%). An overview of the types of injuries is shown in Supplement 2, <http://links.lww.com/MD/F341>. Fig. 1 provides a visualization of the most common injuries by body areas, where the areas are colored by the percentage of injury frequency and labelled the sports discipline which most frequently caused that injury.

The 12-month prevalence of sports injury in all participants was 56%. According to sports disciplines, judo (81%), weightlifting (75%), track and field (74%), and fencing (74%) had the highest 12-month prevalence of injury. Table 2 illustrates most commonly injured areas, most severely injured areas, and the most concerned areas for injuries by sports disciplines. Other than the commonly injured areas mentioned above, specific body areas commonly injured in specific sports were the wrist in bowling (29%), and specific body areas frequently involved in severe injuries in specific sports were the hands in boxing (29%), the wrist in golf (20%), and the feet in taekwondo (22%). The

Table 1

Baseline characteristics of currently enrolled students at Department of Physical Education, Korea National Sport University (n = 624).

Categories	Subcategories	Frequency	%	<i>P</i> value
Age	21.11 ± 2.40			
Sex	Male	437	70.03	.24
	Female	187	29.97	
Sports discipline	Archery	17	2.72	<.001
	Badminton	20	3.21	
	Bowling	21	3.37	
	Boxing	24	3.85	
	Canoe/Kayak	27	4.33	
	Cycling	15	2.40	
	Fencing	23	3.69	
	Golf	25	4.01	
	Gymnastics	27	4.33	
	Handball	31	4.97	
	Hockey	45	7.21	
	Judo	43	6.89	
	Rowing	23	3.69	
	Shooting	29	4.65	
	Skating/Ice sports	27	4.33	
	Skiing/Snow sports	15	2.40	
	Swimming	16	2.56	
	Taekwondo	27	4.33	
	Tennis	12	1.92	
	Track and field	73	11.70	
	Water polo	11	1.76	
	Weightlifting	36	5.77	
	Wrestling	37	5.93	
Career length	0–2 years	7	1.12	.02
	2–4 years	13	2.08	
	4–6 years	63	10.10	
	6–8 years	181	29.01	
	8–10 years	160	25.64	
	10–12 years	118	18.91	
	12–14 years	61	9.78	
	14–16 years	17	2.72	
	16–18 years	4	0.64	

**P* value below the significance level of .05.

most seriously injured areas experienced by more than one third of all players in specific sports were the shoulders in archery (59%) and water polo (55%), the knees in judo (47%), and the back in weightlifting (36%), and rowing (35%). The body areas most frequently mentioned for concern for injuries were the wrist in bowling (29%) and the hands in boxing (25%).

Furthermore, common symptoms during training other than musculoskeletal injuries were reported (multiple answers allowed). The most common symptoms were respiratory symptoms (20%), followed by digestive problems (17%) and dental problems (13%).

3.3. Influence of sex, career length, sports discipline, location and type of injury, and individual fears for injuries on treatment period

Treatment period was defined in this survey as the time taken to treat the most severe injury and was analyzed using a multiple linear regression model (Table 3). Demographic factors such as sex, career length, and sports discipline, injury factors including the area and type of the most severe injury, and psychological

