



OPEN Association between perceived financial hardship and sleep duration among Korean adolescents

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Household financial hardship primarily affects the mental and physical health of children, with adolescence being a particularly vulnerable period for emotional and sleep-related issues. This study aimed to investigate the associations between economic difficulties experienced by families during the coronavirus disease (COVID-19) pandemic and adolescents' sleep patterns, specifically sleep duration and sleep satisfaction as a proxy of sleep quality. Data from the 2020 and 2021 Korea Youth Risk Behavior Surveys, comprising a final sample of 95,816 students, were analyzed. Financial hardship was measured using self-reported perceptions of household financial difficulties, whereas sleep duration was assessed through open-ended questions. The association between financial hardship and sleep duration was examined using multinomial logistic regression analysis conducted in SAS version 9.4. Students who perceived their households as financially strained were more likely to experience both reduced and increased sleep durations (males < 7 h, odds ratio [OR]: 1.10, 95% confidence interval [CI]: 1.00–1.22; females < 7 h, OR: 1.14, 95% CI: 1.01–1.29; females ≥ 9 h, OR: 1.52, 95% CI: 1.16–1.99). These associations were more pronounced among female students and remained statistically significant after adjusting for demographic characteristics, health behaviors, and mental health factors. Severe financial stress was also associated with decreased sleep satisfaction, suggesting an impact on both sleep quantity and perceived quality. These findings suggest that abnormal sleep patterns may be an overlooked manifestation of adolescent stress under economic pressure and highlight the urgent need for targeted mental health and sleep-related interventions during times of crisis.

Keywords Financial hardship, Insufficient sleep, Excessive sleep, Sleep quality, Adolescents

The World Health Organization declared the coronavirus disease (COVID-19) pandemic in March 2020. South Korea subsequently implemented strict initial containment measures, successfully curbing the early spread of COVID-19. However, these policies led to unavoidable psychosocial and economic challenges. In particular, mental health issues, including isolation, lethargy, and depression, became increasingly prevalent due to uncertainty during this period^{1,2}, followed by physical health deterioration, weight gain³, and economic impacts, such as rising unemployment⁴. By the end of 2020, South Korea's household debt had increased to 1,726 trillion KRW, representing a 7.9% increase since 2019, with a debt ratio of 209.8% recorded in 2021⁵.

The sudden economic hardship and ongoing uncertainty resulted in increased anxiety and worry among parents as well as adolescents who were spending more time with them⁶. Social distancing and the transition to online education increased the amount of time young individuals spend at home, exacerbating psychological challenges in vulnerable populations, particularly adolescents, resulting in heightened anxiety, worry, depression, and fatigue^{1,2,7}. However, research on how these psychosocial factors have affected the health behaviors of Korean adolescents remains limited.

Economic hardship is a significant social determinant influencing mental health inequalities among children and adolescents^{8,9}, which also affects behavior and language functions¹⁰. Adolescents' perceptions of their family's financial difficulties are frequently linked to the objective economic situation of their household

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while also reflecting the psychological weight of these circumstances¹¹. Consequently, parents experiencing financial strain may perceive that such stress directly influences the mental health of their children beyond material deprivation¹². For example, during the economic recession in Finland, the psychological well-being of children deteriorated and was influenced by family interactions¹³. According to the Family Stress Model, financial hardship leads to economic pressure and subsequently contributes to parental psychological distress. This distress may manifest as marital conflict and result in compromised parenting behaviors. Such disruptions in parenting are associated with children's maladjustment, including increased aggression, anxiety, depression, deteriorating physical health, overweight status, and impaired self-regulation¹⁴. These factors are closely linked to adolescents' sleep outcomes¹⁵.

These psychological issues can impact sleep in adolescents. Notably, sleep plays an important role in restoring bodily functions and managing stress, particularly during the developmental phase of adolescence. Adolescents experiencing mental health issues such as anxiety, depression, and stress often report poor sleep quality, including difficulty falling asleep, waking during the night, or taking longer to fall asleep¹⁶. During the COVID-19 pandemic, 20% and 27.5% of middle and high school girls, respectively, in South Korea reported experiencing insomnia¹⁷. Similarly, a study in Italy revealed that the pandemic negatively affected the sleep habits of adolescents, leading to psychological distress and insomnia¹⁸.

Economic difficulties are also a fundamental cause of disparities in sleep quality and duration^{19,20}. A study from Brazil reported that individuals earning below the minimum wage, unemployed individuals, and those experiencing significant income loss were twice as likely to experience worsening sleep problems²¹. Sleep in adolescents is closely related to socioeconomic factors. Specifically, economic difficulties can exacerbate psychological challenges, lifestyle changes, and physical activity, all of which adversely affect sleep health^{22,23}.

