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The Impact of Depression during COVID-19 on Suicidal Ideation in Adolescents: Anxiety as a Mediator and Loneliness as a Moderator

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Abstract

Background

This study investigated the mediating effect of anxiety and the moderating effect of loneliness on the relationship between depression during the coronavirus disease 2019 (COVID-19) pandemic and suicidal ideation among adolescents.

Methods

Data were analysed from the 17th Korea Youth Risk Behavior Web-based Survey (KYRBS), a 2020 self-report survey targeting 54,848 middle and high school students in South Korea during the COVID-19 lockdown.

Results

Depression had a significant direct effect on suicidal ideation and an indirect effect mediated by anxiety (B = 1.28, p<.001; Sobel test Z = 36.91, p<.001). A one-unit increase in depression raised the likelihood of suicidal ideation by 2.64 times (Odds Ratio [OR] = 2.64, 95% CI: 2.486–2.811), while anxiety increased the possibility by 3.31 times (OR = 3.31, 95% CI: 3.166–3.460). Loneliness significantly moderated the relationship between anxiety and suicidal ideation, with a one-unit increase in loneliness raising the odds by 4.22 times (OR = 4.22, 95% CI: 4.051–4.219). The interaction between anxiety and loneliness amplified the possibility by 1.68 times (OR = 1.68, 95% CI: 1.654–1.679).

Conclusions

These findings highlight the intricate interplay between depression, anxiety, and loneliness in influencing suicidal ideation among adolescents during the COVID-19 pandemic. Loneliness emerged as a critical factor moderating the relationship between anxiety and suicidal ideation. Early identification of anxiety and interventions aimed at alleviating loneliness as integral components of adolescent suicide prevention strategies, particularly during societal crises. Comprehensive intervention programs addressing these interconnected factors psychological factors are essential for improving adolescent mental health outcomes.

1. Introduction

Adolescent suicide rates are a critical global social issue that has increased significantly following the coronavirus disease 2019 (COVID-19) pandemic. Notably, during the early stages of the pandemic in 2020, while general suicide rates in countries such as the United States, Japan, and South Korea declined compared to those in 2019, adolescent suicide rates increased by 9%. This trend highlights

adolescent suicide as an urgent public health and societal challenge requiring immediate attention (Ministry of Health and Welfare 2022; Bridge et al. 2023; Fushimi 2023).

Adolescence is characterised by rapid biological and emotional changes that make individuals particularly vulnerable to mental health issues. Psychological traits, such as experiential avoidance, during this stage are associated with an increased risk of developing psychosocial disorders (Theberath et al. 2022). Conditions such as anxiety, depression, and phobias are highly prevalent among adolescents, further underscoring their susceptibility to mental health vulnerabilities (Costello et al. 2011). When left unaddressed, these mental health problems can have negative long-term consequences on adolescents' quality of life and functioning, extending into adulthood.

The coronavirus disease (COVID-19) pandemic has exacerbated mental health crises among adolescents (Wiederhold 2022). Public health measures implemented to mitigate viral transmission, such as school closures, restrictions on outdoor activities, and social isolation, have disrupted daily routines and contributed to psychological distress (Samji et al. 2022). Studies indicate that the prevalence of anxiety and depression among adolescents has risen significantly during the pandemic compared to pre-pandemic levels (Racine et al. 2021; Samji et al. 2022; Theberath et al. 2022). Depression and anxiety are the major predictors of mental disorders and suicidal ideation among adolescents (Schnitzer et al. 2023). Wang et al. (2022) found that the prevalence of depression and anxiety peaked during the later stages of pandemic-related restrictions, and longer lockdowns further exacerbated these issues.

Adolescent suicide is widely known to be influenced by various mental health and life stress factors. However, during the pandemic, social isolation due to school closures and home confinement have emerged as key factors contributing to adolescent suicide. The pandemic has disrupted social support systems and mental health services, amplifying suicide risk (Schnitzer et al. 2023). While the pandemic has highlighted the interplay among depression, anxiety, and social isolation, comprehensive studies examining their combined impact on suicidal ideation remain limited.

Research conducted during the lockdown period has revealed that adolescents experience severe loneliness due to restricted social interactions, identifying loneliness as a significant stressor (Cooper et al. 2021; Al Omari et al. 2023). Social isolation affects younger individuals more adversely (Alam et al. 2023). Although adolescent use of social media and online interactions increased during the pandemic, these virtual connections were not perceived as adequate substitutes for in-person interactions (Asscheman et al. 2021). Existing studies demonstrate strong correlations between loneliness, depression, and anxiety, with these variables mutually influencing each other (Gadassi Polack et al. 2021; Barbieri & Mercado 2022; Al Omari et al. 2023; Cena et al. 2023). Adolescents reporting higher levels of loneliness were four times more likely to experience suicidal ideation, emphasising the importance of addressing loneliness as a strategy for suicide prevention (Macalli et al. 2022).

While this study confirmed the significant roles of depression, anxiety, and loneliness in influencing suicidal ideation among adolescents during the pandemic, it sought to fill this gap by understanding the

interactive mechanisms among these factors. Therefore, this study proposes the following hypotheses (Fig. 1):

1. COVID-19-related depression affects suicidal ideation directly and indirectly through anxiety as a mediator.
2. Loneliness moderates the relationship between anxiety and suicidal ideation.
3. The indirect effect of COVID-19-related depression on suicidal ideation, mediated by anxiety, differs by levels of loneliness.

