Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original article

Trends in Depressive Symptoms and Suicidality of South Korean Adolescents: Comparison of Expected and Observed Prevalence During the COVID-19 Pandemic

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A B S T R A C T

Purpose: Depressive symptoms and suicidality of adolescents during the COVID-19 pandemic are emerging public health issues. However, there is a lack of representative studies on adolescents' mental health that considers the preceding secular trends.
Methods: This descriptive study used nationally representative cross-sectional data of Korean adolescents from the Korea Youth Risk Behavior Survey from 2005 to 2020 (N = 1,035,382). We utilized joinpoint regression analysis to explore the temporal prevalence trends of depressive symptoms, suicidal ideation, and suicide attempts. Based on the annual percentage change until 2019, the expected and actual prevalence in 2020 (N = 54,948) was compared to describe departures of prevalence from the trend line. These trends between sex, school level, ethnic status, and socioeconomic status were also compared.
Results: Considering the recent increase in secular trends until 2019, the actual observed values in 2020 were lower than expected by 13% in depressive symptoms, 20% in suicidal ideation, and 40% in suicide attempts. The gap between sexes, school levels, ethnic status, and socioeconomic groups was similar or narrowed in 2020 compared to previous trends.
Discussion: We observed a lower prevalence of depressive symptoms and suicidality among Korean adolescents than expected about 9 months from the beginning of the COVID-19 pandemic despite the recent increase in secular trends.

IMPLICATIONS AND CONTRIBUTION

During the COVID-19 pandemic, there was a lower prevalence of depressive symptoms and suicidality among Korean adolescents than expected. This highlights the effect of environmental changes due to the pandemic on adolescent's mental health might be complex. Preventive strategies for mental disorders in adolescents need to focus on at-risk groups.

As the novel COVID-19 pandemic spreads worldwide, many researchers have raised concerns that this could lead to the deterioration of mental health among adolescents [1–3]. South Korea and other countries have implemented preventive measures involving school closures, online learning, and outdoor restrictions [4,5]. Despite relatively low morbidity and mortality of COVID-19 in adolescents [6], these environmental changes could lead to disruption of daily routine and restriction of physical activity and social interaction, resulting in increased depressive symptoms and suicidality among them.

Adolescence is a vulnerable period for developing depressive symptoms and suicidality because of drastic changes in biological and social systems during this life stage [7]. During puberty, adolescents experience a decrease in parental

Conflicts of interest: The authors have no conflicts of interest to disclose.

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supervision and an increase in peer interactions and conflict with their parents [8]. However, their ability to regulate emotions and cope with distress is still relatively immature, which heightens the risk for depressive symptoms and suicidality [9]. Due to these concerns, South Korea has implemented various mental health policies and services for adolescents after the enactment of the Mental Health Act in 1995. Several evidence-based suicide prevention programs have been offered by the Korean Government. These include referral to mental health professionals outside of the school and screening program with validated tools such as Adolescent Mental Health and Problem Behavior Questionnaire-II and Child Personality and Mental Health Screening Questionnaire-II [10,11]. These changes in accessibility to mental health services might affect the historical trend in prevalence of depressive symptoms and suicidality, and the secular trend might affect the prevalence observed during the COVID-19 pandemic.

Previous studies on adolescent depressive symptoms and suicidality during the COVID-19 pandemic have used various study designs with both methodological advantages and disadvantages [12–14]. A systematic review of 45 cross-sectional and 16 longitudinal studies conducted around the world including China, the Netherlands, the United States, and Australia concluded that children and adolescents suffered from anxiety, depression, and suicidal ideation during the COVID-19 pandemic [14]. The review, however, could not fully address the underlying long-term trend because it summarized mostly cross-sectional studies. Another recent systematic review and meta-analysis summarized 65 longitudinal studies conducted around the world examining changes in mental health before and during the pandemic in 2020 [15]. The article concluded that mental health symptoms slightly increased following the COVID-19 pandemic in most 28 countries including Germany, the United States, China, and Brazil, but decreased and returned to prepandemic levels by mid-2020 [15]. However, most of the cited studies in the review paper had limitations, such as small sample size and lack of representativeness with the possibility of attrition bias. In addition, according to previous studies, there is also the possibility that depressive symptoms and suicidality during the COVID-19 pandemic are heterogeneous according to which subgroups they pertain to. It has been shown that female adolescents, older adolescents, adolescents from lower socioeconomic backgrounds, and ethnic minority adolescents are more susceptible to depressive symptoms and suicidality [16–19]. The responsiveness to mental health services has been found to differ across subgroups [20], and there is a possibility that mental health trends would continue to differ across these subgroups into 2020.

Therefore, we analyzed the secular prepandemic trends of prevalence using representative population-based repeated cross-sectional data. The aim of this descriptive study was to compare the expected and observed prevalence to describe the changes in self-reported depressive symptoms, suicidal ideation, and suicide attempts that occurred during the COVID-19 pandemic. We adopted the joinpoint regression model to estimate the average percent change in the prepandemic trends of depressive symptoms, suicidal ideation, and suicide attempts and evaluated discrepancies in these trends between sex, school levels, ethnic minority status, and socioeconomic status.

