



Original Article

Prediction model for utilization of complementary and alternative medicine for sports injuries among Korean elite collegiate athletes

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ABSTRACT

Background: The purpose of this study was to describe the use of complementary and alternative medicine (CAM) services by Korean elite collegiate athletes and to examine the factors influencing the utilization of CAM, or Korean Medicine (KM).

Methods: Students in Korea National Sport University (KNSU) enrolled and in training during August to December 2017 completed the survey. Data from the survey was analyzed through path analysis.

Results: Students who were training in the Department of Physical Education, KNSU (n = 624, 70% males, mean age 21.3 ± 1.2) participated in this study. 15% of the respondents chose KM clinics for sports injuries, a higher rate than that of the general population, and 44% of KM interventions involved acupuncture. In the path analysis, sports injuries were positive predictors for utilization of medical services and the perception of KM, and KM utilization and the perception of KM were positive predictors of the willingness to receive KM treatments.

Conclusions: The use of KM such as acupuncture was relatively high in elite collegiate athletes. The perception of KM and willingness to receive KM treatments were mediated by previous KM experiences. A higher accessibility towards KM treatments are necessary.

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1. Introduction

Complementary and alternative medicine (CAM) treatments such as acupuncture have been applied to treat a variety of sports injuries.¹ Athletes who have higher risk of chronic pain symptoms including musculoskeletal pain may find CAM service such as acupuncture effective.¹⁻⁴ Shoulder injuries,⁴ sports-related muscle tension headaches,⁵ muscle spasms and tremors of the hands,² and skeletal muscle fatigue⁶ have been reported to be treated with acupuncture. Furthermore, acupuncture have been reported to show effectiveness in the recovery and enhancement of performance of athletes.⁷⁻¹⁵ In Korea, a recent study reported management of sports injuries in Korean national volleyball team with acupuncture.¹⁶ The aforementioned studies suggest that CAM treatments may be selected to treat multiple pain conditions in sports; however, the utilization of and willingness to receive

acupuncture among a large sample of elite athletes across diverse sports discipline is yet to be studied.

The utilization of CAM services, including that of the athletes', is determined by multiple determinants including institutional, socioeconomic and cultural backgrounds of the individual, in addition to the individual preferences.¹⁷⁻¹⁹ While the utilization of Korean Medicine (KM) treatments in Korea throughout the general population is reported to be about 5%,¹⁸ previous studies have shown that the increasing prevalence of chronic diseases and symptoms such as pain was related to higher utilization of CAM services.^{20,21} Studies report that use of CAM is preferred by chronic disease patients who need constant care mainly through outpatient services.²² The highest utilization of CAM service was mainly reported by chronic musculoskeletal disease patients, to relieve symptoms such as pain that influence the health-related quality of life (HRQoL).²³ Many musculoskeletal symptoms in athletes' sports injuries are often caused by overuse,^{24,25} in which case acupuncture, CAM, or KM treatment can be one of the major treatment options. A comprehensive understanding of CAM treatments for sports injuries can help sports experts including sports physicians set the treatment and rehabilitation plans for the injured athletes. In addition, investigating the factors in choosing treat-

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ments for sports injury will help understand the athletes' decisions. Therefore, the purpose of this study is to describe the utilization of CAM services by Korean elite collegiate athletes and to examine the factors which influence their decision to receive CAM services. To specify the CAM services used in Korea, this study focused on KM treatments among a wider range of CAM therapies in the following survey and analysis. This study investigated the causal relationships between past injuries, the overall health care utilization, and the willingness of the athletes to receive CAM treatments through structural modelling.

2. Methods

2.1. Study design

A complete enumeration survey was conducted to elite collegiate athletes enrolled in the Department of Physical Education, Korea National Sport University (KNSU). The research period was between August and December, in 2017. This survey consisted of two independently structured questionnaires, one of which is analyzed in this study. The other questionnaire, which was about the psychological impact of sports injury and the athletes' willingness-to-pay (WTP) for medical treatments, was investigated in another paper. In this study, a researcher visited the Department throughout the research period to provide verbal instruction and questionnaires to the students. All participants were informed that the data they provided will be used for research purposes only and that all responses will be treated with confidentiality to ensure compliance and privacy purposes. Written informed consent was obtained from each participant prior to participation. This study was approved by the Institutional Review Board of Gachon University, Seoul, Republic of Korea (No. 1044396-201708-HR-127-01) and were conducted in accordance with the guidelines issued by the Human Subjects Committee.

