

National level data analysis of facial lacerations in Korea using the National Health Insurance Service (NHIS) database

Young Woong Mo, MD^{a,b}, Gyo-Young Cho, PhD^c, Young Taek Mo, MD^d, Dong Lark Lee, MD, PhD^{b,*} 

Abstract

No national epidemiological investigations have been conducted recently regarding facial lacerations. The study was performed using the data of 3,634,229 people during the 5-year period from 2014 to 2018 archived by the National Health Information Database (NHID) of the Health Insurance Review and Assessment Service. Preschool and children under 10 years old accounted for about one-third of patients. Facial lacerations were concentrated in the “T-shaped” area, which comprised forehead, nose, lips, and the perioral area. The male to female ratio for all study subjects was 2.16:1. Age and gender are significantly related with each other ($P < .001$). Mean hospital stays decreased, and numbers of outpatient department visits per patient were highest for hospitals and lowest for health agencies. Over the study period, hospital costs per patient in tertiary and general hospitals increased gradually. Preschool and school-aged children are vulnerable to trauma. Male patients outnumbered female patients by a factor of more than 2. The “T-shaped” area around forehead is vulnerable to injury. Total cost of medical care benefits per patient in tertiary hospitals was about 7 times on average than in health agencies. Regarding functional, behavioral, and aesthetic outcomes, more attention should be paid to epidemiologic data and hospital costs for facial lacerations.

Abbreviations: KCD = Korean Standard Classification of Diseases, KRW = Korean Won, NHID = National Health Information Database, NHIS = National Health Insurance Service, SD = standard deviation.

Keywords: data analyses, epidemiology, face, lacerations, wounds and injuries

1. Introduction

Facial laceration is the most common injury encountered by plastic surgeons in emergency rooms. Optimizing the management of such injuries and implementing targeted prevention

strategies are important because these injuries can leave permanent scars.^[1,2] Much epidemiology data has been reported on facial lacerations, especially in children.^[2,3] However, the majority of studies have been conducted at single centers and cohort sizes have ranged from hundreds to thousands.^[1,2,4] In fact, no report has ever been issued on the detailed demographics and management of facial lacerations at a national level. In order to minimize scarring after wound repair in an emergency room setting, steady outpatient department follow-up is crucial for overall wound management, including scar management, during the wound maturation period.^[1] That is to say, the management of facial lacerations is costly and correction takes a considerable time, and thus, information on changes in the incidence, anatomical site of injuries, hospital stays, outpatient department visits, and its associated treatment costs are required at a national level.

Since the 1980s, national health insurance extended to the entire country, providing universal health care for all citizens in Republic of Korea. This insurance claim system has the great advantage that it involves collecting data on the overall incidences of specific diseases and facilitates analyses of incidences by sex, age, and severity.^[5,6] Nevertheless, few attempts have been made to analyze this data for facial lacerations.

The Health Insurance Review and Assessment Center introduced a health data management system in 2019 that enables access to data on diseases and injuries recognized by the National Health Insurance Service (NHIS) and categorizes cases by age, sex, hospital stay, number of outpatient visits, and hospital costs. In this study, we analyzed facial laceration data obtained from this database over the 5-year period from 2014 to 2018.

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The study was approved beforehand by the Institutional Review Board of Dongguk University Hospital (IRB approval number: 110757-201908-HR-03-02) and performed in accordance with the principles of the Declaration of Helsinki.

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The datasets generated during and/or analyzed during the current study are publicly available.

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Table 1
Search terms and KCD codes used for database construction.

Search terms and KCD codes used for database construction		
Category	KCD code	Description details
Diagnosis	S01	Open wound of head
	S010	Open wound of scalp
	S011	Open wound of eyelid and periocular area
	S0120, S0121, S0122, S0128, S0129	Open wound of nose (external skin), Open wound of nares, Open wound of nasal septum, Open wound of other and multiple parts of nose, Open wound of nose (part unspecified)
	S0130, S0131, S0132, S0133, S0134, S0135, S0136, S0138, S0139	Open wound of auricle, Open wound of tragus, Open wound of external auditory meatus, Open wound of Eustachian tube, Open wound of ossicles, Open wound of eardrum, Open wound of inner ear, Open wound of other and multiple parts of ear, Open wound of external ear (part unspecified)
	S0140, S0141, S0142, S0148	Open wound of cheek, Open wound of maxillary region, Open wound of mandibular region, Open wound of other and multiple sites of cheek and temporomandibular area
	S0150, S0151, S0152, S0153, S0154, S0158, S0159	Open wound of lip, Open wound of buccal mucosa, Open wound of gum (alveolar process), Open wound of tongue and floor of mouth, Open wound of palate, Open wound of other and multiple parts of lip and oral cavity, Open wound of lip and oral cavity (part unspecified)
	S017	Multiple open wounds of head
	S018	Open wound of other parts of head
	S019	Open wound of head, part unspecified
Operation	M0082	Suture, face, single, <1.5 cm
	M0092	Suture, face, single, 1.5cm~3cm
	M0102	Suture, face, single, deep wound, ≥ 3cm
	M0086	Suture, face, multiple, <1.5 cm
	M0096	Suture, face, multiple, 1.5cm~3cm
	M0106	Suture, face, multiple, deep wound, ≥ 3cm
	M0084	Suture, face, single, <1.5 cm (+debridement)
	M0094	Suture, face, single, 1.5cm~3 cm (+debridement)
	M0104	Suture, face, single, deep wound, ≥3 cm (+debridement)
	M0088	Suture, face, multiple, <1.5 cm (+debridement)
	M0098	Suture, Face, multiple, 1.5cm~3 cm (+debridement)
	M0106	Suture, Face, multiple, deep wound, ≥ 3 cm (+debridement)
	N0166	Face, myorrhaphy (simple)
	N0168	Composite graft (facial area)
	N0162	Local flap (face)

