



Patterns of the Diagnosis Prevalence of Psychiatric Disorders in the Population Aged 0–18 Years Based on the Nationwide Insurance Sample Data

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Objectives: This study aimed to examine the trend in diagnostic prevalence of psychiatric disorders in children and adolescents.

Methods: Individuals aged 0–18 years were included in the study based on the National Health Insurance Claims Data. To investigate the trends in diagnosis and diagnostic prevalence of psychiatric disorders reflecting the decrease in the birth rate, data were analyzed from 2010 as a reference year to 2015.

Results: The number of patients diagnosed with psychiatric disorder decreased annually, from 23,412 on 2010 to 18,821 on 2015. The most common disorder was hyperkinetic disorder in male and depressive episode in female. Although there was no significant change in overall diagnostic prevalence rate of psychiatric disorders, age groups <10 years and some disorders had significant changes in prevalence rate. This study classified the diagnostic prevalence by age into two unique patterns: group in which the diagnosis rate increases with age and group in which the diagnosis rate peaks at a certain age and then decreases.

Conclusion: Diagnostic prevalence of psychiatric disorders was different according to age and sex. These patterns should be reflected in the formulation of policies related to mental health and in medical practice for pediatric patients. It is urgent to identify how these patterns change in young adults.

Key Words: Psychiatric disorder; Diagnosis prevalence; Adolescents; Childhood; Pattern; Trend.

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INTRODUCTION

A considerable number of psychiatric disorders in adults begin to develop in childhood or adolescence [1]. That is, behavioral and emotional problems in the preschool period persist until subsequent periods [2]. A study that followed children aged 9–13 years until 16 years confirmed the continuity of psychiatric disorders [3]. Neurodevelopmental disorders, such as autism spectrum disorder (ASD) or attention-deficit/hyperactivity disorder (ADHD) may also begin in childhood and persist throughout life, further highlighting the need for a survey on the prevalence of psychiatric disorders in children, including preschoolers, and adolescents [4].

The Zürich Epidemiological Study of Child and Adolescent Psychopathology (ZESCAP), which was conducted on 1,964 individuals aged 7–16 years, reported a 6-month men-

tal disorder prevalence of 22.5% based on parent report or self-report form such as the Child Behavior Checklist and Youth Self-Report [5]. The British Child and Adolescent Mental Health Survey examined the prevalence of mental disorders in 10,438 individuals aged 5–15 years using the Development and Well-Being Assessment and reported a prevalence rate of 9.5% [6]. In a study on 1,251 individuals aged 7–14 years in Brazil, the prevalence of mental disorders was 12.7% [7]. As shown here, despite the growing volume of epidemiological study findings on children, the results differ substantially by methodology and target population, and data reflective of the actual clinical setting is limited.

Korea runs a national health insurance system, and care costs claimed by healthcare facilities are reviewed by the Health Insurance Review & Assessment Service (HIRA). Approximately 97% of the entire population are enrolled in the National Health Insurance (NHI), and the remaining 2–3% of the population are beneficiaries of medical aid, whose healthcare costs are paid by the government [8]. The NHI Claims Data (NHICD) is an integration of the data that has

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been reviewed by the HIRA and contains information about patient's general characteristics, diagnosis, history of care, and features of healthcare facility, with 99% of the data computerized [8]. Therefore, the NHICD is a nationally representative data that feature good objectivity and efficiency.

In the present study, the pediatric patient sample data were obtained from the NHICD for analysis to select common psychiatric disorders in the population aged <19 years and examine the trend in the change of diagnostic prevalence and sex- and age-specific differences to complement for the limitations of existing studies on the prevalence of psychiatric disorders in children and adolescents.

METHODS

Study population

The study population is the HIRA pediatric patient sample (HIRA-PPS) for 6 years from 2010 to 2015. The sample size for the HIRA-PPS consisted of 10% of the entire pediatric population, which was 1,047,802 in 2010 and 932,657 in 2015, with an annual average of 989,016 (Supplementary Table 1 in the online-only Data Supplement). Based on the authors' experience of the previous analysis of 2010 NHICD [9], the present study was set from 2010. As the Korean Standard Classification of Diseases (KCD) [10] underwent a seventh revision in 2016, the study period was set to 2010–2015. The KCD is based on the International Classification of Diseases [11].

The HIRA-PPS consists of statistically sampled, deidentified data from the NHICD and contains information on the claims for cares made for a period of one year from the date of care initiation. The data were established via patient-unit stratified hierarchical sampling according to sex and age groups of all patients who utilized healthcare service during the 1-year period and contained information about the details of their care and prescriptions [8]. These data are provided upon submission of a data request form available on the HIRA website along with a written promise regarding the use of the data and a small fee. However, as the HIRA-PPS data is extracted from the insurance claims by year, it is not appropriate for longitudinal studies that follow-up on a group of patients over several years [8].