2.2. Participants

All participants were students from Department of Physical education, KNSU, who are elite collegiate athletes competing at national or international level. A total of 728 students in KNSU were registered as elite athletes in Korean Sport & Olympic Committee Database (<http://g1.sports.or.kr/stat/>). We excluded athletes who were out of campus to participate in off-season training or to treat injuries, and the athletes whose coach or trainer did not agree to participate in the survey to avoid any possible impediments to training.

2.3. Measures

The questionnaire used in this study was designed based on the previous studies related to sports injuries, expert consultations as well as authors' discussion taking into characteristics of the athletes in KNSU.

2.3.1. Sports injuries

Sports injury was defined as any type of acute or chronic musculoskeletal symptoms, caused by sports training or competitions.²⁶ Questions identifying the injuries were divided into most common, and most severe sports injuries that the participant experienced. For both injury experiences, the 16 injury location (based on a modified version of the standardized Nordic Musculoskeletal Questionnaire which is developed to study the prevalence of occupational musculoskeletal symptoms^{27–29}) and the 8 types of injuries (bone dislocation, fracture, ruptured ligament, ruptured muscle, sprain, bruises, disc hernia, and others) were asked. A diagram of the human body with labelled body parts was used in this

measure. Furthermore, participants were asked to survey the area where the athletes fear the most for further injuries. Details of the sports injury data of the athletes of KNSU will be analyzed and discussed in depth in a separate study.

2.3.2. CAM health care utilization

The questions of the overall use of medical services were organized as follows: which medical institution the athlete selects first when a sports injury occurs, which medical institution was the most common choice for sports injury, and what medical institution was the most common choice for disease other than injuries. The choices among which the participants had to choose were KM clinics, KM medical centers, primary care clinics, medical centers, public health care clinics, clinics within the KNSU campus, dental clinics, and pharmacy. The questions about the use of KM services included whether or not the participant has ever used KM treatments including acupuncture before, and the body part as well as the type of injuries for which the participant received KM treatment. The overall utilization and KM service utilization were categorized into different latent variables in the structural equation model. In addition to these latent variables, questions on CAM interventions for sports injuries of elite athletes were included, in specific regarding the use of acupuncture, herbal medicine, Tuina (Chuna), and physical therapies. For this question, multiple answers were allowed.

2.3.3. Perception of KM and willingness to receive treatments

The last part of the questionnaire asked about the perception of KM and willingness to receive KM treatments in this study. The perception of KM treatments was asked in six different items of injury prevention, treatment, rehabilitation, enhanced performance, enhanced power, and enhanced concentration. The stem for items was: "I think the KM treatments above are helpful in". The stem was preceded by instructions designed to focus the athlete's attention to KM treatments through the list of KM treatments. For example, the question asked: "I think the KM treatments above are helpful in injury prevention." These items were measured using a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree).

In this study, "willingness to receive treatment" was used as the term for the athletes' intention or willingness to receive KM treatment. The willingness to receive KM treatments was asked in three different items of "I would like to receive KM treatments in the future", "I would recommend KM treatments to my colleagues", and "I would recommend KM treatments to foreign athletes." These items were also measured using a 5-point Likert-type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). "Willingness to receive treatment" can be seen as a concept included in the perception of KM treatment. However, the intention to revisit and recommend the treatment to others is closely related to patients' satisfaction. Thus, this study distinguished them from the athletes' perception of KM treatment as important factors.

2.4. Statistical analysis

The overall utilization of medical service of the athletes were assessed on the treatments for the sports injuries as well as for the other symptoms. Descriptive statistics were analyzed by frequency and expressed as the mean and standard deviation. Chi-square tests were used to compare the distributions of sex and sports disciplines. The item-level descriptive statistics were examined in order to determine distributional properties types of injuries, utilization of medical services, and the evaluation of KM treatments. Pearson correlation test was used to examine the relationships between the variables. The willingness to receive KM treatments and the percep-

tion of KM were analyzed by computing the average score of each item from the 5-point Likert-type scale.

