



BMJ Open Analysis of medical services provided to patients with ankle sprains in Korea between 2015 and 2017: a cross-sectional study of the health insurance review and assessment service national patient sample database

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ABSTRACT

Objectives To provide useful information for policy-makers and clinicians by analysing the medical service use—divided into Western medicine (WM) and Korean medicine (KM)—of patients with ankle sprains in South Korea between 2015 and 2017.

Design Cross-sectional, retrospective, observational study.

Setting Tertiary hospitals, WM hospitals, WM clinics, KM hospitals, KM clinics and others in South Korea.

Participants We analysed claim data and patient information from the 2015 to 2017 Health Insurance Review and Assessment National Patient Sample (HIRA-NPS) dataset, including 151 415 patients diagnosed with a ‘dislocation, sprain and strain of joints and ligaments at ankle and foot level’ (10th revision of the International Statistical Classification of Diseases code S93) who used medical services at least once in 3 years between January 2015 and December 2017 in South Korea.

Primary and secondary outcome measures Cost of medical care, number of consultations, type of institution visited, types of treatment.

Results There were 160 200 consultations and 53 044 patients in 2015, 149 956 consultations and 50 830 patients in 2016 and 140 651 consultations and 47 541 patients in 2017. The total treatment costs were US\$3 355 044.21, US\$3 245 827.70 and US\$3 128 938.46 in 2015, 2016 and 2017, respectively. The most common age was 10–19 years. The most frequent type of visit was KM outpatient visit (56%). Physiotherapy was most common in WM outpatient visits, while acupuncture was most common in KM visits. Most patients used one institution, rather than alternating between WM and KM.

Conclusions By identifying the trends and costs of treatment methods used for ankle sprains and comparing WM and KM, our data provide basic information for future health policy-making. In addition, the duality of the Korean medical system is highlighted as a possible cause of increased costs.

Strengths and limitations of this study

- The first strength of this study is that it is the first national-level analysis of medical service use of patients with ankle sprains over 3 years (2015–2017) in Korea.
- The second strength is that it provided a detailed analysis of the medical care supplied under the dialysed Korean healthcare system that includes Western medicine and Korean medicine.
- The third strength is that it provided information about the process through which patients with ankle sprains visit the medical institutions in practice by analysing institution choice.
- Due to diagnostic accuracy of claim data, our results may be different if the main diagnosis is narrowed or if patients diagnosed with ankle sprain as the secondary diagnosis are included.
- The limitation is that we only analysed costs that occurred as a result of medical services and did not include non-medical costs (including transit costs for visiting the medical institution to receive medical care and costs associated with caregiving).

INTRODUCTION

Ankle sprains involve soft tissue damage as a result of excessive inner, outer and rotational movement of the ankle joint, leading to damage to the tendon complex of the ankle. Most minor ankle sprains recover completely with timely treatment. However, 10%–30% of ankle sprains progress to chronic ankle sprains, which show continuous pain and repeated symptoms of sprains.¹ In addition, illnesses that are comorbid with ankle sprains (eg, injury to the peroneal tendon, fracture to the bone cartilage of the ankle joint or synovial injury, injury to the inner ligament, injury to the guard ligaments and traction injury to

the nerves near the ankle) can cause chronic pain after sprains.² As shown, ankle sprains occur frequently both in South Korea and overseas, and relapse is common.²

Ankle sprains occur in 2.15 out of 1000 people on average per year in the USA.³ Furthermore, ankle sprains occur most often in young people (15–19 years) in the USA. In terms of sex, it is reported that ankle sprains most commonly occur in men aged 15–19 years and in women aged 30 years or older.³ According to the National Health Insurance (NHI) Statistical Yearbook in South Korea in 2017,⁴ dislocation, sprain and strain of joints and ligaments at the ankle and foot level (10th revision of the International Statistical Classification of Diseases (ICD-10) code: S93) are associated with ankle sprain. The number of patients with ICD-10 code S93 was 1 878 670. There were 898 317 men (ranked 30th) and 980 353 women (ranked 39th) with S93. In particular, it was the fifth most common cause of traditional outpatient visits, and the number of outpatient patients in traditional medicine with ICD-10 code S93 was 1 006 652.

According to the Centers for Disease Control and Prevention, the estimated lifetime medical costs for ankle dislocations or sprains in 2010 will be US\$2 441 377 000 (US\$4 199 168 440 in 2019), or US\$1535 per person (US\$1800 in 2019). The estimated lifetime cost of lost workplace productivity will be US\$2 062 693 000 (US\$2 418 378 326 in 2019), resulting in total estimated lifetime costs due to ankle sprains of US\$4 504 069 000 (US\$5 280 738 747 in 2019).

The resulting medical expenses are substantial, amounting to >US\$250 million per year, and the substantial medical costs of ankle sprains have also been highlighted in other research.^{5–8} Medical costs associated with ankle sprains in South Korea were about US\$179.8 million (S93) (US\$1=1170 South Korean won (KRW); May 2019). In terms of Korean medical care in 2017, for S93, there were 998 066 patients and US\$76.7 million in consultation costs, which equals a per-patient cost of 243 302 KRW (US\$202.08).

The Korean medical system is characterised by the use of Western or Korean traditional medicine at the patient's choice.⁹ Medicine-based pain treatment and physical therapy are mainly used to treat ankle sprains in Western medicine (WM) clinics; acupuncture, moxibustion, cupping and herbal medicine treatments are mainly used in Korean traditional medicine clinics.¹⁰ There is pressure from the public for patients to use Korean traditional medicine, because Korea's health insurance coverage rate was set up based on Korean traditional medicine clinics, which have lower costs than WM clinics have.¹¹

Previous studies have recommended treating ankle sprains with early guide-accompanied movement, weight loading and taping or support, as needed.^{12–15} However, ankle sprains are often considered likely to develop into chronic diseases if they are not treated in time. Conversely, even mild ankle sprains can become problematic due to excessive treatment.¹⁶ Therefore, it is important to identify the prevalence of ankle sprains by country¹⁷ and the

treatment trends¹⁸ to provide appropriate guidelines and cost-effective treatment for ankle sprains. However, to date, large-scale studies of ankle sprains are not sufficient, so epidemiological study of the treatment type and cost of ankle sprains is needed.

This study analysed data from the Health Insurance Review and Assessment Service (HIRA) to compare and analyse the current rates, treatment trends and visit routes for ankle sprains. We divided treatment into both Korean medicine (KM) and WM to compare multiple aspects (frequency of treatment, treatment cost, treatment method, institution choice, etc) using the HIRA-National Patient Sample (HIRA-NPS) database. Through this study, it is possible to provide basic utilisation data of ankle diseases to policy makers and to provide evidence to clinicians for standard clinical guidelines of ankle diseases. Lastly, the public's right to know is guaranteed by providing the patient with an analysis based on institution choice.