Nevertheless, comprehensive research examining the impact of financial stress on adolescent sleep quality and duration in South Korea is lacking. Existing studies in South Korea have focused primarily on the relationships between economic difficulties and mental health outcomes (e.g., suicidal ideation and anxiety)^{22,24} and health risk behaviors (e.g., smoking, alcohol consumption) among adolescents²⁴. However, few studies have comprehensively analyzed the effects of financial stress on sleep among adolescents.

Understanding how financial stress experienced by families affects sleep patterns in adolescents, particularly when they spend extended periods at home, is essential for elucidating the relationship between sleep health and overall health behaviors. Such research can provide valuable insights for developing guidelines tailored to behavioral responses among adolescents during crisis situations.

Therefore, this study aimed to investigate the relationship between financial hardships experienced by families and adolescents' sleep patterns—specifically sleep duration and subjective sleep quality. Based on the family stress model, we hypothesized that perceived financial hardship would be significantly associated with abnormal sleep patterns among adolescents.

Results

Table 1 presents the general characteristics of the study population. Among the 95,816 participants, 12,129 male students (50.2% of the 49,590 male participants) reported that their household financial situation had worsened due to COVID-19, whereas 3,062 (12.7%) reported that it was very difficult. Among the male students who reported their household financial situation as very difficult, 61.4% slept < 7 h per day, whereas 5.8% slept > 9 h.

Among the 46,226 female students, 11,476 (51.4%) reported that their household financial situation had worsened, whereas 2,268 (10.2%) reported it was very difficult. Among the female students who reported their household financial situation as very difficult, 76.5% slept < 7 h per day, whereas 3.3% slept > 9 h. Chi-square analysis revealed significant differences in sleep duration based on perceived household financial difficulty due to COVID-19, grade, academic level, region, household income, type of residence, depressive symptoms, smoking, and stress in males and females.

Table 2 presents the results of the multinomial logistic regression analyses stratified by sex after adjusting for grade, academic level, region of residence, household income, type of residence, depressive symptoms, exercise, smoking status, alcohol consumption, smartphone use, and stress. Compared with those without financial difficulties, female students who reported financial difficulties had significantly greater odds of sleeping for < 7 h (odds ratio [OR]: 1.14, 95% confidence interval [CI]: 1.01–1.29) and significantly greater odds of sleeping for > 9 h (OR: 1.52, 95% CI: 1.16–1.99). In male students, a trend toward increased odds of sleeping for < 7 h (OR: 1.10, 95% CI: 1.00–1.22) or > 9 h (OR: 1.20, 95% CI: 0.99–1.45) was observed with worsening financial hardship, although the difference was not statistically significant. In both sexes, higher grade levels were associated with significantly increased odds of sleeping for < 7 h and significantly decreased odds of sleeping for > 9 h. Alcohol consumption was associated with increased odds of sleeping for < 7 h in both male (OR: 1.25, 95% CI: 1.19–1.31) and female (OR: 1.26, 95% CI: 1.19–1.34) students.

Perceived stress was a significant predictor of reduced sleep duration, with both male (OR: 1.53, 95% CI: 1.46–1.60) and female (OR: 1.65, 95% CI: 1.55–1.75) students reporting higher odds of sleeping for < 7 h.

Table 3 presents the results of the subgroup analysis that examined the relationships among academic performance, health behaviors, economic hardship, and sleep duration. In individuals with above-average academic performance, significant economic difficulties due to COVID-19 were associated with reduced or increased sleep duration. In this group, the ORs for males and females sleeping excessively were 1.42 (CI: 1.06–1.90) and 1.89 (CI: 1.18–3.02), respectively, indicating a stronger impact on female students.

Among female students, nondrinkers and nonsmokers reporting significant economic distress presented marginally significant increases in the odds of decreased sleep duration (smoking: OR: 1.16, CI: 1.02–1.33; alcohol: OR: 1.20, CI: 1.03–1.39). Conversely, the likelihood of increased sleep duration was also greater for these students, with ORs of 1.62 (CI: 1.24–2.12) and 1.77 (CI: 1.34–2.36) for smokers and alcohol consumers, respectively.