The determinants of KM service utilization were evaluated using a structural equation model, in which past injuries and past experiences of health care utilization were specified as direct effects of the overall perception of and willingness to receive KM treatments. The forced entry method was used in the analyses, and the causal model was hypothesized based on the standard partial regression coefficients as well as the significance of the regression equation. Missing values were included in the data analysis, and multiple answers were treated equivalent to missing values. The causal model was examined by using covariance structure analysis. The following fit indices were used to evaluate the adequacy of the model: the chi square test (χ^2), its ratio to the degrees of freedom, comparative fit index (CFI), Tucker Lewis index (TLI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR). Modification indices (MI) were examined for any requirements for modification, and when they were found acceptable, the final model was chosen. All statistical analyses were conducted using R software (ver. 3.4.2 – “Short Summer”, <http://r-project.org/>), and structural equation modelling was conducted using “lavaan” package. A *p* value < 0.001 was considered statistically significant.

3. Results

3.1. General characteristics of the data

The data of 624 participants (86% of the registered as elite athletes in Korean Sport & Olympic Committee Database) who answered the survey were analyzed in this study. The athletes ranged from 18 to 27 years of age (21.3 ± 1.2), and male athletes accounted for 70% of the total (male: *n* = 437, 70%; female: *n* = 187, 30%; *p* < 0.24). Athletes were from 23 sports disciplines, and the largest group was track and field group (12%). The details of athletes' sports discipline are shown in Table 1.

The correlation matrix between variables are shown in Table 2. According to the correlation matrix, there is a positive significant relationship between sports injury and health care utilization, use of KM treatments, and perception of KM. There is also a positive significant relationship between health care utilization and the perception of KM. The use of KM treatments as well as the perception of KM shows a positive significant relationship with the willingness to use KM.

3.2. Use of Korean Medicine treatments by elite athletes

The health care utilization of elite athletes categorized by first choice of visit for injury treatment, the most frequent visits for injury treatment, and visits for other illness are shown in Table 3. The medical institution most frequently visited by athletes were medical centers (including a tertiary medical institution) in Korea (first choice of visit for injury: 47%; most frequent visits for injury: 42%; visits for other illness: 50%). Considering the visits to primary care clinics, the athletes who visited Western medical clinics for

Table 1

The details sports discipline of currently enrolled elite athletes (*n* = 624).

Categories	Frequency	%	p-value
Archery	17	2.72	
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	< 0.001
Rowing	23	3.69	
Shooting	29	4.65	
Skating / Ice sports	27	4.33	
Skiing	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	

sports injuries and other illness summed up to over 50%. Visits to the clinic within campus providing both Western Medicine and Korean Medicine made up about 14% of the first choice of visit for injury and most frequent visits for injury. About 12% of all choices for the first choice of visit for sports injuries, and about 18% of all choices for the most frequent visits for sports injuries were KM clinics and medical centers. In average, about 15% of the visits to medical institutions for sports injury were KM clinics.

Furthermore, Table 4 shows KM treatments experienced by athletes for sports injury. The most common KM treatments experienced by athletes were acupuncture (17%), cupping (16%), moxibustion (13%), electroacupuncture (13%), and pharmacopuncture (10%). In sum, more than 44% of KM treatment interventions involved acupuncture (manual acupuncture, electroacupuncture, laser acupuncture and pharmacopuncture); acupuncture, moxibustion, and cupping summed up to 74% of all KM treatments for sports injuries experienced by elite athletes.

Lastly, the perception of KM is presented in Fig. 1. The perception of KM showed that athletes saw KM treatments as helpful for sports injury prevention (3.48 ± 0.74), treatment (3.59 ± 0.77), rehabilitation (3.41 ± 0.80), skill enhancement (3.22 ± 0.79), condition improvement (3.11 ± 0.85), and concentration (3.08 ± 0.82). Furthermore, the athletes were willing to receive KM treatments in the future (3.43 ± 0.91), were moderately willing to recommend KM treatments to other athletes (3.24 ± 0.83), and were moderately willing to recommend to foreign sports players (3.22 ± 0.86).

3.3. Analysis of the structural model

The structural model demonstrated a reasonable fit to the data ($\chi^2 = 208.9$, $\chi^2/df = 1.41$, *p* = 0.001; CFI = 0.99; RMSEA = 0.03, RMSEA

Table 2

Correlation matrix between variables.

