Impact of the early phase of the COVID-19 pandemic on the use of mental health services in South Korea: a nationwide, health insurance data-based study

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Abstract
Purpose The coronavirus disease 2019 (COVID-19) pandemic has profoundly affected the utilization of mental health services. Existing evidence investigating this issue at the nationwide level is lacking, and it is uncertain whether the effects of the COVID-19 pandemic on the use of psychiatric services differs based on psychiatric diagnosis.

Methods Data from the claims database between October 2015 and August 2020 was obtained from the Health Insurance Review and Assessment agency in South Korea. Based on the main diagnostic codes, psychiatric patients were identified and categorized into diagnostic groups (anxiety disorders, bipolar and related disorders, depressive disorders, and schizophrenia spectrum disorders). We calculated the number of psychiatric inpatients and outpatients and the medication adherence of patients for each month. We compared the actual and predicted values of outcomes during the COVID-19 pandemic and performed interrupted time-series analyses to test the statistical significance of the impact of the pandemic.

Results During the COVID-19 pandemic, the number of inpatients and admissions to psychiatric hospitals decreased for bipolar and related disorders and depressive disorders. In addition, the number of patients admitted to psychiatric hospitals for schizophrenia spectrum disorders decreased. The number of psychiatric outpatients showed no significant change in all diagnostic groups. Increased medication adherence was observed for depressive, schizophrenia spectrum, and bipolar and related disorders.

Conclusions In the early phase of the COVID-19 pandemic, there was a trend of a decreasing number of psychiatric inpatients and increasing medication adherence; however, the number of psychiatric outpatients remained unaltered.

Keywords COVID-19 pandemic · Mental health services · Nationwide study · Psychiatric admission

Introduction

Globally, accumulating evidence highlights associations between the coronavirus disease (COVID-19) pandemic and mental health in various aspects. During the COVID-19 pandemic, the global prevalence of depressive and anxiety symptoms in children and adolescents increased to 25.2% and 20.5%, respectively, almost double those seen in pre-pandemic periods [1]. The COVID-19 pandemic is also associated with an increase of 27.6% and 25.6% in the global prevalence of depressive and anxiety disorders, respectively [2]. The worsening of pre-existing mental disorders during the COVID-19 pandemic has been reported in previous studies [3, 4]. A recent survey suggested that the COVID-19 pandemic is associated with decreased physical and social activities, which may be a leading risk factor for depression related to the COVID-19 pandemic [5].

People with mental illness have concerns, such as disruption of services and running out of medication, regarding their use of psychiatric services during the COVID-19 lockdown [6]. According to a recent report by the World Health Organization, the disruption of essential mental health services occurred in 93% of countries around the world during the period of social isolation [7]. In some developed countries, telemedicine or online treatment had compensated the decrease in face-to-face treatments for mental health issues in response to the COVID-19 lockdown [8, 9]. However,
in low- and middle-income countries, which lack the infrastructure required to employ telemedicine into their mental health services, the COVID-19 pandemic profoundly disrupted essential mental health services [10, 11]. Previous studies have shown that the COVID-19 pandemic was followed by a rapid decrease in the number of psychiatric inpatients, outpatients, emergency room (ER) visits, as well as the use of psychosocial therapy services [12–14]. According to a previous study performed at a tertiary hospital in South Korea [14], the rate of daily outpatient department (OPD) visits for anxiety disorders, depressive disorders, and schizophrenia spectrum disorders decreased during the first 3 months of the COVID-19 pandemic.

Most previous studies on the impact of the COVID-19 pandemic on the use of psychiatric services by people with mental illness have been conducted in a few regions or hospitals, limiting the generalizability of the findings. To date, limited evidence exists regarding the differential impact of the COVID-19 pandemic on the use of psychiatric services based on the psychiatric diagnosis. A previous study showed that increased online consultations in response to a decrease in face-to-face outpatient contacts were less pronounced for psychotic disorders as compared with those for other psychiatric diagnoses [8]. In patients with schizophrenia spectrum disorders, contrary to those with anxiety and depressive disorders, the temporal association between the number of newly confirmed cases with the COVID-19 and the decreased rate of daily OPD visits was not observed [14]. These previous findings suggest the possibility of differential effects of the COVID-19 pandemic on the use of psychiatric services according to psychiatric diagnosis. Together with the number of psychiatric inpatients and outpatients, we expected that changes in patterns of psychotropic prescriptions during the COVID-19 pandemic might provide us with more details on the real-world changes in clinical practice. Given the importance of continuing pharmacotherapy for several psychiatric disorders, including schizophrenia [15] and mood disorders [16], studying whether the medication adherence of patients decreased during the COVID-19 pandemic is of interest.

