Original Article

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Analysis of sedation and general anesthesia in patients with special needs in dentistry using the Korean healthcare big data

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Background: People with special needs tend to require diverse behavioral management in dentistry. They may feel anxious or uncomfortable or may not respond to any communication with the dentists. Patients with medical, physical, or psychological disorders may not cooperate and therefore require sedation (SED) or general anesthesia (GA) to receive dental treatment. Using the healthcare big data in Korea, this study aimed to analyze the trends of SED and GA in special needs patients undergoing dental treatment. It is believed that these data can be used as reference material for hospitals and for preparation of guidelines and related policy decisions of associations or governments for special needs patients in dentistry.

Methods: The study used selected health information data provided by the Korean National Health Insurance Service. Patients with a record of use of one of the eight selected drugs used in dental SED between January 2007 and September 2019, those with International Classification of Diseases-10 codes for attention deficit hyperactivity disorder (ADHD), phobia, brain disease, cerebral palsy, epilepsy, genetic disease, autism, mental disorder, mental retardation, and dementia were selected. The insurance claims data were analyzed for age, sex, sedative use, GA, year, and institution.

Results: The number of special needs patients who received dental treatment under SED or GA from January 2007 to September 2019 was 116,623. Number of SED cases was 136,018, performed on 69,265 patients, and the number of GA cases was 56,308, implemented on 47,257 patients. In 2007, 3100 special needs patients received dental treatment under SED while in 2018 the number of cases increased 6 times to 18,528 SED cases. In dentistry, ADHD was the most common disability for SED cases while phobia was the most common cause of disability for GA. The male-to-female ratio with respect to SED cases was higher for males (M : F = 64.36% : 35.64%).

Conclusion: The application of the SED method and GA for patients with special needs in dentistry is increasing rapidly; thus, preparing guidelines and reinforcing the education and system are necessary.

Keywords: Big Data; Dental Sedation; General Anesthesia; Healthcare; People with Disability.

INTRODUCTION

Dental care for people with special needs is the treatment of patients who are medically, physically, or mentally abnormal [1]. Patients with physical and mental problems may have several difficulties and limitations in receiving dental care [2]. People with special needs who exhibit anxiety and fear during dental treatment or who are not able to cooperate because of cognitive impairment, may need dental treatment under sedation (SED) or general anesthesia (GA) [3]. There is a method of

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controlling behavior in dental treatment for special needs patients, but there is also a method of dental treatment under GA, especially if the treatment takes a long time and or the treatment is invasive and complex [4]. Recently, a thorough investigation of the healthcare big data identified the practice of SED or GA according to the type of disability in dental treatment [5]. Therefore, this study used the big data from the Korean National Health Insurance Service (KNHIS) to analyze and assess the SED and GA practices in dental treatment of patients with special needs in Korea.

The current state of dental SED and GA can be observed through the years using this data applied to the Health Insurance Review and Assessment Service (HIRA) [6]. Specifically, the number and characteristics of patients per year and the number of medical institutions and changes in characteristics can be confirmed. In addition, whether SED or GA was used and the type of disability were analyzed. Medical records of patients who had undergone dental treatments were used to understand the actual condition of the patient. The data analyzed through this can be used as reference data in establishing the dental policy of dental associations and also for the demand of dental hospitals for people with special needs. This can contribute to the direction of education related to medical and dental treatments and institutions for people with special needs.

METHODS

1. Study design and source of data

The healthcare big data hub, operated by the Korean Health Insurance Review and Assessment Service (HIRA) includes information on the use of medical service, usage of medications, and diagnosed diseases [6]. The data are stored and public can remotely access the information for secondary use upon request and payment [7]. HIRA approved the use of customized health information (M20191014119) of the healthcare big data hub (https://opendata.hira.or.kr/). The requested data from January 2007 to September 2019 were used as the data source for the subjects. The study was conducted with the approval of the Institutional Review Board of Seoul National University School of Dentistry (IRB No. S-020200006).

Table 1. Classification of 10 disabilities encountered in dentistry (arbitrarily classified)

ICD-10 Disease Classification Code	Disease	Disability
F90~91	ADHD	1 ADHD
F43	PTSD	2 Phobia
F41~42, F43	Anxiety disorder	
F40	Phobia	
F84	Autism	3 Autism
F80	Speech disorder	4 Mental retardation
F70~73,78,79	Mental retardation	
F30~34,38~40	Depression	5 Mental disorder
F09,20~25,28,29	Schizophrenia	
G00~09,35~37, 61~63,90~99	Diseases of the CNS	6 Brain disease
F06, F07	Brain damage	
I60~69	Cerebrovascular disease	
F05	Delirium	
F10	Mental disorder due to alcohol	
G40~41	Epilepsy	7 Epilepsy
G10~13, G70~73	Diseases of myoneural junction and muscle	8 Genetic disease
G60,	Hereditary neuropathy	
G80~83	Cerebral palsy	9 Cerebral palsy
F00~03, G30~31	Dementia	10 Dementia
G20~23	Parkinson disease	

ADHD, attention deficit hyperactivity disorder; CNS, central nervous system; ICD, International Classification of Diseases; PTSD, post-traumatic stress disorder

Firstly, a request was made to the healthcare big data hub for the payment data of patients at dental hospitals and dental clinics who made insurance claims for one of the following eight sedatives: chloral hydrate, hydroxyzine, propofol, sevoflurane, midazolam, triazolam, N_2O, or dexmedetomidine, which can be used in dental SED. To analyze the medical history of each patient, the general summary information (200 table), treatments (300 table), and diagnosis (400 table) were extracted from the data warehouse containing information on medical treatments carried out between January 2007 and September 2019 [8].

