



Trends in Electroconvulsive Therapy Utilization in South Korea: Health Insurance Review Data From 2008 to 2018

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Objective The study aimed to analyze and clinically correlate 10-year trends in the demographic characteristics of patients receiving electroconvulsive therapy (ECT) to provide an overview of ECT utilization in South Korea.

Methods Using health insurance claims data from 2008 to 2018 retrieved from Health Insurance Review and Assessment Service database in South Korea, we identified individuals undergoing ECT based on procedural codes. Descriptive analysis evaluated baseline clinical characteristics, and trend analysis used a linear regression model.

Results The prevalence of ECT increased by 240.49% (0.405/10⁵ inhabitants in 2008 to 0.974/10⁵ inhabitants in 2018). The increasing trend was more pronounced in younger and older patients. The proportion of women consistently exceeded that of men. A rise in the proportion of patients with affective disorders, and a decrease in the proportion of psychotic disorders was observed. More antidepressants and atypical antipsychotics were prescribed to patients undergoing ECT. The proportion of ECT sessions conducted in large hospital inpatient settings also decreased during the observation period. Despite increasing global trends, ECT prevalence in South Korea remains significantly lower than worldwide rates.

Conclusion This study demonstrated an increasing trend of ECT across a wide range of population demographics and in more accessible settings. The comparatively low prevalence of ECT in Korea compared to other countries might be attributed to insufficient mental health literacy and the stigma associated with ECT. Given the elevated suicide rates in Korea, more extensive adoption of ECT appears imperative.

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Keywords Electroconvulsive therapy; Procedures and techniques utilization; Epidemiologic studies; Mood disorders; Schizophrenia.

INTRODUCTION

The global use of electroconvulsive therapy (ECT) has significantly changed since its introduction in the 1930s.¹ Initially met with controversy, ECT gained prominence in the mid-20th century for severe psychiatric conditions, but faced declining rates with the advent of psychiatric pharmacotherapy.² In recent decades, there has been a resurgence of interest driven by research demonstrating its efficacy in specific

disorders.^{3,4} Modern ECT techniques designed to minimize side effects are considered safe and effective, particularly in treatment-resistant cases. The current global trend reflects a more nuanced and evidence-based approach, with ECT reserved for carefully selected cases and aligned with the established guidelines.⁵⁻⁸

Cultural, medical, and societal factors contribute to the variations in ECT utilization across different countries and healthcare systems.^{3,4,9} In 2005, ECT prevalence rates exhibited substantial variation across diverse countries and regions worldwide, ranging from 7.5 per 10⁵ inhabitants in New Zealand to 44 per 10⁵ inhabitants in Victoria, Australia.³ The relatively low utilization of ECT in low-income nations is associated with insufficient healthcare resources in those areas.³ In Europe, ECT prevalence varies widely, ranging from 0.5 per 10⁵ inhabitants in Italy¹⁰ to 44 per 10⁵ inhabitants in Sweden,^{4,11} based on data surveyed since 2010. This variation is not sole-

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ly attributed to socioeconomic and medical access concepts but is influenced by diverse factors, including the historical background of ECT introduction in each country, clinicians' and patients' perceptions, and the healthcare delivery system.⁴

Generating population-based estimates of the annual number of individuals undergoing ECT would offer valuable supplementary statistics for monitoring and enhancing performance and quality control within both privately and publicly managed healthcare systems.³ In South Korea, 98% of the total population is covered by National Health Insurance (NHI). Most medical procedures, including ECT, are reimbursed by the NHI, with subsequent reviews conducted by the Health Insurance Review and Assessment Service (HIRA). Comprehensive data on the entire range of medical services were collected for analysis using the HIRA database.¹² Thus, utilizing representative national insurance databases such as the HIRA is appropriate for discerning trends in the administration of ECT.

From 2001 to 2009, South Korea's ECT utilization in patients with schizophrenia was examined as part of the Research in East Asia on Psychotropic Prescription, which involved data collection through interviews with clinicians at psychiatric facilities and medical record reviews. However, the study did not report the prevalence of ECT as the ratio of individuals who underwent ECT to the total population.⁹ Subsequently, ECT trends among patients diagnosed with schizophrenia and psychotic disorders from 2010 to 2019 were analyzed using HIRA data.¹³ However, no study has addressed the trends and clinical correlates in the entire population receiving ECT over the past decade.

In this study, our objective was to offer a comprehensive and contemporary analysis of ECT utilization in South Korea from 2008 to 2018, using data from the HIRA database. Our investigation aimed to unveil pertinent trends and infer potential future directions for ECT applications. To achieve this, we systematically gathered information not only on the total number of ECT cases throughout the study period, but also on various clinical parameters related to individuals who underwent ECT. These parameters included age, sex, psychiatric diagnoses, concurrent use of psychotropic medications, insurance coverage type, and type of institution where the ECT procedures were conducted.

