Mental Health of Korean Adolescents in the Era of COVID-19: Web-based Survey Focused on Suicide-related Factors

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Research Article

Keywords: COVID-19, Republic of Korea, adolescents, mental health, suicidal ideation, suicide planning, suicide attempt

Posted Date: February 28th, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1385359/v1>

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Abstract

Background: The coronavirus disease 2019 (COVID-19) pandemic has negatively impacted many aspects of life. In particular, measures for combatting the spread of the virus, such as quarantining and restrictions on social gatherings, may have led to psychological anxiety and depressive symptoms among adolescents. Such mental health impacts may increase the risk of suicidal ideation. This study aimed to examine mental health among adolescents amid the prolonged COVID-19 pandemic, and identify and analyze predictors of suicidal ideation, suicide planning, and suicide attempts.

Methods: Data for 57,925 adolescents who participated in the 2020 Korea Youth Risk Behavior Web-based Survey were used for this research. Based on their responses to suicide-related questions, the sample was divided into a healthy group, suicide-ideation group, suicide-planning group, and suicide-attempt group, respectively. The groups' descriptive statistics were then analyzed. An analysis of covariance, post-hoc tests, and multiple logistic regression were performed on the four groups.

Results: Overall, 6.9% of the participants reported suicidal ideation, 2.2% reported planning suicide, and 1.9% reported attempting suicide in the previous 12 months. Stress, sadness and despair, loneliness, and generalized anxiety disorder were all highest in the suicide-attempt group and lowest in the healthy group. Sex, academic achievement, economic status, impact of COVID-19 on economic status, sleep, alcohol use, drug use, smartphone overdependence, and suicide-associated factors significantly predicted adolescents' mental health status.

Conclusions: Amid the prolonged COVID-19 pandemic, there is a strong need for various individualized programs that identify and intervene to support adolescents with a suicidal risk by accurately assessing their mental health risk factors, such as stress, sadness and despair, loneliness, and generalized anxiety disorder.

Background

As a result of its high infectivity, the coronavirus disease 2019 (COVID-19) has spread rapidly and widely around the world and has caused many deaths; thus, it has had grave impacts across society. However, the impact of COVID-19 is not limited to physical morbidity and mortality—it has triggered a global financial crisis and substantial sociocultural changes, and has also caused changes in individuals' daily lives. For instance, since early 2020, the global prevalence of anxiety and depression has almost doubled, and this can be largely attributed to the effects of the COVID-19 pandemic [1].

The 2003 Severe Acute Respiratory Syndrome (SARS) epidemic affected individuals across 30 different countries. A study that evaluated the mental health of a sample of SARS survivors from Hong Kong reported that, at 30 months after the epidemic had ended, 47.8% were still experiencing posttraumatic stress disorder and 25.6% were showing persistent mental health problems [2]. In May 2015, an outbreak of the Middle East Respiratory Syndrome reached Korea; this resulted in the closure of some schools and hospitals, and individuals with suspected symptoms were required to self-isolate for 2 weeks. A study of individuals who had completed their isolation by mid-June 2015 found that, by September–November 2015, 50% were still feeling anxiety while 50% were feeling anger; further, at approximately 4–6 months after their period of isolation, 20% continued to feel anxiety while 30% felt anger [3]. A population's psychological responses during an explosive outbreak of an infectious disease can not only accelerate the spread of the disease, but can also trigger emotional distress and social impairments that persist even after the eradication of the disease [4, 5].

Adolescence is a key period for the development of one's character, but the continuing threat of the COVID-19 pandemic means many contemporary adolescents have been forced to spend some of these formative years in relative isolation. The consequent psychological anxiety and depressive symptoms such adolescents have felt have had a tremendous negative impact on their mental health [6]. Moreover, normal stress associated with daily and major life events can exacerbate such psychological distress, and may increase the risk of depression and anxiety in later life [7]; for example, the interaction between neglect (e.g., through school closures), anxiety regarding school exams, and exposure to domestic violence has previously been found to trigger anxiety disorder [8].

South Korea has the highest age-standardized suicide rate (23.5, as of 2020) among OECD countries [9], with suicide being the leading cause of death among individuals aged 10–39 years. While the total number of suicide deaths in Korea in 2021 showed a slight drop from the preceding year, the suicide rate among individuals aged 10–29 years showed a marked increase [10]. In particular, sorrow, hopelessness, and depression, which can be caused by the effects of the pandemic, may increase the risk of suicidal ideation [11, 12]. Measures for preventing COVID-19 infection and consequent mortality are crucial for facilitating economic and social recovery [13], however, it is also necessary to consider the means of mitigating the effects of these measures on individuals' mental health. Examining adolescents' mental health amid pandemics and identifying the mental health problems they experience could inform the development of specialized education programs that promote positive mental health among this age group. Therefore, the present study aims to examine mental health among adolescents, including healthy adolescents, amid the prolonged COVID-19 pandemic, and identify the predictors of suicidal ideation, suicide planning, and suicide attempt among this group.