From individuals who received outpatient or inpatient care from a primary, secondary, or tertiary mental healthcare service institutions, those aged <19 years who had been assigned F codes from F00 to F99 for psychiatric disorder in the KCD [10] were extracted for analysis. To enhance the diagnostic accuracy, patients diagnosed with a psychiatric disorder exclusively by psychiatrists were included in the analysis. As previous studies that utilized the NHICD [9,12] set their study population to those aged <19 years, the study

population was also set to those aged <19 years to enable comparison with the authors' previous studies. Both the main diagnosis and subdiagnosis were included, and the diagnoses were classified by the KCD [10].

Methods

To compare with the authors' previous studies that utilized the NHICD [9,12], the study population was divided into 3-year units to analyze the prevalence of F code by year, age, and sex. The year 2010, which is the first year of data for the study population, was set as the reference point to compare yearly trends. This study was approved by the Institutional Review Board of Kyunghee University Hospital (KMC IRB 2017-07-029).

Statistical analysis

The changes in the prevalence of psychiatric disorders from 2010 to 2015 by age, sex, and insurance type were examined based on the rate of increase or decrease in the annual average and significance of the trends using a trend test. The prevalence rate was converted to a percentage of the F code diagnosed by psychiatrists per 1,000 population included in each group as designated by Statistics Korea.

In addition, for F codes with a prevalence rate of $\geq 1\%$, yearly changes in their prevalence by sex were analyzed using a trend test.

The data were analyzed using the SAS 9.4 software (SAS Institute Inc., Cary, NC, USA), R 3.5.1 (<https://cran.r-project.org>), and yearly and sex-specific diagnostic prevalence rates were graphed using "gridExtra," "ggplot2," "plyr," and "gtools" packages. The trend test was performed by applying the "lm" package. The statistical significance was set at 0.05 for all analyses.

RESULTS

Of patients aged <19 years who received outpatient or inpatient care in psychiatric healthcare institutions as shown in the HIRA-PPS data, an annual average of 22,150 patients, with 23,412 in 2010 and 18,821 in 2015, were diagnosed with psychiatric disorders (F00–99) (Supplementary Table 2 in the online-only Data Supplement).

There were 14 psychiatric disorders with a diagnostic prevalence of $\geq 1\%$ in the study population, written in the order of the following codes: bipolar affective disorder (F31); depressive episode (F32); other anxiety disorders (F41); reaction to stress and adjustment disorders (F43); somatoform disorders (F45); other neurotic disorders (F48); mental retardation, mild (F70); specific developmental disorders of speech and language (F80); pervasive developmental disorder

Table 1. High ranked psychiatric disorders as standard of diagnosis prevalence in the year 2010

F-code	Diagnosis	Male		Female		Total	
		Diagnosis prevalence	Weighted % of population	Diagnosis prevalence	Weighted % of population	Diagnosis prevalence	Weighted % of population
F90	Hyperkinetic disorders	6525	11.46	1797	3.46	8322	7.65
F32	Depressive episode	2148	3.77	1810	3.49	3958	3.64
F41	Other anxiety disorders	1872	3.29	1779	3.43	3651	3.36
F43	Reaction to severe stress, and adjustment disorders	1052	1.85	1104	2.13	2156	1.98
F95	Tic disorders	1723	3.03	351	0.68	2074	1.91
F93	Emotional disorders with onset specific to childhood	1209	2.12	746	1.44	1955	1.80
F45	Somatoform disorders	796	1.40	918	1.77	1714	1.58
F98	Other behavioural and emotional disorders with onset usually occurring in childhood and adolescence	817	1.44	472	0.91	1289	1.18
F80	Specific developmental disorders of speech and language	908	1.60	264	0.51	1172	1.08
F84	Pervasive developmental disorders	948	1.67	188	0.36	1136	1.04
F70	Mild mental retardation	715	1.26	340	0.66	1055	0.97
F48	Other neurotic disorders	430	0.76	512	0.99	942	0.87
F91	Conduct disorders	685	1.20	250	0.48	935	0.86
F31	Bipolar affective disorder	374	0.66	229	0.44	603	0.55

der (F84); hyperkinetic disorders (F90); conduct disorders (F91); emotional disorders with onset specific to childhood (F93); tic disorders (F95); and other behavioral and emotional disorders with onset usually occurring in childhood and adolescence (F98) (Supplementary Table 3 in the online-only Data Supplement). In the reference year of 2010, the highest diagnostic prevalence for the entire subjects including both sexes was observed in F90, followed by F32, F41, F43, and F95 (Table 1). The diagnostic prevalence distribution differed between the two sexes, with the most common diagnosis being F90, followed by F32, F41, F95, and F93, in male but F32, followed by F90, F41, F43, and F45, in female.