[Insert Fig. 1 here]

This study aimed to elucidate the complex interplay between depression, anxiety, and loneliness in influencing suicidal ideation during the COVID-19 pandemic. The study sought to uncover the interactive mechanisms of adolescent mental health by integrating the mediating role of anxiety and the moderating role of loneliness. The findings of this study are expected to provide practical insights into suicide prevention and mental health promotion during social crises and offer actionable guidelines for public health and mental health management practices.

2. Method

2.1. Research Design

This study used data from the 17th Korea Youth Risk Behavior Web-based Survey (KYRBS), published in 2021, to examine health behaviours among Korean adolescents. The KYRBS has been conducted annually since 2005 by the Korea Disease Control and Prevention Agency (KDCA) and the Ministry of Education. This is a foundational dataset for formulating adolescent health policies and promotion programmes. The 17th KYRBS dataset analysed in this study comprised data collected in 2020 during the early phase of the COVID-19 pandemic and released in 2021.

The target population for this survey included all middle- and high-school students in Korea as of April 2020. Participants were selected using stratified cluster sampling, which involved three stages: stratification, sample allocation, and sampling. Stratification was based on 39 regional clusters and school types (middle, general, and vocational high schools), resulting in 117 strata. Sample allocation was conducted using proportional allocation methods by dividing the sample into 400 middle and 400 high schools. The sampling units were selected in two stages: schools as the primary sampling units and classes as the secondary sampling units.

Owing to the challenges posed by the COVID-19 pandemic, such as increased workloads for survey-supporting teachers and restrictions on computer lab use, data collection was completed in 796 schools (399 middle schools and 397 high schools) instead of the planned 800 schools. A total of 54,848 students participated in the study, with a student-level response rate of 92.9%. Data were collected through anonymous, self-reported online surveys structured to prevent missing responses. Participants

could not proceed to the next question without answering the current one. Consequently, there were no missing values in the dataset. All 54,848 responses were included in the analysis.

The data collection period for the 17th KYRBS was from August to November 2020. Considering the unique circumstances of the COVID-19 pandemic, items on loneliness and anxiety disorders were added to the 2020 survey. The survey included 113 items covering socioeconomic status, academic performance, smoking, drinking, physical activity, and dietary habits.

The KYRBS is a publicly available secondary dataset containing de-identified information. The Institutional Review Board of a university obtained ethical approval for the exemption on 8 February 2024 (No. [Anonymized]).

2.2. Research Instruments

This study categorised the survey items into general and mental health characteristics. Each variable was reclassified and defined as follows:

2.2. 1 General Characteristics

The general characteristics of the participants included sex, school level, economic status, economic changes during COVID-19, living with family, alcohol consumption, smoking, academic performance, stress levels, and fatigue recovery through sleep. Economic status was initially divided into five categories but was reclassified into three categories: high (high and upper-middle), middle, and low (low and lower-middle). Economic changes during COVID-19 were measured using the question, ‘Has your family’s economic status worsened owing to COVID-19?’ Responses were reclassified into ‘No’ (not at all, slightly not) and ‘Yes’ (somewhat, strongly agree).

Academic performance was assessed using the following question: ‘How would you describe your academic performance over the past 12 months?’ The responses were reclassified into three categories: high (high and upper-middle), middle, and low (low and lower-middle). Living with family was determined by asking, ‘What is your current living arrangement?’ Participants living with family were categorised as ‘Yes’, while those living in dormitories, boarding houses, or other arrangements were classified as ‘No’. Subjective health status was measured using the following question: ‘How would you rate your overall health?’ Responses were categorised as ‘Good’ (very healthy, healthy), ‘Moderate’ (moderate), and ‘Poor’ (unhealthy, very unhealthy).

Alcohol and smoking were assessed by asking about lifetime experiences with drinking and smoking, and responses were retained as ‘No’ and ‘Yes’. Stress levels were measured using the following question: ‘How often do you feel stressed?’ Responses were categorised as ‘Low’ (rarely, never), ‘Moderate’ (sometimes), and ‘High’ (frequently, very frequently). Fatigue recovery through sleep was measured by asking, ‘In the past 7 days, do you think your sleep was sufficient to recover from fatigue?’ Responses were categorised as ‘Enough’ (very sufficient, sufficient), ‘Moderate’ (neither), and ‘Insufficient’ (insufficient, very insufficient).

2.2.2 Mental Health-Related Characteristics

Depression during COVID-19 was measured using the COVID-19 pandemic. 'How has your level of depression changed?' Responses were categorised into three groups: 'Decrease' (significantly decreased, decreased), 'Similar' (no change), and 'Increase' (increased, significantly increased). Anxiety was assessed using the Generalised Anxiety Disorder Scale (GAD-7), which includes seven items based on the question, 'Over the past two weeks, how often have you been bothered by the following problems?' Items include the following: 'Feeling nervous, anxious, or on edge', 'Not being able to stop or control worrying', 'Worrying too much about different things', 'Having trouble relaxing', 'Being so restless that it is hard to sit still', 'Becoming easily annoyed or irritable', and 'Feeling afraid as if something awful might happen'. Responses were provided on a four-point Likert scale. Further, total scores were classified as 'Almost none' (≤ 9), 'Moderate' (10–14), and 'High' (≥ 15). Loneliness was measured using the following question: 'Over the past 12 months, how often have you felt lonely?' Responses were reclassified as 'Almost none' (never, rarely), 'Moderate' (sometimes), and 'High' (often, always). Suicidal ideation was measured using the question, 'In the past 12 months, have you ever thought about suicide?' Responses were categorised as 'No' and 'Yes', maintaining the original classification. This categorisation approach ensures consistency with the variables presented in Tables 1 and 2, supporting an accurate analysis and interpretation.