We used the claims database from the Health Insurance Review and Assessment (HIRA) agency in South Korea to investigate changes in the use of psychiatric services during the early phase of the COVID-19 pandemic at the nationwide level. It is mandatory for all South Koreans to register with the National Health Insurance system which has two components: mandatory social health insurance (National Health Insurance Service) and medical aid. Therefore, the nation-wide claim database would be a useful data source to compensate for the limitations of previous studies, which either have a small sample size or limited generalizability. After the first domestic confirmed case of COVID-19 in Feb 16, 2020, the South Korean government raised the country’s Crisis Alert Level to the highest (Level 4) from Feb 23, 2020. The social distancing campaign was introduced on Feb 29, 2020, and the social distancing level 2 was announced from Aug 19, 2020. The daily number of confirmed cases of COVID-19 in South Korea during this period had been recorded and made publicly available (ncov.mohw.go.kr). We investigated the monthly number or value of patients in psychiatric hospitalization, admissions to psychiatric hospitals, psychiatric outpatients, and medication adherence, and made comparisons between before and during the COVID-19 pandemic. The predictive model was created using the data before the start of the COVID-19 pandemic (January 2020), and the statistical significance of the impact of the pandemic on outcomes was tested using interrupted time-series analyses.

**Materials and methods**

**Data source and study population**

The HIRA agency in South Korea is responsible for reviewing the claims generated from medical institutions and determining whether the National Health Insurance should reimburse the claims. As it is mandatory for all South Koreans to register with the National Health Insurance system, the HIRA database allows researchers to utilize information on the medical services utilized by the entire South Korean population [17]. The claims database includes the following information: demographic data and diagnoses of patients, prescriptions for medications and laboratory tests, and visits to medical institutions, such as hospitalization and ER visits.

We referred to the HIRA database to obtain data from October 2015 to August 2020. From the claims database, we initially selected the data corresponding to psychiatric services based on the main diagnostic code of F00–99. Subsequently, we categorized the claims data into separate diagnostic groups according to the following criteria of main diagnostic codes: schizophrenia spectrum disorders (F20–29), bipolar and related disorders (F30, F31), depressive disorders (F32, F33), and anxiety disorders (F40–49). The present study was approved by the Institutional Review Board of the Asan Medical Center (IRB No. 2021–1575). The requirement for informed consent was exempted owing to the use of anonymous and de-identified data.

**Use of mental health services and medication adherence**

Hospitalization episodes of patients were reconstructed following the methods in a previous study [18]. We labeled episodes of hospitalization as psychiatric hospitalization, whose primary diagnostic code at the start of admission...
was F00-99, along with the type of admission that should be general medical or psychiatric. The observation period was between October 2015 and August 2020. Using the start and end date of psychiatric admissions, we calculated the number of patients undergoing psychiatric hospitalization per month. The number of patients admitted to a psychiatric hospital each month was calculated based on the start date of psychiatric admission. Using the claims data corresponding to OPD visits, we calculated the monthly number of psychiatric outpatients. Medication adherence was determined using the prescriptions for all psychotropic medications shown in Supplementary Table 1. We calculated the medication possession ratio (MPR) for each claim as below:

\[
\text{Medication possession ratio} = \frac{\text{Maximum duration among all psychotropic drugs}}{\text{Date of the next visit} - \text{Date of current visit}}
\]

Regardless of the diagnostic group, we utilized information on all the psychotropic drugs given, because certain psychotropic drugs can be indicative for multiple psychiatric disorders. For example, antipsychotics have been considered the main pharmacologic agents for both schizophrenia and bipolar disorder [19]. We averaged the MPR for each month for each diagnostic group. The MPR is a value between 0 and 1; a value closer to 1 indicates better medication adherence. Previous studies have adopted MPR as a marker for medication adherence in psychiatric patients [20–22].