The International Classification of Diseases (ICD)-10

Table 2. Number of cases and total number of patients by disability (from January 1, 2007, to September 30, 2019)

Disability	Number of cases (%)				Total Patients
	No GA or SED	SED	GA	Total	
ADHD	217885 (88%)	28276 (11.4%)	1451 (0.6%)	247612 (100%)	13685
Phobia	638975 (95.6%)	15721 (2.4%)	13763 (2.1%)	668459 (100%)	22089
Brain disease	650217 (94.4%)	26585 (3.9%)	12169 (1.8%)	688971 (100%)	24842
Cerebral palsy	67828 (88.7%)	6252 (8.2%)	2384 (3.1%)	76464 (100%)	4541
Epilepsy	147408 (89.6%)	12545 (7.6%)	4542 (2.8%)	164495 (100%)	9134
Genetic disease	32338 (90.6%)	2570 (7.2%)	775 (2.2%)	35683 (100%)	1865
Autism	71726 (85.1%)	10263 (12.2%)	2325 (2.8%)	84314 (100%)	6597
Mental disorder	483659 (95.7%)	9806 (1.9%)	12067 (2.4%)	505532 (100%)	16945
Mental retardation	164932 (86.4%)	22232 (11.6%)	3814 (2%)	190978 (100%)	12900
Dementia	133982 (96.6%)	1768 (1.3%)	3018 (2.2%)	138768 (100%)	4025
Total	2608950 (93.1%)	136018 (4.9%)	56308 (2%)	2801276 (100%)	116623

ADHD, attention deficit hyperactivity disorder; GA, general anesthesia; SED, sedation.

codes of the 400 table were searched in the remote statistical analysis system, and patients with the ICD-10 codes for dementia (F00~03), delirium (F05), mental disorder to brain damage (F06), brain disease, damage, dysfunction (F07), unspecified organic or symptomatic mental disorders (F09), mental disorder due to use of alcohol (F10), schizophrenia (F20~25,28,29), mood disorders (F30~34,38,39), phobic anxiety disorders (F40), other anxiety disorders (F41~42), reaction to severe stress (F43), mental retardation (F70~73,78,79), developmental disorder of speech and language (F80), autism (F84), attention deficit hyperactivity disorder (ADHD) (F90~91), inflammatory diseases of the CNS (G00~09), systemic atrophies affecting the CNS (G10~13), extrapyramidal and movement disorders (G20~23), degenerative diseases of the nervous system (G30~31), demyelinating diseases of the CNS (G35~37), hereditary and idiopathic neuropathy (G60), polyneuropathy (G61~63), diseases of myoneural junction and muscle (G70~73), cerebral palsy (G80~83), other disorders of the nervous system (G90~99), and cerebrovascular diseases (I60~69) were selected (Table 1).

When only dental claims were selected among all insurance claims of patients with the selected ICD-10 codes mentioned above, the total number of dental treatments (200 table) for the selected patients was 2,801,276 (Table 2).

The criteria for classifying patients with disabilities were selected using the ICD-10 codes. When various diagnoses was found, only one disease frequently diagnosed was determined as the representative disability. In order to exclude misdiagnosis, the patient was classified as having a disability only if there were more than two prescriptions for diagnosis of this disability (Table 1).

2. Grouping of GA or SED

The GA code (L121) for GA and N_2O behavioral management code (U237) for SED were searched in the medical service item code (DIV_CD; treatment, medical materials, and drugs) of the treatment table (300 table) for each of the 2,801,276 cases. Cases with the GA code were classified as cases of GA. Cases with the N_2O behavioral management code rather than the GA code, or with one or more of the eight sedatives listed above as a named generic drug code (GNL_CD) in the treatment table (300 table), were classified as SED cases. All other cases were classified as no anesthesia cases, where neither SED nor GA had been implemented [9].

3. Yearly trend of special needs patients by GA or SED cases

For analysis, information on the pseudonym personal identification number (JID), pseudonym hospital identification number (YID), sex, age, and claim date were collected from the general summary information table

Table 3. Change in the number of annual sedation cases by disability (from January 1, 2007, to September 30, 2019)

Disability	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
ADHD	402	503	489	658	912	1093	1403	2942	4279	4520	4144	3580	3351	28276
Phobia	661	720	731	777	771	750	891	1323	1847	1917	1873	1743	1717	15721
Brain Disease	590	630	686	806	880	989	1147	2307	3210	3801	4006	3827	3706	26585
Cerebral Palsy	95	128	151	167	208	234	270	537	739	910	942	903	968	6252
Epilepsy	224	279	315	382	446	446	588	1225	1505	1843	1823	1663	1806	12545
Genetic Disease	41	60	65	55	82	94	103	224	284	356	357	407	442	2570
Autism	175	148	160	212	263	348	445	797	1082	1415	1648	1775	1795	10263
Mental Disorder	558	603	576	658	629	516	617	920	1070	1002	991	905	761	9806
Mental Retardation	264	282	309	429	524	644	940	1870	2681	3064	3669	3617	3939	22232
Dementia	90	103	121	131	148	134	150	155	188	192	164	108	84	1768
Total	3100	3456	3603	4275	4863	5248	6554	12300	16885	19020	19617	18528	18569	136018

ADHD, attention deficit hyperactivity disorder.