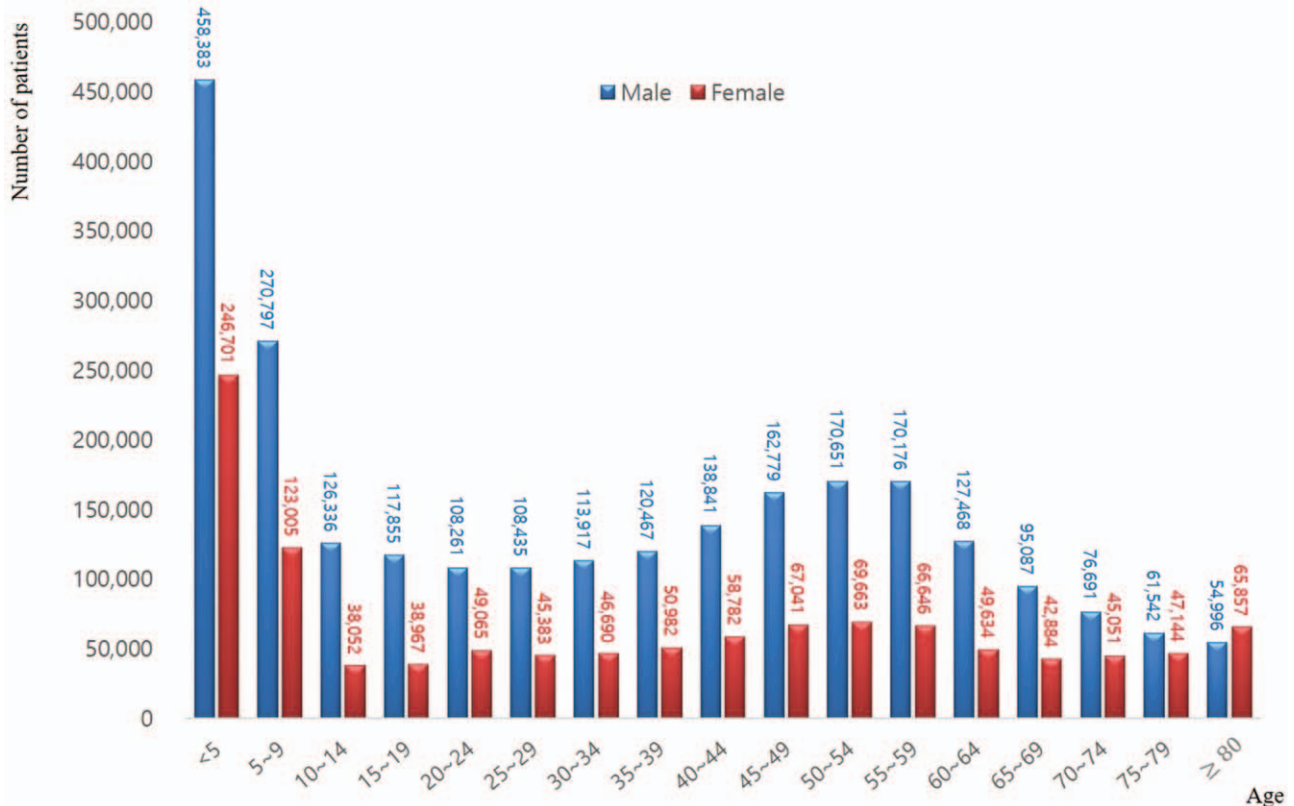


Figure 1. Incidences of facial laceration by age and gender. From 2014 to 2018, preschool and children under 10 years old accounted for about one-third of facial laceration patients (1,098,886/3,634,229; 30.2%). The male to female ratio for all 3,634,229 study subjects was 2.16:1.

