



Perceived household financial decline and physical/mental health among adolescents during the COVID-19 crisis: Focusing on gender differences

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ABSTRACT

COVID-19 has worsened adolescents' mental and physical health. Several studies have reported that the effect may be greater in girls; however, relevant socio-ecological factors have not been examined. This study aimed to examine the factors associated with physical and mental health status among adolescents and the moderating role of gender on the relationship between physical and mental health status and perceived household financial decline. We analyzed the cross-sectional 2020 Korea Youth Risk Behavior Web-based Survey (KYRBS) collected between August and November 2020 in South Korea. It included 54,809 adolescents (28,269 males and 26,540 females), on average aged 15.1. We conducted ordinary least squares (OLS) regressions to examine the factors associated with physical and mental health outcomes. Gender differences were observed in associated factors. Then, we tested the moderating effect of gender by including an interaction term between gender and perceived household financial decline due to the COVID-19 pandemic. Perceived household financial decline due to COVID-19 negatively affected both groups. Perceiving moderate and severe financial decline due to COVID-19 is negatively associated with self-rated health among female adolescents than male counterparts. Female adolescents were also more vulnerable to mental health outcomes (i.e., distress, anxiety, and loneliness) when they perceived severe or moderate household financial decline due to COVID-19 compared to their male peers. Our findings suggest that female adolescents are more vulnerable to household financial shocks due to COVID-19, especially in households that have experienced a severe decline. We suggest the need for gender-sensitive policy interventions for adolescent mental health.

1. Background

Individuals' physical and mental health during childhood and adolescence may affect them later in life (Arpawong et al., 2022; Wade et al., 2020). During the COVID-19 pandemic, children and adolescents also report poor physical and mental health (Li et al., 2021), experiencing changes in lifestyle habits (e.g., sleeping and sedentary activity) due to the COVID-19 lockdown (Dragun et al., 2020), school closure, and disruption in social relationships (Zolopa et al., 2022). Studies conducted in multiple countries have reported worsened physical and mental health compared with the pre-pandemic period (Li et al., 2021; Thorisdottir et al., 2021). In addition, the COVID-19 pandemic had a negative impact on adults' self-rated health (SRH) (Minegishi et al., 2022; Peters et al., 2020; Reigal et al., 2021). Furthermore, individuals'

mental health has also deteriorated: More people have suffered from depression (Burke et al., 2020), anxiety (Burke et al., 2020; Qiu et al., 2020; Wang et al., 2020), and distress (Taylor et al., 2020; Wang et al., 2020) because of the fear of COVID-19 (Taylor et al., 2020), social distancing, lack of interaction with others (El Omrani et al., 2021; Oosterhoff et al., 2020), and limited physical activity (Reigal et al., 2021). Previous studies have also found that financial difficulties are negatively related to mental health during the COVID-19 pandemic (Campbell-Scherer et al., 2021; Halford et al., 2020; Ryan et al., 2021).

According to the life course perspective, the timing of socioeconomic turmoil has a vital impact on shaping an individual's life through interaction with developmental processes (Elder Jr, 1998b). For example, economic downturns (e.g., the Great Depression) and wars have a life-long impact on exposure to individuals in a specific

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developmental period (Elder, 1994; 1998a). Likewise, the COVID-19 pandemic has affected the family systems surrounding youth, and its negative impact on their physical and mental health can also be explained through the lens of life course theory (Benner and Mistry, 2020). Due to the COVID-19 pandemic, many families have experienced financial or economic hardships (Kim, 2022, 2021; Sampson et al., 2021; Zajacova et al., 2020), such as difficulties in managing rent and mortgage payments or job loss (Gratz et al., 2020; Matsubayashi et al., 2022; Saha et al., 2020; Wang et al., 2021). Some studies have presented the possibility that these economic difficulties at the family level could have adverse effects on the mental health of children and adolescents (Aman and Pearson, 2020; Benner and Mistry, 2020; Kelly-Irving and Delpierre, 2021), especially with the increase in parents' distress and the undermined quality of relationships among family members (Benner and Mistry, 2020; Frاسquilho et al., 2015).

Previous studies have indicated that female adolescents are more likely to experience negative changes in subjective well-being than their male counterparts (Batz and Tay, 2018). On the one hand, some researchers claim that men and women have biological differences, such as a different number of X chromosomes, hormones, or brain structure, which result in mental health disparities by sex (Holingue et al., 2020; Hyde and Mezulis, 2020; Kimerling et al., 2018). Other researchers, focusing on "gender" based on social and cultural differences rather than "sex" based on biological distinctions, have discovered that women frequently face different statuses, expectations, stereotypes, and roles based on their gender, such as social roles as caregivers or lower socioeconomic status, resulting in differences not only in mental health status but also in reporting, seeking, and utilizing healthcare (Afifi, 2007; Meisenberg and Woodley, 2015; Tesch-Römer et al., 2008; Umberson et al., 1996).