2.3. Data Analysis

Data analysis was conducted using the SPSS Windows software version 21.0. Following the guidelines provided in the KYRBS analysis manual, the study incorporated complex sample design elements, including stratification variables (strata), cluster variables (cluster), sampling weights (weight), and finite population correction factors (FPCF). This approach applies an unequal probability sampling design while controlling for the overestimation of variance.

The online survey was designed to prevent unanswered items by requiring participants to respond to each question before proceeding to ensure that no missing data were present in the dataset. The Rao-Scott χ^2 test was employed to analyse frequency differences, and the study hypotheses were tested through a two-step analytical process.

2.4. Mediation Analysis

Baron and Kenny's (1986) three-step mediation analysis method was applied to examine whether anxiety mediates the relationship between Depression during COVID-19 and suicidal ideation. The analytical procedure was as follows:

In Step 1, a complex-sample logistic regression analysis was conducted to determine the effect of the independent variable (Depression during COVID-19) on the dependent variable (suicidal ideation). In Step 2, a complex sample linear regression analysis was used to evaluate the effect of the independent variable (Depression during COVID-19) on the mediator (anxiety). As anxiety was treated as an ordinal variable, this method was deemed appropriate. In Step 3, the independent variable (Depression during

COVID-19) and mediator (anxiety) were simultaneously entered into a complex sample logistic regression analysis to assess their effects on the dependent variable (suicidal ideation). This step specifically examined whether the impact of the independent variable on the dependent variable was reduced compared to Step 1. The statistical significance of the mediation effect was verified using the Sobel test.

2.5. Moderation Analysis

The moderating effect of loneliness (V) on the relationship between anxiety (M) and suicidal ideation (Y) was examined using the following steps. First, the effect of anxiety (M) on the dependent variable—suicidal ideation (Y)—was analysed using complex sample logistic regression analysis. Similarly, the effect of loneliness (V) on suicidal ideation was assessed using logistic regression analysis. Second, a logistic regression analysis was performed to determine the effect of the interaction between anxiety (M) and loneliness (V) on suicidal ideation. This step aimed to evaluate whether loneliness moderated the relationship between anxiety and suicidal ideation.

3. Results

3.1. Differences in Suicidal Ideation According to the Characteristics of Adolescents

Significant differences in suicidal ideation were observed according to adolescents' general and health-related characteristics (Table 1). Female students (16.1%) reported significantly higher suicidal ideation than male students (9.5%) ($p<.001$). Middle school students (13.4%) exhibited higher suicidal ideation than high school students (12.0%) ($p<.001$). Economic status was closely associated with suicidal ideation, with students from low economic backgrounds (21.6%) showing significantly higher suicidal ideation than those from middle (11.9%) or high economic backgrounds (11.3%) ($p<.001$). Students who experienced economic change during the COVID-19 pandemic (16.5%) reported higher suicidal ideation than those who did not (11.1%) ($p<.001$).

Students with low academic performance (15.4%) demonstrated significantly higher suicidal ideation than those with high academic performance (11.5%) ($p<.001$). Adolescents who did not live with their families (19.0%) showed higher suicidal ideation than those who lived with their families (12.5%) ($p<.001$). Students who reported poor health (29.3%) had significantly higher suicidal ideation rates than those who reported good health (8.9%) ($p<.001$). Alcohol and smoking experiences were also associated with suicidal ideation; students with alcohol (17.0%) and smoking experiences (21.6%) had significantly higher suicidal ideation than those without these experiences ($p<.001$). Stress levels showed a strong association with suicidal ideation, as students experiencing high levels of stress (25.4%) exhibited higher suicidal ideation than those experiencing little or no stress (2.0%) ($p<.001$). Finally, students who reported insufficient recovery from fatigue through sleep (17.7%) had higher suicidal ideation rates than those who reported sufficient recovery (7.2%) ($p<.001$).

The results revealed significant differences in suicidal ideation among adolescents based on mental health-related characteristics, including levels of loneliness, anxiety, and changes in depression during the COVID-19 pandemic (Table 2). There was a notable variation in suicidal ideation according to loneliness level. Adolescents who reported high levels of loneliness exhibited a markedly higher prevalence of suicidal ideation (40.0%) than those who reported low levels of loneliness (3.8%), representing an approximately tenfold increase (p<.001). Similarly, differences in suicidal ideation were observed across anxiety levels. Adolescents with high anxiety levels showed a significantly higher prevalence of suicidal ideation (54.9%) than those with minimal anxiety (8.5%), indicating a nearly nine-fold increase in anxiety (p<.001).

Furthermore, changes in depressive symptoms during the COVID-19 pandemic were significantly associated with suicidal ideation. Adolescents who experienced an increase in depression reported a higher prevalence of suicidal ideation (24.3%) than those whose depressive symptoms decreased (7.7%) or remained stable (5.6%) (p<.001). These findings underscore the substantial impact of mental health factors on suicidal ideation, particularly in the context of a global crisis such as the COVID-19 pandemic.