Methods

Study participants

We used Korea Youth Risk Behavior Survey (KYRBS) data from 2005 to 2020 to calculate the prevalence of depressive symptoms, suicidal ideation, and suicide attempts among middle and high school students each year (total N = 1,090,330). The KYRBS is a population-based annual cross-sectional study conducted by the Korea Disease Control and Prevention Agency to investigate health-related behaviors among adolescents (aged 12–18 years) across all 17 provinces in South Korea. To represent middle and high school students across the country, participants were selected using nationwide stratified multistage random cluster sampling. Written informed consent to participate was obtained from the participants and not from their parents. The survey was conducted anonymously and self-administered by the participants. On the day of the survey, all participants attended school and participated in the survey in the school's computer room. The response rates of KYRBS ranged from 88.9% to 97.7% (Table A1) [21,22]. The 16th KYRBS was conducted from August to November 2020, when the participants were facing the second and third waves of COVID-19 pandemic (relevant contexts were cited from the Oxford COVID-19 Government Response Tracker; see Table A2) [23,24].

Depressive symptoms and suicidality

In this self-administered web-based survey, participants provided binary responses of "yes" or "no" to items on experience of depressive symptoms, suicidal ideation, and suicide attempt within a year. The question for measuring the experience of depressive symptoms was "During the past 12 months, did you ever feel sad or hopeless almost every day for 2 weeks or more in a row, so that you stopped doing some usual activities?" The question for measuring experience of suicidal ideation was "During the past 12 months, did you ever seriously consider attempting suicide?" The question for measuring experience of suicide attempt was "During the past 12 months, did you ever actually attempt suicide?" Additionally, we used data on suicide plans for a sensitivity analysis. Suicide plans were assessed from 2011 to 2020 by answering yes or no to the question, "During the past 12 months, have you ever planned to attempt suicide?" The KYRBS has used these measurements for 16 years (2005–2020) to monitor mental health in Korean adolescents [25].

Demographic characteristics

We used information on each participant's sex, school level, ethnic minority status, and perceived household socioeconomic status (SES) to stratify the subgroups. Middle school students had 7–9 years of education while high school students had 10–12 years. The SES was assessed by a question, "What is the economic status of your household?", using a five-point Likert scale (low, middle-low, middle, middle-high, and high). We reclassified the SES groups into three groups (low, middle, and high) to estimate representative prevalence and minimize random variability within each SES group. Participants who reported middle-low and low household income were included in the low SES group, while those who reported middle-high and high

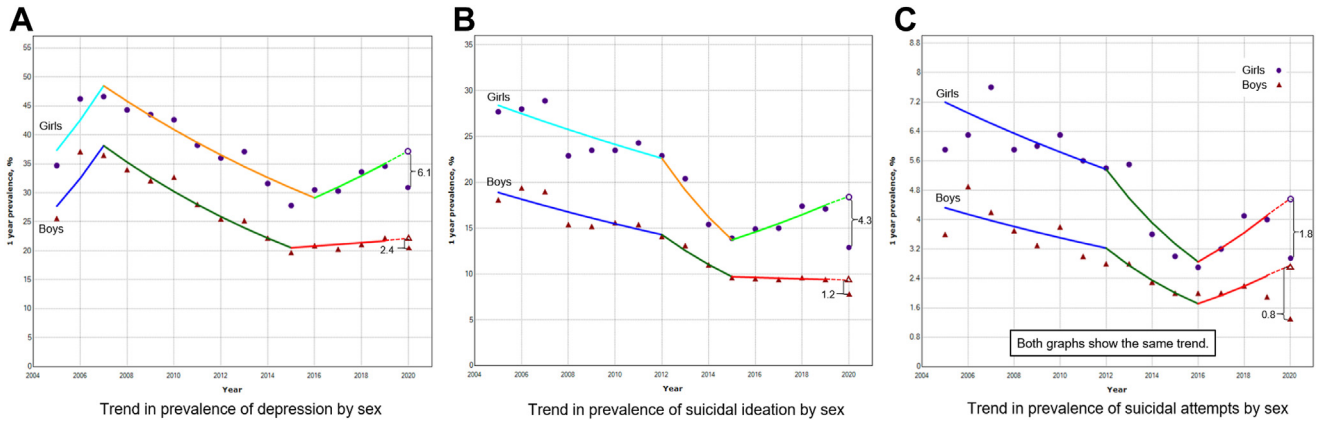

Figure 1. Trends in 1-year prevalence of depression, suicidal ideation, and suicide attempts in Korean adolescents stratified by sex (boys and girls); KYRBS (2005–2019). The same color scheme within each plot indicates parallelism between the two trends as tested by pairwise comparison analysis. The circle represents girls, and the triangle represents boys. The lined symbol represents expected prevalence in 2020. (A) Trends in depression prevalence based on the joinpoint regression analysis stratified by sex. (B) Trends in suicidal ideation prevalence based on the joinpoint regression analysis stratified by sex. (C) Trends in suicide attempts prevalence based on the joinpoint regression analysis stratified by sex.

household income were included in the high SES group. In this subgroup analysis, the SES data in 2005 were excluded because the data had different response coding (low, middle-low, middle-high, and high). The information on ethnic status of participants was identified with parental country of birth. The reason the ethnic status was used for subgroup analysis is that South Korea is regarded as an ethnically homogeneous country, and the ethnic minority adolescents are in a uniquely vulnerable social position [26]. Participants with at least one parent born in a foreign country were defined as being in an ethnic minority group. If respondents did not agree to provide information on their parents' nationality, their data were excluded from this subgroup analysis.