METHODS

Data and subjects

Unlike most countries in the world, Korea has a single health insurance claims data source that can represent the entire nation, and these resources can be used as basic data for research related to national policy establishment and public health promotion in the health and medical field. Health insurance claims data are generated when healthcare facilities make insurance benefit claims with the HIRA after providing medical services to patients. Claims data contain massive amounts of diverse information including details of care (eg, treatment, procedure, examination and prescription), patient demographics, information about care provider and cost. Cost was defined as the cost of care delivered to a health insurance beneficiary at a care facility. It is the sum of the NHI-covered cost and the patient's out-of-pocket cost, as determined by a review of the total cost of care claimed by a care facility.¹⁹ This information is highly valuable for medical research because it is a representative dataset that can represent the medical use history of all Koreans.

The Korea HIRA developed sample data of representative health insurance data in Korea as a way to meet the demands of various fields for health insurance claim data. The purpose of developing and providing sample data is to promote healthcare research by improving understanding and utilisation of health insurance data. The health insurance claim data, which is the target population of HIRA-NPS, is very large. Therefore, the HIRA provide sampling by the number of observations that can secure versatility and representativeness for the convenience of researchers.

The data for this study were obtained from the 2015, 2016 and 2017 HIRA-NPS datasets provided by HIRA.²⁰

The HIRA provides annual sample data (HIRA-NPS) that has been extracted via random stratified sampling to provide researchers with convenient access to data.

Since 2017, the sampling rate has been 3% of all patients (approximately 1.45 million). These secondary data extracts exclude personally identifiable information and corporate information from the raw data, and they contain insurance claims for a 1-year period from the date of care initiation for the corresponding year. Patients who used medical services during a 1-year period were selected via systematic, stratified sampling by sex and age group (5-year units), and their details of care and prescriptions are provided.²⁰

Three per cent of the database was sampled, leading to the inclusion of about 1.4 million patients in 2015 and 2016 and about 1.45 million patients in 2017.¹⁹

Ankle injury

Analysis was conducted on ‘dislocation, sprain and strain of joints and ligaments at ankle and foot level (S93)’, which is the ICD-10 code for ankle sprains. This standard followed previous research that used the S93 ICD-10 code to analyse ankle sprains.²¹ Only patients with S93 in the primary diagnosis were included, and patients with

other illnesses recorded in primary diagnosis and S93 in secondary diagnosis were excluded. Through this process, a total of 451 070 claims without a secondary diagnosis were extracted out of 794 752 claims in the HIRA-NPS data between 2015 and 2017. Among those, cases where the total cost was 0 KRW or cases where the date of visit was missing were excluded, resulting in a final sample of 450 807 claims (151 415 patients) for analysis (figure 1).

Data analysis

The characteristics of the patients with ankle sprains were analysed by age, sex, public insurance scheme, hospital, medical specialty and medical institution. Age was categorised in 10-year increments, sex was categorised as male/female and public insurance scheme was categorised as NHI or Medicaid. Medicaid is a system provided by the state to provide medical assistance to basic living recipients with low incomes. For Medicaid, an individual qualifies if the income of their household is <US\$600 per month. As of 2018, 52 556 653 patients were covered by NHI in Korea, and 1 484 671 patients were covered by

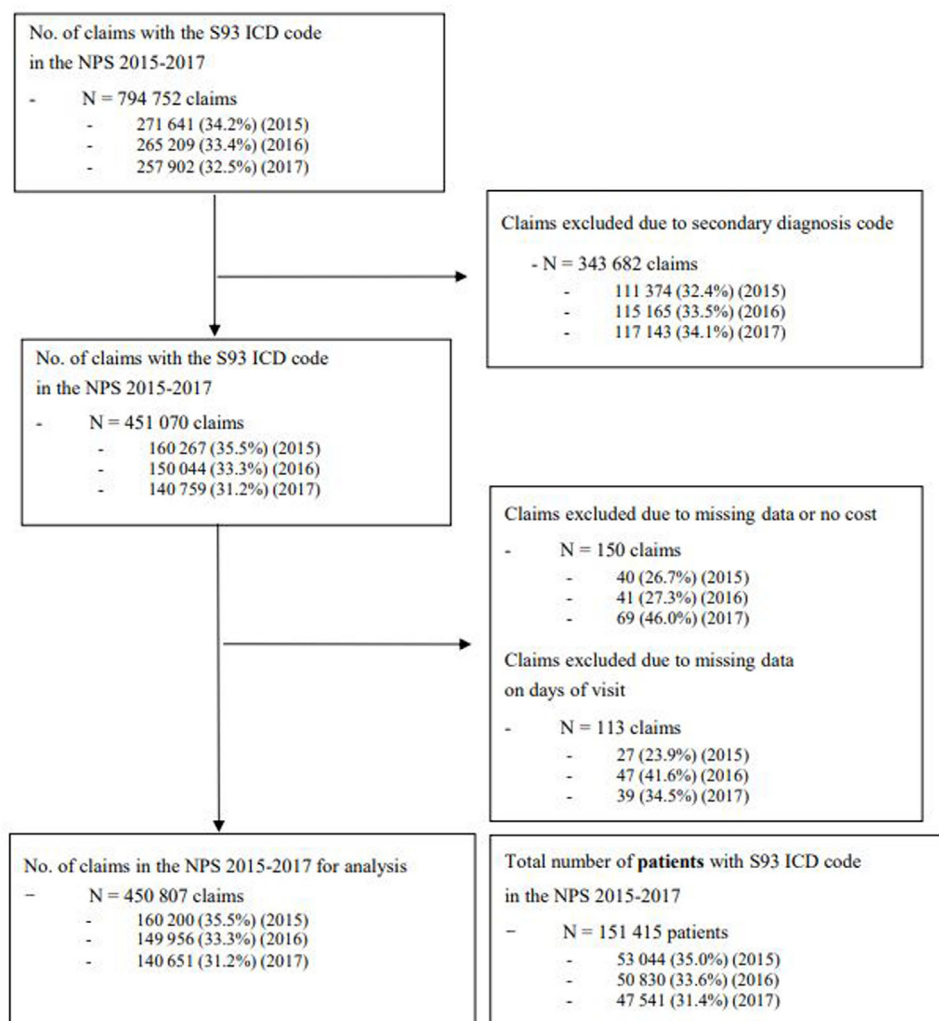


Figure 1 Flow chart of the study of inclusion and exclusion of participants from the 2015–2017 Health Insurance Review and Assessment National Patient Sample (HIRA-NPS). Ankle sprain; S93 10th revision of the International Statistical Classification of Diseases code.