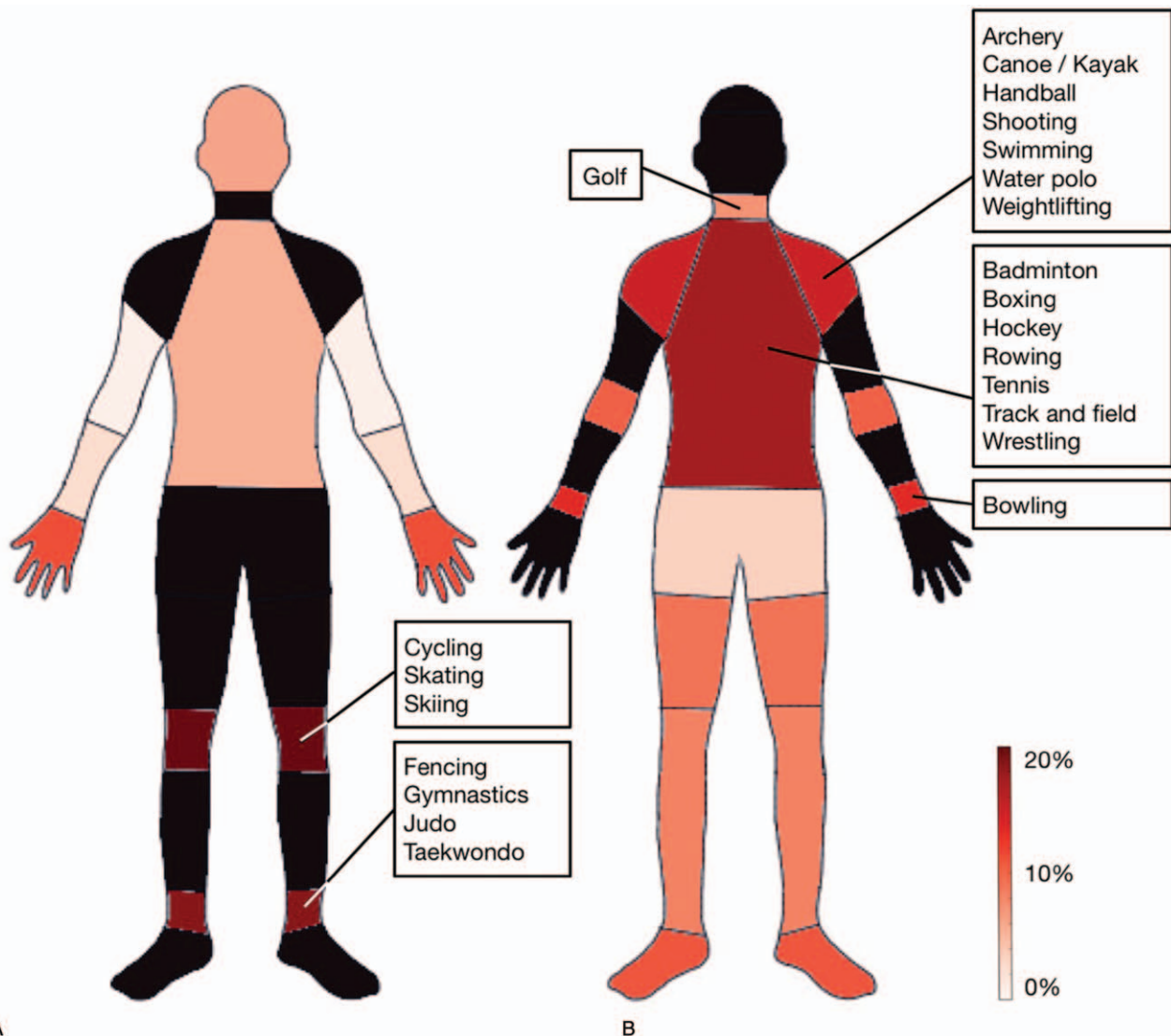


Figure 1. Diagram of the human body. The sections show the most commonly injured areas identified by the participants. The color of the areas shows the ratio (%) of the injuries in each area. The labeling of each area shows the sports discipline that was reported to cause the injury in that area. (A) Anterior view of the human body. (B) Posterior view of the human body.

factors such as fear of injuries, were included in the analysis. The result showed that the treatment period was not significantly different between female and male athletes ($\beta=0.19$, $P=.20$). In terms of career length, compared with athletes with the longest career (16–18 years), those with a shorter career had significantly shorter treatment in general. With respect to the sports disciplines, compared with archery, all other sports disciplines had a significantly longer treatment period except for golf ($\beta=0.66$, $P=.19$).