	Injury	HC Utilization	KM Utilization	Perception of KM	Willingness to receive KM
Injury	1				
HC Utilization	0.28*	1			
KM Utilization	0.19*	0.05	1		
Perception of KM	0.07*	0.15*	0.22*	1	
Willingness to receive KM	-0.06	0.09	0.39*	0.76*	1

HC, health care; KM, Korean Medicine. **p* < 0.05.

Table 3
Health care utilization of elite athletes for sports injury and other symptoms.

	First visit for sports injury		Most frequent visit for sports injury		Most frequent visit for other symptoms	
	Freq	%	Freq	%	Freq	%
KM						
KM clinic	76	12.18	115	18.43	30	4.81
KM medical center	8	1.28	0	0.00	0	0.00
WM						
Primary care clinic	85	13.62	74	11.86	94	15.06
Medical center	293	46.96	260	41.67	309	49.52
KM + WM						
Public healthcare clinic	1	0.16	10	1.60	8	1.28
Clinic within campus	89	14.26	90	14.42	26	4.17
Dental clinic	27	4.33	23	3.69	45	7.21
Pharmacy	9	1.44	10	1.60	58	9.29
Others	21	3.37	25	4.01	10	1.60
Unanswered	15	2.40	17	2.72	44	7.05
Total	624	100.00	624	100.00	624	100.00

Freq, frequency; KM, Korean Medicine; WM, Western Medicine.

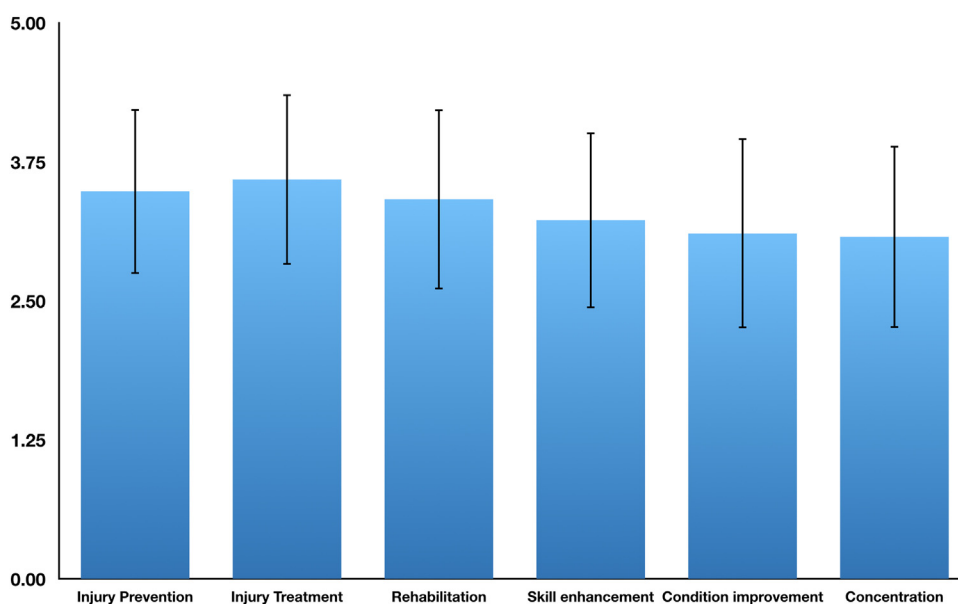


Fig. 1. Perception of KM. The athletes saw KM treatments as helpful for sports injury prevention (3.48 ± 0.74), treatment (3.59 ± 0.77), rehabilitation (3.41 ± 0.80), skill enhancement (3.22 ± 0.79), condition improvement (3.11 ± 0.85), and concentration (3.08 ± 0.82). The athletes showed willingness to receive KM treatments in the future (3.43 ± 0.91), were moderately willing to recommend KM treatments to other athletes (3.24 ± 0.83), and were moderately willing to recommend to foreign sports players (3.22 ± 0.86).