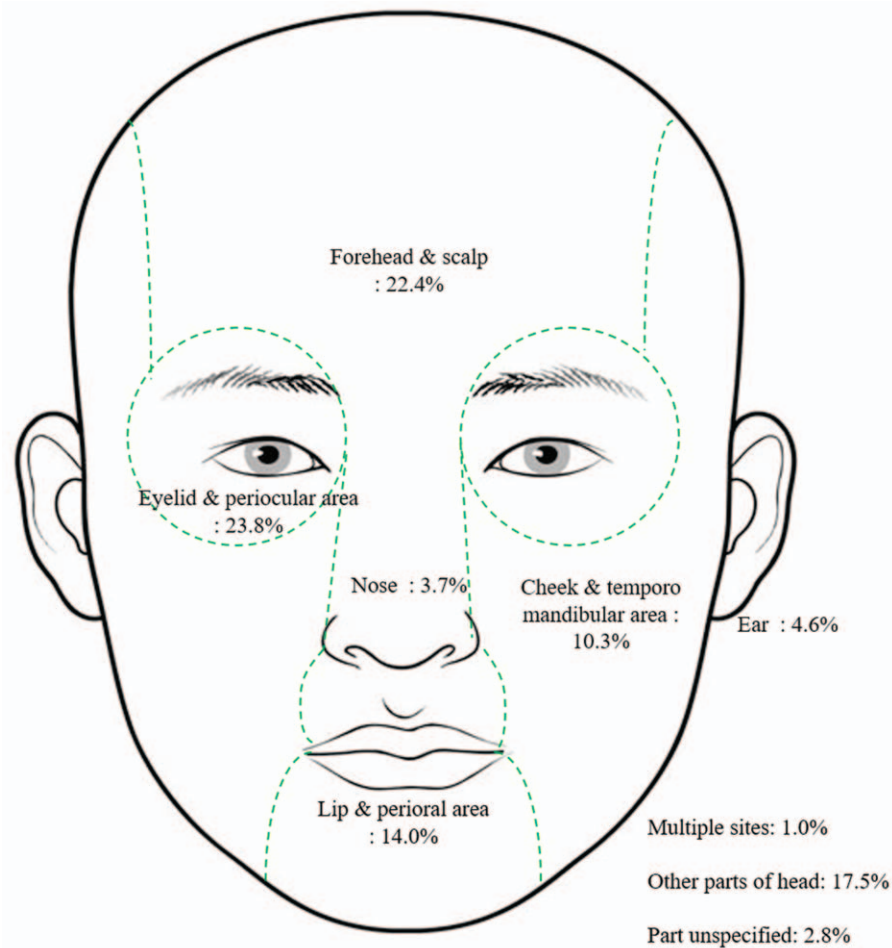


Figure 2. Distribution of sites of injury. (A) Facial lacerations were concentrated in a “T-shaped” area that included forehead (including scalp), nose, lips, and the perioral area (1,454,113/3,634,229; 40.0%). (B) Eyelids and periocular areas (865,452/3,634,229; 23.8%) and foreheads & scalp (813,470/3,634,229; 22.4%) were the most injured regions.

2. Methods

This study was approved by the Institutional Review Board of our hospital (IRB approval # 110757-201908-HR-03-02) and was performed in accordance with the principles of the Declaration of Helsinki.

2.1. Data source, study population, and set variables

Using the NHID of the Health Insurance Review and Assessment Service, we conducted a survey using the data of 3,634,229 cases collected over 5 years from 2014 to 2018. The NHID is a large healthcare data hub and provides an important basis for accurate statistical analyses. The NHID is a public database on health care utilization, health screening, socio-

demographic variables, and mortality for the whole population of South Korea, formed by the National Health Insurance Service. The health care utilization database includes information on records on inpatient and outpatient usage (diagnosis, length of stay, treatment costs, services received) and prescription records (drug code, days prescribed, daily dosage). The long-term care insurance database includes information about activities of daily living and service grades. The health care provider database includes data about the types of institutions, human resources, and equipment. In the NHID, de-identified join keys replacing the personal identifiers are used to interlink these databases.^[7] Anyone can access and set the diagnostic value that meets the criteria to obtain data. Internet domain is as follows; <https://opendata.hira.or.kr/home.do#none>

Table 2
Numbers of outpatient department visits and lengths of hospital stays.

Year of medical service	2014	2015	2016	2017	2018	Mean ± Standard deviation*
Outpatient department visits (times)	2.43	2.44	2.44	2.43	2.42	2.43 ± 0.01
Length of hospital stays (days)	5.51	5.27	3.28	3.31	3.20	4.11 ± 1.05

* The mean by each year was averaged.

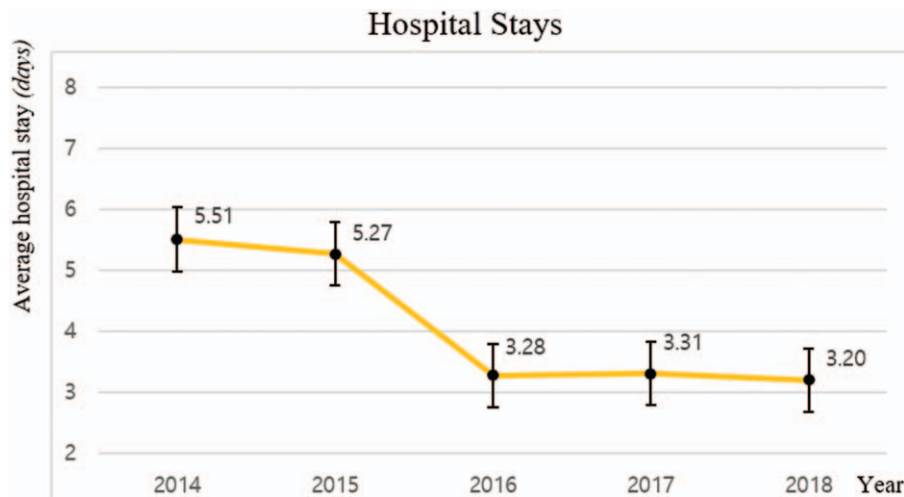


Figure 3. Mean hospital stays. Mean hospital stays of patients that underwent primary closure for facial lacerations. Before 2016 mean hospital stay was 5.4 days, but it dropped markedly to 3.28 days in 2016. From 2016, mean hospital stay per patient remained almost constant at 3.3 days. Over the entire 5-year study period mean hospital stay was 4.11 ± 1.17 days (mean \pm SD).