Variables		Sleep hours										Women										
		Men																				
		Total	N	%	<7 h	7 ~ 9 h	≥9 h	P-value	Total	N	%	<7 h	7 ~ 9 h	≥9 h	N	%	<7 h	7 ~ 9 h	≥9 h	N	%	P-value
Total 95,816		49,590	100.0	13,616	29.5	9044	19.6	1497	3.2		46,226	100.0	15,589	33.7	5921	12.8	808	1.7				
Perceived household financial difficulty due to COVID-19		Not at all	15,080	30.4	8369	55.5	5818	38.6	893	5.9												
		Not difficult	19,319	39.0	11,160	57.8	7225	37.4	934	4.8												
		Difficult	12,129	24.5	7089	58.4	4385	36.2	655	5.4												
		Very difficult	3062	6.2	1881	61.4	1003	32.8	178	5.8												
Grade		Grade7	9004	18.2	2400	26.7	5313	59.0	1291	14.3	<.0001	8659	18.7	4052	46.8	3973	45.9	634	7.3	<.0001		
		Grade8	8796	17.7	3434	39.0	4649	52.9	713	8.1		8369	18.1	5035	60.2	3011	36.0	323	3.9			
		Grade9	8598	17.3	4312	50.2	3892	45.3	394	4.6		7800	16.9	5482	70.3	2139	27.4	179	2.3			
		Grade10	8015	16.2	6051	75.5	1873	23.4	91	1.1		7210	15.6	6110	84.7	1031	14.3	69	1.0			
		Grade11	7941	16.0	6376	80.3	1464	18.4	101	1.3		7313	15.8	6389	87.4	860	11.8	64	0.9			
		Grade12	7236	14.6	5926	81.9	1240	17.1	70	1.0		6875	14.9	6029	87.7	790	11.5	56	0.8			
Academic level		Low	15,803	31.9	9807	62.1	5266	33.3	730	4.6	<.0001	14,430	31.2	10,676	74.0	3332	23.1	422	2.9	<.0001		
		Middle	14,749	29.7	8355	56.6	5531	37.5	863	5.9		14,658	31.7	10,477	71.5	3723	25.4	458	3.1			
		High	19,038	38.4	10,337	54.3	7634	40.1	1067	5.6		17,138	37.1	11,944	69.7	4749	27.7	445	2.6			
Region		Capital area	24,950	50.3	14,874	59.6	8937	35.8	1139	4.6	<.0001	22,911	49.6	17,088	74.6	5244	22.9	579	2.5	<.0001		
		City area	21,701	43.8	12,071	55.6	8312	38.3	1318	6.1		20,450	44.2	14,162	69.3	5640	27.6	648	3.2			
		Rural	2939	5.9	1554	52.9	1182	40.2	203	6.9		2865	6.2	1847	64.5	920	32.1	98	3.4			
Household income		Low	5956	12.0	3826	64.2	1875	31.5	255	4.3	<.0001	5463	11.8	4080	74.7	1222	22.4	161	2.9	<.0001		
		Middle	23,059	46.5	13,330	57.8	8586	37.2	1143	5.0		23,721	51.3	17,163	72.4	5934	25.0	624	2.6			
		High	20,575	41.5	11,343	55.1	7970	38.7	1262	6.1		17,042	36.9	11,854	69.6	4648	27.3	540	3.2			
Type of residence		With family	47,162	95.1	26,784	56.8	17,778	37.7	2600	5.5	<.0001	44,353	95.9	31,635	71.3	11,432	25.8	1286	2.9	<.0001		
		Without family	2428	4.9	1715	70.6	653	26.9	60	2.5		1873	4.1	1462	78.1	372	19.9	39	2.1			
Depression		No	39,427	79.5	21,885	55.5	15,287	38.8	2255	5.7	<.0001	32,230	69.7	22,252	69.0	8945	27.8	1033	3.2	<.0001		
		Yes	10,163	20.5	6614	65.1	3144	30.9	405	4.0		13,996	30.3	10,845	77.5	2859	20.4	292	2.1			
Activity		No	13,471	27.2	8026	59.6	4699	34.9	746	5.5	<.0001	20,353	44.0	15,354	75.4	4489	22.1	510	2.5	<.0001		
		Yes	36,119	72.8	20,473	56.7	13,732	38.0	1914	5.3		25,873	56.0	17,743	68.6	7315	28.3	815	3.2			
Smoking		No	42,743	86.2	23,335	54.6	16,905	39.6	2503	5.9	<.0001	43,260	93.6	30,655	70.9	11,319	26.2	1286	3.0	<.0001		
		Yes	6847	13.8	5164	75.4	1526	22.3	157	2.3		2966	6.4	2442	82.3	485	16.4	39	1.3			
Alcohol consumption		No	31,457	63.4	16,107	51.2	13,288	42.2	2062	6.6	<.0001	33,358	72.2	22,708	68.1	9546	28.6	1104	3.3	<.0001		
		Yes	18,133	36.6	12,392	68.3	5143	28.4	598	3.3		12,868	27.8	10,389	80.7	2258	17.5	221	1.7			
Smartphone usage		No	2186	4.4	1447	66.2	584	26.7	155	7.1	<.0001	830	1.8	624	75.2	173	20.8	33	4.0	<.0001		
		Yes (~ 2 h)	12,139	24.5	6021	49.6	5170	42.6	948	7.8		6629	14.3	4116	62.1	2186	33.0	327	4.9			
Stress		Yes (2 h more)	35,265	71.1	21,031	59.6	12,677	35.9	1557	4.4		38,767	83.9	28,357	73.1	9445	24.4	965	2.5			
		No	12,716	25.6	6089	47.9	5627	44.3	1000	7.9	<.0001	6814	14.7	3992	58.6	2458	36.1	364	5.3	<.0001		
Year		Yes	36,874	74.4	22,410	60.8	12,804	34.7	1660	4.5		18,856	40.8	29,105	72.2	9346	24.7	961	3.1			
		2020	24,081	48.6	13,565	56.3	9020	37.5	1496	6.2	<.0001	22,275	48.2	15,558	69.8	5911	26.5	806	3.6	<.0001		
2021		25,509	51.4	14,934	58.5	9411	36.9	1164	4.6		23,951	51.8	17,539	72.2	5893	24.7	519	3.1				