Table 4. Change in the number of annual general anesthesia cases by disability (from January 1, 2007, to September 30, 2019)

Disability	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
ADHD	47	42	50	55	69	79	108	122	136	183	191	198	171	1451
Phobia	779	755	794	824	850	993	1081	1227	1284	1336	1344	1412	1084	13763
Brain Disease	633	649	753	743	795	913	967	1103	1159	1127	1156	1214	957	12169
Cerebral Palsy	77	90	102	106	122	159	176	210	216	238	295	329	264	2384
Epilepsy	187	175	181	231	259	299	304	426	439	477	549	521	494	4542
Genetic Disease	25	31	38	29	33	61	54	75	66	86	105	96	76	775
Autism	45	67	61	75	85	94	138	171	192	262	353	414	368	2325
Mental Disorder	640	624	744	717	806	820	991	1070	1074	1168	1177	1288	948	12067
Mental Retardation	135	131	135	175	165	209	255	311	351	450	508	504	485	3814
Dementia	142	154	182	183	186	230	276	290	290	286	271	283	245	3018
Total	2710	2718	3040	3138	3370	3857	4350	5005	5207	5613	5949	6259	5092	56308

ADHD, attention deficit hyperactivity disorder.

(the 200 table). All dental treatment cases from January 2007 to September 2019 were categorized into the GA, SED, and No GA or SED groups. Next, JID was used to calculate the number of patients per group. In addition, YID was used to calculate the number of dental clinics and hospitals. Sex data were used to estimate sex ratio.

To determine the annual changes, the number of dental treatment cases per year was estimated, as were the numbers of SED or GA cases per year. Among the total number of treatments, the ratio of SED and GA was also calculated.

4. Analysis of disability and SED and GA cases by year

The number of claims per year for each SED drug and GA code were analyzed. Using JID, we analyzed the number of SED cases and GA cases performed and sorted them by disability. The number of medical institutions that performed SED and GA was also analyzed using YID. The age and sex of each disability undergoing SED or GA were analyzed.

5. Analysis of SED and GA according to medical institutions and province

The number of medical institutions that performed SED and GA was also analyzed using YID. Medical institutions performing SED and GA can be classified as dental clinic, dental hospital, general hospital, and tertiary general hospital. According to the location of the hospital, the city and province could be narrowed down; therefore, SED and GA cases for city and province could be analyzed.

RESULTS

1. Analysis of the number of SED and GA cases according to disability

According to the data from January 1, 2007, to September 30, 2019, a total of 2,801,276 dental cases and 116,623 patients were identified in the HIRA big data for patients with the disabilities (Table 2).

A total of 136,018 cases of SED were performed and 56,308 cases of GA were carried out during the time. In 2007, sedation cases were 3,100. In 2018, the total number of sedation cases was 18,528, an increase of six times (Table 3). In the case of GA in 2007, the total number of cases was 2,710, and in 2018 the number of GA cases increased three-fold to 6,259. The most common disability in dental SED was ADHD, while in GA it was phobia. In SED cases, apart from dementia, all disabilities had an increase over the years. In GA there was an increase in cases in all the disabilities (Table 4, Fig. 1). However, since the total number of treatments also increased, the ratio of the number of GAs among the total number of dental treatments did not increase much in the 2-3% range. However, the ratio of the number of SED cases showed an increasing trend with increase in the total number of sedation cases. The degree of increase differed according to the type of disability (Fig. 2).

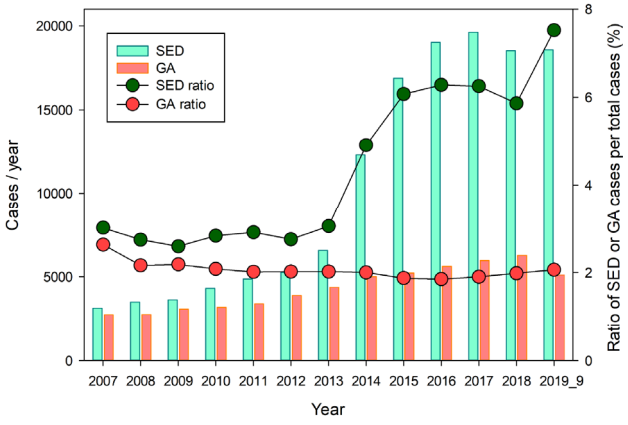

Fig. 1. Annual changes in number of sedation and general anesthesia cases. GA, general anesthesia; SED, sedation.

2. Analysis of sex ratio and average age of patients by disability

In patients receiving SED, the male-to-female ratio was very high for males with ADHD and autism. In all the disabilities analyzed, the male ratio was higher, except