[Insert Table 1 here]

[Insert Table 2 here]

3.2. Mediation Analysis: Mediating Role of Anxiety in the Relationship Between Depression During COVID-19 and Suicidal Ideation

This study employed Baron and Kenny's (1986) three-step mediation analysis to examine whether anxiety mediated the relationship between depression during the COVID-19 pandemic and suicidal ideation (Table 3). First, a complex sample linear regression analysis was performed to investigate the impact of depression during COVID-19 on anxiety during a complex sample linear regression analysis was performed. The results revealed that depression during the COVID-19 pandemic had a significantly positive effect on anxiety (B = 0.18, SE = 0.004, t = 46.57, p < .001). This indicated that higher levels of depression were associated with higher levels of anxiety. The model fit was confirmed using Wald's F(p) = 2168.86 (p < .001) and R^2 = 0.056.

Next, the direct effect of depression during the COVID-19 pandemic on suicidal ideation was examined using complex sample logistic regression analysis. Depression during COVID-19 was found to have a significant direct impact on suicidal ideation (B = 1.28, SE = 0.031, t = 41.56, p < .001), with an odds ratio (OR) of 3.60 (95% CI: 3.388–3.823). This suggests that an increase in depression during the COVID-19 pandemic was associated with a higher likelihood of suicidal ideation. The model fit was Wald F(p) = 1727.00 (p < .001) and McFadden R^2 = 0.075.

Finally, to test the mediating effects of anxiety, depression during COVID-19, and anxiety were simultaneously included in the model to predict suicidal ideation (Fig. 2). The results demonstrated that depression (B = 0.97, SE = 0.031, t = 31.09, p < .001) and anxiety (B = 1.20, SE = 0.023, t = 52.97, p < .001)

significantly influenced suicidal ideation. Anxiety partially mediated the relationship between depression during the COVID-19 pandemic and suicidal ideation, as confirmed by the Sobel test ($Z = 36.91$, $p < .001$). The model fit was further supported by Wald's $F(p) = 2370.493$ ($p < .001$) and McFadden's $R^2 = 0.147$.

The odds ratios (ORs) for depression and anxiety during the COVID-19 pandemic were 2.64 (95% CI: 2.486–2.811) and 3.31 (95% CI: 3.166–3.460), respectively. These findings indicate that a one-unit increase in depression during COVID-19 increases the likelihood of suicidal ideation by 2.64 times, while a one-unit increase in anxiety raises it by 3.31 times. These results highlight the critical mediating role of anxiety and emphasise the importance of addressing anxiety in interventions aimed at reducing suicidal ideation among adolescents.

[Insert Table 3 here]

[Insert Fig. 2 here]

3.3. Moderation Analysis: Moderating Role of Loneliness in the Relationship Between Anxiety and Suicidal Ideation

A complex sample logistic regression analysis was conducted to examine the moderating role of loneliness in the relationship between anxiety and suicidal ideation among adolescents (Table 4).

First, the impact of anxiety on suicidal ideation was analysed. The results revealed that anxiety (M) had a significant positive effect on suicidal ideation (Y) ($B = 1.42$, $SE = 0.022$, $t = 65.44$, $p < .001$). Specifically, a one-unit increase in anxiety was associated with a 4.13-fold higher likelihood of suicidal ideation (95% CI: 3.958–4.310). The model fit was confirmed using Wald's $F(p) = 5501.75$ ($p < .001$) and McFadden's $R^2 = 0.159$.

Next, we examined the effect of loneliness on suicidal ideation. The findings indicated that loneliness (V) also had a significant positive impact on suicidal ideation ($B = 1.44$, $SE = 0.021$, $t = 69.68$, $p < .001$). A one-unit increase in loneliness corresponded to a 4.22-fold higher likelihood of suicidal ideation (95% CI, 4.051–4.219). The model fit for this analysis was Wald $F(p) = 4855.40$ ($p < .001$) and McFadden $R^2 = 0.158$.

Finally, the interaction effect between anxiety and loneliness (M*V) on suicidal ideation was tested to determine whether loneliness moderated the relationship between anxiety and suicidal ideation (Fig. 3). The results confirmed that the interaction term had a significantly positive effect on suicidal ideation ($B = 0.52$, $SE = 0.008$, $t = 68.50$, $p < .001$). The odds ratio for the interaction effect was 1.68 (95% CI: 1.654–1.679)—a one-unit increase in the interaction between anxiety and loneliness increases the likelihood of suicidal ideation by 1.68 times. This finding highlights that loneliness serves as a critical moderating variable amplifying the relationship between anxiety and suicidal ideation. The model fit was Wald $F(p) = 4692.616$ ($p < .001$) and McFadden $R^2 = 0.164$.

Overall, the model fit indices show a progressive increase in McFadden R^2 values across the three steps, from 0.159 in the first step to 0.164 in the final step. This incremental improvement underscores the importance of loneliness in the relationship between anxiety and suicide ideation. These results suggest that adolescents experiencing high levels of anxiety and loneliness are at a significantly greater risk of developing suicidal ideation, emphasising the need for targeted interventions addressing loneliness to mitigate this risk.

[Insert Table 4 here]

[Insert Fig. 3 here]

4. Discussion

This study explored the complex pathways through which depression, anxiety, and loneliness influence suicidal ideation among adolescents during the COVID-19 pandemic. The findings demonstrated that COVID-19-related depression indirectly influenced suicidal ideation through anxiety and that loneliness moderated the relationship between anxiety and suicidal ideation. These results provide critical insights into adolescent mental health during social crises such as the pandemic and highlight the essential considerations for developing effective intervention strategies.