Statistical analysis

Weighted frequencies and percentages were calculated annually to estimate the 1-year prevalence and standard errors of depressive symptoms, suicidal ideation, and suicide attempts in Korean adolescents from 2005 to 2020. Sample weights were calculated by multiplying the inverse of the sampling rate by the inverse of the response rate and then multiplying the product by the postcalibration rate of weight [21].

We then analyzed the trend in the prevalence of depressive symptoms and suicidal behaviors from 2005 to 2019 (N = 1,035,382) using the joinpoint regression model. This model assesses changes in time series data that happen following changes in external conditions and identifies and evaluates when changes in population parameters occur [27]. In the joinpoint regression model, we used the natural logarithm of the weighted prevalence as a dependent variable and the year as an independent variable. Additionally, the joinpoint regression models by sex, school level, and ethnic status were tested for pairwise comparison to assess whether the changes in trends among each group were identical. The pairwise comparison tests were not conducted for the SES subgroups since the joinpoint regression analysis allows pairwise comparison of two groups, but not for three or more groups. The significance levels for the pairwise comparison tests were adjusted for the multiple comparisons [28].

Next, we calculated the expected prevalence of depressive symptoms, suicidal ideation, and suicide attempts in 2020 based on annual percent change (APC), following the trend from the previous regression line without an actual observed value in 2020, and compared it with the observed prevalence in 2020 [29]. For example, if the APC was 1% and the prevalence was 10% in 2019, the expected prevalence would be 10*1.01 = 10.1% in 2020. Therefore, we assumed that the trend in prevalence remained unchanged in 2020 and estimated the expected prevalence in 2020 based on the estimated APC in 2019. For comparison, we used two indicators: absolute difference and relative ratio. The absolute difference was calculated by subtracting the expected prevalence from the observed prevalence. The relative ratio was obtained by dividing the observed prevalence by the expected prevalence.

We used the Joinpoint Regression Program software version 4.9.0.0 (Statistical Research and Applications Branch, National Cancer Institute, Rockville, MD) and SAS version 9.4 (SAS Institute, Cary, NC).

Ethical statement

The KYRBS was approved by the Institutional Review board of the Korea Centers for Disease Control and Prevention, and written informed consent was obtained directly from all the participants [22].

Results

Previous trends in the prevalence of depressive symptoms, suicidal ideation, and suicide attempts

Among Korean adolescents, the overall prevalence of depressive symptoms for more than 2 weeks decreased from 29.9% in 2005 to 25.2% in 2020. The overall prevalence of suicidal ideation reduced from 22.6% in 2005 to 10.9% in 2020. The overall prevalence of suicide attempts also decreased from 4.7% to 2.0% from 2005 to 2020 (Figure A1). A linear regression line could not significantly explain the trends in overall prevalence of depressive symptoms, suicidal ideation, and suicide attempts from