Data collection was performed using the 31 diagnostic and 15 treatment codes of the Korean Standard Classification of Diseases (KCD) (Table 1). Number of people, sexes, ages (in 5-year intervals), number of outpatient visits, days of hospitalization, and total hospital costs were extracted and preprocessed for analysis.

Institution types were categorized as tertiary hospital, general hospital, hospital, clinic, and health agency (a governmental public health center responsible for health) in order of scale. The concepts of clinic, hospital, general hospital, and tertiary hospital are about the size of hospitals legally regulated in Republic of Korea. Medical institution which has less than 30 beds, it is called a clinic. General hospitals are defined as hospitals with more than 100 beds and

at least 7 specialty areas, while hospitals are defined as having more than 30 beds. Finally, tertiary hospital has more than 500 beds with a full complement of services and departments, typically housing the most experienced and widest range of specialist doctors.

2.2. Statistical analyses

Measurements are expressed as means \pm standard deviations (SDs). Age and gender cross tabulation analysis was adopted for independence testing, and the Pearson χ^2 values were calculated. Statistical significance was accepted for *P* values of $<.05$. Data were transferred to MS Excel (Microsoft, USA) and analyzed using SPSS version 22.0 (IBM Corp, Armonk, NY).

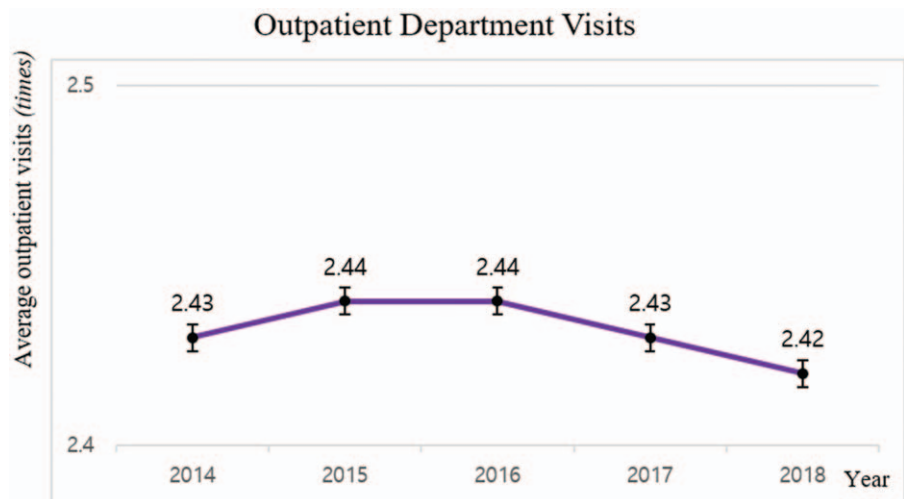


Figure 4. Mean numbers of outpatient visits per patient. The mean number of outpatient visits for facial laceration patients over the 5-year study period was 2.43 ± 0.01 (mean \pm SD) and this remained constant on an annual basis.

Table 3
Total treatment (outpatient department visit & admission) numbers and costs.

Year of medical service	2014	2015	2016	2017	2018	Mean ± Standard deviation*
Number of patients (a)	779,910	754,107	710,305	694,834	683,472	724,526 ± 40,963
Number of patients visiting outpatient department (b)	773,885	748,410	700,142	686,283	674,998	716,744 ± 42,468
Number of admission patients (c)	12,216	12,133	21,619	17,947	17,614	16,306 ± 4,086
Admission rate (%), (c)/(a) × 100	1.57	1.61	3.04	2.58	2.58	2.28 ± 0.65
Total cost of medical care benefits (thousand won)	84,675,121	84,926,399	84,136,713	86,530,109	89,978,303	86,049,329 ± 2,370,417
Total cost of outpatient department medical care benefits (thousand won), (d)	75,439,838	75,556,431	71,803,269	74,871,562	77,726,269	75,079,474 ± 2,129,532
Total hospital cost (thousand won), (e)	9,235,283	9,369,968	12,333,444	11,658,547	12,252,034	10,969,855 ± 1,544,833
Total cost of outpatient department medical care benefits / patients (thousand won), (d)/(b)	97.48	100.96	102.56	109.10	115.15	105.05 ± 7.05
Total hospital cost / patients (thousand won), (e)/(c)	756.00	772.27	570.49	649.61	695.59	688.79 ± 82.25

* The mean by each year was averaged.

3. Results

Classification by age (in 5-year intervals) and gender revealed that preschool and children under 10 years old accounted for about one-third of facial laceration patients (1,098,886/3,634,229; 30.2%). The male to female ratio for all 3,634,229 study subjects was 2.16:1. Male patients outnumber female patients more than

2-fold. The injury incidence rate versus age plot for all study subjects was bimodal with peaks in the first decade and 5~6th decades of life. With the exception of those aged >80 years, male patients were more common in all age groups (Fig. 1). Using the cross tabulation analysis of age and gender, the Pearson χ^2 value for independence was 55,492.646 ($P < .001$).