Table 1. General characteristics of the study population.

Variables		Sleep hours									
		Men					Women				
		< 7 h		7 ~ 9 h	≥ 9 h		< 7 h		7 ~ 9 h	≥ 9 h	
		OR	95% CI	OR	OR	95% CI	OR	95% CI	OR	OR	95% CI
Perceived household financial difficulty due to COVID-19	Not at all			1.00					1.00		
	Not difficult	1.01	(0.96–1.06)		0.90	(0.81–1.00)	1.00	(0.94–1.05)		0.94	(0.81–1.10)
	Difficult	0.99	(0.93–1.05)		1.07	(0.95–1.21)	0.97	(0.92–1.04)		1.16	(0.98–1.36)
	Very difficult	1.10	(1.00–1.22)		1.20	(0.99–1.45)	1.14	(1.01–1.29)		1.52	(1.16–1.99)
Grade	Grade 7			1.00					1.00		
	Grade 8	1.61	(1.50–1.73)		0.62	(0.56–0.66)	1.59	(1.48–1.71)		0.67	(0.57–0.77)
	Grade 9	2.35	(2.19–2.53)		0.41	(0.36–0.47)	2.36	(2.20–2.54)		0.54	(0.45–0.63)
	Grade 10	6.90	(6.31–7.55)		0.19	(0.15–0.24)	5.65	(5.15–6.21)		0.38	(0.30–0.49)
	Grade 11	8.89	(8.10–9.76)		0.27	(0.21–0.34)	6.86	(6.20–7.59)		0.43	(0.33–0.56)
	Grade 12	9.36	(8.4710.35)		0.22	(0.170.29)	6.77	(6.08–7.54)		0.41	(0.31–0.55)
Academic level	High			1.00					1.00		
	Middle	0.90	(0.85–0.95)		1.33	(1.20–1.47)	0.91	(0.86–0.97)		1.47	(1.27–1.69)
	Low	0.90	(0.86–0.96)		1.45	(1.30–1.61)	0.87	(0.81–0.92)		1.69	(1.46–1.96)
Region	Capital area			1.00					1.00		
	City area	0.84	(0.79–0.90)		1.29	(1.17–1.42)	0.76	(0.71–0.80)		1.04	(0.91–1.18)
	Rural	0.72	(0.63–0.82)		1.44	(1.21–1.72)	0.54	(0.49–0.60)		1.01	(0.80–1.27)
Household income	High			1.00					1.00		
	Middle	0.93	(0.890.97)		0.90	(0.830.99)	0.96	(0.91–1.01)		0.90	(0.79–1.03)
	Low	0.97	(0.901.05)		0.94	(0.801.11)	0.89	(0.81–0.97)		1.06	(0.86–1.30)
Type of residence	With family			1.00					1.00		
	Without family	1.02	(0.86–1.21)		0.69	(0.51–0.94)	0.90	(0.75–1.10)		1.02	(0.69–1.49)
Depression	No			1.00					1.00		
	Yes	1.26	(1.20–1.33)		0.96	(0.85–1.07)	1.35	(1.29–1.42)		0.95	(0.82–1.08)
Activity	No			1.00					1.00		
	Yes	0.89	(0.85–0.93)		0.91	(0.83–1.00)	0.84	(0.80–0.88)		0.95	(0.84–1.07)
Smoking	No			1.00					1.00		
	Yes	1.25	(1.16–1.35)		1.06	(0.88–1.27)	0.97	(0.87–1.09)		0.83	(0.59–1.17)
Alcohol consumption	No			1.00					1.00		
	Yes	1.25	(1.19–1.31)		0.91	(0.82–1.01)	1.26	(1.19–1.34)		1.02	(0.86–1.21)
Smartphone usage	No			1.00					1.00		
	Yes (~ 2 h)	0.75	(0.65–0.88)		0.54	(0.44–0.66)	0.75	(0.60–0.93)		0.76	(0.51–1.12)
	Yes (2 h more)	0.92	(0.79–1.07)		0.38	(0.31–0.47)	1.07	(0.87–1.33)		0.51	(0.35–0.75)
Stress	No			1.00					1.00		
	Yes	1.53	(1.46–1.60)		0.75	(0.69–0.82)	1.65	(1.55–1.75)		0.72	(0.63–0.82)
Year	2020			1.00					1.00		
	2021	1.12	(1.06–1.19)		0.75	(0.68–0.82)	1.17	(1.11–1.25)		0.66	(0.58–0.75)