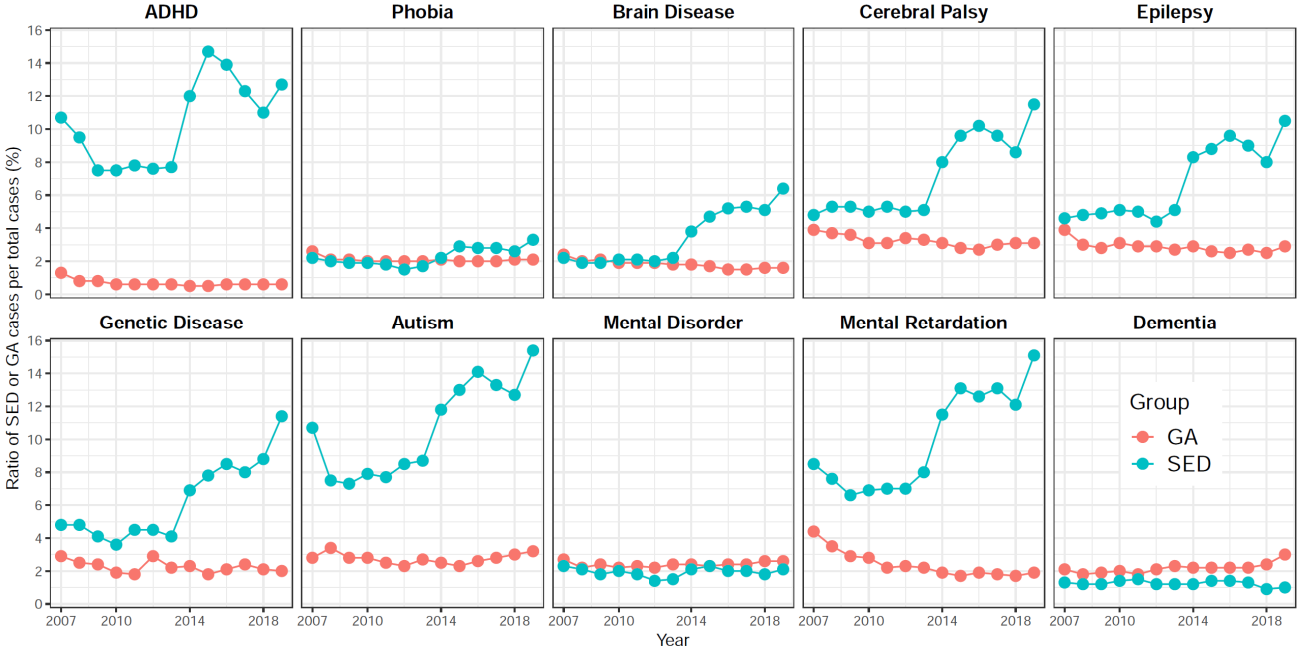

Fig. 2. Ratio of the number of GA and SED among the total number of dental treatments divided by year and disability. ADHD, attention deficit hyperactivity disorder; GA, general anesthesia; SED, sedation.

in the case of mental disorder and dementia, where the female ratio was higher (Table 5). In patients receiving GA, the male ratio was very high again in those with ADHD and autism. However, in dementia, the female ratio was significantly higher (Table 6).

There was a large difference between the age at which SED was performed and the age at which GA was performed by type of disability. The age at which SED was performed was often more than 10 years younger than the age at which GA was performed (Table 5, 6).

3. Analysis of the number of SED and GA cases according to medical institutions and province

In our study, a total of 105,289 SED cases were performed in dental clinics and the majority of SED cases in dentistry were carried out in dental clinics. However, in the case of GA, a total of 27,213 cases were performed in tertiary general hospitals. In tertiary general hospitals and general hospitals, GA method was performed more than SED in treating patients with special needs (Fig. 3). In 2019, there were 406 dental clinics that provided dental SED (Table 7).

The number of GA and SED cases by the city and province in Korea was investigated by year (Table 8, 9), and the ratio of GA and SED was also plotted as a graph (Fig. 4, 5).

DISCUSSION

As of 2006, the registered population of persons with special needs in South Korea was 1,134,177, but increased to 2,618,918 in 2019, accounting for 5.1% of the total population [10]. In 2019, the number of persons

Table 5. Sedation cases with sex ratio and average age of patients by disability (from January 1, 2007, to September 30, 2019)

Disability	Male	Female	Ratio	age [year (SD)]
ADHD	22969	5307	81.2 : 18.8	6.4 (4.1)
Phobia	7963	7758	50.7 : 49.3	31.4 (24.7)
Brain Disease	15488	11097	58.3 : 41.7	31.1 (28.9)
Cerebral Palsy	3473	2779	55.6 : 44.4	10.2 (11.8)
Epilepsy	6748	5797	53.8 : 46.2	11.7 (13.5)
Genetic Disease	1388	1182	54.0 : 46.0	9.6 (12.5)
Autism	7957	2306	77.5 : 22.5	7.6 (5.2)
Mental Disorder	4803	5003	49.0 : 51.0	31.1 (24)
Mental Retardation	15914	6318	71.6 : 28.4	8.5 (7.9)
Dementia	842	926	47.6 : 52.4	56.7 (28.5)

ADHD, attention deficit hyperactivity disorder.

Table 6. General anesthesia cases with sex ratio and average age of patients by disability (from January 1, 2007, to September 30, 2019)

Disability	Male	Female	Ratio	age [year (SD)]
ADHD	1246	205	85.9 : 14.1	13 (6.1)
Phobia	6809	6954	49.5 : 50.5	46.2 (19.7)
Brain Disease	7221	4948	59.3 : 40.7	53 (20.5)
Cerebral Palsy	1437	947	60.3 : 39.7	26.2 (17.9)
Epilepsy	2896	1646	63.8 : 36.2	28 (16.6)
Genetic Disease	467	308	60.3 : 39.7	24 (19.7)
Autism	1838	487	79.1 : 20.9	16.8 (8.3)
Mental Disorder	6112	5955	50.7 : 49.3	43.2 (20)
Mental Retardation	2428	1386	63.7 : 36.3	20.8 (11.6)
Dementia	1117	1901	37.0 : 63.0	68 (14.5)

ADHD, attention deficit hyperactivity disorder.