Medicaid. Medical institutions were classified as one of the following: tertiary and general hospitals, hospitals, western clinics, Korean traditional hospitals and Korean traditional clinics. The division of WM and KM was based on medical institutions. The categories belonging to KM include traditional hospitals and traditional clinics; others are divided into WM.

In accordance with the recommendations of the Centers for Disease Control and Prevention (<https://wisqars.cdc.gov:8443/costT/>), total costs were analysed based on the following categories made by the Ministry of Health and Welfare: consultation fee, hospitalisation, medication, injection, anaesthesia, physiotherapy, procedure and surgery, examination, imaging and radiography. The reason we did the analysis based on that criterion was that we were based on the 10 classification criteria of claims data.

Medical costs determined to be eligible for reimbursement by HIRA out of treatment costs were indicated in the submitted insurance claim statement. Medical costs are the sum of benefits reimbursed by the insurer (Korean NHI Service) to the medical care institutions and self-payment costs paid by the beneficiary (patient). The total expense was evaluated, approved and deducted by the NHI out of the total cost billed by the institution. Per-patient expense and per-case expense was calculated as the sum of costs listed on the number of patient and their claims, respectively.

Surgeries, injections, physiotherapy and use of pain killers were analysed. Frequency analysis was performed based on the number of cases of ankle sprains who were given a code and the bills. Here, the surgery code did not exist independently and was always tied to the procedure and surgery items. Therefore, codes related to treatment were excluded from the code for procedure and surgery. Surgeries that were not limited to the ankles were excluded because of the possibility that surgeries for another part of the body were included.

The treatment codes for ankle sprains were categorised separately in the order of higher frequency for KM and WM. WM outpatient care, WM inpatient care, KM outpatient care and KM inpatient care only included those that were billed at least 200 times, 50 times, 1500 times and 50 times in 3 years, respectively. The number of procedures below these numbers was very small compared with the number of examinations, and the frequency was not constant when comparing 3 years. Therefore, it was regarded as irrelevant to normal treatment of ankle sprains and was excluded from the study population. As a result, the top 14 cases of WM outpatient care, top 13 cases of WM inpatient care, top 13 cases of KM outpatient care and top 7 cases of KM inpatient care were analysed. The prescribed medicine was categorised by the frequency of prescription for ankle sprains, by converting the main ingredient code applied during inpatient and outpatient visits to the Ministry of Health and Welfare categories. If a drug accounted for <3% in all 3 years, it was excluded from the analyses. Because these drugs did

not show a constant frequency in each year, they were not considered as drugs related to the treatment of conventional ankle sprains and were excluded. (These drugs are documented in online supplemental table 1. Total dosage of drug prescriptions for ankle sprains.)

In addition, patient institution choice was classified into six groups (groups 1–6). (Institution choices were excluded if their frequency was 10 times or less.) Frequency, percentage, mean, SD and rate of change were provided for each value. All statistical analyses were performed using SAS V.9.4 TS Level 1M1 (2002–2012 by SAS Institute, Cary, North Carolina, USA).

RESULTS

Number of patients and cost of medical care for ankle sprains

Patients diagnosed with injury S93 of their ankles were sampled from the 2015, 2016 and 2017 HIRA-NPS. There were 271 641 consultations in 2015, 265 209 consultations in 2016 and 257 902 consultations in 2017. Among those, patients whose secondary diagnosis was S93, patients whose total cost was 0 KRW and did not receive treatment and patients with missing data were excluded. In the final sample, there were 160 200 consultations and 53 044 patients in 2015, 149 956 consultations and 50 830 patients in 2016 and 140 651 consultations and 47 541 patients in 2017 ([figure 1](#)). Overall, the number of patients was decreasing, resulting in a decrease in the number of consultations as well.

Total medical costs were US\$3 355 044.21, US\$3 245 827.70 and US\$3 128 938.46, US\$, in 2015, 2016, and 2017, respectively, showing a decreasing trend. However, the cost per patient and the cost of consultation increased.

In cases of ankle sprains who received WM outpatient care, the number of visits to the clinic during the duration of the treatment was about three. For ankle sprains that required hospitalisation, the number of days of care was about 10 days on average ([table 1](#)).

Characteristics of patients with ankle sprains and medical use

The frequency of the illness by age group showed similar trends across the 3 years. The highest frequency was observed in the 10–19 years age group, exceeding 20% in all 3 years (mean 21.44%). The 20–59 years age groups showed similar proportions, followed by a rapid decrease from the age of 60. The number of visits to the clinic showed an increasing trend with increasing age. Patients in the 0–9 years age group had <2.5 visits, while patients who were 70 years or older had 4 or more visits. Overall, there were more female than male patients (53.9% vs 46.1%). The number of visits per patient was higher for women than for men.

More than 97% of the patients were insured with NHI. Generally, the number of visits was slightly higher for patients insured with Medicaid than for patients insured with NHI. Surgeries were rare, and they were performed

Table 1 General medical service use for ankle sprain patients in Korea

Year	Type of visit	No. of patients	Total case	Total expense*	Per-patient expense*	Per-case expense*	Total care	Days in care†	Total visits	No. of visits/length of stay (days)‡
2015	Total	53 044	160 200	3 355 044.21	63.25	20.94	164 656	3.10	161 345	3.04
	Inpatients	158	172	79 021.21	500.13	459.43	1 811	11.46	1 317	8.34
	Outpatients	52 999	160 028	3 276 023.00	61.81	20.47	162 845	3.07	160 028	3.02
2016	Total	50 830	149 956	3 245 827.70	63.86	21.65	153 887	3.03	150 659	2.96
	Inpatients	151	159	68 150.31	451.33	428.62	1 449	9.60	862	5.71
	Outpatients	50 779	149 797	3 177 677.39	62.58	21.21	152 438	3.00	149 797	2.95
2017	Total	47 541	140 651	3 128 938.46	65.82	22.25	144 493	3.04	141 382	2.97
	Inpatients	132	143	59 667.52	452.03	417.26	1 245	9.43	874	6.62
	Outpatients	47 494	140 508	3 069 270.94	64.62	21.84	143 248	3.02	140 508	2.96

*Amount presented in US\$. US\$1=1170 KRW (2 May 2019).

†Days in care: the number of total treatment days denoted in the claims bill including days with drug prescription without medical treatment.

‡No. of visits/length of stay (days): the number of outpatient visits or the number of inpatient care days indicated on the claim bill. KRW, South Korean won.

in <0.1% of all cases. If a surgery was performed, the number of visits increased by a factor of about 2–3.