METHODS

Data source

We employed the HIRA database to obtain claims data from the NHI, a national healthcare system in South Korea. The HIRA encompasses claims data for approximately 98% of the South Korean population and has been used in diverse epide-

miological studies.¹² This study was approved by the Institutional Review Board of the Korea University Guro Hospital (IRB number 2020GR0507). The requirement for written consent was waived because the study utilized the South Korean HIRA dataset, which comprises de-identified secondary data intended for research purposes.

Patient records from January 2008 to December 2018 were retrieved from the HIRA database by querying procedure codes aligned with the fifth to eighth revisions of the Korean Standard Classification of Diseases (KCD). The KCD, derived from the International Statistical Classification of Diseases and Related Health Problems issued by the World Health Organization,¹⁴ is tailored to the circumstances of the Republic of Korea, incorporating data on disease morbidity, mortality, medical records, and cause of death surveys. This systematic classification categorizes diseases and health-related problems across various health and demographic records based on the similarities of health issues.

Data collection

The subjects included patients who had received modified ECT (NN072) or simple ECT (NN071) between 2007 and 2019. We collected procedural codes for modified ECT (NN072), which involves ECT with the administration of anesthesia, and simple ECT (NN071), which involves ECT without anesthesia. Data were collected from all records, on age, sex, primary psychiatric diagnosis based on KCD, prescribed psychotropic medications, the type of medical institution where ECT was conducted, and the type of insurance coverage regarding medical aid from the government.

Data analysis

Descriptive analyses

Using descriptive analysis, the demographic (age, sex), clinical (primary diagnosis, concomitant psychotropic medications), institutional (healthcare delivery service unit), and insurance coverage characteristics of individuals who received ECT each year were evaluated during the investigation period. We categorized the subjects into eight age groups (10–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, ≥80). Primary diagnoses were categorized as psychotic disorders (encompassing conditions within the schizophrenia spectrum - F20–F29), and affective disorders (comprising unipolar depression and bipolar disorders - F30–F39, F51, G47). The category labeled “others” encompassed all remaining disorders. The psychotropic medications prescribed were identified and categorized based on Anatomic Therapeutic Chemical classification (ATC) codes as follows: typical antipsychotics (haloperidol, chlorpromazine, perphenazine), atypical antipsychotics (aripipra-

zole, clozapine, ziprasidone, risperidone, quetiapine, olanzapine, paliperidone, amisulpride, blonanserin, sulpiride, zotepin), antiepileptics or mood stabilizers (lithium, carbamazepine, valproic acid, sodium valproate, divalproex sodium, lamotrigine, oxcarbamazepine, topiramate), antidepressants (selective serotonin reuptake inhibitors [SSRI], serotonin and norepinephrine reuptake inhibitors [SNRI], tricyclic antidepressants [TCA], monoamine oxidase inhibitors [MAOi], and others [trazodone, mirtazapine, bupropion, vortioxetine, agomelatine]), anxiolytics (diazepam, chlorthalidopoxide, lorazepam, bromazepam, clobazam, alprazolam, ethyl loflazepate, etizolam, clonazepam, tofisopam, buspirone), and sedatives (triazolam, zolpidem, flunitrazepam, flurazepam). The Supplementary Table 1 (in the online-only Data Supplement) includes the ATC codes and classifications corresponding to each drug.

The trends were analyzed using linear regression models. The dependent variable was the annual prevalence of ECT treatment, and the independent variable was the year. The percentage change in the expected number of dependent variables was calculated for a one-year increase with a 95% confidence interval. All statistical analyses were performed using Statistical Analysis System software (version 9.4; SAS Inc., Cary, NC, USA).

RESULTS

Prevalence of ECT and demographics

A total of 3,172 individuals underwent ECT between 2008 and 2018 as identified through the HIRA system. A total of 200 instances of ECT were performed in 2008. Over subsequent years, there was a steady annual rise in the incidence of ECT procedures, reaching a total of 505 cases performed in

2018 (Table 1, Figures 1 and 2). Annual rate of ECT use was 0.405 per 10⁵ inhabitants in 2008 and 0.974 per 10⁵ inhabitants in 2018. Regression analyses estimated an annual increase in the annual prevalence of ECT utilization at 0.087.