4.1. Mediating Relationship of Coronavirus Disease 2019-Related Depression, Anxiety, and Suicidal Ideation

First, the results confirmed that COVID-19-related depression significantly impacted suicidal ideation directly and indirectly through anxiety. This finding suggests that depression increases the risk of suicidal ideation and amplifies anxiety, further exacerbating suicidal thoughts. Prior studies support these findings—reducing depression can lower suicidal ideation by 24%, whereas addressing anxiety can lead to a 74% reduction in suicidal ideation (Metts et al. 2023).

Adolescence is a developmental period characterised by a heightened vulnerability to anxiety, and reports have indicated a marked increase in anxiety disorders among adolescents during the pandemic (Foster et al. 2023; Kiviruusu et al. 2023). Risk factors for adolescent anxiety during the pandemic included sex (women), remote learning, younger age, financial difficulties, and future (Jung et al. 2022; Muzaffar et al. 2022; Foster et al. 2023; Kiviruusu et al. 2023). This study highlights the pivotal role of anxiety as a mechanism by which depression influences suicidal ideation, emphasising the need for integrated mental health strategies that address the interplay between these factors.

4.2. Moderating Role of Loneliness

Second, the study found that loneliness moderates the relationship between anxiety and suicidal ideation. While the existing research has primarily focused on the direct link between loneliness and suicidal ideation (Schinka et al. 2012; Wang et al. 2025), this study identified a specific moderating role

of loneliness in amplifying the impact of anxiety on suicidal ideation. Loneliness is an emotional state and a risk factor associated with negative thought patterns, substance abuse, sleep disturbances, and even increased mortality (Holt-Lunstad et al. 2010; Masi et al. 2011; Doane & Thurston 2014; Rönkä et al. 2014).

Adolescents experience heightened loneliness during the pandemic due to prolonged social isolation (Thakur et al. 2023). Research has suggested that the duration of loneliness, rather than its intensity, significantly affects mental health outcomes (Loades et al. 2020). This underscores the importance of targeting loneliness in interventions aimed at enhancing adolescent mental health during periods of social isolation. Although family functioning and peer connections do not mitigate depression directly, they may alleviate loneliness, highlighting the importance of loneliness-focused interventions (Vacaru et al. 2022).

4.3. Interaction Among Depression, Anxiety, and Loneliness

Third, loneliness significantly moderates the pathway through which COVID-19-related depression indirectly influences suicidal ideation through anxiety. Higher levels of loneliness had more potent indirect effects. This aligns with Liang's (2023) findings that demonstrate the interdependent development of depression, social anxiety, and loneliness. This study further elaborates on these relationships by revealing their complex interactions in predicting suicidal ideation. The interpersonal-psychological theory of suicide identifies a lack of belongingness as a critical predictor of suicidal ideation (Ma et al. 2016). During the pandemic, an abrupt increase in social disconnection heightened loneliness, which amplified the risk of suicidal ideation. This finding emphasises the need to prioritise interventions addressing loneliness to prevent suicidal ideation during crises.

4.4. Implications and Limitations

This study provides important insights for the prevention of suicidal ideation in adolescents. Protective factors against loneliness, such as social support (McMahon et al. 2023), family connections (Al Omari et al. 2023), a sense of belonging (Joiner 2009), and peer support (Pandey et al. 2019; Aboagye et al. 2022), can significantly mitigate mental health challenges. However, research has shown that virtual interactions during the pandemic have not fully satisfied relational needs (McMahon et al. 2023), and Gallagher (2014) noted that social support alone may be insufficient for suicide prevention. Therefore, it is critical to address the emotional aspects of loneliness. Mental health professionals should actively assess and intervene in adolescent loneliness during crises. Thus, innovative strategies for fostering belongingness, even in remote environments, are urgently required.

This study had several limitations. First, it used cross-sectional data collected in 2020, limiting its ability to determine long-term causal relationships among the variables. Future longitudinal studies are necessary to examine these changes over time. Second, subjective bias may have influenced self-reported survey data, necessitating the inclusion of objective and multidimensional data collection

methods. Third, the study focused on Korean adolescents, and further research is required to generalise the findings to other cultural contexts.

Nevertheless, this study makes a significant contribution by empirically elucidating the complex interplay between depression, anxiety, loneliness, and suicidal ideation in the unique context of the COVID-19 pandemic. By integrating these psychological factors, our findings offer practical and evidence-based guidance for developing targeted intervention strategies to enhance adolescent mental health and prevent suicidal ideation during future social crises.

Declarations

Ethical approval statement: All participants provided informed consent or assent. The Institutional Review Board of a university approved the study on 8 February 2024 (no. [Anonymized]).

Human Ethics and Consent to Participate declarations: Not applicable

Patient Consent Statement: This study was not obtained patient/parent/guardian consent because it is secondary data analysis research.