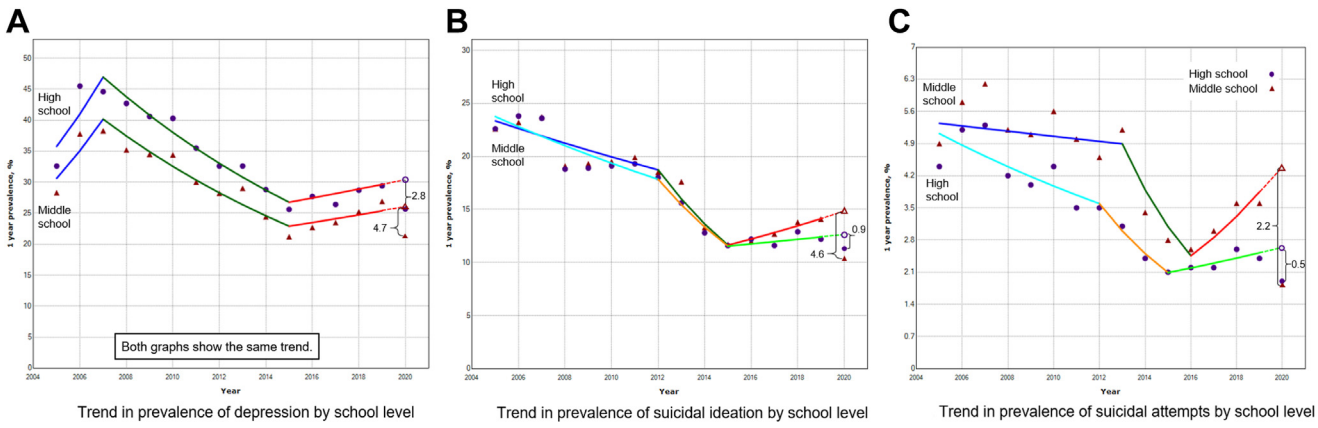

Figure 2. Trends in 1-year prevalence of depression, suicidal ideation, and suicide attempts in Korean adolescents stratified by school level (middle and high school); KYRBS (2005–2019). The same color scheme within each plot indicates parallelism between the two trends as tested by pairwise comparison analysis. The circle represents high school, and the triangle represents middle school. The lined symbol represents expected prevalence in 2020. (A) Trends in depression prevalence based on the joinpoint regression analysis stratified by school level. (B) Trends in suicidal ideation prevalence based on the joinpoint regression analysis stratified by school level. (C) Trends in suicide attempts prevalence based on the joinpoint regression analysis stratified by school level.

2005 to 2019, although it showed an overall decreasing trend [average annual percentage change (AAPC) of depressive symptoms: −1.2 (95% confidence interval [95% CI]: −3.3, 0.9); suicidal ideation AAPC: −4.0 (95% CI: −9.5, 1.7); suicide attempts AAPC: −3.0 (95% CI: −10.5, 5.2)] (Figure A1 and Tables A3–A5).

The overall prevalence of depressive symptoms increased by 15.3% per year from 2005 to 2007 (95% CI: 0.6, 32.1). From 2007 to 2015, the prevalence of depressive symptoms declined annually by 6.8% (95% CI: −8.3, −5.3). The prevalence of depressive symptoms showed an increase from 2015 to 2019 [APC: 2.7 (95% CI: −1.9, 7.4)] (Table A3). The overall prevalence of suicidal ideation decreased by 3.7% per year from 2005 to 2012 (95% CI: −6.4, −0.8). Suicidal ideation decreased from 2012 to 2015 [APC: −13.7 (95% CI: −35.3, 15.1)], followed by increasing trend from 2015 to 2019 [APC: 3.2 (95% CI: −7.1, 14.6)] (Table A4). In terms of suicide attempts, the overall prevalence showed an increase from 2005 to 2007 [APC: 6.9 (95% CI: −15.2, 34.8)], but decreased at an annual rate of 5.9% (95% CI: −11.4, −0.1) from 2007 to 2013, which continued until 2016 [2013–2016 APC: −16.5 (95% CI: −46.6, 30.8)]. The prevalence of suicide attempts showed an increase from 2016 to 2019 [APC: 12.5 (95% CI: −8.8, 38.8)] (Table A5).

The results of the pairwise comparison showed that the trends were different by sex. The prevalence of depressive symptoms, suicidal ideation, and suicide attempts were constantly higher in girls than boys for the whole observed period. The prevalence of depressive symptoms showed the same overall patterns, but recent increase was steeper in girls than in boys [2015–2019 APC in boys: 1.4 (95% CI: −3.5, 6.5); 2016–2019 APC in girls: 6.3 (95% CI: −3.9, 17.6)] (Figure 1A and Table A3). The prevalence of suicidal ideation among girls decreased significantly between 2012 and 2015 and then increased since 2015. Meanwhile, the prevalence of suicidal ideation among boys steadily decreased from 2005 to 2019 (Figure 1B and Table A4). As the pairwise comparison of trends of suicide attempts showed no statistically significant difference between boys and girls, the separated analysis did not elicit important additional conclusions (Figure 1C and Table A5).

According to the pairwise comparison between school levels, the trends of suicidal ideation and suicide attempts showed a statistically significant difference between middle and high school. The trends of suicidal ideation began to differ between those groups in 2015, where middle school students were more likely to experience suicidal ideation than high school students (Figure 2B and Table A4). The percentage of high school students who attempted suicide increased by 4.8% every year since 2015 (95% CI: −9.1, 20.8), while that of middle school students increased by 16.1% since 2016 (95% CI: −2.2, 37.8) (Figure 2C and Table A5). There was no difference in the trend of depressive symptoms among middle and high school students, where the prevalence of depressive symptoms was higher for high school students for 15 years (Figure 2A and Table A3).

The prevalence trends of depressive symptoms, suicidal ideation, and suicide attempts between ethnic minority and ethnic majority teenagers were parallel to each other. Since 2015, the prevalence of depressive symptoms, suicidal ideation, and suicide attempts had increased for both the groups (Figure 3 and Tables A3–A5). The results of the joinpoint regression analysis showed consistent patterns in which the low SES group reported a greater odds of depressive symptoms, suicidal ideation, and suicide attempts than middle and high SES groups from 2006 to 2019 (Figure 4 and Tables A3–A5). The middle and high SES groups featured similar prevalence of depressive symptoms, suicidal ideation, and suicide attempts.

