Increased prevalence of depression in South Korea from 2002 to 2013

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South Korea has one of the highest suicide rates among countries. However, the prevalence of depression in South Korea has been reported to be much lower than in other countries. The current study aims to estimate the prevalence of major depressive disorder using a large representative sample of the South Korean population. The prevalence of depression in a sampled population of one million individuals increased from 2.8% in 2002 to 5.3% in 2013; it was found to increase with the age of the population, and was higher in females than in males for most age groups. A Cox's proportional hazard model showed that suicide risk was significantly higher in people with depression (hazard ratio [HR] 3.79, 95% CI 3.14–4.58) than those without depression. It was also significantly higher in older people (HR 1.52, 95% CI 1.36–1.70) than in younger people, and in males (HR 2.45, 95% CI 2.02–2.96) than in females. Furthermore, higher income groups were at lower suicide risk as compared to lower income groups (HR 0.88, 95% CI 0.80–0.95). This study using the large representative sample data provided evidence that increased prevalence of depression contributed to the increased risk of suicide in South Korea during the recent decade.

In 2017, depression was the third leading cause of years lived with disability after low back pain and headache disorders. Depression is also a major risk factor for suicidal mortality in the general population. South Korea has the highest suicide rate among Organization for Economic Co-operation and Development (OECD) countries, about 2.4 times higher than the average suicide rate of other OECD countries.

However, despite the high suicide rate, the prevalence of depression in South Korea has been reported to be much lower than in other countries. Cho et al. reported that the annual prevalence of major depressive disorder was 1.7%, 2.5%, and 3.1% in 2001, 2006, and 2011, respectively. These values are lower than those of high-income countries (5.5%) and low- to middle-income countries (5.9%) as observed in a cross-national study, and lower than average values of various countries (7.2%) reported in a recent meta-analysis. In the previous cross-sectional national surveys reporting the prevalence of depression in South Korea, the study populations were convenient and different in each study, and the number of subjects in the target population was small, which makes their results less representative of the general population of South Korea.

The access rate to health care services for depression has been reported to be low. One study reported that the percent annual treatment rate for major depressive episodes was 39.2%. The mental health treatment gap for major depression was 56.3%, with 38% of the patients receiving antidepressant pharmacotherapy at primary care facilities. The usage of antidepressants is increasing globally and the association between antidepressants and suicidal risk is still a matter of debate. However, there has been little research on the prevalence of antidepressant treatment with respect to depression in South Korea.

The National Health Insurance Service-National Sample Cohort (NHIS-NSC) is a representative sample database having the clinical record of about one million patients randomly selected from approximately 97% of the overall population of South Korea from 2002 to 2013. Increasing number of researchers have reported the prevalence of various diseases using this database since this large-sized data provides a unique opportunity to examine the epidemiological characteristics of the whole population of South Korea, free from recall bias or nonresponse that are frequently found in survey studies. This study aimed to estimate the annual prevalence and incidence of major depressive disorder in the South Korean population over the last decade. We also investigated the rate of prescription of antidepressants. To understand the influence of depression on suicidal mortality, we examined suicidal risk in populations both with and without depression.

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Results

Table 1 shows the epidemiology of total population and patients with depression in 2013 (refer to Lee et al. for more detailed socio-demographic characteristics of the population from the NHIS-NSC database). The table shows that depression was more prevalent in females than in males, and in older people than in young people. The prevalence of depression was significantly higher in people from the lowest or highest income percentiles than in those belonging to the middle-ranged income percentile. It was also significantly higher in people from non-metropolitan areas than in those from metropolitan areas. Although both these comparisons showed statistical significance, the effect size was small (Table 1).