While the number of individuals diagnosed with a psychiatric disorder declined over the years, the percentage of diagnosis in the entire population did not change statistically significantly (Table 2). However, this rate was on a significant decline only in the female medical aid beneficiary group. By age, there was a significant declining trend in the ≤9 years group (Table 2). Regarding changes in the annual diagnostic rates, there was a significant increasing trend for codes F31, F32, F41, F80, F84, and F95 in both male and female (Table 3). In male, there was a significant increasing trend also for code F91, but the diagnostic rate for F48 and F98 significantly decreased. In female, the diagnostic rate for F93 and F98 significantly decreased. When compared between sexes, the increasing trend for F31 and F84 was stronger in male than in female.

By age group, there was a fixed, unique pattern for each psychiatric disorder (Figs. 1 and 2). Two different patterns were detected: 1) the diagnosis rate increases with age for F31, F32, F41, F43, F45, and F48 in both sexes; 2) the diagnosis rate peaks at a certain age and then decreases, which in turn can be subdivided into three subgroups: 2-1) peaks at 4–6 years and decreases rapidly for F80, F84, and F98; 2-2) peaks at 7–9 years and decreases for F70, F90, F93, and F95; and 2-3) peaks at 13–15 years for F91. Exceptionally, for F98, the diagnosis rate peaks at 4–6 years or 7–9 years in male.

DISCUSSION

The results of this study showed that there were no significant changes in the diagnostic prevalence for psychiatric disorders. Particularly, the diagnostic prevalence of hyperactivity disorder did not change significantly. This is contradictory to the argument that the diagnosis of ADHD is sharply increasing annually and that medications are misused and abused in children [13]. This is also in contrast with the result of a study on the long-term incidence rate of ADHD that the number of diagnoses is continuously increasing [14]. In this study, the authors observed that the diagnosis rate has significantly decreased in the ≤9 years group annually. In fact, the ADHD diagnostic rate or drug

therapy rate in Korea is markedly lower than the anticipated prevalence [15], so a multilateral analysis is needed for the low number of diagnosis and therapeutic exposure. Certain pediatric neurodevelopmental disorders, such as ASD and ADHD, show early onset, which highlights the pressing need to analyze the structural problem underlying the absence of change in the diagnostic rate, as a delay of early diagnosis raises concerns for exacerbation of symptoms and secondary complications [16].

In this study, the diagnosis of bipolar affective disorder, depressive episode, other anxiety disorders, specific developmental disorders of speech and language, pervasive developmental disorder, and tic disorder increased over the years in both male and female. While the increase in the diagnostic rate of bipolar affective disorder may be reflective of an actual increase in the diagnosis, it may also be associated with the change in the insurance payout criteria pertaining to the prescription of psychotropics used for ADHD or ASD [8,16].

Table 2. Trend analysis of psychiatric diagnosis prevalence according to age and years during 2010–2015

Types	Prevalence (the number of people per 1000)						Trend test		
	2010	2011	2012	2013	2014	2015	Trend*	SE	p-value
Total									
Male	25.38	26.58	28.34	26.62	24.62	23.42	-0.497	0.389	0.2709
Female	17.27	17.08	18.86	16.93	15.99	15.37	-0.420	0.242	0.1574
Total	21.51	22.04	23.80	21.96	20.46	19.54	-0.470	0.312	0.2072
Medical insurance									
Male	23.62	24.83	26.48	24.88	22.88	21.68	-0.490	0.381	0.2677
Female	15.57	15.47	17.23	15.47	14.53	13.95	-0.362	0.238	0.2028
Subtotal	19.78	20.36	22.05	20.36	18.86	17.95	-0.438	0.307	0.2263
Medical aid									
Male	1.76	1.75	1.86	1.74	1.74	1.74	-0.007	0.012	0.6036
Female	1.71	1.61	1.63	1.46	1.46	1.42	-0.059	0.010	0.0047
Subtotal	1.73	1.68	1.75	1.61	1.61	1.58	-0.032	0.010	0.0374
0–3 years									
Male	6.32	7.23	6.27	6.35	6.17	5.25	-0.242	0.117	0.1081
Female	3.72	3.98	3.34	3.01	2.90	2.69	-0.249	0.049	0.0069
Subtotal	5.06	5.65	4.85	4.72	4.58	4.00	-0.247	0.078	0.0336
4–6 years									
Male	19.69	19.67	19.12	19.15	17.69	17.56	-0.473	0.095	0.0076
Female	10.73	10.33	9.93	8.88	7.81	7.54	-0.702	0.068	0.0005
Subtotal	15.37	15.16	14.67	14.17	12.90	12.70	-0.590	0.072	0.0012
7–9 years									
Male	34.49	35.44	38.46	34.24	30.02	27.97	-1.516	0.679	0.0894
Female	15.45	14.86	14.83	13.03	11.72	10.52	-1.024	0.134	0.0016
Subtotal	25.37	25.57	27.09	24.02	21.17	19.51	-1.301	0.416	0.0353
10–12 years									
Male	31.27	33.17	35.80	33.45	30.59	29.54	-0.535	0.547	0.3830
Female	13.98	14.43	16.62	14.24	13.37	12.78	-0.331	0.310	0.3462
Subtotal	23.02	24.22	26.63	24.25	22.33	21.47	-0.451	0.429	0.3524
13–15 years									
Male	30.16	32.17	36.12	33.51	30.88	27.45	-0.572	0.741	0.4833
Female	23.07	22.08	26.73	23.16	21.56	20.98	-0.445	0.499	0.4231
Subtotal	26.79	27.36	31.63	28.57	26.42	24.36	-0.515	0.599	0.4380
16–18 years									
Male	28.69	30.38	33.66	33.07	32.14	32.94	0.742	0.349	0.1008
Female	32.27	32.34	36.36	34.19	33.79	33.62	0.255	0.379	0.5376
Subtotal	30.36	31.30	34.93	33.60	32.93	33.27	0.517	0.356	0.2203