95% CI = 0.017 to 0.033; TLI = 0.99; SRMR = 0.04). Significant path coefficients (standardized estimated) are presented in Fig. 2. The χ^2 value was significant and its ratio to the degrees of freedom was below the threshold of 3.0. The CFI and TLI were above the 0.90 criterion for acceptable fit indices, and SRMR was below 0.08, also suggesting acceptable fit.³⁰ RMSEA was less than .05, therefore suggesting excellent fit.^{31,32}

Inspection of the path coefficients (Fig. 2) revealed that sports injury was significant positive predictors of overall utilization of medical services ($\beta = 0.28$, $p < 0.001$), use of KM treatments ($\beta = 0.19$, $p < 0.001$), and perception of KM ($\beta = 0.17$, $p < 0.001$). The use of KM treatments was significant positive predictors of the perception of KM ($\beta = 0.24$, $p < 0.001$), and willingness to receive KM treatment ($\beta = 0.25$, $p < 0.001$). Furthermore, health care utilization was a significant positive predictor of the perception of KM ($\beta = 0.18$, $p = 0.007$), and perception of KM was a significant positive predictor of the willingness to receive KM treatment ($\beta = 0.70$, $p < 0.001$).

Table 4
Types of Korean Medicine treatments experienced by elite athletes for sports injuries.

Korean Medicine treatments	Frequency	%
Acupuncture	257	16.72
Electroacupuncture	203	13.21
Laser acupuncture	59	3.84
Pharmacopuncture	160	10.41
Moxibustion	205	13.34
Cupping	253	16.46
Tuina (Chuna, including chiropractic)	56	3.64
Herbal medicine (decoction)	92	5.99
Herbal medicine (powdered extract)	25	1.63
Herbal medicine (pill)	31	2.02
Herbal medicine (other forms)	7	0.46
Physical therapy	142	9.24
Exercise	39	2.54
Others	8	0.52
Total	1537 ^a	

^a Multiple answers allowed.