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Tables

Table 1. Differences in Suicidal Ideation According to General and Health-Related Characteristics of Adolescents

N=54,848

Variables	Categories	Suicidal ideation		Suicidal ideation		Rao-Scott	*p*
		No (n=47,892)		Yes (n= 6956)			
		n (%)		n (%)			
Sex	Men	25,762	(90.5)	2,639	(9.5)	395.57	<.001
	Women	22,130	(83.9)	4,317	(16.1)		
School	Middle	26,047	(86.6)	3,968	(13.4)	12.82	<.001
	High	21,845	(88.0)	2,988	(12.0)		
Economic status	High	19,139	(88.7)	2,429	(11.3)	218.45	<.001
	Middle	23,892	(88.1)	3,185	(11.9)		
	Low	4,861	(78.4)	1,342	(21.6)		
Economic changes during COVID-19	No	33,912	(88.9)	4,224	(11.1)	284.69	<.001
	Yes	13,980	(83.5)	2,732	(16.5)		
Academic performance	High	18,202	(88.5)	2,326	(11.5)	75.77	<.001
	Middle	14,977	(88.5)	1,926	(11.5)		
	Low	14,713	(84.6)	2,704	(15.4)		
Living with family	No	45,902	(87.5)	6,524	(12.5)	47.18	<.001
	Yes	1,990	(81.0)	432	(19.0)		
Health status	Good	32,437	(91.1)	3,092	(8.9)	948.02	<.001
	Moderate	11,930	(83.6)	2,368	(16.4)		
	Poor	3,525	(70.7)	1,496	(29.3)		
Alcohol	No	33,015	(89.4)	3,894	(10.6)	371.47	<.001
	Yes	14,877	(83.0)	3,062	(17.0)		
Smoking	No	43,719	(88.3)	5,800	(11.7)	351.59	<.001
	Yes	4,173	(78.4)	1,156	(21.6)		
Stress	Not	10,169	(98.0)	208	(2.0)	2343.34	<.001
	Moderate	21,881	(94.1)	1,345	(5.9)		
	High	15,842	(74.6)	5,403	(25.4)		
Fatigue recovery	Enough	11,934	(92.8)	905	(7.2)	501.60	<.001

Moderate	16,176	(90.3)	1,735	(9.7)	
Insufficiency	19,782	(82.3)	4,316	(17.7)	

Note: COVID-19, Coronavirus disease 2019

Table 2. Differences in Suicidal Ideation According to Mental Health Characteristics of Adolescents

N=54,848

Variables	Categories	Suicidal ideation		Suicidal ideation		Rao-Scott	*p*
		No (n=47,892)		Yes (n= 6956)			
		n (%)		n (%)			
Loneliness	Almost none	25,346	(96.2)	975	(3.8)	3225.55	<.001
	Moderate	17,306	(87.6)	2,466	(12.4)		
	High	5,240	(60.0)	3,515	(40.0)		
Anxiety	Almost none	44,075	(91.5)	4,068	(8.5)	3276.34	<.001
	Moderate	2,832	(63.8)	1,639	(36.2)		
	High	985	(45.1)	1,249	(54.9)		
Depression during COVID-19	Decrease	5,151	(92.3)	392	(7.7)	1717.73	<.001
	Similar	27,871	(94.4)	1,691	(5.6)		
	Increase	14,858	(75.7)	4,872	(24.3)		

Note: COVID-19, Coronavirus disease 2019

Table 3. Mediating Effects of Anxiety on Depression During Coronavirus Disease 2019 and Suicidal Ideation

N=54,848

Step	Variable →	Dependent	B	SE	t(p)	OR	95% CI	
							LLCI	ULCI
1	Depression during COVID-19 (X)	Anxiety (M)	0.18	0.004	46.57 (<.001)	N/A	.168	.183
Model fit	Model fit: Wald F(p) 2168.86 (<.001), R^2(.056)							
2	Depression during COVID-19 (X)	Suicidal ideation (Y)	1.28	0.031	41.56 (<.001)	3.60	3.388	3.823
Model fit	Model fit: Wald F(p) 1727.00 (<.001), McFadden R^2(.075)							
3	Depression during COVID-19 (X)	Suicidal ideation (Y)	0.97	0.031	31.09 (<.001)	2.64	2.486	2.811
	Anxiety (M)		1.20	0.023	52.97 (<.001)	3.31	3.166	3.460
Model fit	Model fit: Wald F(p) 2370.493 (<.001), McFadden R^2(.147)							
Sobel test	Z=36.91 (<.001)							

Note: COVID-19, Coronavirus disease 2019; B, coefficient; LLCI, lower limit confidence interval; M, mediate variable; OR, odds ratio; SE, standard error; ULCI, upper limit confidence interval; X, independent variable; Y, independent variable.

Table 4. Moderating Effects of Loneliness on Anxiety and Suicidal Ideation

N=54,848

Step	Variable →	Dependent	B	SE	t(p)	OR	95% CI	
							LLCI	ULCI
1	Anxiety (M)	Suicidal ideation (Y)	1.42	0.022	65.44 (<.001)	4.13	3.958	4.310
Model fit	Wald F(p) 5501.75(<.001), McFadden R^2 (.159)							
2	Loneliness (V)	Suicidal ideation (Y)	1.44	0.021	69.68 (<.001)	4.22	4.219	4.051
Model fit	Wald F(p) 4855.40 (<.001), McFadden R^2(.158)							
3	Anxiety* Loneliness (M*V)	Suicidal ideation (Y)	0.52	0.008	68.50 (<.001)	1.68	1.679	1.654
Model fit	Wald F(p) 4692.616 (<.001), McFadden R^2(.164)							

Note: B, coefficient; LLCI, lower limit confidence interval; OR, odds ratio; SE, standard error; ULCI, upper-limit confidence interval; V, moderated variable; X, independent variable; Y, independent variable.