*annual average growth rate. SE: standard error

Table 3. Trend analysis of prevalence rate for each psychiatric diagnosis under 19 years old

F-code	Male prevalence (the number of people per 1000)										Female prevalence (the number of people per 1000)							
	2010	2011	2012	2013	2014	2015	Trend*	SE	p-value	2010	2011	2012	2013	2014	2015	Trend*	SE	p-value
	F31	0.66	0.81	1.30	1.36	1.62	1.75	0.23	0.02	0.0007	0.44	0.51	0.90	0.90	0.89	1.09	0.12	0.03
F32	3.77	3.82	4.94	4.79	4.23	4.53	0.14	0.11	0.2792	3.49	3.48	4.74	4.17	3.95	3.95	0.09	0.12	0.4840
F41	3.29	3.88	4.99	4.92	4.42	4.25	0.18	0.15	0.2834	3.43	3.61	4.48	4.42	4.16	4.23	0.16	0.08	0.1337
F43	1.85	1.96	2.17	1.72	1.78	1.51	-0.08	0.05	0.1675	2.13	2.05	2.36	1.93	1.95	1.62	-0.09	0.05	0.1151
F45	1.40	1.29	1.35	1.44	1.20	1.07	-0.05	0.03	0.1152	1.77	1.73	1.85	1.76	1.62	1.60	-0.04	0.02	0.1216
F48	0.76	0.81	0.77	0.72	0.68	0.61	-0.03	0.01	0.0235	0.99	1.00	1.06	0.97	1.00	0.82	-0.03	0.02	0.1966
F70	1.26	1.33	1.44	1.24	1.11	1.26	-0.03	0.03	0.3946	0.66	0.69	0.69	0.61	0.62	0.57	-0.02	0.01	0.0632
F80	1.60	1.74	1.78	1.98	1.92	1.91	0.07	0.02	0.0292	0.51	0.56	0.56	0.64	0.64	0.67	0.03	0.01	0.0036
F84	1.67	1.93	1.99	2.10	2.21	2.35	0.13	0.01	0.0006	0.36	0.43	0.43	0.51	0.51	0.57	0.04	0.00	0.0007
F90	11.46	12.28	13.45	12.33	11.15	10.63	-0.25	0.24	0.3597	3.46	3.59	4.04	3.56	3.29	3.29	-0.06	0.07	0.3979
F91	1.20	1.26	1.64	1.55	1.44	1.49	0.05	0.04	0.2039	0.48	0.42	0.57	0.48	0.46	0.47	0.00	0.01	0.9557
F93	2.12	2.57	2.70	2.34	1.99	1.86	-0.10	0.07	0.2526	1.44	1.52	1.64	1.27	1.05	1.02	-0.11	0.04	0.0469
F95	3.03	3.13	3.71	3.59	3.57	3.19	0.06	0.07	0.4725	0.68	0.77	0.83	0.81	0.79	0.84	0.02	0.01	0.0804
F98	1.44	1.57	1.66	1.46	1.31	1.14	-0.07	0.03	0.1139	0.91	0.90	0.95	0.79	0.68	0.65	-0.06	0.02	0.0169
Other	7.67	7.78	8.47	7.94	7.37	7.58	-0.06	0.10	0.5479	5.61	5.38	6.20	5.57	5.57	5.48	-0.02	0.08	0.8041

*annual average growth rate. SE: standard error. F-codes: F31=bipolar affective disorder, F32=depressive episode, F41=other anxiety disorders, F43=reaction to severe stress, and adjustment disorders, F45=somatiform disorders, F48=other neurotic disorders, F70=mild mental retardation, F80=specific developmental disorders of speech and language, F84=pervasive developmental disorders, F90=hyperkinetic disorders, F91=conduct disorders, F93=emotional disorders with onset specific to childhood, F95=tic disorders, F98=other behavioural and emotional disorders with onset usually occurring in childhood and adolescence