Methods

Data and participants

Raw data from the 16th (2020) Korea Youth Risk Behavior Web-based Survey (KYRBS) was used to perform the present research. The KYRBS is an anonymous, self-report online survey that has been conducted annually by the Korea Disease Control and Prevention Agency and the Korean Ministry of Education since 2005. Its aim is to compute health indices for adolescents and determine their health behaviors. The 2020 survey collected data from 57,925 adolescents (7th – 12th graders) from 800 schools (400 middle schools, 400 high schools) nationwide (guideline reference).

2.2. Variables

The participants were divided into a healthy group, suicide-ideation group, suicide-planning group, and suicide-attempt group, respectively, based on their responses to suicide-related questions. For the question “Have you seriously thought about suicide at any time over the past 12 months?,” participants who answered “no” were allocated to the healthy group, while those who answered “yes” were allocated to the suicide-ideation group. Next, those who answered “yes” to the question “Did you make specific plans to commit suicide at any time over the past 12 months?” were allocated to the suicide-planning group. Finally, those who answered “yes” to the question “Have you attempted to commit suicide at any time over the past 12 months?” were allocated to the suicide-attempt group. Individuals who reported planning and attempting suicide, respectively, were removed from the suicide-ideation group. Thus, the final suicide-ideation group contained only those individuals who had considered suicide but had not made plans or attempted to commit suicide. Meanwhile, the suicide-planning group contained only those who had planned suicide, not those who actually attempted suicide.

The dependent variables were perceived stress, sadness and despair, loneliness, and generalized anxiety disorder (GAD; Table 1). The basic control variables were sex, education level, academic achievement, father’s highest education level, mother’s highest education level, living arrangement (i.e., whether the respondents lived with family members), economic status, impact of COVID-19 on economic status, whether the family received financial assistance, sleep, smoking, drinking, drug use, and smartphone overdependence. A score of 24 or higher on the Smartphone Overdependence Scale (score range: 10–40) was defined as smartphone overdependence.

Table 1
Definitions of key variables

Variables	Definition
Stress	How much stress do you usually experience? 1 (“very high”) to 5 (“no stress at all”). Reverse-coded for analysis in this study; thus, a score of 1 represents “no stress at all.”
Sadness and despair	Have you experienced, at any time in the past 12 months, at least two consecutive weeks of sadness or hopelessness to the point that you put your daily life on hold? 1 (“Not in the past 12 months”) 2 (“Yes”)
Loneliness	How frequently over the past 12 months have you felt lonely? 1 (“never”) to 5 (“constantly”).
GAD	GAD-7, “Seven-item Generalized Anxiety Disorder scale”: 1) Feeling nervous, anxious, or on edge. 2) Not being able to stop or control worrying. 3) Worrying too much about different things. 4) Trouble relaxing. 5) Being so restless that it is hard to sit still. 6) Becoming easily annoyed or irritable. 7) Feeling afraid, as if something awful might happen. Each item was scored between 1 (“not bothered at all”) and 4 (“bothered nearly every day”). GAD score was determined by summing the scores for each of the seven items
GAD: Generalized anxiety disorder	

Perceived stress

Stress is a major predictor of suicidal ideation in adolescence—a period of strong impulses [14]. The degree of suicidal ideation increases as the level of stress increases [15]. Environmental changes provoked by the COVID-19 pandemic have been found to represent stressors for adolescents [16]; however, severe stress, sorrow or hopelessness, and suicide-related behaviors declined among Korean adolescents early in the COVID-19 pandemic [17].

Sadness and Despair

Depression, an emotional disturbance resulting from a negative perception of oneself, is a major factor in suicidal ideation and suicidal impulse [18]. Among the various symptoms of depression, sadness and despair are closely related to suicidal ideation among adolescents [19]. Despair is defined as “a state of mind in which there is an entire want of hope” [20, 21]; upon encountering a stressful situation, adolescents can experience despair rather than motivation to solve the problem, and this can result in a higher likelihood of suicidal ideation [22].

Loneliness

Loneliness is a negative emotion associated with one’s interpersonal relationships, and it can be caused by a lack of attachment to close friends, deficiencies in relationships with significant others, and/or a lack of people with whom to build attachment [23]. Anyone can feel loneliness at least once in their lifetime, but serious cases may lead to mental and physical health problems. The thought of being lonely and alone is strongly associated with suicidal behavior [24, 25].