An upward trend was observed over the 10-year study period, with the most significant increase seen in the 20–29 age group, totaling a 300.00% increase (43 instances in 2008 to

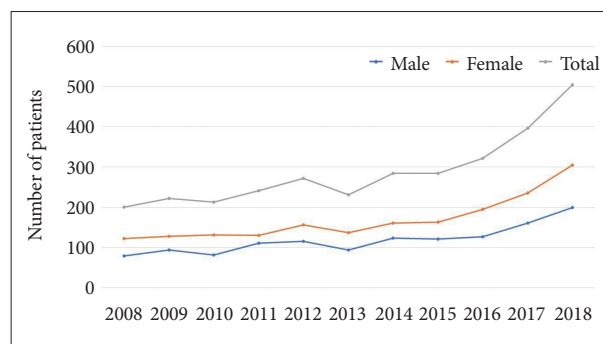


Figure 1. Changes by sex groups in total number of individuals who received ECT by each year. ECT, electroconvulsive therapy.

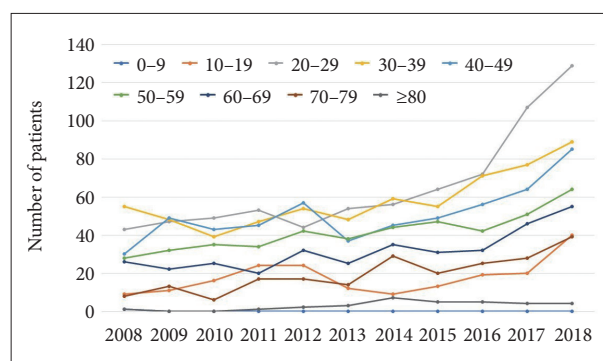


Figure 2. Changes in age groups of individuals received ECT by year. ECT, electroconvulsive therapy.

Table 1. Demographic data by year

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Sex											
Male	79	94	82	111	116	94	123	121	127	161	200
Female	121	128	131	130	156	137	161	163	195	236	305
Age (yr)											
10–19	9 (2)	11 (5)	16 (11)	24 (15)	24 (14)	12 (8)	9 (5)	13 (6)	19 (10)	20 (3)	40 (11)
20–29	43 (20)	47 (25)	49 (26)	53 (33)	44 (24)	54 (26)	56 (33)	64 (39)	72 (33)	107 (60)	129 (66)
30–39	55 (24)	48 (22)	39 (12)	47 (20)	54 (23)	48 (20)	59 (28)	55 (26)	71 (32)	77 (31)	89 (36)
40–49	30 (15)	49 (17)	43 (19)	45 (19)	57 (26)	37 (13)	45 (20)	49 (25)	56 (18)	64 (29)	85 (42)
50–59	28 (5)	32 (14)	35 (8)	34 (12)	42 (13)	38 (14)	44 (10)	47 (13)	42 (15)	51 (12)	64 (20)
60–69	26 (11)	22 (7)	25 (5)	20 (7)	32 (6)	25 (10)	35 (12)	31 (6)	32 (9)	46 (18)	55 (14)
70–79	8 (1)	13 (4)	6 (1)	17 (5)	17 (8)	14 (1)	29 (10)	20 (3)	25 (8)	28 (6)	39 (8)
≥80	1 (1)	0 (0)	0 (0)	1 (0)	2 (2)	3 (2)	7 (5)	5 (3)	5 (2)	4 (2)	4 (3)
Total	200	222	213	241	272	231	284	284	322	397	505

The number within parenthesis denotes the number of male patients

129 instances in 2018) between 2008 and 2018 (Table 1). In 2008, the 10–19 and 20–29 age groups comprised 4.50% and 21.50% of the total ECTs, respectively. By 2018, these rates had increased to 7.92% and 25.54%, respectively. The proportion of the 70–79 and ≥80 years age groups, among all ECT patients increased from 4.00% to 7.72% and 0.50% to 0.79%, respectively. This upward trend was observed in almost all age groups and both sexes (Table 1, Figures 1 and 2).

Primary diagnoses

Overall, the majority number of ECT treatments were conducted for psychotic disorders and affective disorders. The proportion of patients with primary diagnoses who underwent ECT treatments between the study period saw a switch between the two categories, with affective and psychotic disorders accounting for 39.01% and 52.75% in 2008 and 46.50% and 43.42% in 2018, respectively (Table 2). Other diagnoses, including disorders such as dementia, Parkinson's disease, and neuroleptic malignant syndrome, accounted for 10.6% of all ECT treatments over the study period and remained relatively stable over time.