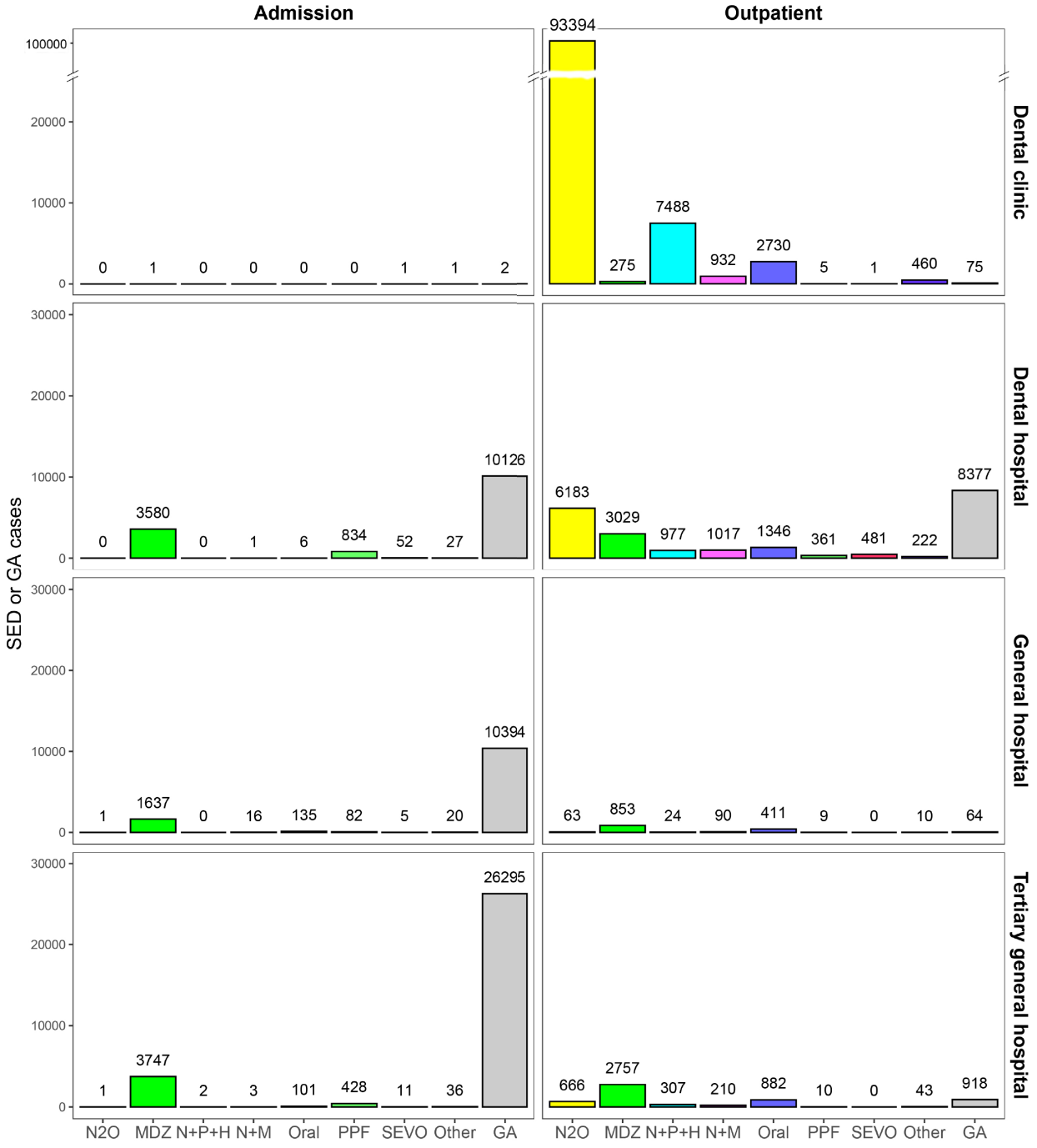

Fig. 3. Number of sedation and general anesthesia (GA) cases according to medical institutions. GA, general anesthesia; MDZ, midazolam; N+M, nitrous oxide and midazolam; N+P+H, nitrous oxide and chloral hydrate and/or hydroxyzine; Oral, oral sedatives (chloral hydrate, hydroxyzine); PPF, propofol; SED, sedation; SEVO, sevoflurane.

with special needs aged 65 or older was 1,263,952 accounting for 48.3% of the registered population for special needs. The male-to-female ratio was 57.8% : 44.2%, which accounted for 15.6% higher males [10]. When analyzing the dental treatment of persons with special needs with a history of dental treatment using the above eight sedative drugs, a total of 116,623 patients received 2,801,276 treatments (Table 2). Among them, 136,018 cases of SED were performed, and 56,308 cases were administered under GA.