Figure 1 shows annual prevalence and incidence of depression during the study period, from 2002 to 2013. The prevalence of depression in the total population in 2002 and 2013 was 2.8% and 5.3%, respectively ('Dx' group). The change in the prevalence of depression diagnosis and history of antidepressant treatment ('Dx and Mx' group), and that of depression diagnosis or history of antidepressant treatment ('Dx or Mx' group), were similar to that of Dx group; the prevalence increased during the study period, with the exception of a minor temporary decrease in 2007 and 2013 in the 'Dx' and 'Dx or Mx' groups. Among those diagnosed with depression, the proportion of people who were prescribed antidepressants increased steadily during the study period. While about a quarter of the people diagnosed with depression were prescribed antidepressants in 2002, close to half were prescribed antidepressants in 2013. There was a stationary pattern of change in the incidence of depression, although there were slight fluctuations during the study period. Notably, the number of 'Unmedicated Dx' individuals decreased.

Figures 2 shows the statistics from 2002 and 2013 as classified by age and sex. The prevalence of depression was higher in females than in males for most age groups. In children under 15 years of age and the elderly over 85 years of age in 2002, males had a higher prevalence than females. In 2013, only male children under 15 years of age had a higher prevalence of depression than female children. As the age of population increased, the prevalence of depression tended to increase. The 65–70 years old group in females and 75–79 years old group in males showed the highest prevalence of depression in 2002. On the other hand, the 75–79 years old group in females and 80–84 years old group in males showed the highest prevalence in 2013.

The cumulative incidence of suicide indicates that the suicide rate of individuals with depressive disorder was significantly higher than that of individuals without the disorder (Fig. 3). Figure 4 and Supplementary Table 1 shows the suicide risk with respect to different population characteristics including depression, age, sex, socioeconomic position, and living area, modelled using Cox's proportional-hazards regression. The suicide risk was significantly higher in people with depression (hazard ratio [HR] 3.79, 95% CI 3.14–4.58) than in those without depression, in older people (HR 1.52, 95% CI 1.36–1.70) than in younger people, and in males (HR 2.45, 95% CI 2.02–2.96) than in females. Higher income groups were at lower suicide risk when compared with lower income groups (HR 0.88, 95% CI 0.80–0.95).
Discussion

The annual prevalence of depression as estimated by medical records of diagnosis increased during the study period, from 2002 to 2013. It was 3.7% in 2006 and 4.8% in 2011, which is higher than 2.5% in 2006 and 3.1% in 2011 as reported by previous survey studies7,8. The annual prevalence of depression was 5.3% in 2013, which was the highest among those reported in South Korea. It is similar to that of high-income (5.5%) and low- to middle-income countries (5.9%) as published in a previous cross-national study9. In survey studies, the prevalence could be underrated due to the participants’ nonresponse or underreporting from the fear that disclosing their history of depression may lead to discrimination or avoidance by communities23. This use of the claims database in this study makes it free from recall bias or nonresponse. The data was carefully prepared from a database covering the whole South Korean population with systematic stratification to minimize sampling bias16. Nevertheless, the data does not include patients who do not visit the clinics or hospitals, allowing for a potential underestimation of depression.

Figure 1. Age- and sex-standardized prevalence and incidence of depressive disorder in South Korea.

Figure 2. Prevalence of depression based on sex and age in 2002 and 2013.
The prevalence of depression has been reported to be lower in Asian countries when compared to Western and Middle Eastern countries\(^9\,10\,24\,26\). Asian people are known to be reluctant to seek psychiatric treatment due to the stigma of mental illness\(^27\,29\). In Japan, only 5% of the Japanese patients with rheumatoid arthritis had been diagnosed with depression, while 35% of the same population had PHQ-9 scores indicative of depression\(^30\). Increasing annual prevalence from 2002 to 2013 approaching the level of high-income western countries and decreased population with unmedicated depression (Fig. 1) suggest that although still prevalent, the prejudice against seeking psychiatric treatment has reduced with increasing public awareness of depression\(^31\).

Figure 3. Cumulative incidence of suicide in the population with or without depressive disorder.