Generalized anxiety disorder

GAD is understood to be independent to depression [26]. GAD encompasses a shorter list of physical symptoms than depression, instead emphasizing worrying, concerns, and anxiety. It can be diagnosed only when the individual experiences repeated, multi-day episodes of excessive anxiety or worry about various events or activities that persist over a period of 6 months or longer. Patients feel they have no control over their worrying. Patients with GAD show significantly higher odds of suicide [27].

Statistical analysis

The descriptive statistics of the four study groups (healthy, suicide-ideation, suicide-planning, and suicide-attempt groups) were analyzed, and an analysis of covariance, post-hoc tests, and multiple logistic regression were performed on the four groups. All analyses were based on multi-stratified cluster sampling and were performed using STATA 17.0 (StataCorp, College Station, Texas). The statistical significance level was $p < .05$.

Results

Characteristics of the study population

Table 2 shows the general characteristics of the participants (N = 57,925) by group: healthy group (n = 48,573; 83.9%), suicide-ideation group (n = 4,003; 6.9%), suicide-planning group (n = 1,251; 2.2%), and suicide-attempt group (n = 1,121; 1.9%).

The healthy group had more males (53.5%) than females, had a similar ratio of high school (49.9%) students to middle school students (50.1%), and featured the highest percentage of students with high academic achievement (37.4%). Many of the students in this group had parents with college or higher education levels (father 42.9%, mother 42.0%). Meanwhile, 96.4% lived with family members, while 48.0% were middle class. Next, 5.2% stated that they had experienced severe financial hardship as a result of COVID-19, while 91.1% stated that their families had not received any financial assistance. Finally, 34.2% reported average sleep adequacy, 10.0% were smokers, 31.6% were alcohol users, 0.5% had experience of drugs, and 23.7% had smartphone overdependence.

The suicide-ideation group comprised mostly females (60.4%), a higher percentage of high school students (54.3%) than middle school students, and students with poor academic achievement (39.4%). Many of the students had parents with college or higher education levels. Meanwhile, 95.2% lived with family members, while 45.2% were middle class. Next, 8.8% stated that they had experienced severe financial hardship as a result of COVID-19, while 86.6% stated that their families had not received any financial assistance. Finally, 52.1% reported inadequate sleep, 16.9% were smokers, 46.2% were alcohol users, 1.9% had experience of drugs, and 40.2% had smartphone overdependence.

The suicide-planning group comprised mostly females (55.8%), a higher percentage of middle school students (51.8%) than high school students, and students with poor academic achievement (41.2%). Many of the students had parents with college or higher education levels. Meanwhile, 94.6% lived with family members, while 44.0% were middle class. Next, 10.7% stated that they had experienced severe financial hardship as a result of COVID-19, while 84.6% stated that their families had not received any financial assistance. Finally, 53.8% reported inadequate sleep, 18.0% were smokers, 45.4% were alcohol users, 2.3% had experience of drugs, and 36.8% had smartphone overdependence.

The suicide-attempt group was predominantly female (65.4%), had a similar ratio of high school (49.3%) and middle school students (50.7%), and was the group with the highest percentage of students with poor academic achievement (47.3%). The percentage of students whose fathers were college graduates (40.6%) was similar to the percentage of students who did not know their father's education level (41.1%). Most students' mothers had college or higher education levels. Meanwhile, 91.0% lived with family members, while 39.7% were middle class. Next, 14.7% stated that they had experienced severe financial hardship as a result of COVID-19, while 84.6% stated that their families had not received any financial assistance. Finally, 56.0% reported inadequate sleep, 30.9% were smokers, 56.5% were alcohol users, 6.6% had experience of drugs, and 36.2% had smartphone overdependence.