Several studies have documented that girls are more vulnerable than boys during the COVID-19 pandemic in terms of mental health (Hall-dorsdottir et al., 2021; Hollenstein et al., 2021; Zolopa et al., 2022). Nevertheless, little research has been conducted to identify what caused the COVID-19 pandemic to further worsen psychological health among girls. Hormonal influences have been indicated as a biological cause (Hall-dorsdottir et al., 2021), but there is little explanation for other socio-ecological factors. For instance, it is well documented that economic crises at a societal level, such as job loss of parents, lead to economic difficulties in the family system, where girls could experience a more negative impact on their mental health (Frasquilho et al., 2017; Matsubayashi et al., 2022; Stavropoulou and Jones, 2013) due to their vulnerability to family conflict and stress, girls tend to display internalizing behaviors (Crawford et al., 2001; Lerner and Steinberg, 2009; McGuinness et al., 2012). Girls may be more likely to internalize their feelings and may have less access to social support and coping resources in school lockdown (Lehmann et al., 2021), which can further exacerbate the negative effects of financial strain or economic disruptions on their physical and mental health (Shanahan et al., 2022). Despite the fact that girls in low and middle-income countries are dropping out of school and working more hours at home due to economic disruptions during the pandemic (Lucas, 2020; Pinchoff et al., 2021), the relationship between household financial decline and physical/mental health differed by gender in high-income countries has not been explored.

During the COVID-19 pandemic, slightly less than one-third (Lee et al., 2020a) to nearly half (49.2 %) of Koreans reported depression (Korean Society for Traumatic Stress Studies, 2020). As observed in other countries (Frank et al., 2021; Giudice et al., 2022; Proto and Quintana-Domeque, 2021; Prowse et al., 2021; Vloo et al., 2021; Zajacova et al., 2020), women reported worse mental health status (e.g., stress, depression, and anxiety) than their male counterparts in Korea (Bahk et al., 2020; Cha et al., 2022; Hong and Cho, 2022; Lee et al., 2020a; Lee et al., 2013; Min et al., 2022) during the COVID-19 pandemic. In spite of these potential gender disparities in the impact of the COVID-19 pandemic on adolescents' health and mental health, no study has been conducted thus far.

The present study compares the self-rated physical and mental health status among South Korean adolescents during the COVID-19 pandemic and examined whether health status differs by gender. Furthermore, it examines the factors associated with physical and mental health, particularly focusing on adolescents' perceived household financial decline due to COVID-19. Finally, it examines whether gender moderates the relationship between physical and mental health status and perceived household financial decline due to COVID-19. Understanding these gender-based differences can inform the development of targeted interventions to support the health and well-being of individuals affected by the pandemic.

2. Method

2.1 Data and participants

We analyzed the Korea Youth Risk Behavior Web-based Survey (KYRBS), a repeated cross-sectional dataset developed and collected by the Korea Disease Control and Prevention Agency and the Ministry of Education since 2005. We used the 2020 KYRBS cross-sectional dataset, the latest survey conducted during the COVID-19 pandemic (between August and November 2020). KYRBS data included adolescents from middle and high schools in Korea. Among the 54,848 cases, we included 54,809 cases by deleting 139 observations with missing values in the age variable based on the list-wise deletion method. The listwise deletion method works well for datasets with less than 5 % missing data (Cheema, 2014; Young et al., 2011). This study is exempt from Institutional Review Boards because it utilizes secondary data that does not contain personal identification information.

2.2. Measures

2.2.1. Dependent variables

The dependent variables were physical (SRH) and mental health status (distress, anxiety, and loneliness) among adolescents. The independent variable was perceived household financial decline due to COVID-19.

SRH. Data on SRH was collected using the question, "How would you rate your health in general?". Responses were rated on a 5-point Likert scale ranging from "very poor" (1 point) to "very good" (5 points).

Distress. We assessed distress based on a single item: "How much distress do you usually feel?" with possible answers of "not much" (1 point) to "a great deal" (5 points).

Anxiety. We used the Generalized Anxiety Disorder-7 (GAD-7) scale to assess anxiety (Spitzer et al., 2006). The questions are based on how often the respondent experienced the symptom over the past two weeks. The scale consists of seven statements, including "feeling nervous, anxious, or on edge," "being so restless that it is hard to sit still," and "feeling afraid as if something awful might happen." Each response was rated on a four-point Likert scale ranging from "not at all" (0 point) to "almost every day" (3 points), and the total score ranged from 0 to 21. We used the total score from the seven responses, and Cronbach's alpha (α) was 0.8982.

Loneliness. We measured loneliness based on the following question: "How often have you felt lonely over the past 12 months?". Possible answers were from "not at all" (0 point) to "always" (4 points).

2.2.2. Independent variables

Perceived household financial decline due to COVID-19. The following items were used: "Do you think the household financial status of your families has become more difficult than before due to COVID-19?" Response options are on a 4-point Likert scale: strongly no, no, yes, and strongly yes. We have operationalized these response options into "no decline," "mild decline," "moderate decline," and "severe decline," aligned with the previous study (Jung et al., 2022).