Among the injured areas, the back ($\beta=1.75$, $P<.001$), shoulders ($\beta=2.11$, $P<.001$), elbow ($\beta=1.84$, $P<.001$), forearm ($\beta=1.75$, $P=.04$), wrist ($\beta=2.17$, $P<.001$), thigh ($\beta=1.69$, $P=.001$), knee ($\beta=1.78$, $P<.001$), calf ($\beta=1.58$, $P=.002$), ankle ($\beta=1.37$, $P<.001$), and feet ($\beta=1.59$, $P=.001$) were related to a significantly longer treatment period. Similarly, among the types of injuries, joint dislocation ($\beta=1.41$, $P=.002$), fracture ($\beta=1.16$, $P=.002$), ruptured ligament ($\beta=0.85$, $P=.018$), and disc hernia ($\beta=2.20$, $P<.001$) led to a significantly

longer treatment period. In addition, fear of injuries in a frequently used area ($\beta=0.72$, $P=.016$), recently injured area ($\beta=0.76$, $P=.031$), area of previous injury ($\beta=0.93$, $P=.005$), and commonly injured area ($\beta=0.78$, $P=.016$) were related to a longer treatment period.

3.4. Influenced of sex, career length, sports discipline, location and type of injury, and individual fears for injuries on WTP

WTP was defined in this survey as the amount of money that the athlete is willing to pay for treatment to return to training by 1 week earlier and was analyzed using a multiple linear regression model (Table 4). The results showed that WTP was not significantly different between female and male athletes ($\beta=0.75$, $P=.15$). Career length was not significantly related to WTP. When compared with archery, canoeing/kayaking ($\beta=-3.86$, $P=.02$), gymnastics ($\beta=-3.89$, $P=.02$), tennis ($\beta=-5.25$,

Table 2

The 12-month prevalence, the most commonly injured area, most severely injured area, and most concerned area for the injury by sports disciplines.

	12-month prevalence (%)	Most commonly injured area			Most severely injured area			Most concerned area for an injury		
		Area	Freq	%	Area	Freq	%	Area	Freq	%
Archery	29.41	Shoulder	13	76.47	Shoulder	10	58.82	Shoulder	12	70.59
Badminton	65.00	Back	5	25.00	Knee	4	20.00	Back	6	30.00
Bowling	66.67	Wrist	6	28.57	Shoulder	5	23.81	Wrist	6	28.57
Boxing	37.50	Back	6	25.00	Hand	7	29.17	Hand	6	25.00
Canoe/Kayak	48.15	Shoulder	9	33.33	Shoulder	7	25.93	Shoulder	7	25.93
Cycling	60.00	Knee	4	26.67	Shoulder	4	26.67	Knee	6	40.00
Fencing	73.91	Ankle	9	39.13	Ankle	5	21.74	Back	6	26.09
Golf	20.00	Neck	5	20.00	Wrist	5	20.00	Back	7	28.00
Gymnastics	62.96	Ankle	9	33.33	Back	8	29.63	Knee	10	37.04
Handball	51.61	Shoulder	5	16.13	Knee	9	29.03	Knee	13	41.94
Hockey	55.56	Back	9	25.71	Ankle	12	26.67	Knee	12	26.67
Judo	81.40	Ankle	7	16.28	Knee	15	46.88	Back	11	25.58
Rowing	47.83	Back	8	34.78	Back	8	34.78	Back	14	60.87
Shooting	51.72	Shoulder	8	27.59	Shoulder	9	31.03	Back	9	31.03
Skating	33.33	Knee	9	33.33	Back	6	22.22	Back	10	37.04
Skiing	26.67	Knee	5	33.33	Knee	4	26.67	Knee	9	60.00
Swimming	56.25	Shoulder	6	37.50	Ankle	5	31.25	Shoulder	6	37.50
Taekwondo	55.56	Ankle	9	33.33	Feet	6	22.22	Knee	9	33.33
Tennis	58.33	Back	3	25.00	Ankle	3	25.00	Back	3	25.00
Track and field	73.97	Back	9	12.33	Ankle	15	20.55	Ankle	14	19.18
Water polo	54.55	Shoulder	7	63.64	Shoulder	6	54.55	Shoulder	8	72.73
Weightlifting	75.00	Shoulder	8	22.22	Back	13	36.11	Back	10	27.78
Wrestling	43.24	Back	6	16.22	Knee	10	27.03	Knee	14	37.84

Freq = frequency.

$P = .01$), and wrestling ($\beta = -4.57$, $P = .01$) had a significantly lower WTP. The injured area and injury types did not significantly influence WTP. On the other hand, fear of injury for frequently used areas in training ($\beta = 1.86$, $P = .048$) and other individual fears for further injuries ($\beta = 3.75$, $P = .039$) were related to higher WTP.