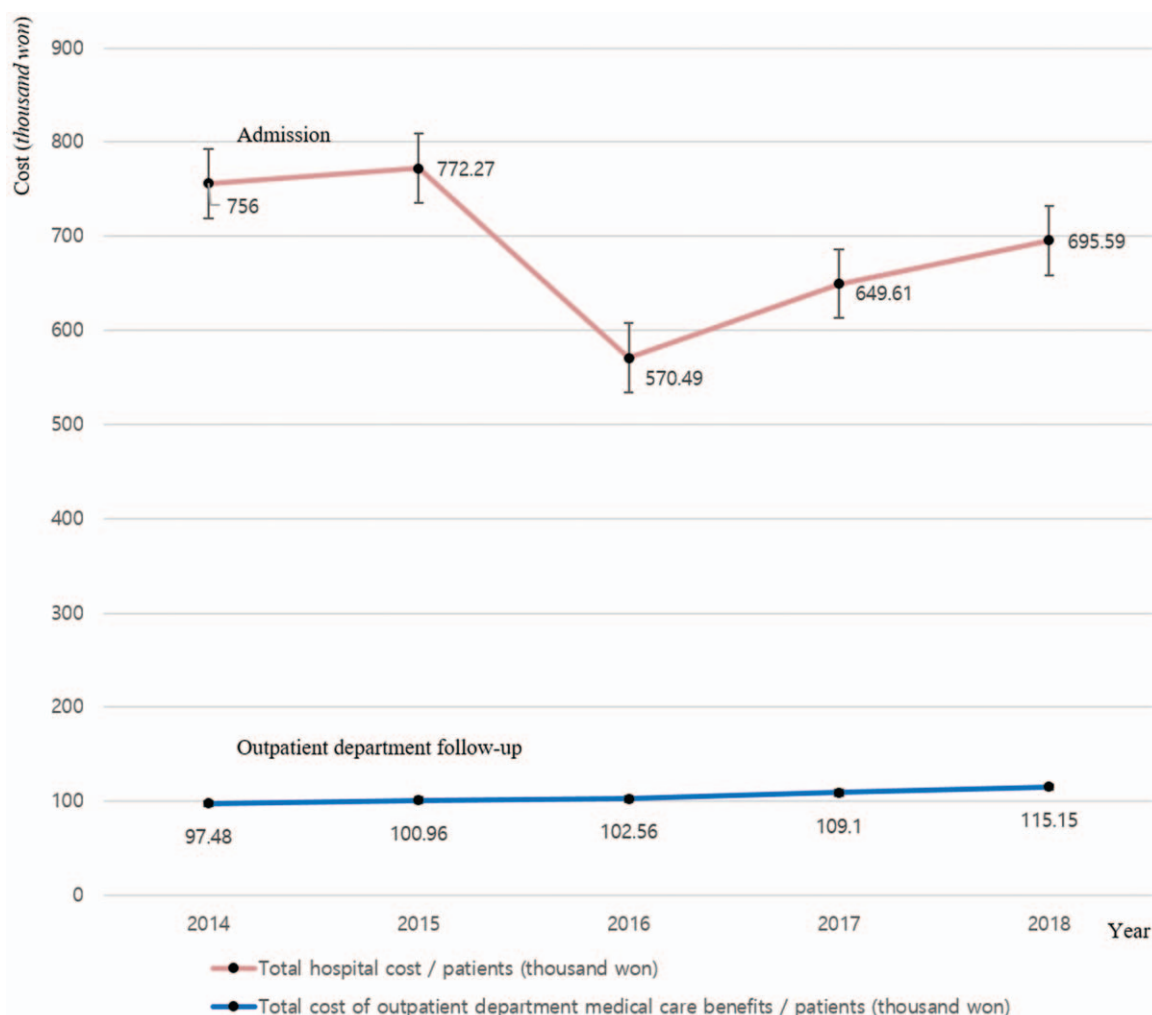


Figure 5. Costs of outpatient care and hospital inpatient costs. Mean hospital costs for inpatients fluctuated about KRW 700,000 (KRW 688,790 ± 82,250) and mean costs for those followed-up in outpatient department also showed little change (KRW 105,050 ± 7050) over the 5-year study period.

Distribution of sites of injury was analyzed, and results are shown schematically in Figure 2. Facial lacerations were concentrated in a “T-shaped” area including forehead, nose, lips, and the perioral area (1,454,113/3,634,229; 40.0%) (Fig. 2A). Eyelids and periocular areas (865,452/3,634,229; 23.8%) and foreheads (813,470/3,634,229; 22.4%) were the most injured regions (Fig. 2B).

Annual numbers of outpatient visits and lengths of hospital stay are provided in Table 2. Mean hospital stay decreased over the study period from 5.27 days in 2015 to 3.28 days in 2016. Mean hospital stay per patient decreased slightly after 2016 (Fig. 3). Regarding outpatient department visits, follow-up visit numbers were relatively steady. Mean ± SD was 2.43 ± 0.01 visits (Table 2, Fig. 4).

Total numbers of patients, outpatient department visits, hospitalized patients, and hospital costs are summarized in Table 3. The costs of outpatient department care per patient and hospital costs per patient are summarized in Table 3 and Figure 5. Although hospital costs of inpatients fluctuated at around Korean Won (KRW) 700,000 (KRW 688,790 ± 82,250) over the study period, the annual mean costs of those followed-up in an outpatient department increased slightly (by KRW 105,050 ± 7,050).

In terms of numbers of patients treated, total outpatient department visits and hospital costs by institution type are

summarized in Table 4. During the 5-year study period, numbers of outpatient department visits per patient were highest for hospitals and lowest for health agencies. Numbers of outpatient department visits per patient showed a decreasing tendency for all institution types, except clinics (Table 4, Fig. 6).