As control variables, we included age and lifestyle factors. The

number of days of moderate exercise per week was assessed using the statement, "In the past 7 days, how many days did you engage in physical activity for more than 60 min?" To operationalize the number of breakfasts a week, the respondents were asked how many days during the past week they had eaten breakfast. The number of hours of phone use during weekdays was operationalized based on the question asking the number of minutes of utilizing the phone during weekdays. We converted the minutes to hours for better interpretation, ranging from 0 to 20 h. Having had enough sleep in a week (1 = not very enough, 5 = very enough) and academic achievement (1 = low, 5 = high) were assessed based on the 5-point Likert scales.

2.2.3. Moderator

Sex was used as the moderator. Information on sex was collected as a binary variable in the original survey: male or female.

2.2.4. Statistical analysis

First, gender differences in each variable were investigated using bivariate analyses (Cramer's V and t-tests). In the case of categorical variables, the Cramer V test was used to detect relationships that were strong enough to be considered practical with large sample size (Lin et al., 2013; Raouafi et al., 2018). Then, we conducted an ordinary least squares (OLS) regression to examine the factors associated with four different outcomes (SRH, distress, anxiety, and loneliness). We fitted the full model with all independent variables, including gender. To investigate gender differences in the associated factors, we conducted OLS regressions separately by gender. Thirdly, to examine any moderating effects, we included the interaction term between gender and perceived household financial decline due to COVID-19. All analyses were conducted using STATA 17.0 software. The significance level was set at $p < 0.05$. The Variance Inflation Factors (VIF) were calculated and an exclusion threshold of $VIF > 5$ was used to evaluate multicollinearity (Sheather, 2010). Because none of our variables exceeded this threshold (the maximum was 2.92), we ran all analyses using full dataset.

3. Results

3.1. Characteristics of participants

Table 1 presents the characteristics of the analytic sample. Considering all participants, the SRH was 3.89 out of 5 (standard deviation [SD] = 0.90), indicating an average to excellent status. Mental health was lower than physical health, and Korean adolescents were found to be more vulnerable to anxiety (mean = 3.9; SD = 4.36) and loneliness (mean = 1.41; SD = 1.07) than to distress (mean = 3.17; SD = 0.94) during the COVID-19 pandemic.

About a quarter reported their academic achievement as either mid-high (24.42%), or mid-low (23.11%), with 30.20% reporting middle achievement. A total of 39.78% perceived mild level, 24.73% perceived moderate, and 5.87% perceived severe household financial decline due to COVID-19. Regarding behavioral factors, Korean adolescents had about 1.9 days of moderate activity a week and had breakfast 3.78 days a week. In addition, about one-third (35.42%) reported not having enough sleep recently. On average, Korean adolescents used their phones for 4.63 hours during the weekdays (SD = 3.30).

All characteristics except for having had sufficient sleep and academic achievement significantly differed by gender; female adolescents reported worse self-rated health and mental health than their male counterparts ($p < 0.001$). Even though the difference was marginally significant ($p = 0.0548$), more girls reported that their scholastic achievement was mid-high (25.12%), middle (31.24%), or mid-low (23.72%) levels compared to boys. Female adolescents perceived mild (40.81%) and moderate (25.38%) household financial decline more than their male counterparts. Female adolescents exercised less ($M = 1.37$, $SD = 1.80$), had breakfast less frequently ($M = 3.61$, $SD = 2.69$), and spent more hours using their phones ($M = 5.16$, $SD = 3.35$)

Table 1
Characteristics of survey participants by gender.

	All (N = 54,809)	Male (N = 28,269)	Female (N = 26,540)	P-value
Mean of Physical and Mental Health (SD)				
Self-rated health	3.89 (0.90)	4.02 (0.90)	3.76 (0.89)	<0.001
Distress	3.17 (0.94)	3.01 (0.95)	3.34 (0.91)	<0.001
Anxiety	3.9 (4.36)	3.12 (3.96)	4.74 (4.61)	<0.001
Loneliness	1.41 (1.07)	1.22 (1.05)	1.61 (1.05)	<0.001
Demographics				
Mean Age (SD)	15.1 (1.75)	15.12 (1.76)	15.07 (1.75)	0.0038
Perceived household financial decline, no. (%)				
<i>No decline</i>	16,230 (29.61)	8624 (30.51)	7606 (28.66)	0.0388
<i>Mild decline</i>	21,805 (39.78)	10,975 (38.82)	10,830 (40.81)	
<i>Moderate decline</i>	13,556 (24.73)	6821 (24.13)	6735 (25.38)	
<i>Severe decline</i>	3,218 (5.87)	1849 (6.54)	1369 (5.16)	
Mean of Lifestyle factors (SD)				
Days of moderate physical activity per week	1.9 (2.12)	2.4 (2.28)	1.37 (1.80)	<0.001
Number of breakfasts per week	3.78 (2.72)	3.94 (2.75)	3.61 (2.68)	<0.001
Hours of phone use during the weekdays	4.63 (3.30)	4.12 (3.18)	5.16 (3.35)	<0.001
Having had sufficient sleep, no. (%)				
<i>More than enough</i>	5,565 (10.15)	3,432 (12.14)	2,133 (8.04)	0.1251
<i>Enough</i>	11,214 (20.46)	6,501 (23.00)	4,713 (17.76)	
<i>Neutral</i>	18,619 (33.97)	9,733 (34.43)	8,886 (33.48)	
<i>Not enough</i>	13,450 (24.54)	6,149 (21.75)	7,301 (27.51)	
<i>Not enough at all</i>	5,961 (10.88)	2,454 (8.68)	3,507 (13.21)	
Academic achievements, no. (%)				
<i>High</i>	6,699 (12.22)	3,831 (13.55)	2,868 (10.81)	0.0548
<i>Mid-high</i>	13,386 (24.42)	6,720 (23.77)	6,666 (25.12)	
<i>Middle</i>	16,555 (30.20)	8,265 (29.24)	8,290 (31.24)	
<i>Mid-low</i>	12,665 (23.11)	6,370 (22.53)	6,295 (23.72)	
<i>Low</i>	5,504 (10.04)	3,083 (10.91)	2,421 (9.12)	