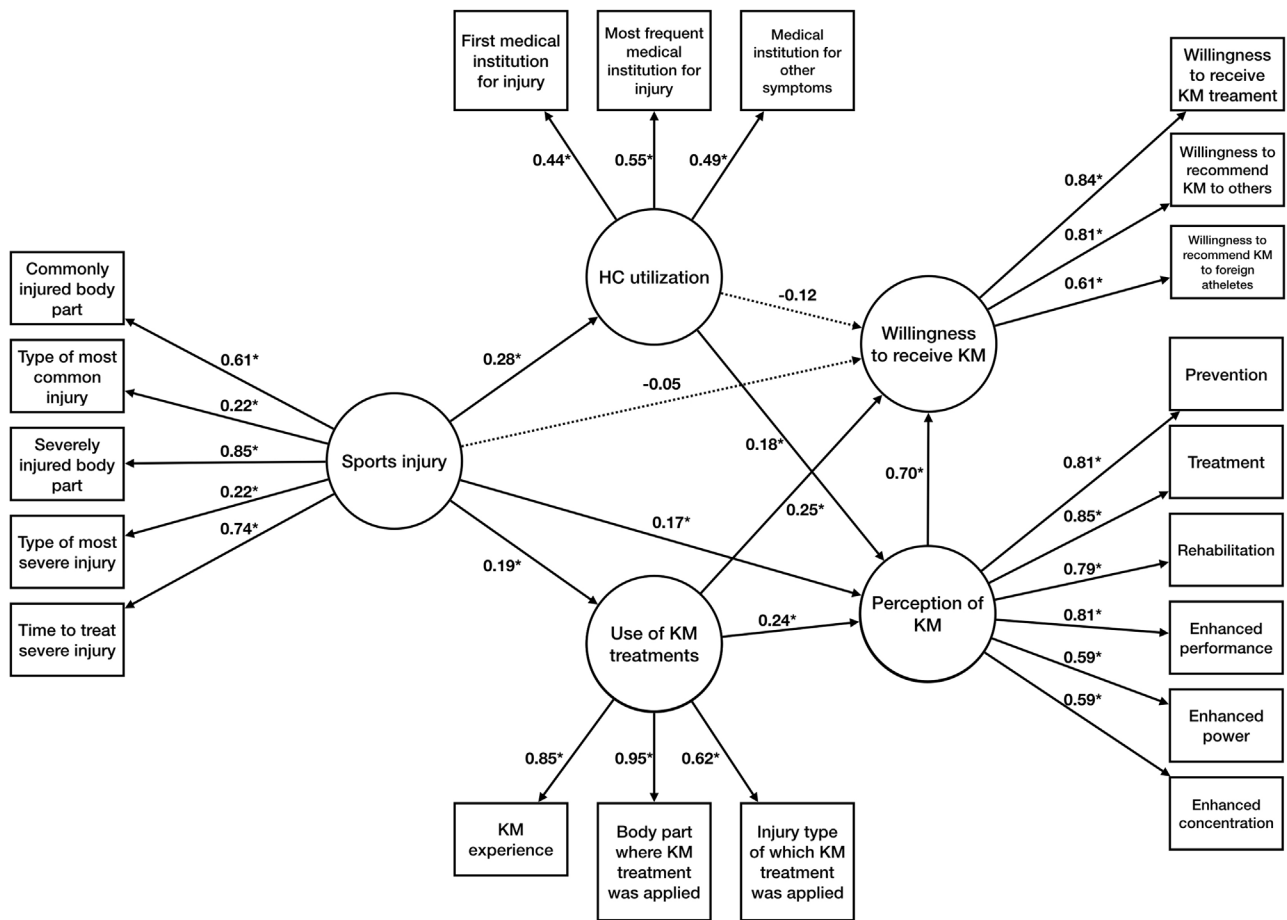


Fig. 2. Structural equation model showing estimated standardized direct effects. Inspection of the path coefficients showed that sports injury was significant positive predictors of overall utilization of medical services ($\beta = 0.28, p < 0.001$), use of KM treatments ($\beta = 0.19, p < 0.001$), and perception of KM ($\beta = 0.17, p < 0.001$). Use of KM treatments was significant positive predictors of the perception of KM ($\beta = 0.24, p < 0.001$), and willingness to receive KM treatment ($\beta = 0.25, p < 0.001$). Health care utilization was a significant positive predictor of the perception of KM ($\beta = 0.18, p = 0.007$), and perception of KM was a significant positive predictor of the willingness to receive KM treatment ($\beta = 0.70, p < 0.001$). HC: health care. KM: Korean Medicine. Dotted line showing insignificant paths. * $p < 0.001$.

4. Discussion

This study aimed to assess CAM service utilization of Korean elite collegiate athletes and to examine the causal relationships between past injuries, the overall health care utilization, and the willingness of the athletes to receive KM treatments. The results showed that about 15% chose KM clinics for sports injuries, and 44% of all KM treatment interventions for sports injuries involved acupuncture. This is a comparatively high rate of utilization compared to general population in Korea where the utilization of KM services was reported to be about 5%.¹⁸ In structural equation modelling, sports injuries experiences were positive predictors for health care utilization, use of KM treatments, and the overall perception of KM; utilization of health care and use of KM treatments were positive predictors of the perception of KM; and the use of KM treatments and the perception of KM were positive predictors of the willingness to receive KM for sports injuries.

This study was conducted with a large sample of elite athletes in Korea by a complete enumeration survey from Department of Physical Education, KNSU, across diverse sports disciplines. To our knowledge, this is a cross-sectional study with a largest sample of elite athletes studied regarding KM treatment and acupuncture. Korea National Sport University (KNSU) is a national educational institution, dedicated to the promotion of sports leaders in Korea, and has the national record of the most Olympic medalists as their students or alumni. Athletes from KNSU won over one third

of all Korean medals in major international games including the Olympics.³³ The Department of Physical Education is where all the elite athletes are enrolled, and has the largest number of elite athletes, a total of 728 students (based on 2017 data, <http://sportsg1.or.kr/stat/>), among the registered educational institutions according to the Korean Sport & Olympic Committee. It has the most diverse range of sport categories in one educational institution in Korea 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. In this respect, study on the health care utilization for sports injuries as well as the use of KM treatments with this sample of participants may have a representative implication on the elite athletes in Korea.

The result of this study shows that the injured body part and type predicts the type of medical institution that athletes visit and their use of KM treatments—specifically, the body part and injury type for which the athletes received KM treatments. This is in line with the previous studies showing that CAM treatments such as acupuncture is applied to musculoskeletal pain and injuries, e.g., shoulder injuries,⁴ sports-related muscle tension headaches,⁵ muscle spasms and tremors of the hands,² and skeletal muscle fatigue.⁶ Furthermore, the use of KM treatments positively predicted the KM treatment’s perception of sports injury prevention, treatment, rehabilitation, recovered athletic performance, physical strength, and concentration. Many previous studies have reported

that acupuncture treatments show effectiveness in the performance recovery of athletes.^{7–15} Taken together, our study has shown that KM treatment is used in athletes to treat sports injuries, and once utilized, provides positive perception and improved willingness to receive KM treatments.