**Statistical analysis**

All statistical analyses were performed using the R software ver. 4.1.1 (R Development Core Team, Vienna, Austria). An alpha value of 0.05 was used for determining statistical significance.

We calculated the monthly number or value of patients in psychiatric hospitalization, admissions to psychiatric hospitals, psychiatric outpatients, and the MPR from October 2015 to August 2020. Based on the date of the first diagnosed case of COVID-19 in South Korea (January 2020), we determined the pre-COVID-19 period, which was used to estimate the predicted values and confidence intervals of outcomes in the period of the COVID-19 pandemic (February 2020 to August 2020) using the “prophet” package [23]. The “prophet” package has three main model components (trend, seasonality, and holidays). The trend component is for fitting a piecewise linear curve over the trend or the non-periodic part of the time series. The seasonality and holiday components account for the period changes and the effects of holidays, respectively. The details of the prophet package are described elsewhere [24]. We discarded the default options of the daily and weekly seasonality in the modeling. We calculated the percentage change of outcomes during the COVID-19 pandemic in comparison with the corresponding period of the previous year (February 2019 to August 2019). Interrupted time-series analyses were performed to test the effects of the COVID-19 pandemic on outcomes by comparing the 1-year pre-pandemic and pandemic periods. The “its. analysis” package [25] was used for the comparisons, which enabled us to perform interrupted time-series analysis on data of a relatively small number of observations.

**Results**

Figure 1 shows the monthly number of patients in psychiatric hospitalization, admissions to psychiatric hospitals, psychiatric outpatients, and the mean monthly MPR from October 2015 to August 2020. Tables 1, 2, 3, 4 present the actual and predicted values and confidence intervals during the COVID-19 pandemic (February 2020 to August 2020) and the results of interrupted time-series analyses for the impact of the pandemic on outcomes.

The monthly number of patients in psychiatric hospitalization and admissions to psychiatric hospitals seemed to decline after the start of the COVID-19 pandemic, regardless of the diagnostic group. The number of psychiatric inpatients and admissions to psychiatric hospitals decreased until Mar 2020, and showed an increasing trend after Apr 2020 to Jul 2020, in all diagnostic categories. Compared with the same period of the previous year (February 2019 to August 2019), all diagnostic groups showed a decrease in the number of psychiatric inpatients (all psychiatric: − 3.7%; anxiety: − 18.6%; bipolar and related: − 8.2%; depressive: − 18.9%; schizophrenia spectrum: − 3.2%) and psychiatric admissions (all psychiatric: − 18.6%; anxiety: − 23.0%; bipolar and related: − 20.4%; depressive: − 28.4%; schizophrenia spectrum: − 24.4%). All psychiatric disorders, bipolar and related disorders, and depressive disorders had a significant decrease in the number of patients undergoing psychiatric hospitalization (all psychiatric: \( F = 14.058, p = 0.002 \); bipolar: \( F = 8.338, p = 0.011 \); depressive: \( F = 10.239, p = 0.006 \)) and admissions to psychiatric hospitals (all psychiatric: \( F = 12.748, p = 0.003 \); bipolar: \( F = 7.316, p = 0.016 \); depressive: \( F = 7.141, p = 0.017 \)). In regard to schizophrenia spectrum disorders, a significant decrease in the number of patients commencing psychiatric hospitalization (\( F = 7.884, p = 0.013 \)) was observed.

The number of psychiatric outpatients seemed to be relatively constant across all diagnostic groups (all psychiatric: 5.4%; anxiety: 5.9%; bipolar and related: 7.3%; depressive: 6.2%; schizophrenia spectrum: -0.4%). There was no significant change in the number of psychiatric outpatients.