The analysis of Korea's NHICD from 2008 to 2015 showed that the annual diagnostic rate of ASD increased from 5.04 (per 100,000 individuals) to 10.97 [16]. In the US National Health Interview Survey, the prevalence of ASD increased

from 1.1% in 2009 to 2.5% in 2017 [4]. The reasons for the increasing ASD diagnostic rate may include the broader diagnostic criteria for ASD than pervasive developmental disorder, increased awareness of the disease among experts and

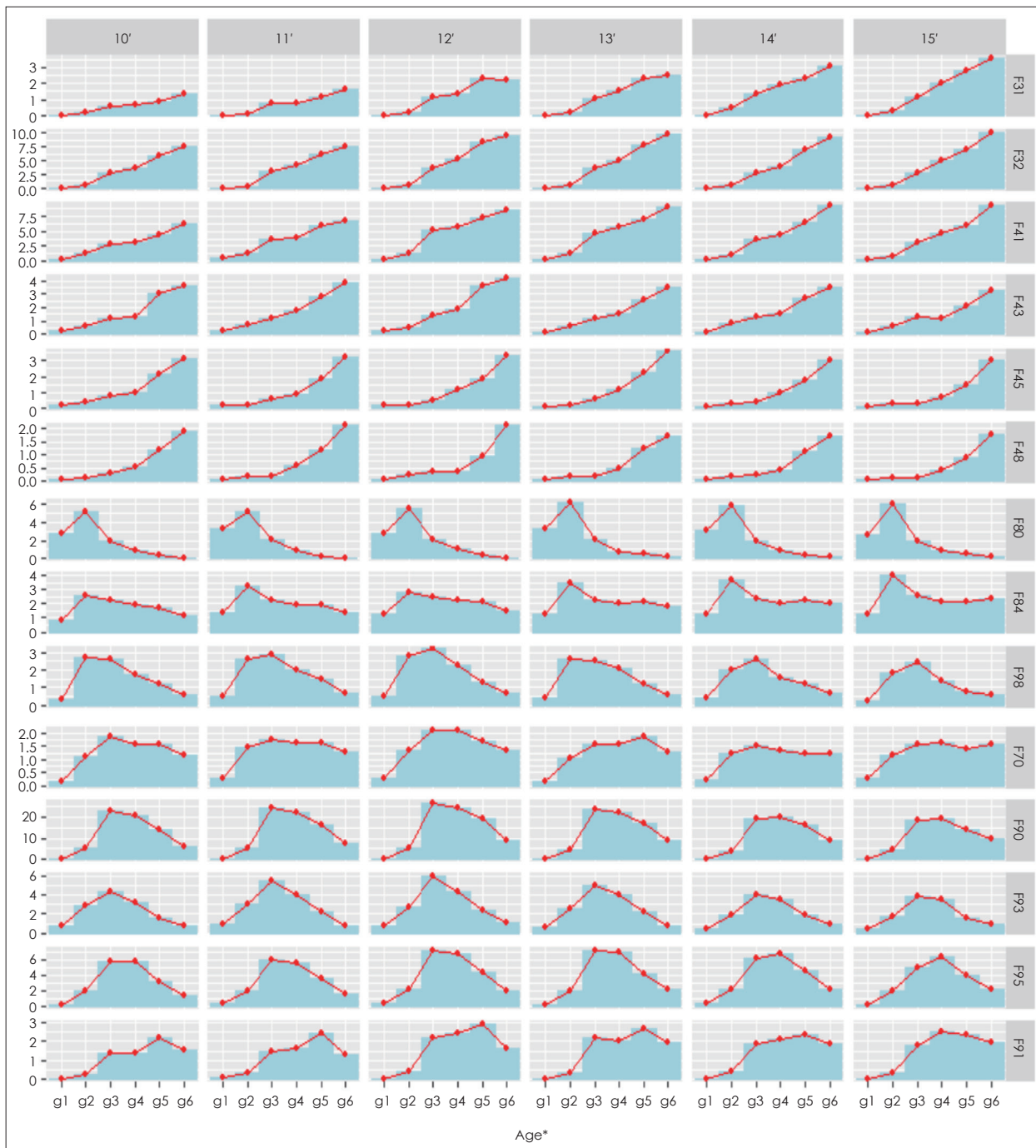


Fig. 1. Characteristics in the diagnosis prevalence of psychiatric disorders in males according to age during 2010–2015. *Age: g1=0–3 years old, g2=4–6 years old, g3=7–9 years old, g4=10–12 years old, g5=13–15 years old, g6=16–18 years old. F-codes; F31=bipolar affective disorder, F32=depressive episode, F41=other anxiety disorders, F43=reaction to severe stress, and adjustment disorders, F45=somatoform disorders, F48=other neurotic disorders, F70=mild mental retardation, F80=specific developmental disorders of speech and language, F84=pervasive developmental disorders, F90=hyperkinetic disorders, F91=conduct disorders, F93=emotional disorders with onset specific to childhood, F95=tic disorders, F98=other behavioural and emotional disorders with onset usually occurring in childhood and adolescence.