The most frequently visited medical institutions were KM outpatient institutions (about 56%), followed by WM outpatient institutions (about 51%). The percentage here includes cases in which one patient has visited other medical institutions, so the total may exceed 100%. Hospitalisations were rare. For KM outpatient visits, the mean number of visits was 3.7 visits, which was higher than the mean number of visits for WM outpatient visits (2.4 visits). By medical specialty, patient frequency was the highest in the order of orthopaedic surgery (OS), internal Korean medicine, Department of Acupuncture and Moxibustion Medicine and general surgery (GS).

More than 90% of all care occurred at the clinic level (WM clinic: 39.49%; KM clinic: 54.82%), which are primary medical institutions. There were no significant differences between the frequencies of visits to the hospital-level and clinic-level institutions (table 2).

Medical costs of ankle sprains by patient characteristics

The results of analysing the total bill by age groups showed that the cost was the greatest for the 10–19 years age group, who frequently experience ankle sprains, and that it rapidly decreased after 60 years of age. The cost per day showed a gradual decreasing trend with increasing age. The cost per visit was higher for men than for women, and higher for WM outpatient visits than for KM outpatient visits. For the medical specialty of WM, the cost per visit was more than four times higher for emergency medicine (EM) visits compared with other specialties. Consultation cost per visit increased with increasing level of medical institution (online supplemental table 2).

Medical costs by the category of treatment

The cost of consultation accounted for >45% of the total medical cost every year: among only WM consultations, the most frequently billed cost was for consultation, comprising >40% in all 3 years. While procedure and surgery accounted for 9% of all cases, its total cost was ranked the second highest at about 24%. Both billing frequency and costs of radiography treatments were about 16%–17%. While the frequency of physiotherapy was second highest at 24%, the cost accounted for about 10% of the total.

For KM visits, consultations and acuapunctures comprised similar proportions (about 48%) of the total number of cases and comprised most of the cost with about 60% being for acuapunctures and about 39% being for consultations (table 3).

Care and prescription

Online supplemental table 3 shows the data for high frequency care for WM and KM. During WM outpatient visits, physiotherapy methods such as deep and superficial heat therapy, transcutaneous electrical nerve stimulation (TENS) and interference current therapy (ICT), were the most common, followed by short leg sprint for sprains.



Table 2 General characteristics and visit details of ankle sprain patients in Korea

Category	Patients																		
	2015-2017 (151 415)				2015 (53 044)				2016 (50 803)				2017 (47 541)						
	Total N	%	Total N	%	Total N	%	Total N	%	Total N	%	Total N	%	Total N	%	Growth rate*				
Age (years)	17 223	11.37	5 644	10.64	5 891	11.60	5 688	11.96	3%	32 459	21.44	11 769	22.19	11 068	21.79	9 622	20.24	-7%	
10~19	22 152	14.63	7 905	14.90	7 379	14.52	6 868	14.45	-1%	18 556	12.26	6 480	12.22	6 277	12.36	5 799	12.20	-1%	
20~29	20 404	13.48	7 337	13.83	6 754	13.29	6 313	13.28	0%	21 274	14.05	7 492	14.12	6 986	13.75	6 796	14.30	4%	
30~39	12 438	8.21	4 047	7.63	4 193	8.25	4 198	8.83	7%	6 909	4.56	2 370	4.47	2 282	4.49	2 257	4.75	6%	
40~49	69 802	46.10	24 487	46.16	23 436	46.13	21 879	46.02	0%	81 613	53.90	28 557	53.84	27 394	53.92	25 662	53.98	0%	
50~59	147 207	97.22	51 572	97.22	49 354	97.15	46 281	97.35	0%	4260	2.81	1 496	2.82	1 492	2.94	1 272	2.68	-9%	
60~69	7	0.00	3	0.01	2	0.00	2	0.00	7%	151 316	99.93	53 007	99.93	50 791	99.98	47 518	99.95	0%	
70 or older	99	0.07	37	0.07	39	0.08	23	0.05	-37%	69 802	46.10	24 487	46.16	23 436	46.13	21 879	46.02	0%	
Sex	81 613	53.90	28 557	53.84	27 394	53.92	25 662	53.98	0%	Male	69 802	46.10	24 487	46.16	23 436	46.13	21 879	46.02	0%
	147 207	97.22	51 572	97.22	49 354	97.15	46 281	97.35	0%	Female	81 613	53.90	28 557	53.84	27 394	53.92	25 662	53.98	0%
Payer type†	4260	2.81	1 496	2.82	1 492	2.94	1 272	2.68	-9%	NHI	147 207	97.22	51 572	97.22	49 354	97.15	46 281	97.35	0%
	7	0.00	3	0.01	2	0.00	2	0.00	7%	Medicaid	4260	2.81	1 496	2.82	1 492	2.94	1 272	2.68	-9%
	151 316	99.93	53 007	99.93	50 791	99.98	47 518	99.95	0%	Others	7	0.00	3	0.01	2	0.00	2	0.00	7%
Surgery‡	99	0.07	37	0.07	39	0.08	23	0.05	-37%	No	151 316	99.93	53 007	99.93	50 791	99.98	47 518	99.95	0%
	393	0.26	142	0.27	141	0.28	110	0.23	-17%	Yes	99	0.07	37	0.07	39	0.08	23	0.05	-37%
Type of visit	77 695	51.31	26 432	49.83	26 496	52.15	24 767	52.10	0%	WM inpatient	393	0.26	142	0.27	141	0.28	110	0.23	-17%
	49	0.03	17	0.03	10	0.02	22	0.05	135%	WM outpatient	77 695	51.31	26 432	49.83	26 496	52.15	24 767	52.10	0%
	84 794	56.00	30 642	57.77	28 041	55.20	26 111	54.92	0%	KM inpatient	49	0.03	17	0.03	10	0.02	22	0.05	135%
										KM outpatient	84 794	56.00	30 642	57.77	28 041	55.20	26 111	54.92	0%