Concomitant medications

The proportion of medications prescribed to patients who

underwent ECT changed over the 10-year study period. Atypical antipsychotics, comprising 38.13% of the prescribed medications in 2008, increased to 54.01% in 2017 and 49.58% in 2018. Antidepressant use has increased from 12.18% to 19.78% (Table 3). Furthermore, there was a concurrent increase in the overall prescription volume of atypical antipsychotics and antidepressants corresponding to an annual increase in the total number of patients undergoing ECT (Figure 3). The quantity and proportion of prescribed antidepressants for patients undergoing ECT exhibited annual variations during the investigation period; however, no distinct trend was evident (Table 3 and Figure 4)

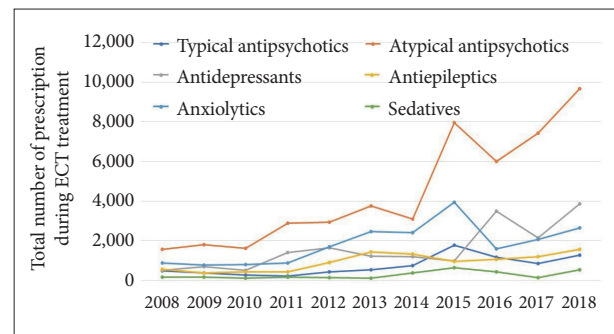


Figure 3. Prevalence of prescribed drugs during ECT treatment by category. ECT, electroconvulsive therapy.

Table 2. The proportion of primary diagnoses among ECT patients by each year

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Psychotic disorders	52.75	56.77	53.76	54.44	48.33	52.87	49.02	54.17	53.25	44.60	43.42
Affective disorders	39.01	34.38	39.31	37.78	40.19	36.31	40.20	32.81	38.96	42.16	46.50
Others	8.24	8.85	6.94	7.78	11.48	10.83	10.78	13.02	7.79	13.24	10.08

Psychotic disorders: schizophrenia, schizotypal, delusional, and other non-mood psychotic disorders (F20–F29); affective disorders: unipolar depression and bipolar disorders (F30–F39, F51, G47); and others: all remaining disorders. ECT, electroconvulsive therapy

Table 3. The proportion of concomitant psychotropic medications used with ECT by each year

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Typical APs	11.19	8.62	6.67	3.75	5.29	5.60	8.09	10.88	8.41	6.05	6.44
Atypical APs	38.13	43.79	43.76	48.56	38.13	39.50	34.01	49.10	43.87	54.01	49.58
Antidepressants	12.18	16.79	13.75	23.69	21.42	12.79	13.00	6.00	25.47	15.45	19.78
Anxiolytics	21.55	18.35	21.66	14.62	21.91	25.99	26.47	24.21	11.60	14.98	13.52
Antiepileptic	13.46	8.88	11.36	7.07	11.56	14.98	14.50	5.90	7.66	8.57	7.97
Sedatives	3.49	3.56	2.80	2.32	1.69	1.15	3.93	3.91	2.98	0.94	2.71
Antidepressants											
SSRI	20.40	63.37	27.15	12.60	30.74	24.28	22.89	18.81	6.65	9.06	24.45
SNRI	29.70	15.70	28.14	22.19	31.59	31.46	33.61	23.74	43.60	29.01	29.14
TCA	15.96	1.89	9.18	5.94	3.71	5.95	7.85	4.21	4.47	4.74	16.62
MAOi	0.81	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.28	0.03
Others	33.13	19.04	35.53	59.27	33.96	38.32	35.30	53.24	45.29	56.90	29.76

ECT, electroconvulsive therapy; APs, antipsychotics; SSRI, selective serotonin reuptake inhibitors; SNRI, serotonin and norepinephrine reuptake inhibitors; TCA, tricyclic antidepressants; MAOi, monoamine oxidase inhibitors

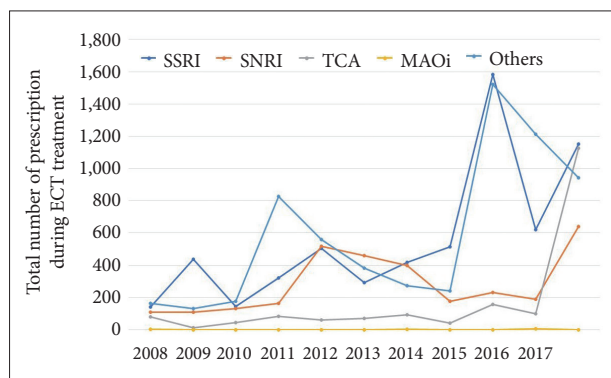


Figure 4. Types of antidepressants used while conducting ECT. SSRI, selective serotonin reuptake inhibitors; SNRI, serotonin and norepinephrine reuptake inhibitors; TCA, tricyclic antidepressants; MAOi, monoamine oxidase inhibitors; ECT, electroconvulsive therapy.