Figure 4. Forest plot of multivariate Cox regression analysis of effect of depression and epidemiological factors on suicide. The number of deaths from suicide according to each factor is listed in Supplementary Table 1.
It is noteworthy that not only did the rate of visits to clinics or hospitals increased, but the rate of antidepressant prescription also increased. Antidepressant prescription rates have also increased in other countries, such as Australia, the USA, and the UK. These trends may have been influenced by several factors including public awareness of depression and improvements in antidepressants. Antidepressants such as selective serotonin reuptake inhibitors (SSRIs) and serotonin and norepinephrine reuptake inhibitors (SNRIs) are popular first-line treatments for depression. Newer antidepressants have superior safety profiles and less adverse effects than older tricyclics and monoamine oxidase inhibitors (MAOIs).

The prevalence of depression increased by about 43.82% (3.72% vs 5.35%) in study population from 2005 to 2013. The increase in the prevalence of major depression seems more rapid in South Korea than in the US. Weinberger et al. reported that the prevalence of depression in the US increased by about 8.16% (6.62% vs 7.16%) from 2005 to 2013. The stationary incidence of depression despite increased prevalence of depression suggests that the recovery rate of depressive disorders is low and that depressive disorders might be chronic, lasting years to decades. This finding is more significant if we consider the decrease in the number of unmedicated incidents of depression. South Korea is a highly competitive society that has experienced rapid economic and sociocultural changes over the past few decades. The costs of these rapid changes include occupational stress, rising housing prices, and high divorce rates, all of which are closely associated with depression in South Korea.

We compared the prevalence of different categories of depression, i.e., Dx, Dx and Mx, and Dx or Mx, and the overall trends were similar. Interestingly, the prevalence of all three categories have increased rapidly since 2008. The financial crisis that occurred when the Lehman Brothers went bankrupt in 2008 had a worldwide impact. In 2008, mental health problems and suicide rates increased in many countries, including South Korea. We observed a higher prevalence of depression in people belonging to the lowest or highest income percentiles than in those of the middle-range income percentile. These findings are consistent with previous reports that people of higher economic status are more likely to recognize symptoms of depression, receive adequate treatment for it, and have more positive association towards medication. Risk factors such as functional impairment, cognitive problems, and social isolation were associated with higher incidence of depression. Robert et al. proposed that old age is not an independent risk factor for depression. They suggested that age-related effects on depression were from chronic health problems and related disability. Risk factors such as functional impairment, cognitive problems, and social isolation were associated with higher rates of depression. In South Korea, rapid economic growth and socio-cultural changes have taken place over the last few decades and the elderly have difficulty in adjusting to this abrupt change with a lack of a social support system. The age group showing the highest prevalence of depression, i.e., 60–79 years of age in 2002, had a lower risk of suicide than those with lower incomes. Suicide risk has been associated with socio-economic factors such as low income and unemployment. To this end, men appear to be more affected by negative economic conditions than women.

There are limitations in this study. Our study could not include people who did not visit clinics or hospital for depression disorder. The diagnosis of depressive disorder may be omitted to avoid the stigma of mental disorder.
or wrongly created by clinicians to reimburse healthcare services. In order to lessen the miscoding error, which is a limitation of claims data, we explored the results with two more auxiliary categories—‘Dx and Mx’ and ‘Dx or Mx’. All three categories showed similar increases in prevalence during the study period.

We analysed a large representative sample of the South Korean population and reported a higher level of prevalence of depression than any previous epidemiological study conducted in South Korea. The prevalence of depression have steadily increased over the last decade with a rapid increase in aged people. Rapid westernization and a competitive social atmosphere in South Korea seem to make people vulnerable to depressive disorders, which is especially true in elderly people who lack a sufficient social support system. We also found that antidepressant prescriptions had increased. The increase in use of healthcare system due to improved economic status or lessening of stigma may be another possible explanation for the observed increase in prevalence of depression. Despite this, the prevalence of depression might still be highly underestimated in South Korea. The relationship between depression and increased suicide risk was confirmed in a large representative sample of the South Korean population.