Table 2
Characteristics of the study population

Variables		Healthy adolescents (N = 48,573)			Suicide-ideation adolescents (N = 4,003)			Suicide-plan adolescents (N = 1,251)			Suicide-attempt adolescents (N = 1,121)	
		no.	Weighted no.	Weighted %	no.	Weighted no.	Weighted %	no.	Weighted no.	Weighted %	no.	Weighted no.
Sex	Male	25,880	1,244,439	53.5	1,552	75,593	39.6	539	26,365	44.2	382	18,443
	Female	22,693	1,083,465	46.5	2,451	115,455	60.4	712	33,303	55.8	739	34,825
Education level	Middle	25,699	1,160,962	49.9	1,980	87,276	45.7	690	30,881	51.8	592	26,247
	High	22,874	1,166,942	50.1	2,023	103,772	54.3	561	28,787	48.2	529	27,021
Academic achievement	Poor	15,567	743,845	32.0	1,598	75,191	39.4	521	24,555	41.2	531	25,215
	Middle	14,916	713,371	30.6	1,059	50,541	26.5	339	16,152	27.1	271	12,896
	High	18,090	870,688	37.4	1,346	65,316	34.2	391	18,961	31.8	319	15,157
Father education level	Under high school	8,853	401,796	17.3	786	35,023	18.3	225	10,241	17.2	213	9,738
	College or higher	20,023	997,547	42.9	1,685	83,770	43.8	509	25,588	42.9	421	21,623
	Unknown	19,697	928,561	39.9	1,532	72,255	37.8	517	23,839	40.0	487	21,908
Mother education level	Under high school	10,166	46,541	2.0	962	44,336	23.2	266	12,279	20.6	262	12,792
	College or higher	19,695	976,940	42.0	1,608	78,578	41.1	481	23,833	39.9	423	20,549
	Unknown	18,712	881,423	37.9	1,433	68,134	35.7	504	23,556	39.5	436	19,927
Living arrangement	With family	46,379	2,244,820	96.4	3,772	181,951	95.2	1,170	56,445	94.6	1,011	48,463
	Without Family	2,194	83,084	3.6	231	9,097	4.8	81	3,223	5.4	110	4,805
Economic status	Low	5,810	268,411	11.5	837	38,224	20.0	273	12,013	20.1	292	13,077
	Middle	23,582	1,116,796	48.0	1,812	86,389	45.2	556	26,273	44.0	447	21,166
	High	19,181	942,697	40.5	1,354	66,436	34.8	422	21,383	35.8	382	19,025
Economic status changed due to COVID-19	Not at all	14,767	718,326	30.9	940	46,767	24.5	305	14,820	24.8	256	12,535
	Really	19,518	939,020	40.3	1,536	73,861	38.7	430	20,294	34.0	357	16,852
	Changed	11,698	549,901	23.6	1,163	53,584	28.0	389	18,160	30.4	333	16,050
	Critically	2,590	120,658	5.2	364	16,837	8.8	127	6,394	10.7	175	7,831
Financial assistance	No	43,961	2,121,168	91.1	3,437	165,410	86.6	1,053	50,486	84.6	934	45,084
	Yes	4,612	206,736	8.9	566	25,638	13.4	198	9,182	15.4	187	8,184
Sleep	Adequate	15,721	745,642	32.0	671	31,280	16.4	244	11,509	19.3	188	9,115
	average	16,750	795,703	34.2	1,260	60,185	31.5	344	16,039	26.9	302	14,316
	Inadequate	16,102	786,559	33.8	2,072	99,582	52.1	663	32,121	53.8	631	29,837
Smoking	No	43,766	2,096,121	90.0	3,308	158,675	83.1	1,024	48,923	82.0	769	36,822
	Yes	4,807	231,783	10.0	695	32,373	16.9	227	10,745	18.0	352	16,447
Drinking	No	33,285	1,593,087	68.4	2,144	102,850	53.8	687	32,578	54.6	475	23,150
	Yes	15,288	734,817	31.6	1,859	88,198	46.2	564	27,090	45.4	646	30,118
Drug use	No	48,346	2,316,576	99.5	3,931	187,475	98.1	1,226	58,300	97.7	1,040	49,752
	Yes	227	11,328	0.5	72	3,573	1.9	25	1,368	2.3	81	3,516

* <0.05, ** <0.01, *** <0.001

Variables		Healthy adolescents (N = 48,573)			Suicide-ideation adolescents (N = 4,003)			Suicide-plan adolescents (N = 1,251)			Suicide-attempt (N = 1,121)	
		no.	Weighted no.	Weighted %	no.	Weighted no.	Weighted %	no.	Weighted no.	Weighted %	no.	Weighted no.
Smartphone	No	37,209	1,776,021	76.3	2,434	114,313	59.8	809	37,702	63.2	721	33,990
	Yes	11,364	551,883	23.7	1,569	76,735	40.2	442	21,966	36.8	400	19,278
overdependence												
* <0.05, ** <0.01, *** <0.001												

Comparisons of stress, sadness and despair, loneliness, and GAD among the different groups of adolescents

Comparisons of the key variables are displayed in Fig. 1.

The suicide-attempt group showed the highest level of stress (4.136); this group was followed by the suicide-ideation group (3.938), suicide-planning group (3.923), and healthy group (3.065), respectively. The difference was statistically significant ($p < .0001$).

The suicide-attempt group showed the highest level of sadness and despair (1.807); this group was followed by the suicide-ideation group (1.684), suicide-planning group (1.680), and healthy group (1.192), respectively. The difference was statistically significant ($p < .0001$).

The suicide-attempt group showed the highest level of loneliness (3.645); this group was followed by the suicide-ideation group (3.331), suicide-planning group (3.305), and healthy group (2.281), respectively. The difference was statistically significant ($p < .0001$).

The suicide-attempt group showed the highest level of GAD (10.252); this group was followed by the suicide-planning group (8.685), suicide-ideation group (8.131), and healthy group (3.289), respectively. The difference was statistically significant ($p < .0001$).