Type of medical facilities, insurance coverage, and inpatient/outpatient treatment

South Korea's healthcare delivery system operates in two phases: the first covers benefits from clinics as well as general and secondary hospitals, whereas the second focuses on tertiary hospitals. Accessing the second phase required a referral letter from the initial doctor. Clinics have fewer than 30 beds, general hospitals have 30 to 99 beds, and secondary hospitals have more than 100 beds with specific specialties and certified medical staff. Tertiary hospitals affiliated with medical schools or specialized institutions undergo more rigorous evaluations.¹⁵ In addition to the aforementioned healthcare delivery systems, medical institutions specifically established to provide extended care for hospitalized patients are termed nursing hospitals.¹⁶ A day hospital, considered a form of partial hospitalization in psychiatric treatment, serves as an intermediary between inpatient and outpatient care.¹⁷ In 2008, 98.50% of the ECT treatments were conducted in general, secondary, and tertiary hospitals. Although minor annual variations were observed, the predominant trend of ECT being administered primarily in institutions as large as or larger than general hospitals was consistently maintained. In 2018, ECT conducted in these institutions accounted for 99.00% of all ECTs (Table 4).

Medical coverage confirmed in the HIRA data takes two forms: regular NHI and medical benefits. The regular NHI operates as a social insurance system funded by subscribers' contributions and subsidies, whereas the medical benefits system functions as a public assistance system funded by public sources and general taxes, typically aiding individuals with low socioeconomic status.¹⁵ In 2008, the proportion of patients receiving medical benefits among the entire patients undergoing ECT was 0.00%. From 2009 to 2018, this percentage exhibited variability, reaching a nadir of 4.04% in 2012 and a zenith of 12.16% in 2009. In 2018, the proportion of medical

Table 4. Type of medical facilities where ECT is conducted and health insurance coverage of ECT patients

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Insurance coverage											
Regular NHI	200 (100.00)	195 (87.84)	200 (93.90)	222 (92.12)	261 (95.96)	219 (94.81)	269 (94.72)	266 (93.66)	310 (96.27)	376 (94.71)	470 (93.06)
Medical benefit	0 (0.00)	27 (12.16)	13 (6.10)	19 (7.88)	11 (4.04)	12 (5.19)	15 (5.28)	18 (6.34)	12 (3.73)	21 (5.29)	35 (6.93)
Type of medical facilities											
Tertiary hospital	130 (65.00)	139 (62.61)	144 (67.63)	163 (67.63)	200 (73.53)	171 (74.03)	219 (77.11)	213 (75.00)	224 (69.57)	277 (69.77)	336 (66.53)
Secondary hospital	52 (26.00)	53 (23.87)	48 (22.54)	55 (22.82)	56 (20.59)	49 (21.21)	57 (20.07)	62 (21.83)	83 (25.78)	92 (23.17)	94 (18.61)
General hospital	15 (7.50)	29 (13.06)	21 (9.86)	23 (9.54)	15 (5.51)	10 (4.33)	8 (2.82)	9 (3.17)	14 (4.35)	19 (4.79)	70 (13.86)
Nursing hospital	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	7 (1.76)	5 (0.99)
Clinics	3 (1.5)	1 (0.45)	0 (0.00)	0 (0.00)	1 (0.37)	1 (0.43)	0 (0.00)	0 (0.00)	1 (0.31)	2 (0.50)	0 (0.00)

Values are presented as number (%). ECT, electroconvulsive therapy; NHI, National Health Insurance

benefit beneficiaries was 6.93% (Table 4).

The HIRA database employs a structured form that categorizes patients into medical inpatients, medical outpatients, psychiatric inpatients, and psychiatric day hospital admissions. When an individual undergoes psychiatric inpatient or outpatient treatment at a general, secondary, or tertiary hospital with diverse specialties, the classification primarily falls into medical inpatient or outpatient settings. Psychiatry was identified separately using department codes. Conversely, in hospitals specializing in psychiatry, even if they surpass the size of the hospital in the healthcare delivery system, patients are classified as psychiatric inpatients. Daytime hospital admissions are coded using distinct code.¹⁸ The percentage of medical inpatients varied, reaching a peak of 98.50% in 2008 and a minimum of 87.39% in 2009. Until 2014, the proportion of medical outpatient cases fluctuated between 0.90% (2009) and 1.86% (2016), increasing to 4.53% in 2017 and 6.93% in 2018. The ratio of day hospital and psychiatric inpatient cases exhibited annual fluctuations, but did not demonstrate a discernible trend (Table 5).

DISCUSSION

We conducted an observational study among South Korean patients who underwent modified and simple ECT between 2008 and 2018. A consistent upward trajectory in the number of ECT cases was evident over the 10-year study period, with a remarkable 240% increase, from 0.405 to 0.974 per 10⁵ inhabitants. Notably, within the past decade, an increase in the proportion of ECT utilization has been observed among both younger and older populations. The increased prevalence of ECT in both the younger and older population segments may indicate an increasing acceptance of ECT as a secure and dependable treatment option across diverse age groups.