Figures

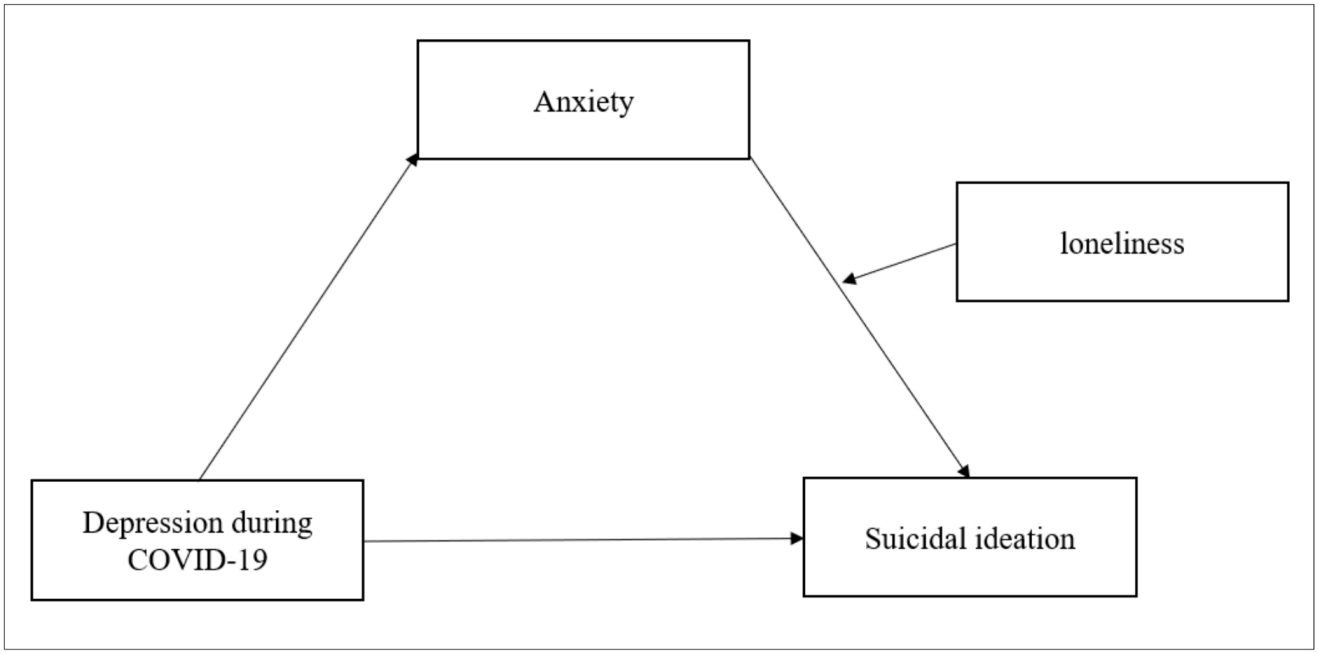


Figure 1

The research model.