compared to the male counterparts.

3.2. Factors associated with physical and mental health outcomes among Korean adolescents during COVID-19

Table 2 shows the factors associated with SRH among adolescent participants. Participants who did not perceive household financial decline due to COVID-19 tended to report better SRH than those who

Table 2
OLS regression on SRH.

	All (N = 54,809)	Male (N = 28,269)	Female (N = 26,540)
Demographics			
Gender			
Male	Ref		
Female	-0.139*** (-0.154, -0.124)		
Age	0.0019 (-0.002, 0.006)	0.019*** (0.014, 0.025)	-0.019*** (-0.025, -0.013)
Perceived household financial decline			
No decline	Ref	Ref	Ref
Mild decline	-0.149*** (-0.167, -0.132)	-0.147*** (-0.171, -0.122)	-0.149*** (-0.174, -0.124)
Moderate decline	-0.175*** (-0.195, -0.155)	-0.148*** (-0.176, -0.121)	-0.197*** (-0.225, -0.169)
Severe decline	-0.146*** (-0.179, -0.114)	-0.089*** (-0.132, -0.046)	-0.214*** (-0.263, -0.164)
Lifestyle factors			
Moderate physical activity per week	0.0662*** (0.063, 0.070)	0.0776*** (0.073, 0.082)	0.0462*** (0.040, 0.052)
Number of breakfasts per week	0.0061*** (0.003, 0.009)	-0.0000 (-0.004, 0.004)	0.0125*** (0.009, 0.016)
Hours of phone use during the weekdays	-0.0074*** (-0.010, -0.005)	-0.0039* (-0.007, -0.001)	-0.0108*** (-0.014, -0.008)
Having had sufficient sleep			
More than enough	Ref	Ref	Ref
Enough	-0.183*** (-0.210, -0.155)	-0.195*** (-0.231, -0.160)	-0.168*** (-0.211, -0.124)
Neutral	-0.335*** (-0.361, -0.310)	-0.352*** (-0.385, -0.318)	-0.326*** (-0.366, -0.286)
Not enough	-0.479*** (-0.506, -0.452)	-0.492*** (-0.528, -0.455)	-0.473*** (-0.514, -0.432)
Not enough at all	-0.668*** (-0.700, -0.636)	-0.644*** (-0.6888, -0.5987)	-0.683*** (-0.729, -0.637)
Academic achievements			
High	Ref	Ref	Ref
Mid-high	-0.044*** (-0.069, -0.019)	-0.062*** (-0.096, -0.028)	-0.016 (-0.054, 0.021)
Middle	-0.053*** (-0.078, -0.029)	-0.083*** (-0.116, -0.050)	-0.014 (-0.051, 0.022)
Mid-low	-0.119*** (-0.145, -0.093)	-0.162*** (-0.197, -0.127)	-0.065*** (-0.104, -0.027)
Low	-0.192*** (-0.224, -0.161)	-0.216*** (-0.257, -0.174)	-0.164*** (-0.212, -0.117)
Adjusted R ²	0.1050	0.0933	0.0838

Note: Standardized coefficients (Beta) were reported. 95% confidence intervals in parentheses.

*p < 0.05, **p < 0.01, *** p < 0.001.

perceived moderate, mild, or severe household financial decline. For lifestyle factors, having lower academic achievements, not having enough sleep, and having more hours of phone use during the weekdays were negatively associated with better SRH, whereas more breakfasts per week and having moderate physical activity over the week were positively related to better SRH. When controlling for other factors, being female was negatively associated with self-rated health ($\beta = -0.139, p < 0.001$).

Some associated factors differed by gender. A negative impact of perceived household financial decline due to COVID-19 was observed among both male and female adolescents. However, the SRH of female participants who perceived moderate ($\beta = -0.1971; p < 0.001$) and severe ($\beta = -0.2137, p < 0.001$) household financial decline due to COVID-19 was more negatively impacted than their male counterparts. The impact of age on SRH also varied by gender; age was positively related to better SRH among male adolescents ($\beta = -0.0194, p < 0.001$), whereas it was negatively related to better SRH among female adolescents ($\beta = -.0187, p < 0.001$). Having breakfast was positively related to better SRH among female adolescents ($\beta = 0.0125, p < 0.001$) but not among male adolescents.