Comparison of the expected and observed prevalence in 2020

The observed prevalence of depressive symptoms, suicidal ideation, and suicide attempts in 2020 were below the expected prevalence that was estimated based on APC in 2019 (Table 1). The observed prevalence of depressive symptoms was 25.19% in 2020, 13% lower than the expected. For suicidal ideation, the observed prevalence in 2020 (10.88%) was 20% lower than the expected prevalence (13.52%). The largest gap between the expected and observed prevalence was for suicide attempts, where the observed prevalence (2.02%) was 40% lower than the expected value (3.38%).

We found that the observed prevalence of depressive symptoms, suicidal ideation, and suicide attempts was lower than expected across all the subgroups (Table 1). The largest gap

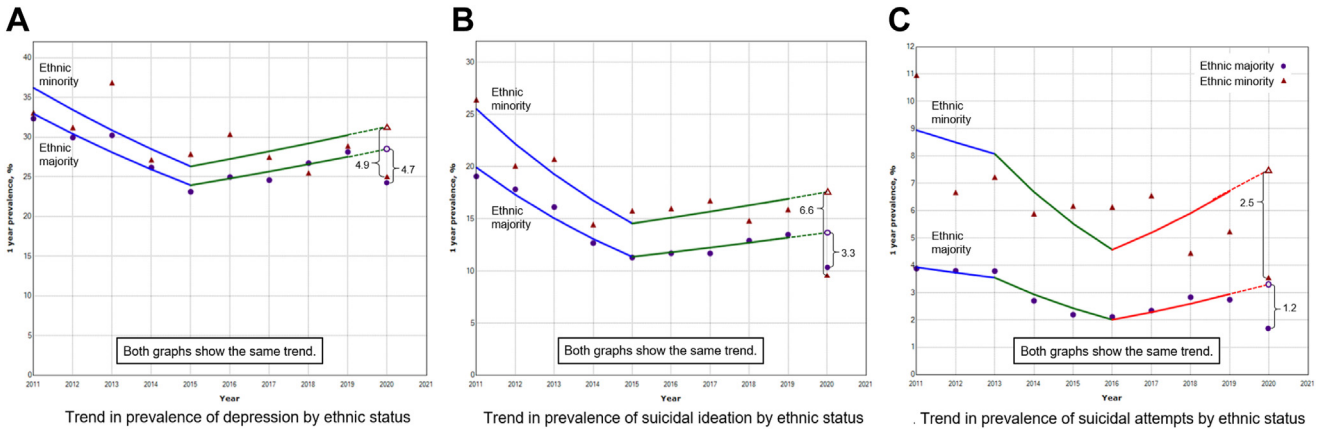

Figure 3. Trends in 1-year prevalence of depression, suicidal ideation, and suicide attempts in Korean adolescents stratified by ethnic status (ethnic minority and majority); KYRBS (2011–2019). The same color scheme within each plot indicates parallelism between the two trends as tested by pairwise comparison analysis. The circle represents the ethnic minority group, and the triangle represents the ethnic majority group. The lined symbol represents expected prevalence. (A) Trends in depression prevalence based on the joinpoint regression analysis stratified by ethnic status. (B) Trends in suicidal ideation prevalence based on the joinpoint regression analysis stratified by ethnic status. (C) Trends in suicide attempts prevalence based on the joinpoint regression analysis stratified by ethnic status.

between expected and observed prevalence was that of suicide attempts among Korean adolescents with low SES (47% lower than expected). The differences in the prevalence of depressive symptoms, suicidal ideation, and suicide attempts between sex, school levels, ethnic status, and SES decreased or at least remained steady, in 2020 compared to the previous trends (Figures 1–3). Furthermore, the sensitivity analysis using suicide plans data corroborated the findings of the current study (Figure A2).

Discussion

In this trend analysis of population-based data collected over the previous 15 years, we found that the prevalence of self-reported depressive symptoms, suicidal ideation, and suicide attempts in 2020 deviated from historical trends from 2005 to 2019. Despite the prevalence of depressive symptoms and suicidality having increased since 2015, the observed prevalence of depressive symptoms, suicidal ideation, and suicide attempts in 2020 were 13%, 20%, and 40% lower than expected, respectively. The gaps between the expected and observed prevalence of depressive symptoms and suicidal behaviors were larger in girls, middle school students, those with low SES, and the ethnic minority.

To our knowledge, the current study is the first descriptive study to comprehensively evaluate the effect of the COVID-19 pandemic on depressive symptoms and suicidal behaviors in general Korean adolescents, while considering long-term secular trends in prevalence. Our study extends previous evidence by demonstrating that decreased depressive symptoms and suicide in 2020 cannot be fully explained by underlying trends. The results from the current study are partly consistent with the previous studies showing that the elevated severity of mental health symptoms in the early stages of the pandemic (March–April) decreased in mid-2020 and was recovered to the pre-pandemic level, which is an indication of psychological resilience [15]. According to previous studies using data of emergency department visits resulting from suicide attempts among Korean adolescents, suicide attempts in Korean adolescents increased between 2015 and 2019 [30], whereas in 2020, the overall trend of suicide attempts did not change significantly from before the pandemic [31]. Improved mental health outcomes among adolescents were also observed in other Asian countries during the pandemic and lockdown [32–35]. A prospective survey of 815 convenience samples of adolescents in Hunan Province, China, found a reduction in depressive symptoms and anxiety symptoms during the Chinese lockdown compared to in 2018 and 2019 [32]. The 4,342 primary and secondary school students from Shanghai, China, perceived benefits from home quarantine, which were correlated with increased life satisfaction during March 2020 [33]. Furthermore, the national suicide statistics of Japan showed that the monthly suicide rate of adolescents slightly decreased from February to June 2020, but then increased by 49% from July to October 2020 [34].