Mean hospital cost per patient showed an increasing trend at all institution types. Since 2015, hospital costs per patient in tertiary and general hospitals have increased markedly (Fig. 7).

4. Discussion

Although facial lacerations are the injuries most commonly encountered by plastic surgeons in emergency departments, no previous study has analyzed national statistical data on the topic in the Republic of Korea. YH Jung et al analyzed 5,149 pediatric facial lacerations,^[3] and JH Lee et al analyzed 3234 cases in a provincial hospital,^[1] but both studies were conducted on patients registered at a provincial hospital over a 2-year period. Although such studies provide information on many aspects of facial laceration, single center study conducted over a short period are subject to regional differences and cannot detect nationwide trends, and thus cannot fully represent a disease or phenomenon. Because the Health Insurance database has not been provided, analyses of relations between facial lacerations

Table 4
Numbers of patients, total outpatient department visit numbers, total cost of medical care benefits, outpatient department visits per patient, the cost of medical care benefits per patient by institution type.

Year of medical service	2014	2015	2016	2017	2018
Number of patients (a)					
Institution Groups					
Tertiary Hospital	110,708	104,211	97,937	89,661	97,748
General Hospital	216,667	217,101	209,356	205,117	198,868
Hospital	136,197	125,704	114,859	113,443	103,049
Clinic	379,829	368,658	348,205	344,918	341,860
Health Agency	5,690	5,478	5,159	4,959	4,453
Total	849,091	821,152	775,516	758,098	745,978
Total outpatient department visiting number (times), (b)					
Institution Groups					
Tertiary Hospital	197,140	185,064	176,986	157,118	164,384
General Hospital	456,686	468,505	446,482	427,375	409,937
Hospital	344,183	319,082	292,033	292,319	257,479
Clinic	941,052	910,785	852,257	844,242	849,944
Health Agency	9,172	9,058	8,345	8,155	7,043
Total	1,948,233	1,892,494	1,776,103	1,729,209	1,688,787
Total cost of medical care benefits (thousand won), (c)					
Institution Groups					
Tertiary Hospital	20,938,449	20,107,045	20,412,824	20,142,695	22,617,007
General Hospital	30,669,856	32,595,257	32,943,056	34,508,839	35,136,116
Hospital	12,675,916	11,958,146	11,284,573	11,839,110	10,973,395
Clinic	20,222,827	20,117,342	19,344,826	19,889,645	21,109,783
Health Agency	168,075	148,613	151,437	149,822	142,001
Total	84,675,121	84,926,399	84,136,713	86,530,109	89,978,303
Total outpatient department visiting number / patients (times), (b) / (a)					
Institution Groups					
Tertiary Hospital	1.78	1.78	1.81	1.75	1.68
General Hospital	2.11	2.16	2.13	2.08	2.06
Hospital	2.53	2.54	2.54	2.58	2.50
Clinic	2.48	2.47	2.45	2.45	2.49
Health Agency	1.61	1.65	1.62	1.64	1.58
Total cost of medical care benefits / patients (thousand won), (c) / (a)					
Institution Groups					
Tertiary Hospital	189	193	208	225	231
General Hospital	142	150	157	168	177
Hospital	93	95	98	104	106
Clinic	53	55	56	58	62
Health Agency	30	27	29	30	32