Trends of higher MPR were observed for all diagnostic groups (anxiety: 2.5%; bipolar and related: 0.8%; depressive: 1.3%; schizophrenia spectrum: 0.6%). A significantly
before [26–30]. Tromans et al. reported reduced numbers during the COVID-19 lockdown, as compared with that reported a significant decrease in psychiatric admissions line with the current results, several previous studies have seemed to be more notable in the number of admissions to psychiatric hospitals, as compared with the number of patients already undergoing psychiatric hospitalization. In to psychiatric hospitals, as compared with the number of patients in psychiatric hospitalization and admissions to psychiatric hospitals seemed to decline after the start of the COVID-19 pandemic for bipolar and related disorders. The monthly number of patients in psychiatric hospitalization and admissions to psychiatric hospitals declined after the start of the COVID-19 pandemic for bipolar and related disorders. The monthly number of patients in psychiatric hospitalization and admissions to psychiatric hospitals, especially for acute adult and mental health services for older people. However, in some regions, the rate of psychiatric hospitalizations during the COVID-19 pandemic remained unaltered in comparison with that in the control periods [31, 32]. Despite the inconsistency in previous results regarding the overall number of psychiatric admissions during the COVID-19 pandemic, it is noteworthy that an increased proportion of involuntary or urgent admissions have been consistently reported in previous studies [27, 28, 32, 33]. The reasons for the decreased psychiatric hospitalizations in the current study may be that the restriction policies for controlling the spread of COVID-19, such as social distancing, could not be applicable to most psychiatric facilities in South Korea. Therefore, it is assumed that clinicians might have not recommended psychiatric hospitalization considering the balance between psychiatric risks and the risks associated with COVID-19 infection. Psychiatric hospitalization is regarded as intensive care and is usually considered when patients have suicidal or violent tendencies that cannot be managed in an outpatient setting. Given the possibility of delay in psychiatric hospitalization during the COVID-19 pandemic in patients who were more suitable for inpatient care than outpatient care, the long-term effects of decreased psychiatric hospitalizations during the COVID-19 pandemic should be investigated in follow-up studies. Hormann et al. found an increase in involuntary admissions for suicide, and psychiatric admissions for the first suicide attempt, during the first 6 months of the COVID-19 pandemic. The authors mentioned that this could be a signal for upcoming threats of psychiatric crises associated with the COVID-19 pandemic.

As for the differential effects of the COVID-19 pandemic by diagnostic group, only a significant decrease was found in the number of admissions to psychiatric hospitals for schizophrenia spectrum disorders, which was contrary to the significantly decreased number of psychiatric inpatients and those admitted to psychiatric hospitals for depressive, and bipolar and related disorders. The current results indicated that despite the possible increased risk for the spread and infection of COVID-19 inside psychiatric hospitals, the decrease in the number of psychiatric inpatients with schizophrenia spectrum disorders was not significant. This may be associated with impairments of risk assessment and decision-making capacity of patients with schizophrenia [34, 35]; however, the poor community-based mental health system and support system for managing patients with psychosis in South Korea could also have contributed to these results [36]. Further studies would be beneficial for clarifying disease-specific and environmental factors regarding the current findings by investigating the coping strategy for the risk of COVID-19 infection according to psychiatric disorder.

Discussion

We examined the changes in the use of mental health services before and during the COVID-19 pandemic using the HIRA database at the nationwide level. Using the main diagnostic codes, we categorized patients into diagnostic groups and investigated changes in outcomes classified according to the diagnostic group. By utilizing data before the date of the first confirmed case of COVID-19 in South Korea (January 2020), we estimated the predicted values and confidence intervals of the outcomes during the COVID-19 pandemic. Interrupted time-series analysis was adopted to test the statistical significance of the impact of the COVID-19 pandemic on outcomes. The monthly number of patients in psychiatric hospitalization and admissions to psychiatric hospitals seemed to decline after the start of the COVID-19 pandemic, and a significant decrease in these outcome variables was found for all psychiatric disorders, bipolar and related disorders, and depressive disorders, when compared with the pre-pandemic period. No significant change in the monthly number of psychiatric outpatients was observed. The mean monthly MPR was significantly increased after the start of the COVID-19 pandemic for bipolar and related disorders, depressive disorders, and schizophrenia spectrum disorders.