Middle and high schools in South Korea successfully reopened without an abrupt surge in pediatric cases of COVID-19 in 2020. During the period of school closure, the Korean Ministry of Education provided vulnerable students with electronic devices for online learning, possibly mitigating the inequality of education. The South Korean government also distributed free mobile mental health services for the general population, and the core principles of mental health intervention for children and adolescents amid the pandemic were published by Korean Neuropsychiatric Association [36]. These administrative efforts might have contributed to the reduction of distress from social distancing and changing the form of schooling. Meanwhile, a recent study using the KYRBS data found that South Korean adolescents in 2020 spent less time studying, slept better, and experienced less bullying than in 2019 [37]. The majority of South Korean students devote most of their time to schoolwork and private tutoring (*hakwon* in Korean), rather than sleeping, leisure, or socializing [38], and the stress of such academic achievement is closely related to depression and suicide [39–41]. The implementation of online schooling and absolute grading on academic tests during the pandemic may have reduced academic distress by giving students distance from the highly competitive environment.

The current study of adolescent mental health amid the pandemic is not consistent with the previous studies on Korean adults. Despite South Korea successfully controlling the rapid

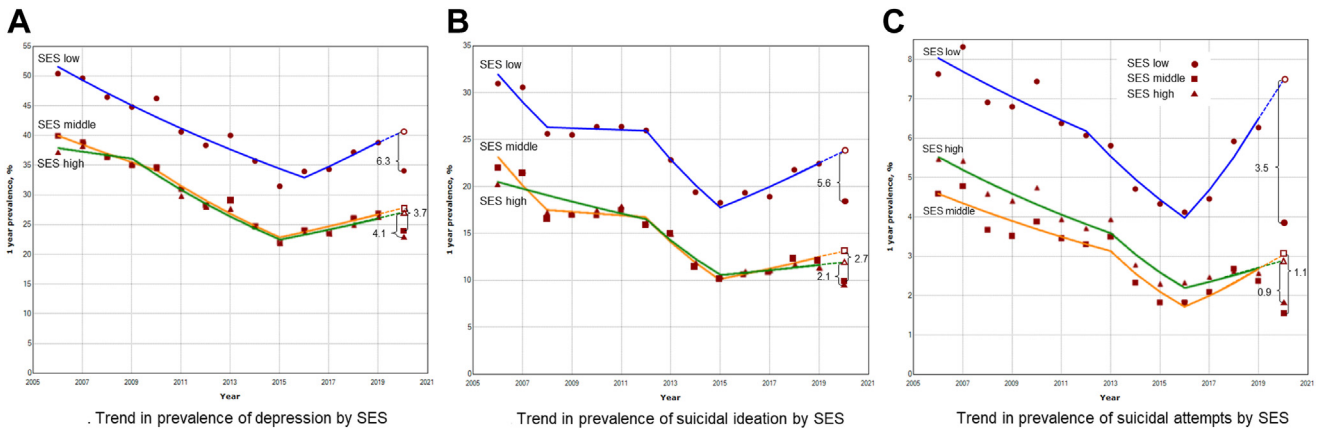

Figure 4. Trends in 1-year prevalence of depression, suicidal ideation, and suicide attempts in Korean adolescents stratified by SES group (low, middle and high level); KYRBS (2006–2019). The color scheme is different from Figures 1–3 because the pairwise comparison analysis were not conducted on the SES subgroup analysis.The blue line represents the low SES group, the orange line represents the middle SES group, and the green line represents the high SES group. The lined symbol represents expected prevalence. (A) Trends in depression prevalence based on the joinpoint regression analysis conducted separately for each SES level. (B) Trends in suicidal ideation prevalence based on the joinpoint regression analysis conducted separately for each SES level. (C) Trends in suicide attempts prevalence based on the joinpoint regression analysis conducted separately for each SES level.

spread of COVID-19 without imposing regional lockdowns, many Korean adults reported deterioration of their mental health in 2020, except for suicide mortality [42–44]. A repeated cross-sectional online survey of Korean adults reported that the prevalence of depressive symptoms and suicidal ideation increased, especially for younger adults, from March to September 2020 [45]. A similar finding was documented in a retrospective cross-sectional study that healthy lifestyles and mental health in Korean adults declined between August and October 2020, compared to before the pandemic [46]. The discordance between the current study and previous research might be explained by the difference in the study population and period. Adults' experiences of the pandemic were different from adolescents' experiences regarding the morbidity and mortality of COVID-19, and the distressing situation each group faced. Emerging adulthood is a period when individuals must embark on their independent life with uncertainty about competence and future [47]. Therefore, the economic recession due to the pandemic might affect the psychological states of adults more than adolescents. Indeed, the depressive symptoms and suicidality of Korean adolescents were associated with their perceived economic decline due to the COVID-19 pandemic [48].