Continued

Table 2 Continued

		Patients								
		2015-2017 (151 415)		2015 (53 044)		2016 (50 803)		2017 (47 541)		
Category		Total N	%	Total N	%	Total N	%	Total N	%	Growth rate*
Medical speciality§	OS	65 998	43.59	22 504	42.43	22 555	44.40	20 939	44.04	-1%
	Internal Korean medicine	47 771	31.55	16 085	30.32	16 217	31.92	15 469	32.54	2%
	Department of Acupuncture and Moxibustion Medicine	39 965	26.39	15 653	29.51	12 793	25.18	11 519	24.23	-4%
	GS	3109	2.05	1 103	2.08	1 079	2.12	927	1.95	-8%
	EM	2366	1.56	796	1.50	781	1.54	789	1.66	8%
	IM	2039	1.35	668	1.26	685	1.35	686	1.44	7%
	AN	1894	1.25	584	1.10	644	1.27	666	1.40	11%
	NS	1534	1.01	529	1.00	524	1.03	481	1.01	-2%
	FM	1251	0.83	414	0.78	418	0.82	419	0.88	7%
	RM	1098	0.73	399	0.75	375	0.74	324	0.68	-8%
Medical institution¶	General hospital or above	6419	4.24	2 103	3.96	2 197	4.32	2 119	4.46	3%
	Hospital	13 029	8.60	4 365	8.23	4 470	8.80	4 194	8.82	0%
	Clinic	59 792	39.49	20 552	38.75	20 338	40.03	18 902	39.76	-1%
	Korean medicine hospital	1589	1.05	385	0.73	606	1.19	598	1.26	5%
	Korean medicine clinic	82 999	54.82	29 972	56.50	27 431	53.99	25 596	53.84	0%
	Others	1303	0.86	619	1.17	340	0.67	344	0.72	8%

$$* \text{Growth rate} = \frac{n \text{ of patients}_{2017} - n \text{ of patients}_{2016}}{n \text{ of patients}_{2016}}$$

†'Others' for payer type refers to state-funded medical aid beneficiaries and veterans.

‡'Yes' for surgery indicates the patients received at least one surgery.

§For medical speciality, top 10 most frequent medical specialties were selected.

¶'General hospital or above' refers to both general hospitals and tertiary hospitals. 'Others' refers to nursing hospitals, mental care hospitals, health centres, health clinics, healthcare centres and health and medical clinics.

AN, anaesthesiology; EM, emergency medicine; FM, family medicine; GS, general surgery; IM, internal medicine; KM, Korean medicine; NHI, National Health Insurance; NS, neurosurgery; OS, orthopaedic surgery; RM, rehabilitative medicine; WM, Western medicine.

Table 3 Number of bills and medical costs per category

	Western medicine											
	2015			2016			2017					
	Case	%	Cost*	%	Case	%	Cost*	%	Case	%	Cost*	
Western medicine												
Outpatient visits (consultations)†	55 862	42	575 247.43	42	55 287	43	591 413.82	42	50 475	43	557 078.87	42
Hospitalisations	151	0	33 794.45	2	112	0	25 196.62	2	95	0	21 570.21	2
Medication	1291	1	3210.65	0	1088	1	2858.91	0	939	1	2233.69	0
Injections	6425	5	17 098.82	1	5700	4	14 979.37	1	4672	4	11 707.29	1
Anaesthesia	497	0	7416.11	1	511	0	8545.15	1	413	0	6320.99	0
Physiotherapy	32 904	25	150 231.53	11	31 924	25	152 072.22	11	29 273	25	142 421.14	11
Procedure/Surgery	12 145	9	337 534.17	24	12 282	9	346 925.64	25	10 905	9	316 771.01	24
Examinations	280	0	10 598.42	1	235	0	10 175.68	1	205	0	8462.70	1
Radiography	21 939	17	230 859.83	17	21 999	17	243 386.62	17	20 298	17	232 323.06	18
Others	549	0	19 461.10	1	654	1	18 330.37	1	935	1	20 917.62	2
Total	132 043	100	1 385 452.53	100	129 792	100	1 413 884.39	100	118 210	100	1 319 806.58	100
Korean medicine												
Outpatient visits (consultations)†	103 844	48	780 792.27	39	94 071	48	725 475	39	89 501	48	709 051.87	39
Hospitalisations	19	0	6716.11	0	14	0	3173	0	25	0	7810.02	0
Medication	7737	4	13 000.85	1	7060	4	11 724	1	8397	4	14 132.66	1
Acupuncture	103 803	48	1 194 128.28	60	94 021	48	1 114 803	60	89 455	48	1 102 556.85	60
Others	99	0	280.14	0	53	0	181	0	40	0	132.69	0
Total	215 501	100	1 994 910.26	100	195 218	100	1 855 349	100	187 418	100	1 833 684.09	100

Article 26 (Medical Specialty Code): for the medical specialty, the medical specialty in which actual consultation was received (at least a hospital-level care institution) or the corresponding medical specialty (clinic-level care institution) is reported in accordance with Asterisk 5 ('Medical Specialty Codes'). If there are more than one medical specialties, all are recorded. Article 27 (Consultation Code): the consultation code used to bill for care follows the 'Consultation code' determined and made official by the Director of Health Insurance Review and Assessment Service. Where there are missing values in the bills and costs, data are excluded.

*Amounts are presented in US\$. US\$1=1170 KRW (2 May 2019).

†Consultation fee: eg, the consultation fee for a hospitalisation includes the Fee for Infection Prevention and Control, the consultation fee, the Medication Keeping Fee and the Healthcare Quality Evaluation Grant. The consultation fee for outpatient care also includes the Healthcare Quality Evaluation Grant.

During WM inpatient visits, subcutaneous or intramuscular injections were performed often. The mean number of physiotherapy sessions performed during WM outpatient visits was similar to the mean number of visits (2.4). During KM inpatient and outpatient visits, acupuncture and cupping were the main methods used, followed by warming and cryotherapy of the meridian muscle and moxibustion.

The number of cases per item and the mean number of cases per patient were not proportional across WM outpatient visits and KM outpatient visits. Thus, it can be inferred that the same patient who visited medical institutions multiple times receives similar treatments (online supplemental table 3).

Online supplemental table 1 shows the total dosage of drug prescriptions made at WM outpatient and inpatient visits categorised by the Ministry of Health and Welfare categories. During WM outpatient visits, the total dosage of prescription of non-steroidal anti-inflammatory drugs (NSAIDs) accounted for >45%. Next, enzymes accounted for >23%, followed by gastrointestinal drugs. Furthermore, during WM inpatient visits, the total dosage of

prescription of NSAIDs accounted for >30% and the prescription of enzymes and gastrointestinal drugs exceeded 10%. In 2017, the number of prescriptions of drugs for peptic ulcer were not counted due to the changes in Ministry of Health and Welfare categories. These drugs appear to have been counted as gastrointestinal drugs (online supplemental table 1).

Visit route

Investigation of medical institution visit routes showed that >95% of the patients received care from either WM alone or KM alone, rather than alternating between the two. A total of 52.45% of the patients first sought KM care, and these patients were older than those who first sought WM care. In patients aged 60 years or older, 19.52% first sought KM and only 5.65% first sought WM. The group of patients who only received KM accounted for 50.78% of the total and were the oldest in age. The group of patients who only received WM accounted for 45.03% of the total and were the youngest in age (table 4).