Table 2. Results of factors associated with sleep duration using multinomial logistic regression.

Figure 1 illustrates a pseudo U-shaped relationship between extreme household financial hardships and sleep duration. Male students who perceived their household financial difficulty as very severe were more likely to have a short sleep duration of < 5 h (OR: 1.22, CI: 1.05–1.42) than those without household financial difficulty. Furthermore, female students who perceived their household financial difficulty as serious were less likely to sleep for > 10 h (OR: 1.55, 95% CI: 1.17–2.05) or < 5 h (OR: 1.22, CI: 1.03–1.44) than were those without household financial difficulty.

Table 4 presents sleep satisfaction stratified by sleep duration. Overall, the odds of sleep dissatisfaction were notably higher. Specifically, among male students, the odds of dissatisfaction with normal sleep increased significantly with greater perceived economic hardship (OR: 1.41, CI: 1.17–1.70). For female students, significant increases in the odds of dissatisfaction were observed for both short sleep duration (OR: 1.33, CI: 1.11–1.59) and normal sleep (OR: 1.41, CI: 1.10–1.81) as the perception of economic difficulty intensified.

Discussion

This study investigated the associations between perceived financial hardship due to COVID-19 and sleep duration. The findings indicate that students who perceived their households as financially strained because of the pandemic were more likely to experience reduced or increased sleep duration. Importantly, the severity

Variables			Sleep hours							
			Men				Women			
			7–9		< 7 h		≥ 9 h		< 7 h	
			OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Academic level	High	Not at all		1.00				1.00		
		Not difficult	1.00	0.96 (0.89–1.04)	1.07	(0.92–1.25)	0.97	(0.89–1.05)	0.87	(0.69–1.10)
		Difficult	1.00	0.95 (0.87–1.04)	1.18	(0.99–1.42)	1.00	(0.90–1.11)	1.29	(0.98–1.70)
		Very difficult	1.00	1.07 (0.90–1.28)	1.42	(1.06–1.90)	1.25	(1.00–1.56)	1.89	(1.18–3.02)
	Middle	Not at all		1.00				1.00		
		Not difficult	1.00	1.04 (0.95–1.15)	0.76	(0.63–0.91)	1.00	(0.91–1.11)	1.09	(0.85–1.39)
		Difficult	1.00	1.00 (0.89–1.12)	1.03	(0.84–1.26)	0.93	(0.83–1.04)	1.26	(0.96–1.65)
		Very difficult	1.00	1.10 (0.91–1.33)	1.22	(0.89–1.68)	1.07	(0.83–1.37)	1.70	(1.03–2.81)
	Low	Not at all		1.00				1.00		
		Not difficult	1.00	0.91 (0.74–1.13)	0.86	(0.70–1.05)	1.00	(0.89–1.11)	0.85	(0.64–1.14)
		Difficult	1.00	1.02 (0.92–1.13)	0.97	(0.78–1.20)	0.97	(0.86–1.09)	0.94	(0.69–1.26)
		Very difficult	1.00	1.12 (0.96–1.31)	0.96	(0.68–1.35)	1.08	(0.89–1.32)	1.16	(0.74–1.82)
Smoking	No	Not at all		1.00				1.00		
		Not difficult	1.00	1.00 (0.95–1.06)	0.92	(0.83–1.02)	0.99	(0.93–1.04)	0.95	(0.82–1.10)
		Difficult	1.00	0.99 (0.93–1.06)	1.12	(0.99–1.26)	0.97	(0.91–1.04)	1.17	(0.99–1.38)
		Very difficult	1.00	1.09 (0.98–1.21)	1.24	(1.02–1.52)	1.16	(1.02–1.33)	1.62	(1.24–2.12)
	Yes	Not at all		1.00				1.00		
		Not difficult	1.00	1.06 (0.90–1.25)	0.66	(0.43–1.02)	1.17	(0.90–1.53)	0.74	(0.30–1.85)
		Difficult	1.00	0.97 (0.81–1.15)	0.60	(0.37–0.98)	1.01	(0.77–1.31)	0.77	(0.30–1.97)
		Very difficult	1.00	1.16 (0.89–1.50)	0.73	(0.38–1.41)	0.97	(0.65–1.45)	0.34	(0.07–1.63)
Alcohol consumption	No	Not at all		1.00				1.00		
		Not difficult	1.00	0.98 (0.92–1.05)	0.92	(0.82–1.04)	1.00	(0.94–1.07)	0.94	(0.81–1.10)
		Difficult	1.00	1.01 (0.94–1.09)	1.10	(0.96–1.27)	0.99	(0.92–1.06)	1.25	(1.05–1.48)
		Very difficult	1.00	1.13 (0.99–1.29)	1.27	(1.02–1.58)	1.20	(1.03–1.39)	1.77	(1.34–2.36)
	Yes	Not at all		1.00				1.00		
		Not difficult	1.00	1.05 (0.97–1.15)	0.81	(0.65–1.02)	0.97	(0.86–1.09)	0.91	(0.64–1.29)
		Difficult	1.00	0.96 (0.87–1.06)	0.97	(0.76–1.24)	0.92	(0.80–1.05)	0.80	(0.53–1.20)
		Very difficult	1.00	1.06 (0.90–1.23)	1.01	(0.70–1.46)	1.00	(0.80–1.24)	0.79	(0.41–1.53)