South Korea is rapidly becoming one of the oldest countries in the world, with the population aged 65 years or older accounting for 15.5% of the total population in 2019.¹⁹ Geriatric depression is also increasing with this demographic shift and is expected to pose a significant personal, familial, and public health burden in the future.²⁰ ECT has emerged as a secure and promising intervention for older adults, particularly in the context of severe depression.²¹ Acknowledged for its swift therapeutic onset, ECT exhibits favorable tolerability with contemporary techniques, mitigating conventional side effects.²² Its commendable safety profile, efficacy, and expeditious therapeutic outcomes position it as a valuable consideration, particularly when alternative treatments yield suboptimal results or present heightened risks.^{23,24} Innovations in administration techniques including unilateral electrode placement address fewer cognitive concerns, and ECT is a viable option for pa-

Table 5. Hospitalization and outpatient treatment during ECT treatment

Inpatient vs. outpatient	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Medical inpatient	197 (98.50)	194 (87.39)	199 (93.43)	220 (91.29)	260 (95.59)	218 (94.37)	269 (94.72)	265 (93.31)	305 (94.72)	363 (91.44)	451 (89.30)
Medical outpatient	3 (1.50)	2 (0.90)	1 (0.47)	3 (1.24)	2 (0.74)	1 (0.43)	3 (1.06)	3 (1.06)	6 (1.86)	18 (4.53)	35 (6.93)
Day hospital	0	17 (7.66)	9 (4.23)	12 (4.98)	5 (1.84)	6 (2.60)	5 (1.76)	8 (2.82)	5 (1.55)	8 (2.02)	8 (1.58)
Psychiatry inpatient	0	9 (4.05)	4 (1.88)	6 (2.49)	5 (1.84)	6 (2.60)	7 (2.46)	8 (2.82)	6 (1.86)	8 (2.02)	11 (2.18)

Values are presented as number (%). ECT, electroconvulsive therapy

tients who exhibit limited responsiveness to psychiatric medications.⁶ Furthermore, it serves as an effective maintenance therapy to prevent the recurrence of depressive episodes.²⁵

The American Academy of Child and Adolescent Psychiatry recommends ECT for adolescents experiencing treatment-resistant depression, self-injurious behavior, and multiple other indications.^{26,27} ECT in minors has been considered safe regarding adverse effect under certain circumstances.²⁸ Despite these results, negative perceptions toward ECT for adolescents among psychiatrists were prevalent in studies conducted in the United States, the United Kingdom, and Australia.²⁹ In a study examining the current utilization of ECT in adolescents in the United States, concerns were raised about its appropriateness compared to the expected effects.²⁷ Given the low utilization rate of ECT, it is possible that appropriate utilization may not be achieved in Korea because of the negative perception of ECT among adolescent patients, as observed in previous studies in other countries. However, the rising number of ECT cases among minors is likely associated with a reduction in negative perceptions of ECT and an increase in adolescents exhibiting self-harm and suicidality.³⁰

In this study, a similar upward trend was found in both sexes, with a 150.00% increase in males and a 153.16% in females from 2008 to 2018. Additionally, examining the sex ratio for each year from 2008 to 2018, there was an average of 1.60 times more females than males. A study examining the demographic features of patients undergoing ECT in the United States showed a sex ratio (female, 62.3%) comparable to the findings of this study.³¹ A possible explanation for this result is that females have twice the prevalence of depression as males.^{32,33} Bipolar disorder, which can be treated with ECT, has a higher prevalence in women than in men.^{34,35} In previous studies, the sex interaction effects on clinical variables related to ECT were investigated, confirming that ECT was equally effective in women and men.³⁶

ECT utilization has increased in affective disorder treatments during the investigation period, comprising 46.50% of the total ECTs in 2018. This contrasts with 2008, when more than half (52.75%) of ECTs were used to treat psychotic disorders. Although psychotic disorders still comprise the majority of ECT treatments, the gradual and significant increase in ECT conducted for depression highlights the importance of ECT in treating treatment-resistant depression. Analyzing the trends in various countries revealed that ECT is predominantly utilized for schizophrenia and psychotic disorders in Asian nations with constrained medical infrastructure, such as China and India.³⁷ Conversely, in developed Western countries, ECT is predominantly employed to treat affective disorders, particularly depressive disorders.³⁸ Based on the findings of this study, the shift in the diagnostic rate of patients undergo-

ing ECT appears to align with the evolving clinical trends of ECT in South Korea, mirroring the trends observed in developed countries over time.