4. Discussion

The purpose of this study was to describe the prevalence and types of sport injuries of elite athletes by their sports disciplines and to examine the factors which may have influence on their treatment period and WTP for treatment. In this study, more than half of the respondents (56%) had experienced sports injuries in the past year; judo, weightlifting, track and field, fencing, and bowling had the highest 12-month prevalence of injury. This study hypothesized that the injured areas would vary according to sports disciplines, and the results showed certain sports-specific differences in the areas of injury. The most frequently injured areas, most seriously injured areas, and the areas of concern in most sports discipline included the knee, ankle, back, and shoulders. The specific areas commonly injured in specific sports included the wrist in bowling; the most frequent severe injuries involved the hand in boxing, the wrist in golf, and the feet in taekwondo. The most frequent area of concern for injuries was the wrist in bowling and the hand in boxing. Another hypothesis tested in our study was that the treatment period and WTP for sports injury will vary according to the sports disciplines, past injuries, and psychological factors related to further injuries. The results showed that the treatment period was indeed influenced by the sports discipline, career length, location and types of injuries, and fears for the injuries. In addition, WTP was

influenced by individual fears for the injuries. Specifically, participants who were highly aware of injuries in frequently used areas were willing to pay a higher price for injury treatment.

Numerous studies have been conducted on sports injuries across different sports disciplines, mainly focusing on major sport events such as the Olympic Games. The high risk of injury in weightlifting,^[2,11] track and field,^[2] and badminton^[2] at the Summer Olympics, and the low risk of injury in archery^[2] and golf^[29] were similar to our findings. In the Beijing Summer Olympics, the most common types of injuries during the season were ankle sprain and thigh strain.^[11] In the Winter Olympics, the sports disciplines that showed higher risks of injuries were skiing, snowboarding, and bobsleighbing, and the most commonly injured areas were the head, neck, and knee.^[12,30] The symptoms with the highest prevalence other than musculoskeletal symptoms were respiratory symptoms.^[2]

Although the results on the injuries of elite athletes in our study are mostly consistent with previous studies, differences exist which may be attributed to the influence of the on and off seasons on the athletes. For instance, in the case of taekwondo, our results showed a moderate frequency of injuries, in contrast to previous investigations in the last 3 summer Olympics^[2,11,29] which reported a high risk of injuries. Similarly in boxing, a high risk of injuries was reported in London^[2] and Rio Olympic Games;^[29] however, in our study, the frequency of boxing injuries was low. Given that this study provides data based on the injury experience of elite athletes over 12 months including both the seasons and off-seasons, these differences may be due to the training intensity between games and training. Furthermore, this study suggests while the risk of sports injuries is present across all types of sports, the impact of the injuries may vary widely according to the career length. Previous studies found that factors such as high training

Table 3
Analysis of treatment period from the most severe injury by sex, sports, and injuries.