Among those, group 3 (0.16%), who received KM care followed by WM and back to KM care, was further analysed

Table 4 Patient hospital visit route according to age range

Group	Age (years)	Total		2015		2016		2017	
		N	%	N	%	N	%	N	%
KM (50.9%)	All	72 742	100.0	26 218	100.0	23 984	100.0	22 540	100.0
	<40	30 250	41.6	11 244	42.9	10 011	41.7	8 995	39.9
	40–59	28 295	38.9	10 227	39.0	9 274	38.7	8 794	39.0
	60+	14 197	19.5	4 747	18.1	4 699	19.6	4 751	21.1
KM-WM (1.5%)	All	2 172	100.0	795	100.0	748	100.0	629	100.0
	<40	1 321	60.8	490	61.6	458	61.2	373	59.3
	40–59	645	29.7	243	30.6	216	28.9	186	29.6
KM-WM-KM (0.2%)	All	239	100.0	83	100.0	60	100.0	96	100.0
	<40	142	59.4	50	60.2	33	55.0	59	61.5
	40–59	77	32.2	29	34.9	20	33.3	28	29.2
	60+	20	8.4	4	4.8	7	11.7	9	9.4
WM (45.0%)	All	64 517	100.0	21 738	100.0	22 140	100.0	20 639	100.0
	<40	51 477	79.8	17 409	80.1	17 706	80.0	16 362	79.3
	40–59	9 396	14.6	3 171	14.6	3 153	14.2	3 072	14.9
	60+	3 644	5.6	1 158	5.3	1 281	5.8	1 205	5.8
WM-KM (2.4%)	All	3 459	100.0	1 330	100.0	1 132	100.0	997	100.0
	<40	2 358	68.2	934	70.2	771	68.1	653	65.5
	40–59	865	25.0	306	23.0	288	25.4	271	27.2
	60+	236	6.8	90	6.8	73	6.4	73	7.3
WM-KM-WM (0.1%)	All	117	100.0	30	100.0	48	100.0	39	100.0
	<40	85	72.6	20	66.7	36	75.0	29	74.4
	40–59	27	23.1	9	30.0	10	20.8	8	20.5
	60+	5	4.3	1	3.3	2	4.2	2	5.1

KM, Korean Medicine; WM, Western medicine.

Table 5 Radiography and casting rate for group 3 patients in Western medicine hospitals

Year	All	Radiography		Cast	
		N	%	N	%
2015	83	55	66.26	17	20.48
2016	60	50	83.33	8	13.33
2017	96	70	72.91	19	19.79
Total	239	175	73.22	44	18.41

in terms of which treatments they received in their WM visit. Across 3 years, 73.22% on average visited both for radiography and 18.41% received a cast (table 5).

Additional analyses were performed to test whether group 3 and group 6 revisited the same clinic when they returned to the Korean or Western medical institution. The results showed that 73% and 80% of the patients returned to the same Korean and Western medical institutions, respectively.

DISCUSSION

There were no large differences in the proportions of inpatient and outpatient visits across the 3 years. The average rate of hospitalisation was <0.3%, and both the number of inpatient and outpatient patients decreased in the 3 years with a decrease in the total number of patients. The comparison of the total number of patients and the total number of cases showed that <10% of hospitalised patients were re-hospitalised. Although the total cost of ankle sprains decreased, the cost per patient generally showed an increasing trend. The number of days of consultation at a hospital was about 3 days for outpatient care and 9 days for inpatient care.

The fact that the proportion of patients aged between 10 and 19 was the highest at 21.44% on average is in line with the findings from previous studies.⁴ The frequency of ankle sprains decreased to below average after 60 years of age. The mean number of visits by age group showed a continuous increase with increasing age. This suggests that ankle sprains are more severe or require a longer duration of treatment with increasing age. In terms of sex, ankle sprains were slightly more common in women than men, and the mean number of visits was also higher for women. The fact that ankle sprains occur more commonly among women has been studied in previous research.²² Ankle sprains are more common in the younger generation, as the main cause is the loss of the foot. Women are especially likely to wear high-heeled shoes to increase their chances of getting injured.

The number of visits among patients covered under Medicaid may have been higher because these patients are older in age and they show a higher frequency of visits to medical institutions compared with patients covered under NHL.²³ Surgeries with ankle sprains as the main ailment were rare, accounting for <0.1% of all cases. This is in line with previous findings that there were no clear

differences between functional treatment and surgical treatments, and that there was no clear evidence of the clinical usefulness of surgical treatments in treating acute lateral ankle sprains.²⁴ However, in the case of chronic instability that shows positive on repeated pain, giving way and load test, surgery may be necessary.²⁵

The comparison between KM and WM showed that more patients visited KM institutions. Because the mean number of visits per patient was higher for KM, there also was a higher number of bills for KM than for WM. For specialties under WM, OS was by far the most common at >83%, followed by GS, EM and internal medicine. Given its characteristics, EM had the lowest frequency of visit. Other specialties under WM did not show significant differences. Most consultations occurred in primary care, that is, the clinics and KM clinics. Compared with visitors to the KM clinic, visitors to the KM hospital were low in number. Comparatively, the number of visitors to the hospitals or tertiary hospitals instead of clinics was relatively high (means of 39.5% for clinics, 8.6% for hospitals and 4.2% for tertiary hospitals).

The proportion of visits to clinics and hospital-level institutions increased slightly across 3 years for both WM and KM. This was related to the medical characteristics of Korea (concentration of patients to large hospitals) in which patients prefer upper-level institutions, even for minor ailments that can be treated in primary medical institutions.²⁶ The number of visits per year to the KM clinics was >3.6 visits for all 3 years, showing around one more visit compared with the clinic-level institutions. The number of visits was the lowest for inpatient care at tertiary hospitals.

The medical cost per visit decreased with increasing age according to the bills. This appears to be because, as the number of visits increases with increasing age, the fees for initial consultation and examinations that are billed at the first visit are not billed again for subsequent visits, thus decreasing the medical costs of return visits.²⁷ For similar reasons, the cost per visit was higher for women, who also had a higher number of visits compared with men. The fact that the number of bills relative to the number of patients increased with increasing age can be attributed to the impact of the increasing number of visits.

The medical cost per category on the bill was analysed separately for WM and KM. As a result, the categories with the highest cost in WM were consultation, procedure and surgery, radiography and physiotherapy. Online supplemental table 2 shows that the rate of surgery for ankle sprains was low, and thus it seems that most of the costs for procedure and surgery were for casting. Because the costs of procedure and surgery were both relatively high compared with other services, the total cost was the highest after consultation fees. As physiotherapy is relatively low cost, the total cost was relatively low compared with the number of cases. The comparison of the 3 years showed that the number of visits was decreasing due to the overall decrease in the number of patients. While costs of medication and injections were also decreasing by

large amounts, care categories that cost much of the total cost such as radiography, physiotherapy and procedure and surgery maintained their costs.