Table 7. Change in the number of number of SED and GA cases according to medical institutions and number of institutions (from January 1, 2007, to September 30, 2019)

		Tertiary General Hospital		General Hospital		Dental Hospital		Dental Clinic	
cases	year	SED	GA	SED	GA	SED	GA	SED	GA
	2007	794	1529	269	672	874	509	1163	
	2008	899	1551	308	574	776	593	1473	
	2009	934	1873	285	537	887	630	1478	
	2010	814	1822	336	608	1076	707	2049	
	2011	743	1844	317	647	1154	877	2649	
	2012	626	1828	310	740	960	1289	3351	
	2013	671	2088	367	929	1018	1333	4494	
	2014	763	2284	278	898	1438	1823	9820	
	2015	652	2531	183	783	1772	1885	14276	8
	2016	736	2583	125	1048	2029	1960	16124	13
	2017	641	2699	144	970	2159	2248	16672	20
	2018	523	2543	217	1211	2144	2475	15643	18
	2019	409	2038	217	841	1841	2174	16097	18
	Total	9205	27213	3356	10458	18128	18503	105289	77
hospital numbers	year	SED	GA	SED	GA	SED	GA	SED	GA
	2007	29	37	51	58	26	9	121	
	2008	28	36	52	57	30	11	146	
	2009	33	37	50	59	35	12	157	
	2010	34	36	49	54	34	10	191	
	2011	32	36	57	60	40	15	208	
	2012	27	35	49	71	36	15	223	
	2013	24	36	45	63	38	14	251	
	2014	25	34	42	62	39	13	300	
	2015	24	33	39	67	43	17	336	3
	2016	22	34	34	69	47	14	370	3
	2017	21	33	30	66	52	15	398	2
	2018	20	32	24	57	50	15	397	2
	2019	16	29	32	49	46	15	406	1

GA, general anesthesia; SED, sedation.

Table 8. Change in the number of annual sedation cases by city and province in Korea (from January 1, 2007, to September 30, 2019)

Disability	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Seoul	1084	1100	1125	1180	1313	1285	1639	3117	4241	4259	4114	4114	4183	32754
Busan	210	336	270	325	284	450	598	1206	1909	2389	2462	2348	2506	15293
Inchon	260	258	260	285	368	349	375	555	638	754	743	701	757	6303
Daegu	210	278	296	312	366	366	352	643	815	987	1184	1041	1070	7920
Gwangju	148	173	218	279	249	247	404	586	669	850	774	584	556	5737
Daejeon	58	80	51	59	117	153	212	479	681	648	693	655	588	4474
Ulsan	41	68	53	50	73	85	116	218	437	456	450	392	435	2874
Gyeonggi-do	503	600	674	962	1175	1436	1849	3705	4899	5592	5842	5478	5466	38181
Gangwon-do	258	215	244	241	230	210	200	271	354	364	386	393	272	3638
Chungcheongbuk-do	35	32	44	52	60	70	121	277	311	401	308	370	313	2394
Chungcheongnam-do	83	81	48	55	82	80	110	157	228	234	249	335	385	2127
Jeollabuk-do	80	76	108	114	124	143	234	478	683	840	1023	906	718	5527
Jeollanam-do	24	32	21	21	34	35	46	93	195	173	170	109	117	1070
Gyeongsangbuk-do	11	13	34	34	33	47	84	148	237	282	354	369	352	1998
Gyeongsangnam-do	80	73	145	291	332	239	165	297	419	456	522	464	552	4035
Jeju-do	15	41	12	15	23	53	49	70	94	148	104	110	103	837
Sejong									75	187	239	159	196	856
Total	3100	3456	3603	4275	4863	5248	6554	12300	16885	19020	19617	18528	18569	136018

Table 9. Change in the number of annual general anesthesia cases by city and province in Korea (from January 1, 2007, to September 30, 2019)

Disability	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	Total
Seoul	1035	1011	1127	1128	1182	1336	1383	1829	1839	1893	2049	2332	1805	19949
Busan	238	268	258	203	205	211	253	252	265	307	365	325	326	3476
Inchon	68	81	73	96	71	85	80	94	99	151	136	164	129	1327
Daegu	242	211	268	295	309	310	334	321	357	364	361	402	346	4120
Gwangju	165	173	163	136	172	195	254	342	384	316	324	342	276	3242
Daejeon	100	86	97	114	106	132	166	179	130	138	122	123	86	1579
Ulsan	71	36	49	58	48	61	117	107	169	139	123	145	31	1154
Gyeonggi-do	307	317	352	380	460	479	636	692	715	939	857	860	789	7783
Gangwon-do	76	61	86	66	113	128	124	121	119	112	158	150	97	1411
Chungcheongbuk-do	62	77	79	66	74	59	62	66	76	71	73	66	28	859
Chungcheongnam-do	151	184	165	190	194	229	270	304	313	403	525	424	397	3749
Jeollabuk-do	111	138	240	235	218	280	358	364	367	395	396	370	329	3801
Jeollanam-do	4	4	8	5	4	7	6		1	1	3	2		45
Gyeongsangbuk-do	3	4	4	3	4	7	7	2		4	4	13	5	60
Gyeongsangnam-do	69	59	61	150	200	329	286	316	361	363	439	479	367	3479
Jeju-do	8	8	10	13	10	9	14	16	12	17	14	62	81	274
Total	3100	3456	3603	4275	4863	5248	6554	12300	16885	19020	19617	18528	18569	136018