Our results only investigated the data from about 9 months after the COVID-19 outbreak began. We could not analyze the further long-term changes in the trend in prevalence of major mental indices. Although we focused on the current phenomenon induced by COVID-19, it is important to examine the long-term psychological effects because of the possibility of the delayed onset of psychiatric sequelae resulting from prolonged stressful conditions. As seen in the case of previous pandemics such as the Middle East Respiratory Syndrome, the traumatic effects of a pandemic can be delayed for a long time, especially for survivors [49]. An observational study of Severe Acute Respiratory Syndrome interviewed 997 survivors at 6, 12, and 18 months after hospitalization and found that 13% of them exhibited delayed psychological dysfunctions [50].

We also described the trend of depressive symptoms, suicidal ideation, and suicide attempts among Korean adolescents from 2005 to 2019. Korean adolescents' mental health steadily improved until mid-2010, except for the prevalence of depressive symptoms surging during 2005–2007. These trends were fairly similar between boys and girls and middle and high school students, with only minor differences in the extent or timing of changes. These secular changes might be affected by political and administrative efforts to mitigate psychological problems among Korean adolescents. The Ministry of Education, Science and Technology started a mental health screening program for adolescents in 2007. Identified at-risk individuals were referred to specialized mental health centers for adolescents, community mental health centers, or psychiatric hospitals. Moreover, under the Elementary and Secondary Education Act, counseling teachers have been assigned to schools since 2005.

However, since 2015 and 2016, depressive symptoms and suicidality among Korean adolescents have increased. A previous study used the KYRBS data to describe the prevalence of depressive symptoms and suicidality over time [51], but there were few in-depth explanations provided for the specific reasons for the increase from 2015 to 2019. It is possible that increasing academic stress and pressure for college entrance could lead to an increase in depressive symptoms and suicidality since the relationship between academic stress and mental health of South Korean adolescents was reported by several studies [39–41]. Additional in-depth studies should be conducted using data collected in 2015 and 2016 to determine what factors contributed to the increase in suicidality and depression symptoms during these times. Also, despite reductions, there remained disparities in depressive symptoms, suicidal ideation, and suicide attempts between sexes, school levels, ethnicities, and socioeconomic levels. These results highlight that preventive strategies for mental disorders in adolescents need to focus on vulnerable groups such as girls, younger adolescents, lower SES, and ethnic minorities. In particular, it would be helpful to provide vouchers or interdisciplinary care for adolescents from low-income households to access professional mental health services without financial barriers. Generating more evidence related to the mental health of girls is another significant step that needs to be taken. A psychoeducation program that includes sexual education would cultivate the healthy development of adolescent

Table 1
Differences between expected and observed prevalence of depression, suicidal ideation, and suicide attempts in 2020 among South Korean adolescents (N = 54,948)

		2019		2020				
		Prev, %	APC, %	Case N	Prev, %		Difference	
Outcome	Group				Expected	Observed	Absolute, %	Relative
Depression	Total	28.16	2.7	13,840	28.96	25.19	−3.77	0.87
	Sex							
	Boy	21.56	1.4	5,633	22.51	20.08	−2.43	0.89
	Girl	33.89	6.3	8,207	36.78	30.71	−6.07	0.83
	School							
	Middle	26.68	2.6	6,740	27.60	22.94	−4.66	0.83
	High	29.77	2.6	7,100	30.16	27.41	−2.75	0.91
	SES							
	Low	38.77	5.7	2,529	40.99	34.72	−6.27	0.85
	Middle	26.98	4.0	6,385	27.97	24.29	−3.68	0.87
	High	26.65	3.7	4,926	27.34	23.26	−4.08	0.85
	Ethnic status							
	Minority	28.91	3.6	245	29.95	25.03	−4.92	0.84
	Majority	28.14	3.6	9,481	29.15	24.48	−4.67	0.84
Suicidal ideation	Total	13.52	3.2	5,979	13.52	10.88	−2.64	0.80
	Sex							
	Boy	9.24	−0.8	2,254	9.32	8.10	−1.22	0.87
	Girl	17.24	6.3	3,725	18.18	13.88	−4.30	0.76
	School							
	Middle	14.44	5.0	3,013	14.81	10.25	−4.56	0.69
	High	12.52	1.8	2,966	12.42	11.51	−0.91	0.93
	SES							
	Low	23.21	6.1	1,332	23.80	18.21	−5.59	0.77
	Middle	12.78	5.2	2,639	12.75	10.10	−2.65	0.79
	High	11.76	2.4	2,008	11.62	9.50	−2.12	0.82
	Ethnic status							
	Minority	15.89	3.8	100	16.49	9.86	−6.63	0.60
	Majority	13.48	3.8	4,159	13.99	10.72	−3.27	0.77
Suicidal attempts	Total	2.79	12.5	1,121	3.38	2.02	−1.36	0.60
	Sex							
	Boy	1.67	13.0	382	2.15	1.35	−0.80	0.63
	Girl	3.75	13.0	739	4.52	2.75	−1.77	0.61
	School							
	Middle	3.37	16.1	592	4.18	2.01	−2.17	0.48
	High	2.15	4.8	529	2.52	2.04	−0.48	0.81
	SES							
	Low	5.84	17.8	292	7.39	3.94	−3.45	0.53
	Middle	2.42	15.8	447	2.77	1.69	−1.08	0.61
	High	2.38	7.1	382	2.75	1.81	−0.94	0.66
	Ethnic status							
	Minority	5.24	13.6	31	5.95	3.47	−2.48	0.58
	Majority	2.74	13.6	729	3.11	1.89	−1.22	0.61