It can be inferred that the proportions of medication prescription or injection were decreasing and that the proportion of radiography, physiotherapy and casting were staying at a consistent level or increasing. Using NSAIDs or casting can reduce the pain due to sprains before complete recovery. However, 30% of patients have been reported to be injured again because patients tend to exercise or exercise before recovery.²⁸ According to previous research, overuse of painkillers²⁹ and steroid injections³⁰ is not recommended. Therefore, the fact that the proportion of Western prescriptions and injections decreased over the 3 years is considered positive.

In KM, the number of claims for consultation decreased every year. With this, the cost of consultation and acu-punctures also decreased continuously. The similar number of bills for injections and for consultation shows that most patients in KM received acu-punctures. However, the cost of medication was the highest in 2017, and it can be inferred that the rate of prescription in insured KM has increased.³¹

Treatments administered in WM and KM are shown in online supplemental tables 2 and 3. In most WM outpatient visits, physiotherapy (eg, heat therapy, TENS and ICT) were performed and NSAIDs were prescribed for the purposes of pain control. However, the effect of physiotherapy for acute ankle sprains remains unclear to date.³² The use of short leg splints was also common. The frequency of subcutaneous or intramuscular injections was high for WM inpatient visits compared with outpatient visits. In the case of KM, the number of bills for consultation, injection and procedure were similar. Thus, it can be inferred that most common treatment was acupuncture, followed by warming meridian (infrared ray irradiation), cupping and electric acupuncture stimulation. Among these, acupuncture comprised the largest number, thus showing that most treatments involved acupuncture. Acupuncture for ankle sprains is as effective as other conventional treatments, and complications are rare.³³ However, the quality of randomised controlled trial research on this topic is not high, and additional research is needed. A large number of cupping procedures were also performed. This may be related to previous research findings that showed that using acupuncture and cupping together on ankle sprains can be more effective than using acupuncture alone.³⁴ Because there are differences in the total number of treatments and the mean number of treatments per patient, it can be assumed that patients who return after receiving one type of care receive a similar type of care.

Table 5 shows that the preference for KM treatment increases with increasing age. This finding is in line with the preference for KM service among Korean citizens.³³ With increasing age, the frequency of visiting a hospital due to ankle sprains increased further. Furthermore, it was found that higher frequency of visiting a KM

institution was also related to the age of the patient. In other words, older age was associated with prioritised visits to KM clinics for ankle sprains. Therefore, the overall number of visits to the KM institutions was increased. Considering that only 5% of patients receive treatment in both WM institutions and KM institutions, the preference for medical institution for ankle ailments was distinct for each individual in Korea.

Online supplemental table 4 shows that a high proportion (73%) of patients visited a KM institution, then a WM institution, followed by the same KM institution. It can be inferred that the visit to a different medical institution was because of the need for a medical service that cannot be fulfilled at the original institution given the differences in medical care in the WM institutions and the KM institutions. For this reason, higher numbers of radiography and casts were performed on patients who visited a WM institution after visiting a KM institution (table 5). This finding exemplifies the discomfort experienced by KM visitors who must visit a WM institution again for radiography to identify the fracture and skeletal shape. In Korea, western and traditional medicine are divided, and Korean medical doctors are unable to use imaging equipment such as X-rays or MRI. In the previous study, 20.8% of overlapping visits to traditional medicine were mentioned, and the increase in medical expenses was mentioned.³⁵ Although the total number of these cases was not high in this study, it is assumed that these medical limitations cause time, effort, and discomfort for patients and will induce an overall increase in medical costs when the entire population of Korea is considered rather than the sample used in this study.

Strengths and limitations

First, there may have been errors in the accuracy of the data because patients were sampled based on the main diagnosis indicated by the claim data.¹⁹ Ankle sprain disease is classified only by ICD-10 code S93, so it is not possible to distinguish the grade of the ankle sprain (grades 1 and 2). According to previous research, the diagnostic accuracy of the bills submitted to the NHI is about 70%.³⁶ To overcome this limitation, we only included subjects whose main diagnosis was a 'dislocation, sprain and strain of joints and ligaments at ankle and foot level (S93)'. The reason that we widened the ankle sprain category with S93 rather than S93.4 is that there may be errors in the data accuracy of the major diagnosis shown in the claim data. Although our study population has been defined broadly, it can show the characteristics of ankle sprain at the category level, because S93.6 and S93.4 account for >90% of cases (online supplemental table 5). The number of patients who visited with ankle sprains as their main diagnosis decreased slightly from 2015 to 2017. The results may be different if the main diagnosis is narrowed as 93.4 or if patients diagnosed with ankle sprain as the secondary diagnosis are included.

Second, medical costs are generally categorised into direct costs, indirect costs and intangible costs.³⁷ However,



this study only analysed direct costs that occurred as a result of medical services, while also excluding non-medical costs (including transit costs for visiting the medical institution to receive medical care and costs associated with caregiving). There are a total of 201 KM insurable items included in the Billing Data in South Korea. Compared with the 5611 insurable items in WM, this is a low number and the proportion of non-insured items is high. Therefore, it is difficult to conclude that the data billed by Korean medical institutions accurately reflect all KM treatments for patients with ankle sprains.

Despite these limitations, there were several strengths to this study. First, this study analysed the medical service use of patients with ankle sprains over 3 years of data from 2015 to 2017 in the HIRA-NPS. To date, there has been no study comparing the medical use of patients with ankle sprains by year at a national level. Second, we have described the medical care provided in WM and KM in terms of the special characteristics of Korea, which is a dualised healthcare system. Finally, this study provides information about the process through which patients with ankle sprains visit the medical institutions in practice by analysing their visit routes.

The results of the study are summarised as follows: patients with ankle sprains are predominantly young, with the incidence highest in teens; on average, patients visit medical institutions about three times a year; and patients mostly visit medical clinics. In particular, our study found that the cost of medication and injections/procedures decreases and the cost of physical therapy or braces increases in patients who visited KM.

CONCLUSION

This study analysed the patient sample data over 3 years through the Billing Data from the HIRA service to examine the current state of medical service use for ankle sprains in South Korea. By identifying high frequency treatments and high costs associated with ankle sprains, this study provides information that is useful for insurance systems and health policy-makers to plan future directions. In addition, analysing the visits separately for WM and KM led to the inference that the dualised system caused an additional increase in cost, and it was confirmed that more patients visited KM institutions for ankle sprains. Considering that research comparing patients with ankle sprains has not yet been presented, it is anticipated that the findings of this study can be used as basic data for national health policy-making in the future, such as rational decision-making for appropriate care of patients with ankle sprains, determining the number of health insurance-covered services for related services, and determining funding.