On the other hand, sports injuries and the overall health care utilization did not show a direct effect to the willingness to receive KM treatments. While use of KM treatments positively influence the perception of KM and lead to higher willingness to receive KM treatments, the injury itself and health care utilization did not directly lead to higher willingness to receive KM treatments. Our results showed that the relationship between sports injury and the willingness to receive KM treatments were mediated by the prior use of KM treatments as well as the overall healthcare utilization, indicating indirect effects. The visits to medical institutions for sports injuries and other illness, shown in Table 3, provide a hint in understanding this absence of direct effect, for about 40% of the first medical institution and the most frequent medical institutions are concentrated in the medical centers of Western Medicine. The reason for this high utilization of tertiary medical institutions might be attributed to the characteristics of musculoskeletal injuries in which a high accessibility of imaging tools such as X-ray, computed tomography (CT), or magnetic resonance imaging (MRI) are required to rule out a specific injury. One study demonstrated this by describing the demand and workload of radiology services during the Olympics and Paralympics season.^{34,35} This perspective implies the need to consider the role of accessibility in the studies of sports injuries. In a similar aspect, the frequent visits of the athletes to the clinics within campus can also be explained in terms of accessibility. Therefore, this study suggests that a lowered barrier and enhanced accessibility towards acupuncture and other KM treatments is necessary to improve the use of KM treatments by elite athletes.

There is a lack of empirical studies concerning the utilization of medical services by elite athletes, not to mention acupuncture, in order to serve as a foundation for our discussion. Notwithstanding, researchers found a behavioral model regarding health care utilization of general population which is structured with predisposing factors such as age, sex, and marital status, enabling factors such as employment status, and need factors such as underlying diseases and disability.¹⁹ A recent study applied this model to the utilization of acupuncture treatments in KM clinics using Korean Health Panel.¹⁸ This study expands this idea to the population of elite athletes and proposes a model that predicts the willingness to receive KM treatments for sports injuries. Due to the narrow range of age and lack of occupation diversity of the study population, the predisposing factor was not a major factor in the final model. Instead, the previous injuries, accounting for the need factor, and experiences of health care utilization was elaborately specified in the current model. The final model showed acceptable fit indices in all of the parameters for the fit indices of structural equation models.

The limitations of this study include the inability of some athletes to participate in the study. Some sports disciplines were not included in the study, for instance some of the winter sports, as the students were in training camps to prepare for PyeongChang Winter Olympics 2018. However, a complete enumeration was conducted on all eligible students who were training in the campus at the time. In addition, some disciplines were analyzed by merging some disciplines to a larger category; such as diving categorized as swimming, due to a small number of athletes training in each discipline. While the categorization of sports disciplines was not accounted for in the analysis of this study, we can't rule out the role of specific sports disciplines in the utilization of health care and KM treatments. Furthermore, this study investigated the use of KM services only by Korean elite collegiate athletes. Therefore, these results might be limited to Korean society. The use of CAM ther-

apies such as acupuncture and cupping in other countries would require further studies in the future.

In conclusion, this study assessed the use of KM services by Korean elite collegiate athletes and examined the causal relationships between past injuries, the overall health care utilization, and the willingness of the athletes to receive KM treatments. The results showed that about around 15% chose KM clinics for sports injuries, and 44% of all KM treatment interventions for sports injuries involved acupuncture. Furthermore, this study proposes a model to predict the overall perception of and willingness to receive KM treatments based on the methodology of structural equation model.

Author Contributions

Conceptualization: JKO and SYK. Methodology: SYK. Formal analysis: YSL and SYK. Investigation: SYK. Data Curation: DSP and SYK. Writing - Original Draft: YSL. Writing - Review & Editing: YSL, JKO, DSP and SYK. Supervision: SYK. Funding acquisition: SYK.

Conflict of interest

The authors declare no conflict of interest.

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Ethical statement

This study was approved by the Institutional Review Board of Gachon University, Seoul, Republic of Korea (No. 1044396-201708-HR-127-01).

Data availability

The data will be made available upon request.

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