parents, and increased development of early intervention services for these children [4]. In Korea, the reason for the increase in the prevalence of specific developmental disorders of speech and language may be attributable to the

vouchers for families of children with disability [17]. Thus, this may be due to the launching of vouchers for developmental rehabilitation service in February 2009 and vouchers for speech-language therapy service in August 2010 [17]. Be-

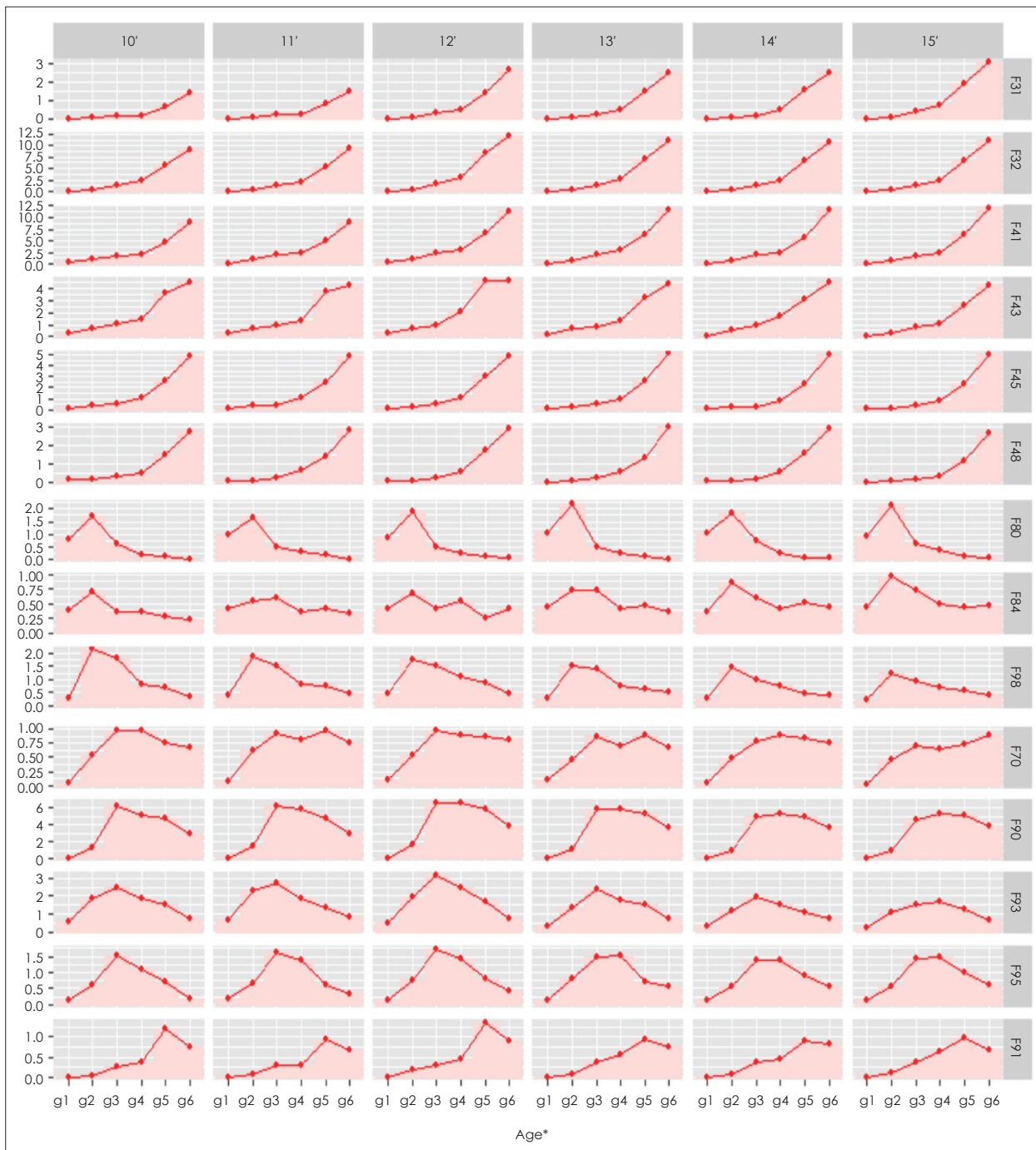


Fig. 2. Characteristics in the diagnosis prevalence of psychiatric disorders in females according to age during 2010–2015. *Age; g1=0–3 years old, g2=4–6 years old, g3=7–9 years old, g4=10–12 years old, g5=13–15 years old, g6=16–18 years old. F-codes; F31=bipolar affective disorder, F32=depressive episode, F41=other anxiety disorders, F43=reaction to severe stress, and adjustment disorders, F45=somatoform disorders, F48=other neurotic disorders, F70=mild mental retardation, F80=specific developmental disorders of speech and language, F84=pervasive developmental disorders, F90=hyperkinetic disorders, F91=conduct disorders, F93=emotional disorders with onset specific to childhood, F95=tic disorders, F98=other behavioural and emotional disorders with onset usually occurring in childhood and adolescence.

cause people consider the diagnosis of a mental disorder as a stigma, there are cases in which parents seek treatment under the code as R62, delayed milestone, and R47, speech disturbance not elsewhere classified, which increases the possibility that the actual prevalence of specific developmental disorders of speech and language and pervasive developmental disorder may be higher [17].