Table 3. Subgroup analysis stratified by independent variables.

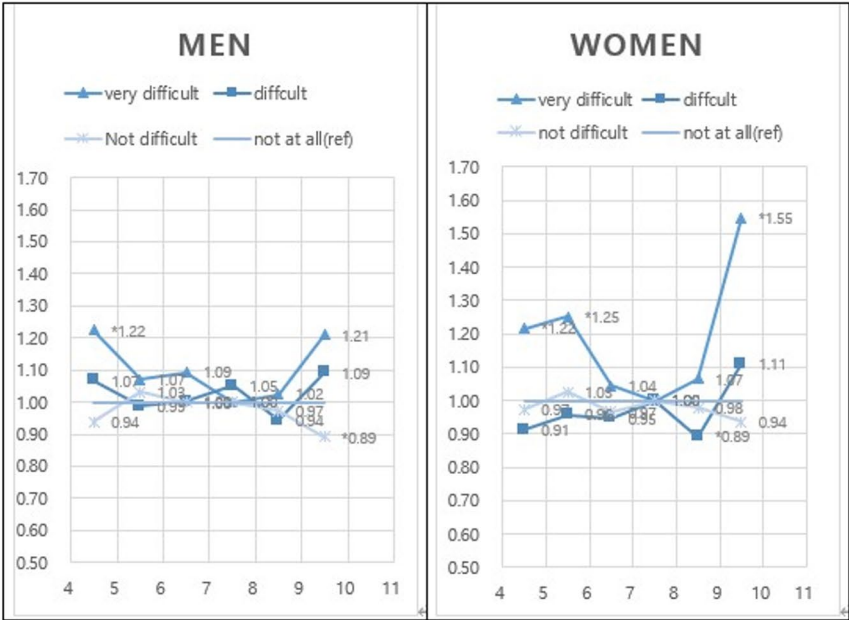


Fig. 1. Dependent subgroup analysis stratified by sleep duration. †Statistically significant results ($p < 0.05$).

Variables		Sleep satisfaction				
		Satisfied	Moderate		Dissatisfied	
		OR	OR	95% CI	OR	95% CI
Perceived household financial difficulty due to COVID-19						
Men	Sleep duration < 7 h					
	Not at all (ref)	1.00				
	Not difficult		1.10	(1.01–1.19)	1.03	(0.95–1.12)
	Difficult		1.20	(1.09–1.33)	1.18	(1.07–1.30)
	Very difficult		0.92	(0.79–1.07)	1.05	(0.91–1.22)
	7 h ≤ Sleep duration < 9 h					
	Not at all (ref)	1.00				
	Not difficult		1.29	(1.19–1.40)	1.09	(0.98–1.21)
	Difficult		1.33	(1.21–1.46)	1.10	(0.98–1.24)
	Very difficult		1.14	(0.97–1.35)	1.41	(1.17–1.70)
	Sleep duration ≥ 9 h					
	Not at all (ref)	1.00				
	Not difficult		1.36	(1.09–1.71)	1.23	(0.87–1.73)
	Difficult		1.20	(0.93–1.55)	1.42	(0.99–2.05)
	Very difficult		1.41	(0.94–2.11)	1.52	(0.89–2.60)
Women	Sleep duration < 7 h					
	Not at all (ref)	1.00				
	Not difficult		1.36	(1.25–1.48)	1.23	(1.13–1.33)
	Difficult		1.34	(1.21–1.48)	1.28	(1.16–1.41)
	Very difficult		1.11	(0.91–1.34)	1.33	(1.11–1.59)
	7 h ≤ Sleep duration < 9 h					
	Not at all (ref)	1.00				
	Not difficult		1.26	(1.14–1.40)	1.14	(1.00–1.30)
	Difficult		1.32	(1.16–1.49)	1.47	(1.27–1.70)
	Very difficult		1.09	(0.85–1.39)	1.41	(1.10–1.81)
	Sleep duration > 9 h					
	Not at all (ref)	1.00				
	Not difficult		1.17	(0.83–1.64)	1.03	(0.67–1.59)
	Difficult		1.22	(0.84–1.77)	0.97	(0.59–1.60)
	Very difficult		0.88	(0.46–1.69)	1.27	(0.59–2.73)