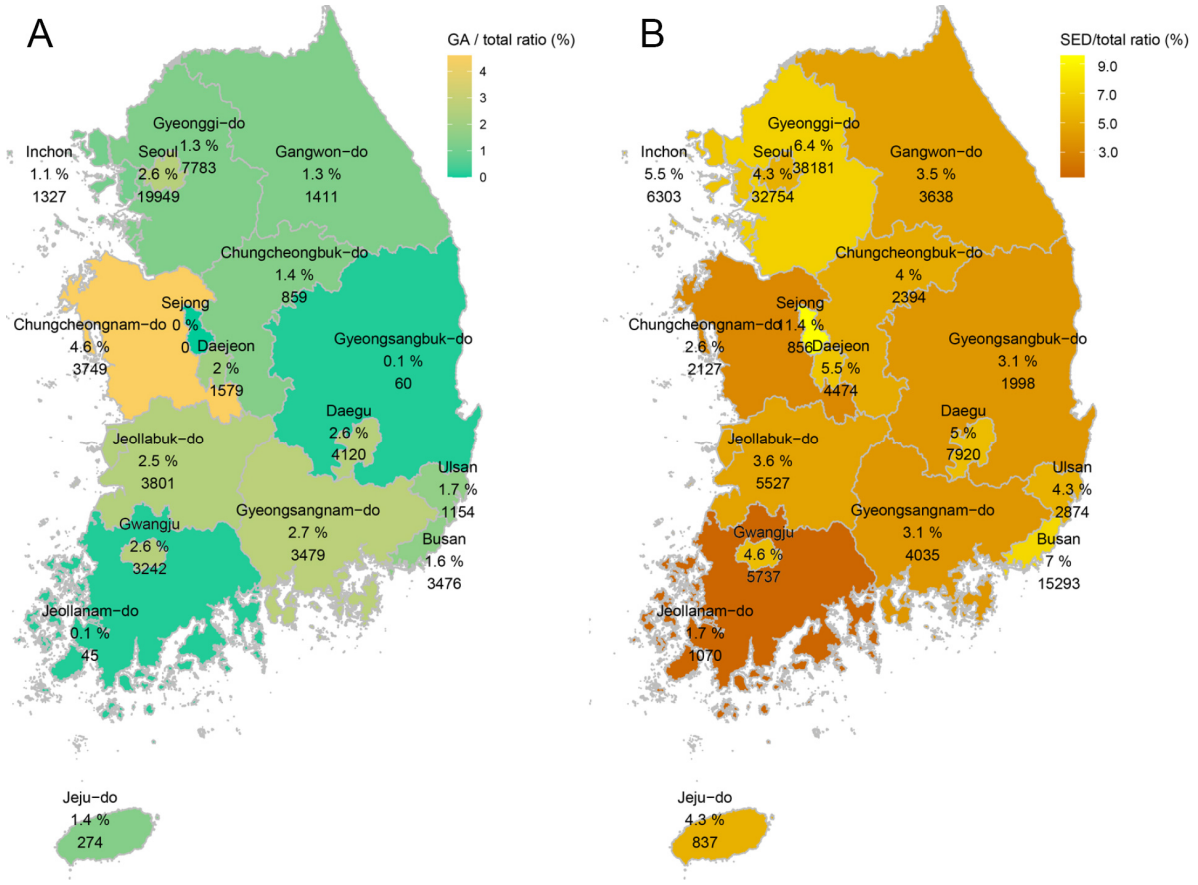

Fig. 4. Ratio of the number of GA (A) and SED (B) among the total number of dental treatments divided by city and province. Data are expressed province or city name, ratio (%), total cases from January 1, 2007, to September 30, 2019. GA, general anesthesia; SED, sedation.

In this study, patients with ADHD represented the greatest number of cases of dental SED while patients with brain disease had the most number receiving dental treatment among the disabilities (Table 3). However, the