A 2005 Korean pediatric prevalence report for psychiatric disorders [18] showed the order of prevalence as ADHD, tic disorders, and anxiety disorders, but a recent study reported that other anxiety disorders and depressive episodes had the highest diagnostic rate in late adolescence and early female adulthood [19]. In a study on the prevalence of pediatric mental disorders in Taiwan, which runs a national health insurance system similar to that of Korea, the lifetime prevalence was the highest for anxiety disorder at 15.2%, followed by ADHD, sleep disorder, and tic disorder [20]. In the present study, the increasing trends of bipolar affective disorder and pervasive developmental disorder were stronger in male than in female. While the result for pervasive developmental disorder is similar to that observed in previous studies, the result that the increasing trend in bipolar affective disorder was stronger in male than in female differs from the findings of a community-based study, where most trends were consistent between male and female [3]. As previously mentioned, this may be related to the increasing use of psychotropics prescribed to patients with ASD as a result of an increase in the diagnostic rate of ASD [9].

The authors identified a characteristic pattern in the distribution of diagnostic prevalence by age. There were two patterns: 1) continuous increase in diagnostic rate with age and 2) peaks at a certain age and decrease. First, the diagnosis rate increases continually with advancing age in bipolar affective disorder (F31), depressive episode (F32), other anxiety disorders (F41), reaction to stress and adjustment disorder (F43), and somatoform disorders (F45). In the present study, depressive episode increases with increasing age regardless of sex, particularly after the age of 13 years. In the Quebec Child Mental Health Survey (QCMHS) conducted on children and adolescents aged 6–14 years, depressive disorder was more prevalent in younger children than in adolescents in male and was about 6.6 times more prevalent in female adolescents compared to male adolescents [21]. Similar to our findings, a Korean study that assessed depressive symptoms in 2,203 individuals observed that depressive symptoms increased in the high school period compared to the middle school period [22].

In this study, other anxiety disorders were more common among female and increased with increasing age in both sexes. It was more common in female than in male and those

aged 6–8 years than those aged 12–14 years from QCMHS [21]. However, unlike the present study, the said study included separation anxiety disorder and simple phobia, which do not fall under other anxiety disorders (code F41). A follow-up of children aged 9–13 years until the age of 16 years revealed that the prevalence of depressive disorder and social phobia increased among female adolescents [3]. The prevalence of anxiety disorder among preschool children aged 2–5 years was <1%, with 0.5% for separation anxiety disorder and 0.6% for simple phobia [23]. The lower prevalence in this group compared to older children may be due to the difficulty of identifying internalizing symptoms in young childhood.

The prevalence of specific developmental disorders of speech and language (F80), pervasive developmental disorder (F84), and other behavioral and emotional disorders with onset usually occurring in childhood and adolescence (F98) peaks in 4–6 years group, after which it continues to decline. Following early diagnosis, patients with these disorders are likely to receive intervention under the diagnosis of different mental problems with R or Z codes or due to coexistent symptoms after the age of 6 years [17]. This is because when patients with ASD are prescribed medications due to behavioral problems during growth, such as self-mutilation, impulsivity, and aggression, the diagnosis of psychoticism-related disorders must be provided in place of ASD due to the current health insurance regulations [9]. The reason for the decline in the prevalence after 4–6 years may be that the chief discomfort from specific developmental disorders of speech and language shifts from language to problems in social functioning and social relationships in adulthood [1]. As rehabilitation service utilization among children aged <19 years with disabilities is increasing annually from 56.0% in 2011 to 62.5% in 2014 and 69.4% in 2017 in Korea, it is possible that this pediatric patient population may receive service from paramedical specialists, which is not covered by national health insurance, once they pass the preschool period [17]. The reason for the decrease in the diagnostic rate of other behavioral and emotional disorders with onset usually occurring in childhood and adolescence with advancing age may be attributable to possible improvement of problems in young childhood in later ages, possibility that the patient did not seek medical care even with persistent problems, and possibility that the patient was re-diagnosed with another psychiatric disorder later in life as the problems became clearer [12].