Table 3 shows that adolescents, both male and female, who perceived severe, moderate, and mild household financial decline due to COVID-19 were more likely to be distressed than those who did not perceive a decline in household financial status. Additionally, adolescent participants who were older, had mid-low or low academic achievement, did not have a sufficient sleep, and used a phone more often during the weekdays reported a higher distress score than their counterparts who were younger, had high academic achievement, had sufficient sleep and used a phone less frequently. Distress was positively correlated with being female after controlling for other factors ($\beta = 0.244, p < 0.001$). Other behavioral factors, such as moderate physical activity and having breakfast, were negatively associated with distress among male adolescents, but the impact of physical activity was not found among female adolescents.

Factors associated with anxiety were similar to those associated with distress. First, the perception of household financial decline due to COVID-19 was positively related to anxiety among adolescents (Table 3). Female adolescents were more likely to report higher anxiety scores than their male counterparts ($\beta = 1.283, p < 0.001$). Across the genders, low academic achievement, insufficient sleep, and frequent phone use were positively related to anxiety. Finally, physical activity was negatively related to anxiety only among male adolescents, whereas breakfast consumption frequency was negatively related to anxiety only among female adolescents.

The perceived household financial decline due to COVID-19 was also positively associated with loneliness among all participants. As previously observed, being female was positively related to higher loneliness ($\beta = 0.320, p < 0.001$). For all participants, the impact of loneliness from age, mid-low or low academic achievement, insufficient sleep, and frequent phone use during weekdays were likewise positive. Mid-level academic achievement and breakfast consumption was negatively related to loneliness among all participants. However, academic achievement and breakfast consumption were not significantly related to loneliness among male adolescents.

3.3. Interaction between perceived household financial decline due to COVID-19 and gender on self-rated health and mental health among adolescents

Table 4 and Fig. 1 show the interaction effect of gender on the relationship between perceived household financial decline due to COVID-19 and physical health (SRH) and mental health outcomes (distress, anxiety, and loneliness). Female adolescents were more vulnerable to household financial decline than male adolescents across all four physical and mental health outcomes. In particular, the interaction between being female and severe decline was significant in all self-rated health ($\beta = -0.168, p < 0.001$), distress ($\beta = 0.08, p < 0.05$), anxiety ($\beta = 1.198, p < 0.001$), and loneliness ($\beta = 0.211, p < 0.001$). On the other hand, the interaction of being female and moderate decline was significant in the self-rated health ($\beta = -0.052, SE = 0.021$), anxiety ($\beta = 0.503, SE = 0.099$), and loneliness ($\beta = 0.082, SE = 0.024$), except for distress.

Table 3
OLS regression on mental health.