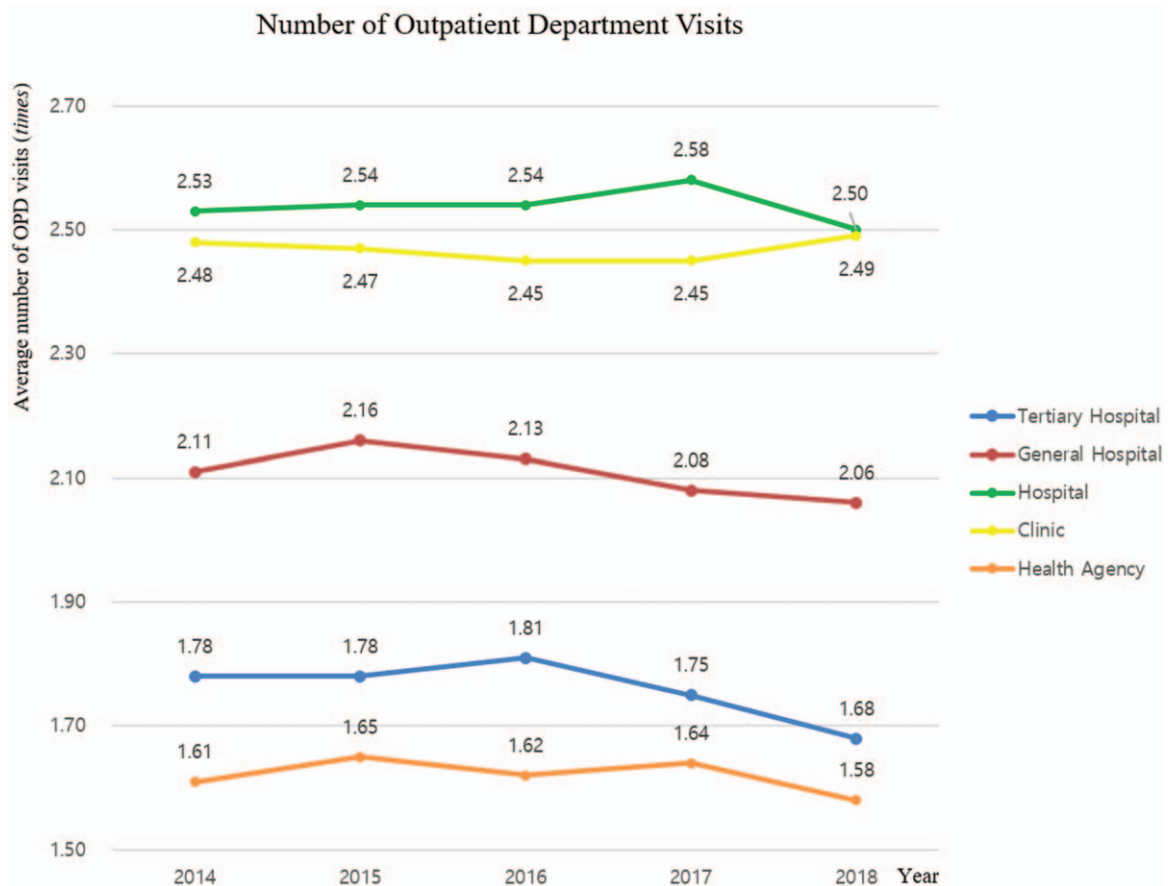


Figure 6. Numbers of outpatient department visits by institution type. Mean number of outpatient department visits per patient was highest for hospitals and lowest for health agencies, and showed a decreasing tendency over the study period at all institution types, except clinics. Overall patients visited outpatient departments a mean 2.43 ± 0.01 times over the 5-year study period.

data and epidemiological variables such as sex, age, and hospital types are difficult. However, the Health Insurance Review and Assessment Service provides a wealth of data in a form that can be processed statistically. The NHID is a large healthcare data hub and provides an important basis for “accurate” and “reliable” statistical analyses.^[6]

In the present study, analyses of numbers of patients treated per year, distributions by hospital type, outpatient visit numbers, and lengths of hospital stays provided meaningful data. Regarding the age and gender distributions of facial laceration patients treated over the 5-year study period, about one-third that received treatment were in the first decade of life (1,098,886/3,634,229; 30.2%), which was higher than the percentage accounted for by any other age group. As all in this age group were preschool or school-aged children, injuries were caused by being struck, bumping into something, slip-downs, and falls on stairs, they were probably due to lack of attention or care or instability while walking.^[2,3] The male to female ratio for all 3,634,229 study subjects was 2.16:1, and there were more than twice as many male patients, presumably because males are more active than females.^[2] Furthermore, the numbers of the patients showed bimodal peaks in first decade and 5~6th decades of life, and with the exception of those aged >80 years, male patients were more common in all age groups (Fig. 1). Interestingly, as women have longer life expectancies than men, there are twice as many women aged over 80 in the general population, which means men aged

over 80 are much more likely to suffer injury than women. Using the Chi-Squared test for independence in the 2-way contingency table, age, and gender are statistically dependent and strongly correlated with each other ($P < .001$).

The regions most frequently injured were eyelids and periocular areas including eyebrows (865,452; 23.8%), foreheads (813,470; 22.4%), lips and perioral areas (including chin) (507,263/3,634,229; 14.0%), and noses (133,380/3,634,229; 3.7%). These findings are consistent with those of previous studies with respect to the “T-shaped” concentration pattern shown by facial lacerations.^[1,3,8-10] These areas are more prone to injury because they overlie bony prominences and are thus more at risk from any blow to the face.^[11]

Mean duration of hospital stay was 4.11 ± 1.17 days, but this tended to decrease as year, whereas follow-up counts remained relatively steady (2.43 ± 0.01) for outpatient department patients. It was interesting to find that mean hospital stay shortened by 2.31 days over the 5-year study period. Usually, in post-traumatic emergency rooms, sutures or dressings are administered and patients with severe injuries are hospitalized. It would appear that times taken for wounds and patient conditions have reduced, which reflects several changes over recent years. First, dressing materials have been improved. Unlike in the past, when dressing materials for wound dressing were limited, there are now many different types of effective dressing materials such as hydrogel, hydrocolloid, alginate, hydrofiber, foam, composite, biologic,