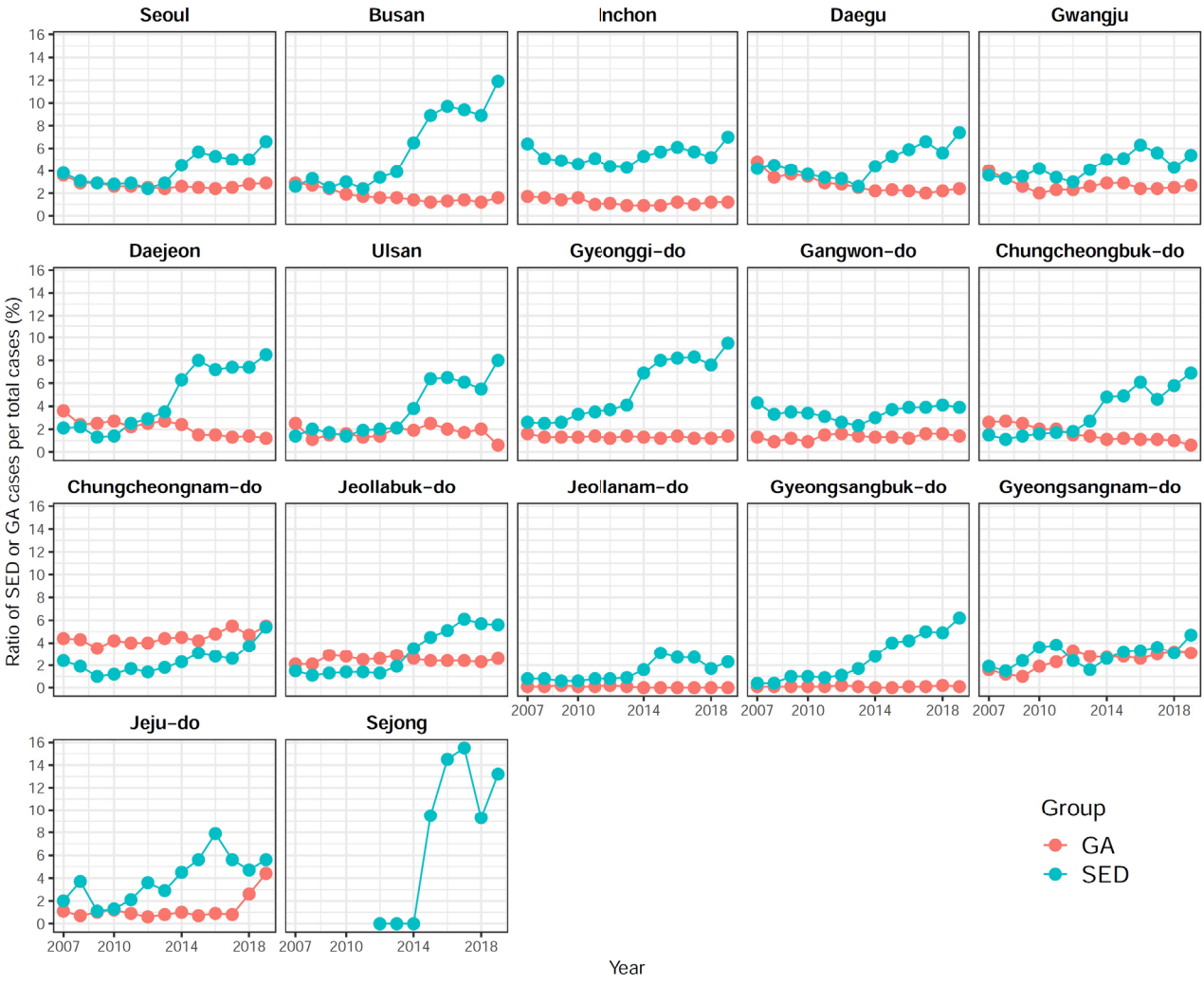

Fig. 5. Ratio of the number of GA and SED among the total number of dental treatments divided by year and province from January 1, 2007, to September 30, 2019. GA, general anesthesia; SED, sedation.

most common disability that received GA was phobia, and this disability had the most patients and most cases in receiving GA (Table 4).

Dental phobia patients unable to respond to and cooperate well with psychotherapeutic interventions, and not willing to undergo these types of treatment, should seek pharmacological therapies such as SED or GA [11]. Prevalence of extreme or very high dental anxiety has been estimated to be between 5 and 22% in representative adult samples [12]. As prevalence of dental anxiety is quite high and results in avoidance of dental treatment, irregular dental attendance, and poor cooperation, measures to attend to the dental phobia population must be taken into consideration. These data are meaningful in understanding the importance and severity of dental phobia.

According to the study, ADHD, brain disease and mental retardation were the three disabilities with the most cases of SED (Table 3), while in GA, phobia, mental disorder, and brain disease were the most common cause for undergoing GA in dental treatment (Table 4).

From 2007 to 2019, an increase in both SED and GA cases were observed, but a much more rapid increase was found in the number of SED cases. In 2007, there were 3,100 SED cases, but in 2019, it was 18,569 cases, a six-fold increase (Fig. 1). From 2014, SED cases increased rapidly possibly because of the N2O code being claimed at the insurance [9].

The increase in yearly SED cases over the years from 2007 to 2018 which included ADHD, cerebral palsy, genetic disease, autism, and mental retardation, showed a near ten-fold increase in the course of 12 years. The increase in number of GA cases was much less than that of SED; nevertheless, in autism, the number of GA cases increased ten times from 2007 to 2013. This could be owing to an increase in the prevalence of autism spectrum disorders that has increased in recent decades, which could be because of changes in diagnosis reporting practices [13].

There were ample differences in the male-to-female ratio and age in receiving SED or GA according to types of disability. The majority of the disabilities showed a higher ratio in male population, except in dementia where the female ratio was higher [5]. Pediatric patients were of the mean age in receiving SED or GA for ADHD and autism. Overall, the mean age for all disabilities was in younger patients receiving SED than GA (Table 5, 6). In the case of dementia among disabilities, 1344 patients with dementia received 1515 procedures with SED and 3015 patients underwent 3396 procedures with GA. Consequently, it can be understood that dementia patients received SED and GA at least once. This predicts that the demand for SED and GA for patients will increase in the aging population as the dementia population is also rising.

In the case of tertiary hospitals and general hospitals, the number of cases of SED is decreasing year by year, while the number of cases of GA is increasing.

In terms of SED, most cases were carried out in the Gyeonggi province and Seoul came in second. However, in terms of GA, the majority of cases were carried out in Seoul. In 2007, the number of medical institutions in Seoul that were capable of performing dental SED or GA was 70 while in 2019 the number increased to 125.

In conclusion, a total of 116,623 patients with disabilities received 2,801,276 dental care with insurance during the survey period. Among these, 69,265 patients underwent 136,018 dental procedures with SED method and 47,257 patients underwent 56,308 procedures with GA.

The improvement of welfare and newly opened dental hospitals for people with special needs, an increase in insurance coverage and easier accessibility has led to a steep rise in the practice of SED and GA in patients with special needs.

Recently, the number of patients with dental phobias has shown an increase and the number of SED and GA has also increased accordingly. This is a subject that should be taken into consideration, such that dental phobia may be included as a type of disorder in dentistry and the need for implementation of SED and GA during dental treatment may be considered.

Overall, from the results of analyzing dental SED and GA for patients with special needs, data show that the number of dental SED and GA cases and the number of patients with disabilities is increasing compared to that in the past. It is suggested that guidelines for SED and GA for patients with special needs need to be prepared, and reinforcement of related policies and management needs to be implemented.

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