The prevalence rate for mental retardation (F70), hyperactivity disorder (F90), emotional disorder with onset specific to childhood (F93), and tic disorder (F95) spikes in a certain age group and then declines. Mental retardation in-

creases with advancing age until reaching a plateau, after which it begins to decline. A meta-analysis of the prevalence of mental retardation reported that mental retardation becomes less prevalent among adults compared to children and adolescents, because, even though children and adolescents had been burdened with school, adults have left school and thus show a decline in academic pressure and prevalence of mental retardation [24]. Although this might be a result reflecting the loss of the need to diagnose mental retardation, as patients with mild mental retardation show mild improvements in adaptive functions through early diagnosis and intervention, it may also be a result of discontinuation of treatment following diagnosis [12]. In the present study, the diagnostic rate of hyperactivity disorder sharply increases at the age of 7–9 years and then begins to decline slowly. A study that observed changes from elementary school period to adolescence reported that the prevalence of ADHD, separation anxiety disorder, enuresis, encopresis, and tic disorder had a downturn from the age of 12 years [3]. A study that investigated diagnostic rates in the period between ages 3 and 6 years found that the 3-month prevalence of ADHD significantly increased from 2.4% among children aged 3 years to 5.4% among children aged 6 years [25]. As the period of school entry is marked by escalated social and academic needs and needs for behavioral control, symptoms are more clearly identified.

Lastly, conduct disorder (F91) in childhood is known to have an adverse effect on the development of internalization symptoms in adulthood [26]; however, it might not fit well in the clinical practice. It also differs culturally and by country. The diagnostic rate of conduct disorder in this study steeply increased at the age of 13–15 years and declined afterward. In the previous studies that analyzed HIRA-NPS of the year 2011, the diagnostic rates of F91 were 1.9% among the 0–18-year-old population [12] and dropped to 0.09% among the 19–30-year-old population [19]. Estimates of point prevalence rate of conduct disorder from 5–15 years in the UK [6] and from youths aged 11–17 years in the USA [27] were 1.47% and 3.32%, respectively. Interestingly, the diagnostic prevalence of conduct disorder abruptly increased from 1.25% in the 11–12-year-old population to 3.31% in the 13–15-year-old population in the UK study [6]. The 12-month first incidence rate of conduct disorder was 1.88% in a community study with youths aged 11–17 years [28]. While oppositional defiant disorder and conduct disorder are the most common disruptive disorders in adolescence, accompanied by substance use disorder, such as alcohol or marijuana abuse/dependence [27], the lifetime prevalence of substance abuse/dependence in Korea is as low as 0.25% [29].

These patterns do not reflect the actual prevalence rates. Some disorders exhibit a repeated cycle of improvement and exacerbation, such as tic disorder, but the reason for the changes in the diagnostic rate of neurodevelopmental disorders that persist for a prolonged period, such as ASD and ADHD, may be that the symptoms of coexisting mental disorders are the major treatment targets in patients with these disorders as an underlying disorder. Based on such age-specific diagnostic distribution patterns for pediatric mental disorders, relevant experts should understand that the currently manifested symptoms are simply phenotypes and that patients may have a persistent underlying illness [30]. Large-scale longitudinal studies are urgently needed to shed light on the changes of diagnosis in the same group of patients as they age.

This study has a few limitations. First, the limitations of the NHICD should be considered. Patients who received health-care under R and Z codes as opposed to F code, patients who received treatment with non-reimbursement, patients who received treatment with paramedical specialists, and patients prescribed non-reimbursed medications are excluded from the NHICD. There is also limited information about the specific diagnostic instruments or methods used. Second, per the Personal Information Protection Act, information about patients' socioeconomic factors, such as income and education, and health-related factors, such as smoking and drinking, are not provided to researchers. Subsequent studies should obtain socioeconomic factors with cooperation from government agencies and include them in their analysis. Third, this is a cross-sectional study, not a longitudinal study, so long-term follow-up of patients was not possible. Thus, analyzing the trends of changes in diagnoses of an individual through long-term follow-up cohort studies would enable a more detailed design of intervention services.

Despite these limitations, this study has the following significance: as this study only analyzed data on diagnoses made by psychiatrists from the HIRA data, it reflects the incidence rate of mental disorders among the population aged <19 years in the clinical setting in Korea.

CONCLUSION

In the analysis of the annual trends in the diagnostic prevalence of mental disorders in the population aged <19 years, there were no significant changes in the overall diagnostic prevalence rate, but there were some significant changes by sex, age, and psychiatric disorder. The most common diagnoses were hyperactivity disorder in male and depressive episode in female. The prevalence of bipolar affective disorder, depressive episode, specific developmental

disorders of speech and language, pervasive developmental disorder, and tic disorders significantly increased. Four patterns of change were observed in the diagnostic prevalence rates according to age: fortissimo-pianissimo type, crescendo type, accelerando-piano type, and forte-decrescendo type. Follow-up studies are needed to examine how the age-specific patterns for each disorder continue onto early adulthood.

Supplementary Materials

The online-only Data Supplement is available with this article at <https://doi.org/10.5765/jkacap.200017>.

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Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Geon Ho Bahn. Data curation: Seung Yup Lee. Investigation: Geon Ho Bahn, Seung Yup Lee. Methodology: Geon Ho Bahn. Writing statistics: Seung Yup Lee. Writing—original draft: Seung Yup Lee. Writing—review and editing: Geon Ho Bahn.

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