We observed a decreasing trend in the monthly number of patients in psychiatric hospitalization and admissions to psychiatric hospitals regardless of the diagnostic group. The magnitude of the decreasing effect of COVID-19 pandemic seemed to be more notable in the number of admissions to psychiatric hospitals, as compared with the number of patients already undergoing psychiatric hospitalization. In line with the current results, several previous studies have reported a significant decrease in psychiatric admissions during the COVID-19 lockdown, as compared with that before [26–30]. Tromans et al. reported reduced numbers of psychiatric admissions during the COVID-19 lockdown, especially for acute adult and mental health services for older people. However, in some regions, the rate of psychiatric hospitalizations during the COVID-19 pandemic remained unaltered in comparison with that in the control periods [31, 32]. Despite the inconsistency in previous results regarding the overall number of psychiatric admissions during the COVID-19 pandemic, it is noteworthy that an increased proportion of involuntary or urgent admissions have been consistently reported in previous studies [27, 28, 32, 33]. The reasons for the decreased psychiatric hospitalizations in the current study may be that the restriction policies for controlling the spread of COVID-19, such as social distancing, could not be applicable to most psychiatric facilities in South Korea. Therefore, it is assumed that clinicians might have not recommended psychiatric hospitalization considering the balance between psychiatric risks and the risks associated with COVID-19 infection. Psychiatric hospitalization is regarded as intensive care and is usually considered when patients have suicidal or violent tendencies that cannot be managed in an outpatient setting. Given the possibility of delay in psychiatric hospitalization during the COVID-19 pandemic in patients who were more suitable for inpatient care than outpatient care, the long-term effects of decreased psychiatric hospitalizations during the COVID-19 pandemic should be investigated in follow-up studies. Hormann et al. found an increase in involuntary admissions for suicide, and psychiatric admissions for the first suicide attempt, during the first 6 months of the COVID-19 pandemic. The authors mentioned that this could be a signal for upcoming threats of psychiatric crises associated with the COVID-19 pandemic.

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## Table 1 Impact of the COVID-19 pandemic on monthly number of patients in psychiatric hospitalization

| Diagnosis          | Date       | Actual     | Predicted (95% CI)          | Statistic<sup>a</sup> |
|--------------------|------------|------------|-----------------------------|------------------------|
|                    | Feb-20     | Mar-20     | Apr-20          | May-20     | Jun-20     | Jul-20     | Aug-20     | F         | P          |
| All psychiatric    | Actual     | 191,125    | 185,755         | 185,578    | 187,091    | 188,960    | 190,928    | 189,901   | 14.058    | 0.002      |
|                    | Predicted  | 193,950.8  | (193,228.4–194,681) |             |            |            |            |           |            |
| CI                 |            |            | (193,800.1–195,335.2) |            |            |            |            |           |            |
| Anxiety            | Actual     | 1,195      | 1,080           | 1,136      | 1,180      | 1,389      | 1,432      | 1,326     | 0.595     | 0.452      |
|                    | Predicted  | 1,321.1 (1286.7–1357.6) |             |            |            |            |            |           |            |
| CI                 |            | (1435.1–1503.7) |            |            |            |            |            |           |            |
| Bipolar            | Actual     | 3,776      | 3,521           | 3,541      | 3,622      | 3,743      | 3,881      | 3,735     | 8.338     | 0.011      |
|                    | Predicted  | 4,137.1 (4090.8–4188.8) |             |            |            |            |            |           |            |
| CI                 |            | (4275.4–4335.7) |            |            |            |            |            |           |            |
| Depressive         | Actual     | 4,130      | 3,596           | 3,585      | 3,754      | 3,924      | 4,106      | 3,896     | 10.239    | 0.006      |
|                    | Predicted  | 4,522.2 (4397.9–4649.1) |             |            |            |            |            |           |            |
| CI                 |            | (4835.6–4851.1) |            |            |            |            |            |           |            |
| SSP                | Actual     | 38,366     | 37,283          | 37,400     | 37,775     | 38,266     | 38,578     | 38,570    | 2.592     | 0.127      |
|                    | Predicted  | 39,021.1  | (38,878.3–39,155.7) |             |            |            |            |           |            |
| CI                 |            | (39,181.5–39,312.1) |            |            |            |            |            |           |            |
| CI confidence interval, SSP schizophrenia spectrum