Categories	β	S.E.	P value
Sex			
Female	0.19	0.15	.201
Career length			
2–4 years	−4.30*	0.83	<.0001
4–6 years	−3.76*	0.72	<.0001
6–8 years	−3.47*	0.70	<.0001
8–10 years	−3.41*	0.70	<.0001
10–12 years	−3.01*	0.69	<.0001
12–14 years	−3.20*	0.71	<.0001
14–16 years	−2.49*	0.79	.002
16–18 years	−1.92	1.02	.060
Sports discipline			
Badminton	1.25*	0.50	.014
Bowling	1.69*	0.51	.001
Boxing	1.97*	0.52	.000
Canoe/Kayak	1.74*	0.48	.000
Cycling	2.04*	0.58	.000
Fencing	2.19*	0.51	<.0001
Golf	0.66	0.50	.191
Gymnastics	1.41*	0.49	.005
Handball	1.58*	0.48	.001
Hockey	1.33*	0.46	.004
Judo	1.43*	0.47	.002
Rowing	1.56*	0.52	.003
Shooting	1.50*	0.48	.002
Skating	2.07*	0.50	<.0001
Skiing	1.23*	0.55	.024
Swimming	1.26*	0.56	.024
Taekwondo	1.57*	0.50	.002
Tennis	1.60*	0.59	.008
Track and field	2.19*	0.44	<.0001
Water polo	2.18*	0.60	.000
Weightlifting	1.33*	0.47	.005
Wrestling	1.70*	0.47	.000
Injured area			
Head/Face	0.45	0.66	.492
Neck	1.49	0.81	.069
Chest/Abdomen	0.35	0.67	.604
Back	1.75*	0.38	<.0001
Shoulders	2.11*	0.36	<.0001
Upper arm	2.11	1.13	.062
Elbow	1.84*	0.44	<.0001
Forearm	1.75*	0.83	.036
Wrist	2.17*	0.46	<.0001
Hand	0.81	0.46	.080
Hip	1.06	0.72	.144
Thigh	1.69*	0.51	.001
Knee	1.78*	0.37	<.0001
Calf	1.58*	0.50	.002
Ankle	1.37*	0.38	.000
Feet	1.59*	0.47	.001
Type of injury			
Joint dislocation	1.41*	0.45	.002
Fracture	1.16*	0.38	.002
Ruptured ligament	0.85*	0.36	.018
Ruptured muscle	0.64	0.40	.112
Sprain	0.24	0.38	.523
Bruise	−0.5	0.44	.251
Disc hernia	2.20*	0.46	<.0001
Others	1.08*	0.35	.002
Reasons for fear of injuries			
Frequently used	0.72*	0.28	.016
Recently injured	0.76*	0.35	.031
Old injury	0.93*	0.33	.005
Commonly injured	0.78*	0.32	.016
Personally weak	0.44	0.35	.213
Others	1.19*	0.52	.024
(Intercept)	2.03*	0.86	.018

* P value below the significance level of .05.

Table 4
Analysis of willingness to pay to return to training by one week earlier by sex, sports, and injuries.

Categories	β	S.E.	P value
Sex			
Female	0.75	0.52	.148
Career length			
0–2 years	1.35	2.86	.638
2–4 years	−2.03	2.49	.416
4–6 years	−1.22	2.42	.616
6–8 years	−0.84	2.42	.728
8–10 years	−1.54	2.39	.519
10–12 years	−2.07	2.44	.398
12–14 years	−1.77	2.72	.517
14–16 years	−1.36	3.53	.700
Sports discipline			
Badminton	−1.40	1.74	.422
Bowling	−2.74	1.76	.120
Boxing	−1.13	1.81	.531
Canoe/Kayak	−3.86*	1.68	.022
Cycling	−1.09	1.99	.587
Fencing	−0.93	1.77	.600
Golf	0.68	1.74	.697
Gymnastics	−3.89*	1.71	.023
Handball	−1.45	1.65	.382
Hockey	−2.42	1.59	.129
Judo	−1.56	1.61	.332
Rowing	−3.43	1.80	.057
Shooting	−0.70	1.66	.676
Skating	−1.91	1.72	.267
Skiing	−0.94	1.89	.618
Swimming	−0.82	1.92	.671
Taekwondo	−1.04	1.74	.552
Tennis	−5.25*	2.02	.010
Track and field	−0.26	1.53	.866
Water polo	−0.60	2.09	.775
Weightlifting	−2.42	1.62	.136
Wrestling	−4.57*	1.64	.006
Injured area			
Head/Face	−2.46	2.28	.280
Neck	3.88	2.79	.164
Chest/Abdomen	−1.05	2.32	.650
Back	0.56	1.31	.670
Shoulders	−0.72	1.24	0.561
Upper arm	−1.11	3.91	.778
Elbow	1.59	1.53	.300
Forearm	−1.38	2.88	.631
Wrist	2.33	1.59	.142
Hand	1.31	1.60	.412
Hip	4.08	2.50	.103
Thigh	0.00	1.76	.999
Knee	0.09	1.28	.944
Calf	−0.85	1.71	.620
Ankle	0.34	1.30	.794
Feet	0.14	1.62	.933
Type of injury			
Joint dislocation	−0.05	1.55	.976
Fracture	0.44	1.31	.738
Ruptured ligament	−0.48	1.24	.698
Ruptured muscle	1.88	1.38	.176
Sprain	0.82	1.30	.526
Bruise	0.84	1.51	.576
Disc hernia	2.78	1.59	.082
Others	−0.39	1.22	.746
Fear of injuries			
Frequently used	1.86*	0.97	.048
Recently injured	0.90	1.21	.460
Old injury	1.48	1.14	.194
Commonly injured	1.02	1.11	.361
Personally weak	0.24	1.21	.839
Others	3.75*	1.81	.039
(Intercept)	10.18*	2.96	.001