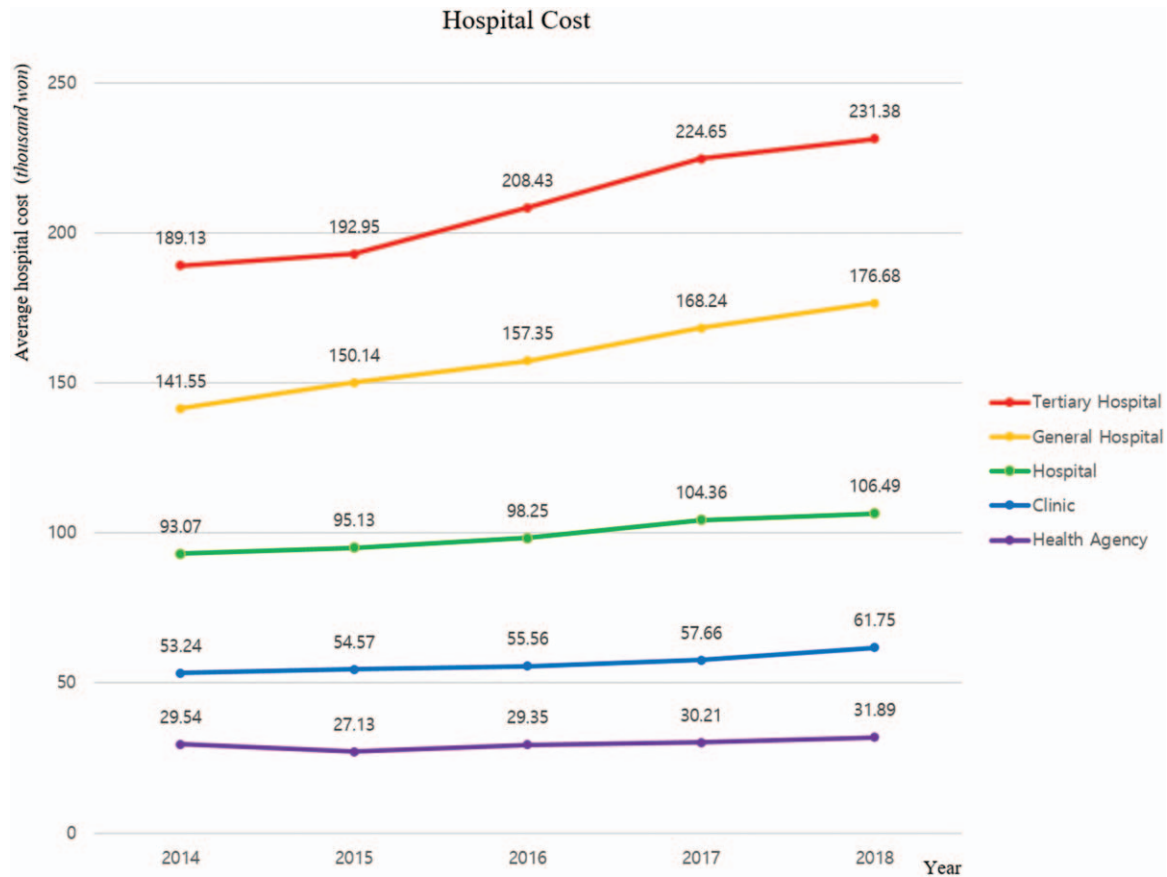


Figure 7. Hospital cost per patient by institution type. Mean hospital cost per patient showed an increasing trend at all institution types. Since 2015, hospital cost per patient in tertiary and general hospitals have increased sharply. The hospital cost per patient in tertiary hospital was about 7 times higher on average than in health agencies during the study period.

and impregnated dressings.^[12] Second, hospitals are more concerned about bed turnover rates. Actually, admission rates increased from about 1.6% before 2016 to around 3% in 2016 (Table 3).

In 2016, hospital costs decreased in-line with reductions in hospital stays, but from 2016, hospital stays remained almost unchanged at 3.3 days, but hospital costs increased rapidly. On average, hospital cost per patient, increased by 21.93% from KRW 570,490 in 2016 to KRW 695,590 in 2018 (Table 3, Fig. 5). During the same period, according to data from the national statistics portal operated by the Korean National Statistical Office, inflation was only 3.43%.^[13] These findings show treatment costs for facial lacerations increased substantially more than inflation over this 3-year period, and indicate a greater economic burden is being imposed on patients and caregivers. This might be due in part to the increased usage of non-payment dressing materials and adjunctive topical ointments.

However, in the whole period, it decreased from KRW 756,000 in 2014 to KRW 695,590 in 2018. Considering inflation rates, the decrease got steeper. Rather, the costs fall sharply in the 2016 and then gradually recovered until 2018 (Table 3, Fig. 5). The overall hospital cost per patient was on the rise, but in 2016 alone, it suddenly dropped from the previous year. This is because the people benefited greatly from the national health insurance, which was suddenly changed in 2016, and the benefits of health insurance for the 4 major diseases were expanded, and

the 3 non-insurance benefits were improved, so patients were able to reduce the burden of medical expenses. The 3 major medical expenses include optional medical expenses (special treatment expenses) and nursing care expenses.

Mean hospital cost per patient showed an increasing trend at all institution types (Table 3, Fig. 7), and remarkably, hospital cost per patient increased more steeply at tertiary and general hospitals than at other institutions from 2015. In fact, during the study period, the hospital cost per patient at tertiary hospitals was about 7 times that at health agencies on average.

This study has some limitations because Korean NHID information database was not originally designed for the purpose of research. In addition, it was not available on data not covered by the National Health Insurance system, such as cosmetic procedures and materials. It is necessary to make standardized criteria more globally and standardize these data for comparative analysis.

It has been reported facial lacerations are associated with a number of long-term functional, behavioral, and mood disorder problems associated with low self-esteem and lower health-related quality of life scores due to problems related to facial nerve injuries and the aesthetic aspects of permanent scarring. Furthermore, because most facial laceration patients are injured during their first decade of life, the economic burdens imposed on caregivers are considerable. We suggest unnecessary increases in medical costs will also eventually have negative impacts on patients and doctors.

By presenting this statistical analysis of epidemiologic data and of hospital costs for facial laceration in Korea over the period 2014 to 2018, we hope that institutional changes will be made that reduce financial burdens on patients and their caregivers.

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