	Distress			Anxiety			Loneliness		
	All (N = 54,809)	Male (N = 28,269)	Female (N = 26,540)	All (N = 54,809)	Male (N = 28,269)	Female (N = 26,540)	All (N = 54,809)	Male (N = 28,269)	Female (N = 26,540)
Demographics									
Gender									
Male	Ref			Ref					
Female	0.244*** (0.229, 0.259)			1.283*** (1.212, 1.355)			0.320*** (0.303, 0.338)		
Age	0.022*** (0.017, 0.026)	0.012*** (0.006, 0.018)	0.033*** (0.027, 0.038)	0.053*** (0.033, 0.073)	0.061*** (0.035, 0.086)	0.053*** (0.022, 0.084)	0.012*** (0.007, 0.017)	0.035*** (0.029, 0.042)	-0.012*** (-0.019, 0.005)
Perceived household financial decline									
No decline	Ref			Ref			Ref		
Mild decline	0.093*** (0.075, 0.111)	0.100*** (0.074, 0.125)	0.084*** (0.059, 0.109)	0.406*** (0.323, 0.489)	0.382*** (0.274, 0.489)	0.424*** (0.296, 0.552)	0.187*** (0.166, 0.207)	0.168*** (0.140, 0.197)	0.209*** (0.179, 0.238)
Moderate decline	0.173*** (0.153, 0.193)	0.177*** (0.148, 0.205)	0.165*** (0.137, 0.193)	0.890*** (0.796, 0.983)	0.698*** (0.576, 0.819)	1.078*** (0.934, 1.221)	0.298*** (0.275, 0.321)	0.264*** (0.232, 0.296)	0.336*** (0.302, 0.369)
Severe decline	0.321*** (0.288, 0.354)	0.316*** (0.271, 0.361)	0.325*** (0.276, 0.374)	1.614*** (1.459, 1.768)	1.269*** (1.078, 1.460)	2.053*** (1.802, 2.304)	0.403*** (0.365, 0.441)	0.340*** (0.290, 0.391)	0.488*** (0.430, 0.545)
Lifestyle factors									
Moderate physical activity per week	-0.005** (-0.009, 0.001)	-0.009*** (-0.014, 0.005)	0.002 (-0.003, 0.008)	-0.006 (-0.022, 0.011)	-0.029** (-0.048, 0.009)	0.028+ (-0.001, 0.058)	0.010*** (0.006, 0.014)	0.007* (0.002, 0.012)	0.013*** (0.006, 0.019)
Number of breakfasts per week	-0.011*** (-0.014, 0.009)	-0.006** (-0.010, 0.003)	-0.017*** (-0.021, 0.013)	-0.029*** (-0.042, 0.016)	0.002 (-0.014, 0.019)	-0.063*** (-0.083, 0.043)	-0.008*** (-0.011, 0.005)	0.000 (-0.004, 0.004)	-0.017*** (-0.021, 0.012)
Hours phone use during the weekdays	0.009*** (0.007, 0.012)	0.006*** (0.002, 0.009)	0.012*** (0.009, 0.016)	0.055*** (0.044, 0.066)	0.031*** (0.017, 0.045)	0.073*** (0.056, 0.089)	0.017*** (0.015, 0.020)	0.012*** (0.008, 0.016)	0.021*** (0.017, 0.025)
Having had enough sleep									
More than enough	Ref			Ref			Ref		
Enough	0.242*** (0.214, 0.270)	0.261*** (0.224, 0.298)	0.216*** (0.173, 0.259)	0.418*** (0.287, 0.549)	0.492*** (0.335, 0.649)	0.313** (0.092, 0.535)	0.236*** (0.204, 0.268)	0.246*** (0.204, 0.287)	0.213*** (0.161, 0.264)
Neutral	0.466*** (0.440, 0.493)	0.483*** (0.448, 0.519)	0.447*** (0.407, 0.487)	1.202*** (1.079, 1.325)	1.210*** (1.061, 1.358)	1.199*** (0.993, 1.404)	0.463*** (0.433, 0.493)	0.481*** (0.442, 0.520)	0.422*** (0.374, 0.469)
Not enough	0.659*** (0.631, 0.686)	0.671*** (0.633, 0.709)	0.643*** (0.602, 0.684)	2.215*** (2.086, 2.344)	2.216*** (2.056, 2.377)	2.218*** (2.007, 2.429)	0.649*** (0.618, 0.681)	0.667*** (0.624, 0.709)	0.610*** (0.561, 0.658)
Not enough at all	1.049*** (1.017, 1.082)	1.082*** (1.035, 1.129)	1.015*** (0.969, 1.061)	4.076*** (3.925, 4.227)	3.842*** (3.643, 4.041)	4.215*** (3.979, 4.451)	0.901*** (0.864, 0.938)	0.946*** (0.893, 0.998)	0.840*** (0.785, 0.894)
Academic achievements									
High	Ref			Ref			Ref		
Mid-high	0.001 (-0.025, 0.026)	-0.001 (-0.036, 0.035)	0.003 (-0.034, 0.040)	-0.008 (-0.128, 0.111)	0.043 (-0.108, 0.193)	-0.057 (-0.247, 0.134)	0.004 (-0.025, 0.034)	0.010 (-0.030, 0.050)	0.001 (-0.043, 0.045)
Middle	0.016 (-0.009, 0.041)	0.018 (-0.016, 0.053)	0.015 (-0.021, 0.051)	-0.155** (-0.272, 0.038)	-0.114 (-0.261, 0.033)	-0.188* (-0.374, 0.001)	-0.035* (-0.063, 0.006)	-0.025 (-0.064, 0.014)	-0.040+ (-0.083, 0.003)
Mid-low	0.083*** (0.057, 0.109)	0.084*** (0.047, 0.121)	0.082*** (0.044, 0.121)	0.170** (0.047, 0.294)	0.150+ (-0.006, 0.305)	0.185+ (-0.011, 0.382)	0.056*** (0.026, 0.086)	0.051* (0.010, 0.092)	0.062** (0.017, 0.108)
Low	0.173*** (0.141, 0.205)	0.150*** (0.107, 0.194)	0.205*** (0.158, 0.252)	0.685*** (0.535, 0.834)	0.345*** (0.161, 0.530)	1.127*** (0.884, 1.369)	0.131*** (0.094, 0.168)	0.058* (0.009, 0.106)	0.222*** (0.166, 0.278)
Adjusted R ²	0.1495	0.1124	0.1373	0.1319	0.0889	0.1164	0.1195	0.0897	0.0948

Note: Standardized coefficients (Beta) are reported. 95% confidence intervals in parentheses.
+p<0.1, *p < 0.05, **p < 0.01, *** p < 0.001.

Table 4

Interaction between perceived household financial decline due to COVID-19 and gender on self-rated health and mental health among adolescents.