* P value below the significance level of .05.

volume, repetitive motions, high physical loads, repetitive mechanical strain, and extreme body positions might be responsible for musculoskeletal pain (e.g., back pain).^[3,5,31] Our study suggests that the aforementioned factors of musculoskeletal pain, accumulated over time, lead to injuries which require a longer period to completely recover.

Furthermore, this study showed that fear of an injury influences both the WTP and treatment period. While no study has been conducted to date on the athletes WTP for the treatment of their pain or injury, WTP is widely used to quantify the amount an individual is willing to pay to procure the required treatment and avoid damage.^[32] A previous study that implemented WTP in a cross-sectional survey showed that recognition of one's own problems may influence the general WTP.^[33] WTP was investigated in studies that compared the needs for prevention of a disease,^[33] as well as the needs for improvement in the health condition and working environments.^[34,35] Taken together, this study suggests that the athletes increased WTP may indicate their awareness of the injuries and the willingness to return to sport. Furthermore, the athletes increased treatment period in relation to fear of an injury indicate possible negative emotional feedbacks from previous injuries, which may form a loop of negative feedback hindering returns to sport following injury rehabilitation. From these results, it seems crucial that sports medicine practitioners and sport psychology specialists form a strategy for athletes to cope with their fear of an injury during rehabilitation and training.^[36]

To our knowledge, this is the first study with a large sample size to Korean elite collegiate athletes, as well as a first study to conduct a complete enumeration survey in the Department of Physical Education, KNSU across diverse sports disciplines. This is meaningful because the characteristics of the subjects of this study can be a kind of sample group for athletes from various sports participating in sports events such as the Olympics. KNSU focuses on the training of elite athletes in sports disciplines that may be less popular and need more attention. Consequently, KNSU has the national record in Korea of being the school with the most Olympic medalists, and of winning more than one-third of all Korean medals in major international competitions. While some students were out of the campus for training camps or for injury treatments, we were able to collect data from all students who were enrolled in KNSU at the time. Thereby, this study analyzed the information of 624 elite athletes in Korea across 23 different sports disciplines.

The limitation of this study is the categorization of the sports disciplines. Some disciplines such as marathon and javelin were categorized as track and field, owing to the limited number of athletes in those disciplines. Similarly, diving was included in swimming, and canoeing and kayaking were categorized as 1 discipline. Furthermore, some disciplines, especially winter sports, were not included in the study because many students were in training camps to prepare for the PyeongChang Winter Olympics 2018, which was only a few months away when this study was conducted.

5. Conclusions

In conclusion, this study illustrates the sports injuries and symptoms of Korean elite collegiate athletes and shows the influence of career length, past injuries, and individual fears for injuries on the treatment period and WTP. A recent study on the management of pain in elite athletes concluded that there are

many gaps in the current knowledge, and that further information and studies are required.^[37] This study suggests that a specialized approach in training as well as in treatment and rehabilitation is required according to the discipline and career length. Furthermore, this study implicates the importance of psychological supports to the athletes during rehabilitation and training in order to overcome their fear of further injuries. Although gaps undoubtedly exist, studies on injury experiences, treatment period, and subsequent WTP for treatment across diverse sports disciplines may contribute to the effective and efficient management of sports injuries.

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Author contributions

Conceptualization: SYK, JKO, and YSL.
Data acquisition: JKO and DSP.
Data analysis: YSL; Supervision, SYK.
Funding acquisition: SYK.
Investigation: YSL, DSP, JKO and SYK.
Methodology: SYK, JKO and YSL.
Visualization: YSL and SYK.
Writing – original draft: Preparation, YSL.
Writing – review & editing: YSL and SYK.

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