Methods
Data sources and study population. We analysed the NHIS-NSC database of South Korea (2002–2013) which has been implemented by the NHIS of Korea, a single national insurance provider. This cohort consists of a nationally representative random sample of 1,025,340 participants, generated by the NHIS using a systematic, stratified random sampling method from all 46,605,433 individuals from 20026. To maintain the cohort size of approximately one million samples, the NHIS-NSC was renewed annually by adding a representative sample of newborns to compensate for annual disqualifications owing to death and emigration. This database was generated using medical bill expenses of the participants, claimed by medical service providers including hospitals, private clinics, and public centres in South Korea. Depression was diagnosed by physicians, including psychiatrists. The disease diagnosis codes are based on the International Codes of Disease 10th Edition (ICD-10). The database contains subject demographics, disease diagnosis, drug prescription, medical aid beneficiaries, medical bill details, and clinical procedure information generated by all types of medical providers6.

Ethical approval was waived in this study by the Institutional Review Board of Asan Medical Center, Seoul, South Korea. Informed consent was waived because the data in the NHIS-NSC were anonymized and de-identified.

Definition of depression. Depression was defined using the ICD-10 codes for depression (F32.0, F32.1, F32.2, F32.3, F32.8, F32.9, F33.0, F33.1, F33.2, F33.3, F33.4, F33.8, and F33.9). Identification of depression done solely based on diagnosis can be misleading due to the possibility of over-inclusion or misdiagnosis66. Therefore, we investigated the prevalence of two more categories of depression. One was the prevalence of depression diagnosis and a history of antidepressant treatment (‘Dx and Mx’ group), and the other was prevalence of depression diagnosis or a history of antidepressant treatment (‘Dx or Mx’ group). The ‘Dx and Mx’ and ‘Dx or Mx’ groups were identified based on the availability of patient claims records with a diagnosis of depression along with records of prescription of antidepressants, and of claims records with a diagnosis of depression or records of prescription of antidepressants, respectively. Here, antidepressants included all in the market available in South Korea during the study period: Selective Serotonin Reuptake Inhibitors, Serotonin-Norepinephrine Reuptake Inhibitors, Norepinephrine-Dopamine Reuptake Inhibitors, Tricyclic antidepressants, Monoamine Oxidase Inhibitors.

Statistical analyses. We calculated the annual age- and sex-standardized prevalence of depression from 2002 to 2013 and annual age- and sex-standardized incidence of depression from 2005 to 2013, which were standardized based on the cohort structure of 2013 (Supplementary Table 2). Only individuals with no previous diagnosis for depression from 2002 to 2004 were counted as incident cases for the relevant year. The annual prevalence according to sex and age groups was calculated in 2002 and 2013 to visualize the pattern of increased prevalence during the decade. The presence of any linear trends in time for annual prevalence was tested using the chi-square test. Survival analysis was performed using Cox’s proportional models to determine the associations between population characteristics (age group, sex, socioeconomic position measured by income group, living in metropolitan versus non-metropolitan area, and diagnosis of depression) and the risk of committing suicide. We selected cases of incidence in 2008 to analyse the latest five-year suicide for the depressive disorder. Randomly selected non-case controls, subjects with no major depressive disorder, were matched with a ratio of 3:1 to the patients with major depressive disorder from the NHIS-NSC in 2008, according to age and sex (Supplementary Table 3). All statistical analyses were conducted using the R package ver. 3.2.3.

Data availability
The data that support the findings of this study are available from the Korea National Health Insurance Service upon reasonable request and with the appropriate review process.

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Y.W.S. and M.W.J. contributed to the idea and design of this study. Y.W.S. and M.W.J. contributed to data collection, data analysis, and preparation of figures. G.E.K., M.W.J. and Y.W.S. drafted and revised the manuscript. All authors approved the final version of the manuscript.

Competing interests
The authors declare no competing interests.

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