Predictors of mental health status among Korean adolescents

Table 3 shows the results of the multiple logistic regression analysis that was performed to identify the predictors of mental health status among Korean adolescents.

The odds ratios (ORs) for stress, sadness and despair, loneliness, and GAD were higher among males than females (stress OR = 1.779, 95% CI = 1.700–1.862; sadness and despair OR = 1.632, 95% CI = 1.561–1.707; loneliness OR = 1.768, 95% CI = 1.703–1.836 and GAD OR = 1.581, 95% CI = 1.517–1.646). Regarding education level, the ORs for stress (OR = 1.113, 95% CI = 1.063–1.166) and GAD (OR = 1.071, 95% CI = 1.027–1.116) were higher among high schoolers than middle schoolers. Regarding academic achievement, the ORs were lower among students with good grades than those with poor grades (stress in high ORs = 0.901, 95% CI = 0.852–0.953; sadness and despair in middle ORs = 0.843, 95% CI = 0.799–0.890; in high ORs = 0.770, 95% CI = 0.729–0.813; loneliness in middle ORs = 0.893, 95% CI = 0.853–0.936; in high ORs = 0.940, 95% CI = 0.897–0.984; and GAD in middle ORs = 0.908, 95% CI = 0.863–0.954; in high ORs = 0.937, 95% CI = 0.892–0.985). The ORs for stress, sadness and despair, and loneliness were higher among students whose fathers were college graduates than among those whose fathers had high school or lower education levels (stress in college or higher ORs = 1.134, 95% CI = 1.055–1.218; in unknown ORs = 1.094, 95% CI = 1.005–1.191; sadness and despair in college or higher ORs = 1.086, 95% CI = 1.013–1.164; loneliness in college or higher ORs = 1.073, 95% CI = 1.011–1.139). The ORs for GAD was lower among students whose mothers were unknown than among those whose mothers had below high school education (ORs = 0.928, 95% CI = 0.862–0.999). Regarding living arrangement, the ORs for loneliness was higher among students who lived with a non-family member than those who lived with a family member (ORs = 1.182, 95% CI = 1.084–1.290). Regarding economic status, the ORs were lower among students with middle and high status than those with low status (stress in middle ORs = 0.781, 95% CI = 0.721–0.847; in high ORs = 0.704, 95% CI = 0.647–0.766; sadness and despair in middle ORs = 0.857, 95% CI = 0.801–0.917; loneliness in middle ORs = 0.754, 95% CI = 0.709–0.801; in high ORs = 0.715, 95% CI = 0.669–0.764; and GAD in middle ORs = 0.767, 95% CI = 0.721–0.817; in high ORs = 0.743, 95% CI = 0.693–0.795). The ORs were higher among those who had experienced financial hardship as a result of COVID-19 than among those who did not experience such financial difficulty (stress in really ORs = 1.310, 95% CI = 1.245–1.379; in changed ORs = 1.507, 95% CI = 1.418–1.603; in critically ORs = 1.540, 95% CI = 1.382–1.715; sadness and despair in really ORs = 1.068, 95% CI = 1.011–1.128; in changed ORs = 1.294, 95% CI = 1.218–1.376; in critically ORs = 1.645, 95% CI = 1.497–1.808; loneliness in really ORs = 1.336, 95% CI = 1.277–1.398; in changed ORs = 1.585, 95% CI = 1.505–1.669; in critically ORs = 1.536, 95% CI = 1.409–1.674 and GAD in really ORs = 1.196, 95% CI = 1.137–1.257; in changed ORs = 1.382, 95% CI = 1.307–1.462; in critically ORs = 1.500, 95% CI = 1.370–1.641). Regarding financial assistance, the ORs for sadness and despair, loneliness, and GAD were higher among students who lived with a non-family member than those who lived with a family member (sadness and

despair ORs = 1.147, 95% CI = 1.068–1.1233; loneliness ORs = 1.133, 95% CI = 1.062–1.208; GAD ORs = 1.115, 95% CI = 1.402–1.193). The ORs were higher among those who had adequate sleep than among those who had not experienced adequate sleep (stress in average ORs = 2.242, 95% CI = 2.133–2.358; in inadequate ORs = 3.197, 95% CI = 3.024–3.381; sadness and despair in average ORs = 1.399, 95% CI = 1.320–1.483; in inadequate ORs = 2.132, 95% CI = 2.016–2.255; loneliness in average ORs = 1.666, 95% CI = 1.592–1.743; in inadequate ORs = 2.206, 95% CI = 2.107–2.311; and GAD in average ORs = 1.639, 95% CI = 1.555–1.728; in inadequate ORs = 2.759, 95% CI = 2.621–2.905). The values for sadness and despair (ORs = 1.405, 95% CI = 1.310–1.507) and for loneliness (ORs = 1.256, 95% CI = 1.176–1.340) were higher among smokers than non-smokers. The ORs for all four mental health conditions were higher among those with inadequate sleep, alcohol users, drug users, and individuals with smartphone overdependence.