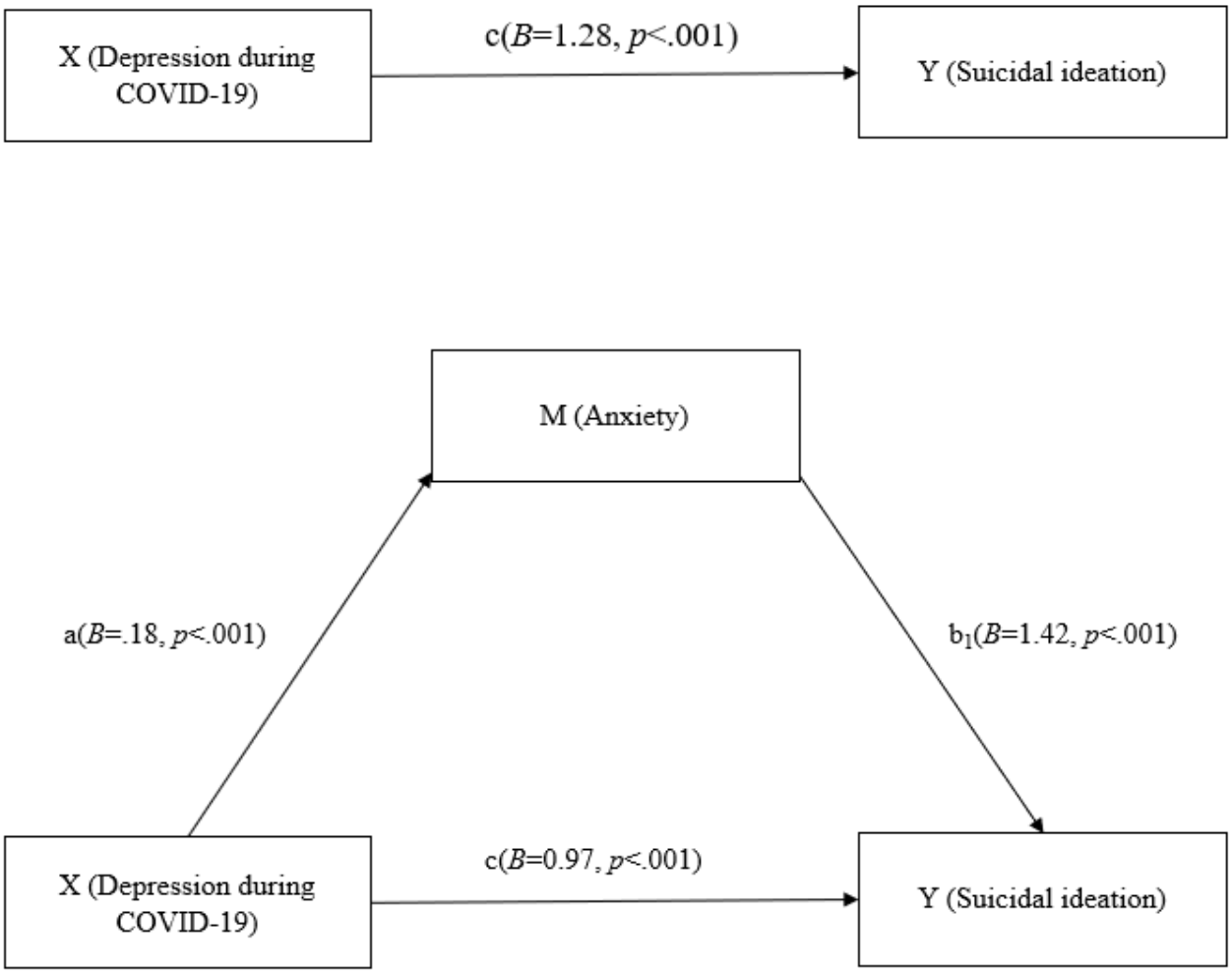


Figure 2

Statistical model of mediation

Note:**a path:** Effect of X on M, **b_1 path:** Effect of M on Y, **c path:** Direct effect of X on Y, **c' path:** Total effect of X on Y controlling for M, **M:** Mediator variable, **X:** Independent variable, **Y:** Dependent variable.

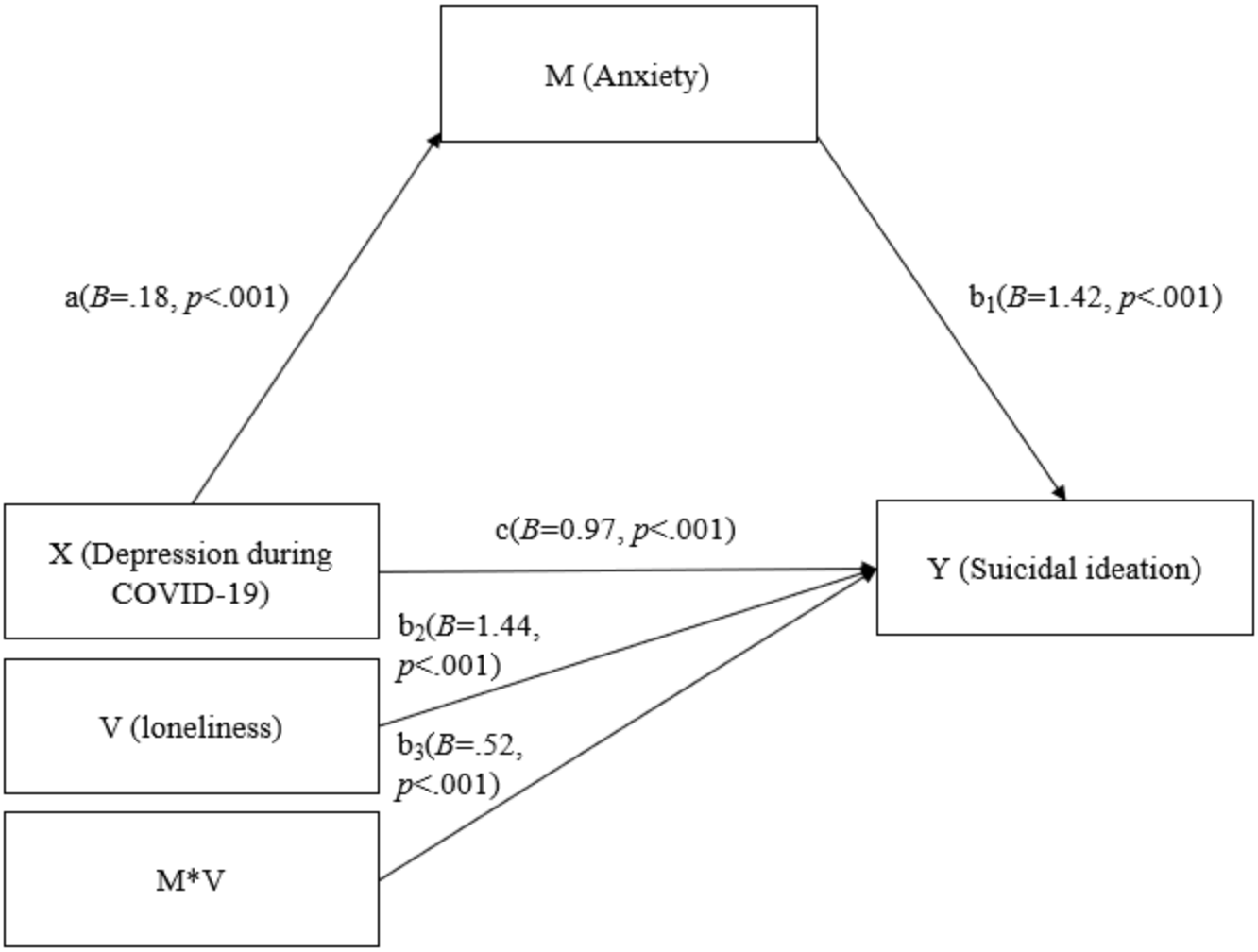


Figure 3

Statistical model of moderated mediation.

Note: **a path:** Effect of X on M, **b_1 path:** Effect of M on Y, **b_2 path:** Effect of V on Y, **b_3 path:** Interaction effect of M*V on Y, **c path:** Direct effect of X on Y, **M:** Mediator variable, **M*V:**Interaction term between M and V, **V:** Moderator variable, **X:**Independent variable, **Y:** Dependent variable.