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REFERENCES

- 1 Papa JA. Clinical orthopaedic rehabilitation: an evidence-based Approach—Third edition. *J Can Chiropr Assoc* 2012;56:234.
- 2 O'Neill PJ, Parks BG, Walsh R, *et al*. Excursion and strain of the superficial peroneal nerve during inversion ankle sprain. *J Bone Joint Surg Am* 2007;89:979–86.
- 3 Waterman BR, Owens BD, Davey S, *et al*. The epidemiology of ankle sprains in the United States. *J Bone Joint Surg Am* 2010;92:2279–84.
- 4 National Health Insurance Service. *National health insurance statistical Yearbook*. National Health Insurance Service, 2018.
- 5 Knowles SB, Marshall SW, Miller T, *et al*. Cost of injuries from a prospective cohort study of North Carolina high school athletes. *Inj Prev* 2007;13:416–21.
- 6 Konradsen L, Bech L, Ehrenbjerg M, *et al*. Seven years follow-up after ankle inversion trauma. *Scand J Med Sci Sports* 2002;12:129–35.
- 7 Soboroff SH, Pappius EM, Komaroff AL. Benefits, risks, and costs of alternative approaches to the evaluation and treatment of severe ankle sprain. *Clin Orthop Relat Res* 1984;183:160–8.
- 8 Verhagen RA, de Keizer G, van Dijk CN. Long-term follow-up of inversion trauma of the ankle. *Arch Orthop Trauma Surg* 1995;114:92–6.
- 9 Jung B, Bae S, Kim S. Use of Western medicine and traditional Korean medicine for joint disorders: a retrospective comparative analysis based on Korean nationwide insurance data. *Evid Based Complement Alternat Med* 2017;2017:1–31.
- 10 National Development Institute of Korean Medicine. *NIKOM report of Korean medicine policy*, 2016.
- 11 Jung B, Kim J, Ha I-H, *et al*. Factors affecting utilisation of traditional Korean medical services by privately insured persons: a retrospective study using Korean health panel survey (KHPS). *BMJ Open* 2020;10:e033159.

- 12 Kannus P, Renstrom P. Treatment for acute tears of the lateral ligaments of the ankle. *J Bone Joint Surg Am* 1991;73:305–12.
- 13 Kerkhoffs GMMJ, Rowe BH, Assendelft WJJ, *et al*. Immobilisation and functional treatment for acute lateral ankle ligament injuries in adults. *Cochrane Database Syst Rev* 2002:CD003762.
- 14 Kerkhoffs GMMJ, Struijs PAA, Marti RK, *et al*. Different functional treatment strategies for acute lateral ankle ligament injuries in adults. *Cochrane Database Syst Rev* 2002:CD002938.
- 15 Pijnenburg AC, Van Dijk CN, Bossuyt PM, *et al*. Treatment of ruptures of the lateral ankle ligaments: a meta-analysis. *J Bone Joint Surg Am* 2000;82:761–73.
- 16 Sung KS, Park JM. Acute ankle sprains. *Arthrosc Orthop Sports Med* 2016;3:11–17.
- 17 Hootman JM, Dick R, Agel J. Epidemiology of collegiate injuries for 15 sports: summary and recommendations for injury prevention initiatives. *J Athl Train* 2007;42:311.
- 18 Hunt KJ, Lawson P. Acute ankle ligament injuries. In: *Sports injuries of the foot and ankle*. Springer, 2019: 3–12.
- 19 Kim JA, Yoon S, Kim LY, *et al*. Towards actualizing the value potential of Korea Health Insurance Review and Assessment (HIRA) data as a resource for health research: strengths, limitations, applications, and strategies for optimal use of HIRA data. *J Korean Med Sci* 2017;32:718–28.
- 20 Kim L, Kim J-A, Kim S. A guide for the utilization of health insurance review and assessment service national patient samples. *Epidemiol Health* 2014;36:e2014008.
- 21 Kim SK, Kleimeyer JP, Ahmed MA, *et al*. Two genetic loci associated with ankle injury. *PLoS One* 2017;12:e0185355.
- 22 Doherty C, Delahunt E, Caulfield B, *et al*. The incidence and prevalence of ankle sprain injury: a systematic review and meta-analysis of prospective epidemiological studies. *Sports Med* 2014;44:123–40.
- 23 Kwon S. Health care financing and delivery for the poor in Korea. *International Rev Public Adm* 2000;5:37–45.
- 24 Kerkhoffs GMMJ, Handoll HHG, de Bie R, *et al*. Surgical versus conservative treatment for acute injuries of the lateral ligament complex of the ankle in adults. *Cochrane Database Syst Rev* 2007:CD000380.
- 25 Peters JW, Trevino SG, Renstrom PA. Chronic lateral ankle instability. *Foot Ankle* 1991;12:182–91.
- 26 Lee JY, Jo M-W, Yoo W-S, *et al*. Evidence of a broken healthcare delivery system in Korea: unnecessary Hospital outpatient utilization among patients with a single chronic disease without complications. *J Korean Med Sci* 2014;29:1590–6.
- 27 Park JY, Chai H-Y. The effects of an increase of outpatient Co-insurance rate on the financial status of the National health insurance. *Korean Insurance J* 2003;64:109–36.
- 28 Miklovic TM, Donovan L, Protzuk OA, *et al*. Acute lateral ankle sprain to chronic ankle instability: a pathway of dysfunction. *Phys Sportsmed* 2018;46:116–22.
- 29 Aronson JK. *Meyler's side effects of analgesics and anti-inflammatory drugs*. Elsevier, 2009.
- 30 Buchman AL. Side effects of corticosteroid therapy. *J Clin Gastroenterol* 2001;33:289–94.
- 31 National Health Insurance Service. *Claim status for covered drugs*. National Health Insurance Service, 2017.
- 32 Brison RJ, Day AG, Pelland L, *et al*. Effect of early supervised physiotherapy on recovery from acute ankle sprain: randomised controlled trial. *BMJ* 2016;355:i5650.
- 33 Lim J-H, Lim S-M. A literature study about utilization of Oriental medical services. *J Korea Institute Orient Med Diagnos* 2012;16:11–22.
- 34 Hwang J-set *et al*. Study of the effect of blood-letting cupping treatment for acute ankle sprain: a randomize controlled trial. *J Acupuncture Res* 2005;22:243–52.
- 35 Park YS, Kim JS. Analysis of the current status outpatient utilization of medical and Korean traditional medical institutions: focus on outpatient frequent outpatient diseases. *J Korean Med Assoc* 2017;60:912–9.
- 36 Park B. *Studying on diagnosis accuracy for health insurance claims data in Korea*. Seoul: Seoul National University, 2003: 17–29.
- 37 Hodgson TA, Meiners MR. Cost-Of-Illness methodology: a guide to current practices and procedures. *Milbank Mem Fund Q Health Soc* 1982;60:429–62.