Table 3
Multiple logistic regression analysis on stress, sadness and despair, loneliness, and generalized anxiety disorder of 54,948 students

Variables		Stress		Sadness and despair		Loneliness		GAD	
		ORs	p	ORs	p	ORs	p	ORs	p
		(95%	CI)	(95%	CI)	(95%	CI)	(95%	CI)
Sex (Ref.=Male)	Female	1.779	***	1.632	***	1.768	***	1.581	***
		1.700	1.862	1.561	1.707	1.703	1.836	1.517	1.646
Education level (Ref.= Middle)	High	1.113	***	0.999		1.002		1.071	**
		1.063	1.166	0.955	1.046	0.964	1.041	1.027	1.116
Academic achievement (Ref.=Poor)	Middle	0.989		0.843	***	0.893	***	0.908	***
		0.935	1.046	0.799	0.890	0.853	0.936	0.863	0.954
	High	0.901	***	0.770	***	0.940	**	0.937	*
		0.852	0.953	0.729	0.813	0.897	0.984	0.892	0.985
Father education level (Ref.= Below high school)	College or higher	1.134	**	1.086	*	1.073	*	1.060	
		1.055	1.218	1.013	1.164	1.011	1.139	0.995	1.130
	Unknown	1.094	*	1.037		0.961		1.005	
		1.005	1.191	0.956	1.125	0.896	1.031	0.932	1.083
Mother education level (Ref.= Below high school)	College or higher	0.975		1.034		1.002		1.019	
		0.910	1.045	0.968	1.105	0.947	1.061	0.959	1.083
	Unknown	0.979		1.010		0.953		0.928	*
		0.900	1.065	0.933	1.094	0.889	1.020	0.862	0.999
Living arrangement (Ref.=With family)	Without family	0.976		1.012		1.182	***	0.986	
		0.877	1.086	0.916	1.117	1.084	1.290	0.899	1.082
Economic status (Ref.=Low)	Middle	0.781	***	0.857	***	0.754	***	0.767	***
		0.721	0.847	0.801	0.917	0.709	0.801	0.721	0.817
	High	0.704	***	0.937		0.715	***	0.743	***
		0.647	0.766	0.870	1.009	0.669	0.764	0.693	0.795
Economic status changed due to COVID-19 (Ref.=Not at all)	Really	1.310	***	1.068	*	1.336	***	1.196	***
		1.245	1.379	1.011	1.128	1.277	1.398	1.137	1.257
	Changed	1.507	***	1.294	***	1.585	***	1.382	***
		1.418	1.603	1.218	1.376	1.505	1.669	1.307	1.462
	Critically	1.540	***	1.645	***	1.536	***	1.500	***
		1.382	1.715	1.497	1.808	1.409	1.674	1.370	1.641
Financial assistance (Ref.=No)	Yes	1.005		1.147	***	1.133	***	1.115	**
		0.927	1.089	1.068	1.233	1.062	1.208	1.042	1.193
Sleep (Ref.=Adequate)	Average	2.242	***	1.399	***	1.666	***	1.639	***
		2.133	2.358	1.320	1.483	1.592	1.743	1.555	1.728
	Inadequate	3.197	***	2.132	***	2.206	***	2.759	***
		3.024	3.381	2.016	2.255	2.107	2.311	2.621	2.905
Smoking (Ref.=No)	Yes	0.945		1.405	***	1.256	***	1.029	
		0.872	1.024	1.310	1.507	1.176	1.340	0.961	1.101
Drinking (Ref.=No)	Yes	1.148	***	1.396	***	1.373	***	1.166	***
GAD: Generalized anxiety disorder									
* <0.05, ** <0.01, *** <0.001									

		1.089	1.210	1.329	1.467	1.315	1.433	1.114	1.221
Drug use	Yes	1.510	*	2.216	***	1.397	**	2.056	***
(Ref.=No)		1.072	2.127	1.742	2.820	1.096	1.781	1.621	2.608
Smartphone overdependence	Yes	1.724	***	1.484	***	1.817	***	2.436	***
(Ref.=No)		1.627	1.828	1.415	1.556	1.741	1.897	2.333	2.545
Suicide	Ideation	6.233	***	7.080	***	4.950	***	5.227	***
(Ref.=Healthy)		5.237	7.417	6.581	7.616	4.528	5.411	4.844	5.640
	Plan	3.211	***	7.144	***	3.595	***	5.293	***
		2.563	4.022	6.300	8.101	3.121	4.142	4.641	6.037
	Attempt	6.003	***	11.911	***	6.136	***	6.602	***
		4.320	8.343	10.191	13.921	5.098	7.384	5.678	7.676
GAD: Generalized anxiety disorder									
* <0.05, ** <0.01, *** <0.001									