	Self-rated Health Coefficient (95 % CI)	Distress Coefficient (SE)	Anxiety Coefficient (SE)	Loneliness Coefficient (SE)
Gender				
Male	Ref	Ref	Ref	Ref
Female	−0.240*** (−0.268, −0.213)	0.323*** (0.295, 0.352)	1.388*** (1.257, 1.519)	0.338*** (0.306, 0.370)
Perceived household financial decline				
No decline	Ref	Ref	Ref	Ref
Mild decline	−0.184*** (−0.209, −0.159)	0.127*** (0.101, 0.153)	0.437*** (0.317, 0.557)	0.194*** (0.165, 0.224)
Moderate decline	−0.195*** (−0.224, −0.167)	0.232*** (0.203, 0.262)	0.853*** (0.718, 0.988)	0.317*** (0.284, 0.350)
Severe decline	−0.145*** (−0.190, −0.101)	0.399*** (0.353, 0.445)	1.567*** (1.354, 1.781)	0.410*** (0.358, 0.462)
Female*Perceived household financial decline				
No decline	Ref	Ref	Ref	Ref
Mild decline	0.003 (−0.033, 0.039)	−0.003 (−0.041, 0.034)	0.102 (−0.071, 0.275)	0.047* (0.005, 0.089)
Moderate decline	−0.052* (−0.093, −0.012)	0.007 (−0.035, 0.049)	0.503*** (0.309, 0.697)	0.082*** (0.034, 0.129)
Severe decline	−0.168*** (−0.236, −0.100)	0.080* (0.009, 0.150)	1.198*** (0.873, 1.522)	0.211*** (0.131, 0.290)

Note: Standardized coefficients (Beta) are reported. 95% confidence intervals in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4. Discussions

4.1. Conclusions

Our results indicate that perceived household financial decline during the COVID-19 pandemic is associated with worsened self-rated health and mental health outcomes among adolescents in South Korea across male and female adolescents. Furthermore, female adolescents reported significantly worse physical and mental health (i.e., self-rated health, distress, anxiety, and loneliness) indicators than their male counterparts. These results are aligned with previous studies that show that female adolescents generally have worse mental health outcomes (Canady, 2021; Etinosa et al., 2022; Halldorsdottir et al., 2021; Hollenstein et al., 2021; Zolopa et al., 2022). From 2015 to 2019, female adolescents in Korea have been reported to have a higher suicide rate than male adolescents (World Health Organization, 2021), despite the fact that suicide rates are higher among male adolescents in most countries, according to a meta-analysis (Miranda-Mendizabal et al., 2019). Based on the findings of this study, the COVID-19 pandemic may have added another layer of vulnerability to the mental health of female adolescents.

Across all physical and mental health indicators, perceptions of household financial decline have stronger associations with health-related outcomes among adolescents, particularly female adolescents, than male adolescents. This finding is consistent with the results of the previous research that have found that the economic crisis may have a greater negative impact on girls than boys using the interaction effect

analysis (Levine and Ames, 2003; Stavropoulou and Jones, 2013). In addition, during an economic crisis, girls are more likely to be withdrawn from school or take on more caregiving responsibilities and burdens within their families, which can be a socio-ecological risk factor for physical and mental health (Gupta, 2021; Nguanbanchong, 2010; Power, 2020; Seguino, 2010), suggesting a gender-tailored support for adolescents during the pandemic.

In general, women who value interpersonal relationships more than men (Giles-Sims and Chodorow, 1979; Umberson et al., 1996) might report worse mental health when physical interaction with others is prohibited during the pandemic. Among female adolescents, peer relationships are valued and can act as a protective factor (Eberhart et al., 2006), so that social distancing may keep them from attending school or preventing them from interacting/seeking support among peers; this could have negatively impacted their mental health. Significantly, South Korea has implemented a social distancing policy during the COVID-19 pandemic, including school lockdown with remote classes in middle and high school for 1 year and 8 months in total from March 2020 to November 2021 (Korean Culture and Information Service, 2021).

Further, the remote learning environment could have blurred the line between family and school, exposing them to heightened tensions within families, including parent–child or marital conflicts and distress from role overload (Lee et al., 2020b), aligned with the vulnerability to family conflict and stress among girls (Crawford et al., 2001; Lerner and Steinberg, 2009; McGuinness et al., 2012). Thus, in the process of recovering from the COVID-19 pandemic, targeted intervention for female adolescents and gender-sensitive policies are recommended in interventions for adolescent mental health (Hidrobo et al., 2020; King et al., 2020).

4.2. Limitations and future directions

There are several limitations to be acknowledged, which are mostly caused by data limitations. First, it was not feasible to include the actual occurrence of physical diseases in the results because all health and mental health-related items were measured based on self-reports. In addition, with the exception of anxiety (GAD-7), two mental health scales (distress, and loneliness) were operationalized as a single item due to the constraint of a large-scale survey. Further studies using more psychometrically validated scales, such as the Kessler Psychological Distress Scale (K10) (Kessler et al., 2002), are needed to more accurately examine mental health among adolescents during the pandemic.

Furthermore, because this study utilized cross-sectional data, we were not able to control baseline household economic status, self-rated health or mental health prior to the COVID-19 pandemic, making it impossible to confirm the causality. Future studies using longitudinal data could aid in understanding the causal relationships between the COVID-19 pandemic and health or changes in health caused by the pandemic. Finally, we did not include the variables of family-related stressors (e.g., increased caring burden), which has been reported as a potential stressor that has a greater impact on female adolescents during economic downturns (Frasquilho et al., 2017; Stavropoulou and Jones, 2013). Furthermore, future studies may delve deeper into variables related to the direct impact of the COVID-19 pandemic, such as whether there was a confirmed case of COVID-19 in the family or a hospitalized case.