Table 4. Subgroup analysis stratified by sleep satisfaction. *Enough time to recover my fatigue (in the last 7 days).

of financial hardship was associated with a greater likelihood of abnormal sleep patterns. Additionally, these patterns differed in intensity between male and female students, with female students exhibiting a stronger association between financial hardship and both reduced and increased sleep. This relationship remained significant even after adjusting for demographics, health behaviors, and mental health factors. Notably, severe financial hardship affects both the quantity and quality of sleep²⁵. Adolescents facing financial difficulties may experience stress, which contributes to anxiety and depression and disrupts sleep patterns, ultimately adversely affecting developmental outcomes²⁰.

These findings can be interpreted within the framework of the Family Stress Model. According to this model, economic hardship increases parental psychological stress, which in turn leads to negative family interactions such as conflict and emotional distancing. These dynamics ultimately affect children's sleep and overall health outcomes^{14,15}. Previous research has consistently demonstrated an association between financial stress and adverse sleep outcomes. Several studies report that financial hardship is correlated with reduced sleep duration and diminished sleep quality^{19,26}. A South Korean study indicated that household income significantly influences sleep duration in adolescents and that children from higher-income families tend to have shorter sleep durations²⁷. However, our study found that adolescents perceiving severe financial difficulty—especially females—were more likely to report both insufficient and excessive sleep. This divergence from prior findings may be attributed to the unique context of the COVID-19 pandemic. Adolescents may have perceived the pandemic as a highly uncertain and uncontrollable event, which could have adversely affected their mental health by increasing psychological stress. Such conditions may have contributed to the disruption and polarization of their sleep patterns²⁸.

Early reports from Europe and China during the COVID-19 pandemic highlighted widespread sleep disturbances, with financial stress being a notable factor associated with poor sleep health²⁹. Furthermore, in the United States, financial difficulties arising during the pandemic were correlated with increased rates of sleep disorders, particularly among women¹⁹.

Interestingly, students with average or above-average academic performance were more likely to experience excessive sleep under financial stress. These findings suggest that excessive sleep may serve as a coping mechanism for managing or avoiding stress^{30,31}. Existing research suggests that excessive sleep under financial stress may reflect a coping mechanism. For instance, Özkan and Bostan (2022) found that students perceiving higher financial stress tended to sleep longer, which was interpreted as a behavioral symptom of stress-related avoidance³². Additionally, students who did not smoke or consume alcohol were more likely to experience both insufficient and excessive sleep under financial stress, indicating the need for further research on this demographic. Male students from households with relatively high socioeconomic status who perceived severe financial difficulties during the pandemic presented an increased risk of insufficient sleep, suggesting that sleep disturbances may stem not only from persistent economic challenges but also from sudden financial crises.

Our findings revealed that responses to economic stress manifested as both insufficient and excessive sleep among adolescents, with these patterns differing according to sex. Therefore, excessive sleep, as well as insufficient sleep, may serve as an indicator of stress in adolescents. During adolescence, insufficient sleep is associated with numerous negative outcomes, including reduced academic achievement, mental health issues, risky behaviors, substance use, and weight gain^{33,34}. Although insufficient and excessive sleep are often linked to cognitive impairment and dementia in adults^{35,36}, studies on their health implications among adolescents are lacking. Consequently, further studies are needed to explore excessive sleep as a response to stress and examine its potential health impacts on adolescents.