While the use of ECT consistently increased throughout the study period, it is noteworthy that the identified prevalence of ECT was notably lower than that reported in other countries. A composite event rate of 16.9 per 10⁵ inhabitants was documented in a meta-analysis involving 12 countries: the United States, United Kingdom, Belgium, Norway, South Africa, Asia, Thailand, Hong Kong, Poland, Russia, Spain, Ireland, Scotland, and Wales.³ The reduced use of ECT may be attributed to inadequate mental health literacy. Globally, the 12-month treatment rate for depression is approximately 50% in high-income countries and 20% in lower-middle-income countries.³⁹ Meanwhile, findings from the 2021 National Mental Health Survey of Korea indicate that only 23.8% of individuals diagnosed with depressive disorders availed themselves of psychiatric treatment in South Korea.⁴⁰ Compared to the global treatment rate, the overall rate of depressive disorder treatment in South Korea appears low, especially when considering the country's developed economic status⁴¹ and the accessibility of medical facilities covered by the NHL.¹⁵ Moreover, in an investigation conducted by Rim et al.,⁴⁰ a substantial number of patients reported that their decision to forego psychiatric treatment was rooted in the belief that they could independently manage their symptoms.

The stigma associated with ECT has long been reported as one of the greatest contributors to its underutilization, despite its demonstrated efficacy and safety.⁴² Furthermore, this stigma is suggested to worsen with limited experience, and further use of and experience with ECT have been suggested to have a positive impact on attitudes toward ECT. In addition, the nomenclature of ECT has been suggested to compound its stigma due to its containing "electricity" and "convulsion," which may be worse in South Korea, since ECT is often mistranslated to "electro-shock therapy."⁴³ Thus, limited facilities, experience, familiarity, and nomenclature may compound the stigma of ECT in South Korea. However, we postulate that the upward trend in prevalence is a positive sign that more specialists and patients are becoming familiar with ECTs.

Regarding trends in the use of different types of medications, the use of antidepressants and atypical antipsychotics has increased during this period, while that of typical antipsychotics, anxiolytics, and antiepileptic decreased. The increase in both the number and percentage of individuals with affective disorders, particularly depression, seems to contribute to the increased prescription of antidepressants for patients undergoing ECT. The diminishing utilization of typical antipsychotics in patients with schizophrenia observed globally, including in Korea, owing to their adverse effect profile, is similarly

reflected in the ECT patient population, as indicated by this study.⁴⁴ Benzodiazepines, which comprise the majority of anxiolytics and antiepileptic medications, have long been known to increase seizure thresholds and inhibit seizure propagation; thus, they are not recommended during ECT treatment.⁴⁵ The decrease in the use of anxiolytics is in line with current knowledge on effective ECT and may reflect an improved awareness of proper ECT management in South Korea. In terms of the types of antidepressants used during ECT, TCAs showed a steady decline, but other medications such as SSRIs, SNRIs, and MAOis did not reveal a significant trend.

Along with the overall increase in ECT treatments, the settings in which ECT was conducted have expanded significantly. In 2008, the vast majority (98.50%) of ECTs were conducted among hospital inpatients. This decreased to 89.30% in 2018, and more ECT sessions were conducted in outpatient settings, day hospitals, and psychiatric clinics. Outpatient protocols and guidelines have been established in various countries, making ECT a routine treatment conducted in non-hospital settings.⁴⁶ This may reflect the acceptance of ECT as a viable and safe treatment option not only among patients, but also among medical professionals, including psychiatrists, in South Korea.

South Korea faces a substantial challenge with one of the highest suicide rates among developed countries, posing a significant social and mental health concern.⁴⁷ Given the effectiveness of ECT in treating treatment-resistant depression, especially in the context of a high suicide rate,⁴⁶ and evidence suggesting its potential to reduce suicidality, there is a plausible avenue to explore the role of ECT in lowering suicide rates. While previous studies on the impact of ECT on suicide rates have yielded mixed results,⁴⁸⁻⁵⁰ recent research using Swedish registry data, meticulously corrected for confounding variables, demonstrated a significant reduction in suicide attempts with ECT.⁵¹ Given the current underutilization of ECT, there is a noteworthy opportunity to consider its expanded use, particularly in patients with elevated suicidality.

This study has certain limitations, including the inability to explore various clinical correlates associated with ECT, such as the number of ECT sessions per patient, stimulation intensity, coexisting diagnoses, and whether ECT was administered as an acute or maintenance treatment. Furthermore, although the study provided a decade-long overview of ECT use in South Korea, it did not delve into the variables that could determine the post-ECT prognosis of patients. The analysis only covered data up to 2018, thus lacking information on ECT utilization during the COVID-19 pandemic, which has reportedly influenced ECT rates globally.^{52,53} Future research should address these limitations, investigating recent trends through a comprehensive exploration of clinical factors and

considering the impact of the pandemic on ECT practices.