<sup>a</sup>Interrupted time-series analysis was performed to investigate the impacts of the COVID-19 pandemic on the outcome
## Table 2  Impact of the COVID-19 pandemic on the monthly number of admissions to psychiatric hospitals

| Diagnosis | Date  | Actual | Predicted (95% CI) | F     | P     |
|-----------|-------|--------|--------------------|-------|-------|
|           | Feb-20 | 26,895 | 29,756 (28,778.6–30,735.8) |       |       |
| All psychiatric | Mar-20 | 22,762 | 33,503.3 (32,545.8–34,512.1) |       |       |
|           | Apr-20 | 23,172 | 30,318.2 (29,384.8–31,306.6) |       |       |
|           | May-20 | 25,797 | 31,663.4 (30,669.2–32,627.2) |       |       |
|           | Jun-20 | 27,785 | 31,951.7 (30,963.8–32,910.2) |       |       |
|           | Jul-20 | 28,787 | 32,410 (31,424.1–33,419.1) |       |       |
|           | Aug-20 | 26,565 | 33,351.6 (32,275.9–34,317.7) |       |       |
| Anxiety   | Actual | 540    | 649.5 (618.2–680.2) |       |       |
|           | Predicted (95% CI) | 509 | 808.5 (775.4–839.4) |       |       |
|           |       | 556    | 764.5 (734.9–793.2) |       |       |
|           |       | 638    | 782.7 (752.4–813.2) |       |       |
|           |       | 800    | 797.5 (767.5–827.3) |       |       |
|           |       | 767    | 867.7 (835.3–896.1) |       |       |
|           |       | 677    | 913.4 (881.6–943.4) |       |       |
| Bipolar   | Actual | 942    | 1070.8 (1024.8–1117.1) |       |       |
|           | Predicted (95% CI) | 775 | 1260.4 (1216.4–1302.1) |       |       |
|           |       | 821    | 1160.3 (1116.2–1206.1) |       |       |
|           |       | 937    | 1281.8 (1237.2–1327.0) |       |       |
|           |       | 1,015  | 1264.0 (1216.6–1308.5) |       |       |
|           |       | 1,081  | 1172.4 (1128.8–1217.9) |       |       |
|           |       | 890    | 1178.6 (1134.6–1223.5) |       |       |
| Depressive| Actual | 1,286  | 1,001 (1,153.0–1,693.0) |       |       |
|           | Predicted (95% CI) | 1,001 | 1,905.4 (1,826.0–1,986.0) |       |       |
|           |       | 1,062  | 1,796.7 (1,717.7–1,870.3) |       |       |
|           |       | 1,251  | 1,845.4 (1,767.3–1,933.1) |       |       |
|           |       | 1,424  | 1,895.1 (1,813.2–1,978.3) |       |       |
|           |       | 1,507  | 1,874.1 (1,793.4–1,957.9) |       |       |
|           |       | 1,305  | 1,926.9 (1,842.2–2,001.9) |       |       |
| SSP       | Actual | 3,410  | 4,259.3 (4,109.0–4,419.2) |       |       |
|           | Predicted (95% CI) | 2,568 | 4,271.9 (4,065.4–4,419.4) |       |       |
|           |       | 2,762  | 4,062.8 (3,904.9–4,221.3) |       |       |
|           |       | 3,179  | 4,290.9 (4,122.7–4,440.4) |       |       |
|           |       | 3,563  | 4,158.6 (4,003.5–4,310.2) |       |       |
|           |       | 3,505  | 4,071.3 (3,909.4–4,226.6) |       |       |

CI confidence interval, SSP schizophrenia spectrum

*aInterrupted time-series analysis was performed to investigate the impacts of the COVID-19 pandemic on the outcome*
Table 3  Impact of the COVID-19 pandemic on the monthly number of psychiatric outpatients