Discussion

Since the outbreak of COVID-19 in Hubei, China, in December 2019, restrictions have been imposed on people's daily lives to address the virus' threat; however, these restrictions have had prolonged negative consequences. The severing of social relationships due to measures such as social distancing has resulted in mental health problems in the general population, and fear of quarantine has led to depression, anxiety, stress, and despair, thereby impairing people's quality of life. In particular, 59.8% of adolescents in Korea have been found to have dominant feelings of "anxiety and worry" as a result of COVID-19 [28]. The present study aimed to analyze the factors associated with mental health issues and suicide among adolescents by categorizing a representative sample into a healthy group, suicide-ideation group, suicide-planning group, and suicide-attempt group, respectively, and also sought to specifically identify the predictors of related mental health issues. The following results were obtained.

First, among 57,925 Korean adolescents, 6.9% showed suicidal ideation, 2.2% reported planning suicide, and 1.9% reported attempting suicide over the 12 months preceding the data collection. These are lower rates than those reported in a 2019 study conducted in the US, in which 18.8% reported seriously considering attempting suicide, 15.7% reported planning suicide, and 8.9% reported attempting suicide [29]. The above data show that adolescents in Korea and the US are more likely to engage in suicidal ideation than to actually plan or attempt suicide [30]. In other words, there is a large discrepancy between suicidal ideation and suicidal behavior among adolescents; this is in contrast to the situation for middle-aged and older adults [31]. As adolescents, when compared to adults, have relatively lesser life experience and tolerance of various forms of shocks and stressors, they can be more impulsive regarding suicide. This indicates that there is a need for national policies that exclusively target the prevention of suicide among adolescents.

Second, all demographic characteristics examined in this study, with the exception of father's highest education level, significantly predicted adolescents' mental health status. In the healthy group, male high schoolers with good grades were mentally healthier. In the suicide-ideation and suicide-attempt groups, female high schoolers with poor grades showed a higher risk of mental health problems. When compared to the healthy group, the risk of mental health problems was higher among students who were not living with family members, those who were from a lower socioeconomic class, and those who reported planning or attempting suicide. The risk of stress, sadness and despair, loneliness, or GAD was higher among those who had experienced greater financial difficulty as a result of COVID-19. The level of financial assistance received had little effect. Further, the risk was also higher among those with inadequate sleep, smokers, alcohol users, those with experience of drug use, and those with smartphone overdependence.

In other words, the risk to attempt suicide was higher among female high schoolers with "poor" grades, those living with non-family members, and those in the lower socioeconomic class. The risk of suicidal ideation, suicide planning, and suicide attempt was higher among those with inadequate sleep, smokers, alcohol users, drug users, and those with smartphone overdependence. These are similar to the findings of previous Korea-based studies, where the risks of suicidal ideation, suicide planning, and suicide attempt were found to be higher among female students than male students [32–34]. A possible reason for this is that male students tend to interpret an event cognitively, while female students are more heavily influenced by and sensitive to the emotional aspects of the event [34, 35]. Between 2010–2017, the mean suicide rate among adolescents aged 10–19 years in Korea has been 5.45 for boys and 4.30 for girls, differing from the US rates of 7.57 for boys and 2.57 for girls [36]. Both the Korean and US data show differences between genders, which indicates that a gender-specific approach should be taken to address this issue. Alcohol consumption, smoking, drug use, and excessive use of smartphones in adolescence impair not only physical health, but also mental health; thus, it is necessary to lower adolescents' exposure to these substances and such technology. To achieve this, education systems should facilitate various forms of psychological support that strengthens students' mental health and ultimately enhances their quality of life.

Third, we comparatively analyzed mental health and suicide-related factors. The results showed that negative emotions among adolescents increase the odds of their progressing from suicidal ideation to attempting suicide. This supports previous findings that adolescents with emotional problems exhibit high levels of depressive symptoms, stress, and impulse to drop out of school [37], and that loneliness is a powerful predictor of suicidal ideation [38, 39]. However, in a

contrasting finding, Naragon-Gainey and Watson [40] reported that, while depression is a significant factor in suicidal ideation, GAD is not. Emotional intelligence has also been found to be associated with health indices, with decreasing emotional intelligence being associated with an increase in suicidal behaviors [41]. Thus, programs that cultivate one's ability to control and positively manage emotions should be provided for adolescents who are psychologically unstable and who are repeatedly exposed to negative emotions; this may help to promote psychological stability and functionality.