Despite its limitations, this study is significant because it revealed changes in the prolonged utilization rates of ECT in South Korea. The assessment of ECT appropriateness in South Korea, considering comparisons with other countries and the distinctive features of Korea's healthcare system, highlights significantly low ECT usage rates despite a decade-long increase. Given the persistently low ECT usage rate, there is ample room to increase its use in South Korea. Recognizing the potential for expanded ECT utilization, the authors suggest that ECT is a viable solution to urgent social and mental health challenges, including high suicide rates.

In conclusion, ECT in South Korea from 2008 to 2018 have shown a significant increase, more than doubling the number of cases, particularly among the younger and older populations. Additionally, there has been a shift toward more outpatients and day clinics conducting ECTs. Although ECT remains a third-line treatment option in many treatment guidelines, the results of this study showed that ECT is being more widely used across various settings. Given the prevalence of treatment-resistant mental disorders and the rising geriatric depression population in South Korea, ECT will likely become an important treatment option in the future. However, the current ECT utilization rate in South Korea is still significantly lower than that in other countries. Low utilization rates may have arisen from the low psychiatric literacy and stigma associated with ECT. We believe that the rising trend of ECT treatments in the past decade reflects reduced stigma, improved psychiatric literacy, higher accessibility, and greater familiarity with ECT. There is still much room for ECT growth in the country.

Supplementary Materials

The online-only Data Supplement is available with this article at <https://doi.org/10.30773/pi.2024.0070>.

Availability of Data and Material

The datasets generated and/or analyzed in the current study are not publicly available owing to Data Protection Laws and Regulations in Korea. However, the final analysis results are available from the corresponding authors upon reasonable request.

Conflicts of Interest

Changsu Han, a contributing editor of the *Psychiatry Investigation*, was not involved in the editorial evaluation or decision to publish this article. All remaining authors have declared no conflicts of interest.

Author Contributions

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Supplementary Table 1. Categorization of concomitant psychotropic medication

Type of psychotropics	Generic Name[ATC code]
Typical antipsychotics	chlorpromazine[N05AA01], perphenazine[N05AB03], haloperidol[N05AD01]
Atypical antipsychotics	ziprasidone[N05AE04], clozapine[N05AH02], quetiapine[N05AH04], olanzapine[N05AH03], amisulpride[N05AL05], sulpiride[N05AL01], blonanserin[N05AX*], risperidone[N05AX08], zotepin[N05AX11], aripiprazole[N05AX12], paliperidone[N05AX13]
Antiepileptics or mood stabilizers**	lithium[N05AN01], carbamazepine[N03AF01], valproic acid***[N03AG01], oxcarbazepine[N03AF02], lamotrigine[N03AX09], topiramate[N03AX11]
Anxiolytics	diazepam[N05BA01], chlordiazepoxide[N05BA02], lorazepam[N05BA06], bromazepam[N05BA08], clobazam[N05BA09], alprazolam[N05BA12], ethyl loflazepate[N05BA18], etizolam[N05BA19], clotiazepam[N05BA21], tofisopam[N05BA23], buspirone[N05BE01]
Sedatives	triazolam[N05CD05], zolpidem[N05CF02], flunitrazepam[N05CD03], flurazepam[N05CD01]
Antidepressants	
SSRI	fluoxetine[N06AB03], escitalopram[N06AB10], fluvoxamine[N06AB08], paroxetine[N06AB05], sertraline[N06AB06]
SNRI	duloxetine,[N06AX21], venlafaxine[N06AX16], desvenlafxine[N06AX23], milnacipran[N06AX17]
TCA	Imipramine[N06AA02], amitriptyline[N06AA09], nortriptyline[N06AA10], doxepin[N06AA12], clomipramine[N06AA04], amoxapine[N06AA17], dosulepin[N06AA16], quinupramine[N06AA23]
MAOi	moclobemide[N06AG02]
Other ADs	trazodone[N06AX05], mirtazapine[N06AX11], bupropion[N06AX12], vortioxetine[N06AX26], agomelatine[N06AX22], tianeptine[N06AX14]

*within the South Korean ATC code system, the N05AX category is designated for “Other antipsychotics”. It has been verified that blonanserin is the sole antipsychotic medication encompassed within this classification; **mood stabilizers encompass lithium, which assorted into the N05AN subcode, along with antiepileptic medications that are used clinically in the treatment of bipolar disorder, categorized under N03A; ***divalproex sodium and sodium valproate are all categorized into valproic acid. ATC, Anatomic Therapeutic Chemical classification; SSRI, selective serotonin reuptake inhibitors; SNRI, serotonin and norepinephrine reuptake inhibitors; TCA, tricyclic antidepressants; MAOi, monoamine oxidase inhibitors; AD, antidepressant