| Diagnosis | Date       | Actual | Predicted (95% CI)       | Statistic<sup>a</sup> |
|-----------|------------|--------|--------------------------|----------------------|
|           |            |        |                          |                      |
| All psychiatric | Feb-20 | 1,410,104 | (1,408,090.7–1,458,620.7) | 0.657                |
|           | Mar-20    | 1,417,740 | (1,501,696.2–1,551,997.9) | 0.429                |
|           | Apr-20    | 1,429,267 | (1,459,478.8–1,509,897.1) | 0.360                |
|           | May-20    | 1,470,665 | (1,489,835.5–1,539,711.1) | 0.280                |
|           | Jun-20    | 1,506,442 | (1,508,351–1,555,797.4)   | 0.205                |
|           | Jul-20    | 1,541,192 | (1,520,452.6–1,544,528.6) | 0.134                |
|           | Aug-20    | 1,492,313 | (1,534,054.1–1,583,928.5) | 0.091                |
| Anxiety   | Feb-20    | 333,469  | (332,662.4–346,599)       | 0.959                |
|           | Mar-20    | 340,994  | (332,662.4–346,599)       | 0.342                |
|           | Apr-20    | 345,111  | (348,814.6–362,949.6)     | 0.205                |
|           | May-20    | 359,493  | (355,613.3–369,403.1)     | 0.134                |
|           | Jun-20    | 369,016  | (360,689.7–374,857.5)     | 0.134                |
|           | Jul-20    | 377,917  | (368,023.1–381,731.2)     | 0.091                |
|           | Aug-20    | 362,237  | (368,023.1–381,731.2)     | 0.091                |
| Bipolar   | Feb-20    | 62,123   | (61,407.9–62,572.9)       | 1.057                |
|           | Mar-20    | 62,787   | (63,602.6–65,388.5)       | 0.319                |
|           | Apr-20    | 63,112   | (64,947.2–66,833.5)       | 0.192                |
|           | May-20    | 64,016   | (65,569.9–67,377.4)       | 0.134                |
|           | Jun-20    | 65,407   | (66,703.9–68,126.4)       | 0.868                |
|           | Jul-20    | 66,546   | (68,513.2)                | 0.360                |
|           | Aug-20    | 64,811   | 1                        | 0.134                |
| Depressive| Feb-20    | 363,181  | (361,344.4–375,112.5)     | 0.886                |
|           | Mar-20    | 366,383  | (374,590.4–387,877.8)     | 0.360                |
|           | Apr-20    | 369,112  | (381,605.9–394,433.2)     | 0.134                |
|           | May-20    | 382,082  | (384,354–396,502.1)       | 0.134                |
|           | Jun-20    | 390,351  | (391,849.9–405,416.1)     | 0.091                |
|           | Jul-20    | 399,415  | (398,149.9–405,416.1)     | 0.091                |
|           | Aug-20    | 387,122  | 1                        | 0.091                |
| SSP       | Feb-20    | 133,245  | (131,054.6–134,886.6)     | 1.748                |
|           | Mar-20    | 133,864  | (136,805.9–141,008.1)     | 0.205                |
|           | Apr-20    | 133,320  | (133,277–137,353)         | 0.134                |
|           | May-20    | 133,629  | (136,367.1–140,394.2)     | 0.134                |
|           | Jun-20    | 135,473  | (136,046.4–140,118)       | 0.134                |
|           | Jul-20    | 136,543  | (134,803.4–138,952.9)     | 0.134                |
|           | Aug-20    | 133,302  | (138,896.2–142,699.3)     | 0.134                |

<sup>a</sup>Interrupted time-series analysis was performed to investigate the impacts of the COVID-19 pandemic on the outcome.

CI confidence interval, SSP schizophrenia spectrum.
We observed no significant change in the number of psychiatric outpatients during the COVID-19 pandemic, compared with the control periods. Inconsistent with the present findings, previous studies have shown a decreased number of psychiatric outpatient visits during the COVID-19 pandemic, compared with that before the pandemic [10, 14, 37]. This difference between results can be attributed to several factors, including socioeconomic status, medical system, and study population. The current study is based on the claims data on hospital-based mental health services in South Korea. The community-based mental health service system in South Korea barely accounts for the psychiatric care of South Koreans; instead, most psychiatric treatments occur in medical facilities [36]. Owing to the compulsory nature and high coverage rate of the National Health Insurance system in South Korea, individuals are more likely to visit medical institutions for their psychiatric care at relatively low economic costs. The larger sample size in the current study could also have contributed to the difference from previous results. Notably, there was an increasing trend of the MPR during the COVID-19 pandemic, indicating better medication adherence, than that before. We postulated that the worries of unexpected disruption of OPD visits owing to the COVID-19 lockdown might have led to surplus psychotropic medications, which might be reflected in the increased MPR. Several previous studies have reported the increased prevalence of anxiety and depression during the early phase of the COVID-19 pandemic in South Korea, and the COVID-19-related fear and the level of restrictions in daily life are predictive of anxiety and depression [38, 39]. It might, therefore, be suggested that the increased level of anxiety and depression would have been implicated in a change in the pattern of psychotropic prescriptions, i.e., surplus psychotropic medications. Another possible explanation is that, as the number of psychiatric inpatients decreased, clinicians might have managed patients who needed to be hospitalized on more short-term intervals. Our results may suggest that even during the COVID-19 pandemic, the adherence to medication by psychiatric patients did not decrease; however, the abovementioned possibilities should be considered in the interpretation of our results. Future studies should be conducted to examine the long-term course of medication adherence, and validate the hypotheses for the increased medication adherence during the COVID-19 pandemic observed in the present study.