Participants with at least one parent born in a foreign country were defined as being in an ethnic minority group.
APC = annual percentage change; Prev = prevalence; SES = socioeconomic status.

girls. Lastly, efforts to reduce barriers to access to special care due to stigma are critical in a Korean society that values homogeneity. Therefore, it is imperative to create an inclusive environment that acknowledges diverse backgrounds.

There are several limitations to the current study. First, depressive symptoms, suicidal ideation, and suicide attempts were measured by self-reported single questions answered using computers. Therefore, the prevalence of psychological problems observed in this study could be underestimated [52]. Nevertheless, these measurement tools have comparability in that the KYRBS used the same questionnaire for 16 years (2005–2020). Second, the measures of depressive symptoms and suicidality used in the KYRBS were not validated in the Korean adolescent population. However, the validity and reliability of the measures in the US Youth Risk Behavior Survey, the KYRBS's predecessor, were reported to be satisfactory [53,54]. Further studies should examine the psychometric properties of the KYRBS's measures of depressive symptoms and suicidality, especially in terms of recall bias. Third, 5.4% of Korean adolescents were not included in the sampling procedure because they were not enrolled in school [55]. Although most Korean adolescents are enrolled in school, we cannot extrapolate the prevalence of depressive symptoms and suicidality among out-of-school adolescents from this study. In addition, the response rate of schools in 2020 (99.1%) was slightly lower than that in 2019 and 2018 (100%, see Table A1). In order to minimize the possibility of selection bias, we used sampling weights to estimate prevalence that considered sampling rate and response rate. According to the report of the Korea Disease Control and Prevention Agency, the distribution of weights in 2020 KYRBS was similar to the surveys in 2019 and 2018, and the deviation of weights was not large [55], which validates the representativeness of KYRBS data in 2020. Fourth, we could not use the objective measure of SES but instead relied on a subjective report of perceived household income. Although the previous study supported that the self-report of SES by adolescents could be as valid as that by adults [56], the results of

trend analysis using objective measures of SES may differ from those of this study. In addition, the reclassification of perceived SES into three groups might introduce misclassification bias. The findings of the SES subgroup analysis should therefore be interpreted as exploratory and further research linked to external SES data is necessary in order to validate the results. Finally, the same analytical approach utilized in this study could be used to evaluate the suicides committed or attempted by adolescents during the pandemic. Although a previous study using emergency department visits due to suicide attempts among Korean adolescents showed similar results to the findings of this study [31], the actual suicide attempts might differ from self-reported suicide attempts.

Our study used nationally representative data of adolescents across South Korea. The participant selection and data collection procedures were consistent over the 16-year period. We also calculated the prevalence of depressive symptoms and suicidality based on 1,090,330 participants. Moreover, we considered prior trends in prevalence when assessing the psychological changes in adolescents in 2020. These approaches enabled us to understand the pre-COVID-19 environment and context, allowing us to evaluate the impact of the pandemic on adolescent mental health with greater accuracy. In addition, we evaluated the prevalence not only in the total adolescent population but also in sub-populations divided by sex, school level, ethnic status, and SES. This allowed us to observe in detail how the effects of COVID-19 on pediatric mental health varied for each subgroup.

Despite the recent increasing trends in the prevalence of depressive symptoms, suicidal ideation, and suicide attempts, we observed the prevalence of self-reported depressive symptoms, suicidal ideation, and suicide attempts in 2020 deviated from the historical trends from 2005 to 2020. The gaps in the prevalence of depressive symptoms, suicidal ideation, and suicide attempts between sex, school level, ethnic status, and SES groups were similar or decreased in 2020 compared to the previous trends. However, since the long-term effects have not yet been evaluated, further monitoring and care are needed. Although it has narrowed, the mental health disparity between subgroups still existed in 2020. Therefore, we recommend that preventive strategies for mental disorders in adolescents during the COVID-19 pandemic be developed by focusing on at-risk groups such as female, lower SES, and ethnic minority adolescents. Further, individual-level investigations are needed to clarify what and how risk factors or protective factors changed during the COVID-19 pandemic.

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Supplementary Data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jadohealth.2023.02.014.

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