5. Declarations

5.1. Ethics approval and consent to participate

This study utilized secondary data without personally identifiable information and Ethical approval was exempt from a University Human Research Ethics Committee. The Korean Youth Risk Behavior Survey is one of the government-approved by Statistics Korea (No. 117058).

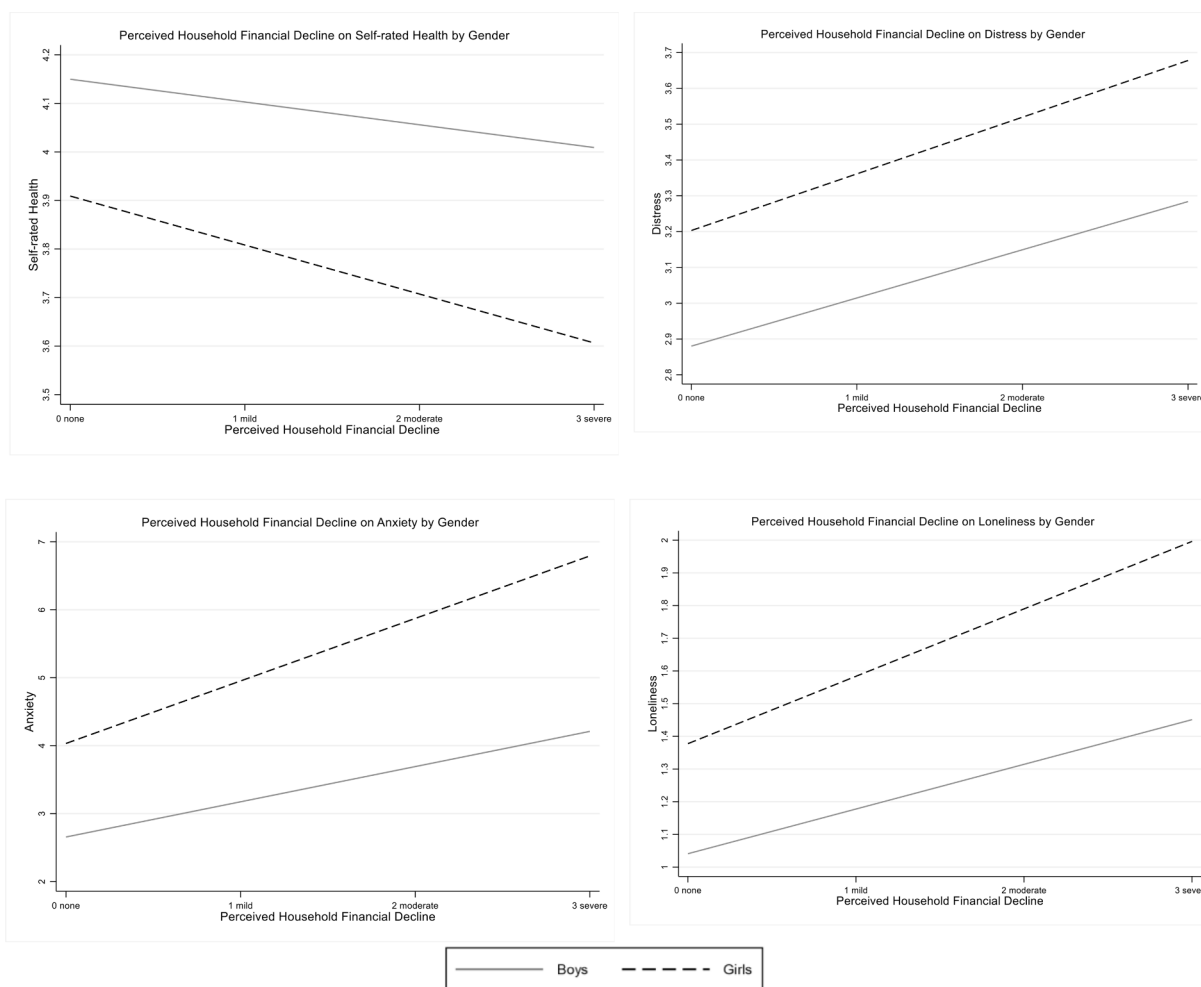


Fig. 1. Interaction between perceived household financial decline due to COVID-19 and gender on self-rated health and mental health among adolescents.

5.2. Consent for publication

Not applicable.

5.3. Availability of data and materials

A secondary data utilized in this study is available at the Korea Disease Control and Prevention Agency website (<https://www.kdca.go.kr/yhs/>).

CRediT authorship contribution statement

Gahwan Yoo: Conceptualization, Methodology, Software, Data curation, Writing – original draft, Visualization, Investigation. **Sou Hyun Jang:** Conceptualization, Methodology, Writing – original draft, Investigation, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data. The data utilized in this study is publicly available at the Korea Disease Control and

Prevention Agency website (<https://www.kdca.go.kr/yhs/>).

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