The current study was a nationwide health insurance data-based study and utilized the claims database that includes information on medical services used by the nationwide population in South Korea. Besides the number of psychiatric inpatients and outpatients, we included medication adherence as an outcome to investigate changes in patterns of psychotropic prescriptions in real-world clinical practice. However, some limitations of our study

Table 4: Impact of the COVID-19 pandemic on the mean monthly medication possession ratio

| Diagnosis | Date | F | P       | Statistic | Confidence interval |
|-----------|------|---|---------|-----------|---------------------|
| Anxiety   | Feb-20 | 0.793 | 0.800   | 0.786 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | Mar-20 | 0.801 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | Apr-20 | 0.800 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | May-20 | 0.801 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Jun-20 | 0.801 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Jul-20 | 0.800 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Aug-20 | 0.800 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
| Bipolar   | Feb-20 | 0.800 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | Mar-20 | 0.801 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | Apr-20 | 0.800 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | May-20 | 0.801 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Jun-20 | 0.801 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Jul-20 | 0.800 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Aug-20 | 0.800 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
| Depressive| Feb-20 | 0.800 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | Mar-20 | 0.801 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | Apr-20 | 0.800 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | May-20 | 0.801 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Jun-20 | 0.801 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Jul-20 | 0.800 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Aug-20 | 0.800 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
| SSP       | Feb-20 | 0.800 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | Mar-20 | 0.801 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | Apr-20 | 0.800 | 0.801   | 0.785 | 0.784 (0.782–0.788) | 10.581 (0.005) |
|           | May-20 | 0.801 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Jun-20 | 0.801 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Jul-20 | 0.800 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
|           | Aug-20 | 0.800 | 0.807   | 0.791 (0.789–0.793) | 10.581 (0.005) |
should be considered. First, we used the main diagnostic codes of patients for categorization, which may lead to false-positive or false-negative diagnoses. The diagnostic validation of the HIRA database through further studies would be beneficial to verify the current findings. Second, our results showed a decreased number of psychiatric inpatients and increased medication adherence during the COVID-19 pandemic. However, owing to the inherent limitation of unavailable access to medical records of patients, we could not perform further exploration on the specific reasons for these results. Third, we included the early phase of the COVID-19 pandemic as the study period of the COVID-19 pandemic in this study. Therefore, our results only indicated the association between the early phase of the COVID-19 pandemic and the outcomes. Follow-up studies are required to examine the long-term effects of the COVID-19 pandemic. Fourth, the Ministry of Health and Welfare in South Korea allowed telemedicine from Feb 24, 2020, for patients who were unable to visit medical institutions owing to the risk of COVID-19 infection. However, the HIRA database does not contain information on whether patients visited medical institutions. Future studies are needed to explore the effects of telepsychiatry on the use of psychiatric services, especially outpatient care, during the ongoing era of the COVID-19 pandemic.

We used the claims database of the nationwide health insurance to examine changes in the use of psychiatric services after the start of the COVID-19 pandemic. During the early phase of the COVID-19 pandemic, we found a decrease in the number of patients in psychiatric hospitalization, a decrease in admissions to psychiatric hospitals, unaltered number of psychiatric outpatients, and an increase in MPR indicating better medication adherence. Using a retrospective observational study design and nationwide claims database, we investigated the impact of early phase COVID-19 on the use of psychiatric services at the nationwide level. Follow-up studies on the long-term effects of the COVID-19 pandemic on the use of psychiatric services are needed for a more comprehensive understanding of the impact of the pandemic on mental health services.

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**Data and/or code availability** The data sets used in this study are available from the Health Insurance Review and Assessment service on reasonable request.

**Declarations**

**Conflict of interest** The authors have no competing interests to declare that are relevant to the content of this article.

**Ethical approval** The authors assert that all procedures contributing to this work complied with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, as revised in 2008.

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