Fourth, we identified factors that predict adolescents' mental health status. Specifically, sex, academic achievement, economic status, impact of COVID-19 on economic status, sleep, alcohol use, drug use, smartphone overdependence, and suicide-related factors were identified as significant predictors. Many studies have similarly reported that sex, academic achievement, economic status, health behaviors, and emotional characteristics influence adolescents' mental health and suicidal impulses [42–44]. Further, studies exploring the influence that COVID-19-induced changes in subjective economic status have on adolescents' stress have found that deterioration in economic status has a negative impact on adolescents' mental health [45–47].

Suicide is an outcome of complicated, dynamic, and unique interactions among numerous contributors [44]. Thus, educational programs and campaigns that raise awareness of behaviors that increase the risk of suicide (e.g., smoking and drug and alcohol use) should be frequently conducted in order to improve adolescents' mental health status. Additionally, individualized mental health programs should be developed to help adolescents manage their mental health, as this would contribute to addressing the emotional aspects and other factors associated with suicide (e.g., stress, depression, loneliness). Childhood and adolescence are critical periods for physical and emotional growth and development, and COVID-19-induced changes in daily life can have a tremendous impact on young people's future lives. Hence, as the COVID-19 pandemic continues, it is important to pay attention, both in a social context and in research, to restrictions in daily life that can affect adolescents' mental health, and to mitigate these effects where possible.

Past studies on suicide have generally examined predictors of suicidal ideation. In contrast, this study is significant in that it classified adolescents into a healthy group, suicide-ideation group, suicide-planning group, and suicide-attempt group. In other words, rather than considering it a simple, isolated event, suicide should be understood as a complex and dynamic process that forms a continuum from suicidal ideation through planning suicide to attempting suicide. Thus, examining the demographic characteristics and the transition to suicidal attempt in individuals in the healthy group would shed light on the specific directions for interventions targeting each stage of mental health crisis among adolescents, from suicidal ideation to suicidal planning and suicide attempt. Furthermore, while past studies have generally focused on depression when examining factors associated with suicide in adolescents, we confirmed in this study that sadness and despair and GAD elevate the risk of suicidal ideation, suicide planning, and attempting suicide. Therefore, there is a need for programs that, through accurate mental health evaluations, focus on these factors and enable the early screening and implementation of interventions for adolescents at risk of suicide. Another strength of this study is that it provides an opportunity to identify new means of maintaining adolescents' mental health amid the prolonged COVID-19 pandemic.

Despite these strengths, this study also has some limitations.

First, we only analyzed the variables presented in the 16th KYRBS data; thus, the findings cannot be generalized to the entire adolescent population in Korea or populations in other countries. However, the effects of isolation, restrictions on outdoor activities, and other measures for preventing COVID-19 transmission are probably not unique to adolescents in Korea. Thus, subsequent studies should examine a broader scope of variables, including mental health, career path, and school work, to more clearly determine the impact of COVID-19 on adolescents' lives. Second, as suicide occurs during moments of heightened cognitive and emotional vulnerabilities, both cognitive and emotional aspects should be examined to gain an in-depth understanding of (and identify means of disrupting) the process preceding a suicide attempt. Third, continuous research on adolescents' mental health—as opposed to single-year surveys—is required to prepare for challenges associated with potential future pandemics.

Abbreviations

COVID-19

Coronavirus disease 2019

GAD

Generalized anxiety disorder

KYRBS

Korea Youth Risk Behavior Web-based Survey

SARS

Severe Acute Respiratory Syndrome

Declarations

Ethics approval and consent to participate:

The 16th (2020) Korea Youth Risk Behavior Web-based Survey was approved by the Institutional Review Board of the Korea Disease Control and Prevention Agency (KCDA), since 2005, it has been exempted. This study was conducted in accordance with the Declaration of Helsinki, and all of the materials used in the article were publicly available data. Moreover, all of the data are non-identifying and can be used by anyone. All surveys are conducted with the informed consent of the participants and are recorded on the computer and server. As this research involved secondary data analysis, no ethics committee approval was required.

Consent for publication: Not applicable

Availability of data and materials: The data are available from the KCDA website (<https://www.kdca.go.kr/yhs/>).

Competing interests: The authors declare that they have no competing interests.

Funding: This research was supported by the Research Grant of Jeonju University in 2021.

Authors' contributions:

S-M Kim initiated the idea and led the formal analysis, and reviewed and edited the final draft of the article. H-S Park reviewed the literature and developed the discussion. Y-M Jeong presented the framework of this article, reviewed the literature, and developed the discussion.

Acknowledgements: Not applicable.

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Figures

Figure 1

Analysis of covariance and post-hoc test for stress, sadness and despair, loneliness, and generalized anxiety disorder in the health, suicide-ideation, suicide-planning, and suicide-attempt adolescent groups. The basic control variables included adjusted sex, education level, academic achievement, father's highest education level, mother's highest education level, living arrangement, economic status, impact of COVID-19 on economic status, whether the family received financial assistance, sleep, smoking, drinking, drug use, and smartphone overdependence.