The sleep satisfaction among adolescents exhibited an overall decline, with an average sleep duration of 6.99 h, which was below the National Sleep Foundation's recommended 8–10 h of sleep³⁷, likely contributing to low sleep satisfaction. Additionally, severe financial stress was found to significantly impact higher levels of sleep dissatisfaction. Further stratification by sleep duration revealed that severe financial stress significantly impacted higher levels of sleep dissatisfaction, indicating that financial stress affects both short and long sleepers and plays a critical role in influencing both sleep quantity and quality³⁸.

Social distancing measures and remote learning resulted in adolescents spending more time at home with family members³⁹, increasing their awareness of the household's financial situation. In effect, financial stress extends beyond parental concern, emerging as a household issue that significantly impacts the psychological well-being of adolescents. Although they may have been aware of their family's general economic status, the unforeseen financial repercussions due to the pandemic likely triggered anxiety and stress, directly affecting their sleep patterns and quality^{17,40,41}.

Sudden economic stress is not only a temporary disruption but also a significant stressor affecting the health and well-being of adolescents. Stress stemming from financial hardship may further impair sleep and health, warranting additional research on long-term effects. This study emphasizes the wide-ranging impact of economic stress on the sleep of adolescents and the need for public health interventions to mitigate these adverse effects.

This study also has some limitations. First, the cross-sectional design of this study limits its ability to establish causality between financial difficulties and sleep duration. While associations were identified, the temporal order of events cannot be determined, and thus causal inferences should be made with caution. Future research using longitudinal or experimental designs would provide greater clarity on the directionality of these relationships.

Second, the survey relied on adolescent perceptions rather than objective measures of economic hardship. Future studies should incorporate objective economic data to better understand the effects of the pandemic. Third, owing to the measurement differences, direct comparisons of this study with studies from other countries and the generalization of our findings to different contexts or populations may not be feasible. Finally, the sleep data in this study were limited to weekdays; however, prior research indicates that insufficient sleep during the week can often be compensated for on weekends⁴². Nevertheless, given that middle school education is mandatory in Korea and that the study utilized a stratified sampling approach on the basis of region and population size, the risk of selection bias was minimal.

Nonetheless, our study also has several strengths. It utilized a nationwide dataset representing the health of Korean adolescents, enabling a robust stratified analysis by sex, region, and grade level supported by a large sample size. Additionally, this study includes data from both 2020 and 2021, capturing the perceptions of adolescents related to financial difficulties due to COVID-19 and the persistence of these challenges.

This study revealed that the likelihood of experiencing both insufficient and excessive sleep increased as students increasingly perceived their households as financially strained due to COVID-19, with distinct sleep patterns between male and female students. Furthermore, the severity of financial hardship was correlated with an increase in abnormal sleep patterns, underscoring the necessity for policy interventions aimed at supporting student growth and well-being. Future research should explore the relationship between psychological stress originating from the household or parents and the risks associated with insufficient and excessive sleep to gain a more comprehensive understanding of the potential health implications.

Methods

Data sources and samples

This study used data from the 16th and 17th Korea Youth Risk Behavior Surveys (KYRBS) of 2020 and 2021. The KYRBS is an annual, nationwide cross-sectional survey of a representative Korean youth population conducted by the Korea Disease Control and Prevention Agency (KCDC) since 2005. Participants ranged from 7th to 12th grade, with the majority aged between 13 and 18 years. The self-reported online survey of middle and high school students was conducted between August and November in 2020 and 2021. The primary objective of the KYRBS is to assess the socioeconomic and health statuses and behaviors of adolescents to generate internationally comparable health indicators. The sampling framework involved stratification by 39 regional and school-type categories (middle school and high school), with cluster sampling at the school and class levels. This study used raw data from the KYRBS, a government-approved statistical survey (approval number 117058)

conducted by the KDCA. The anonymized raw data were obtained and downloaded from the KDCA website. As a government-approved statistical survey, the KYRBS collects data only after obtaining informed consent from all participants prior to the survey. Since the KYRBS data are publicly available secondary data, this study did not require additional review by an Institutional Review Board (IRB).

In 2020, the target population included 2,631,888 students, from which a sample of 54,948 was drawn (28,353 males and 26,595 females; response rate, 94.9%). In 2021, the target population was 2,629,588, with a sample of 54,848 students (28,401 males and 26,447 females; response rate, 92.9%). After individuals with missing data on key variables were excluded, the final sample for this study included 95,816 students.

Variables

The dependent variable was sleep duration, which was calculated as the difference between bedtime and wake-up time on weekdays. Sleep duration was self-reported through questions such as “What time do you usually go to bed on weekdays?” and “What time do you usually get up on weekdays?” The participants were categorized into three groups: <7 h of sleep (short-time sleeper), 7–9 h of sleep (moderate sleeper), and >9 h of sleep (long-time sleeper).

The independent variable was perceived household financial difficulty due to COVID-19. This variable indicates the psychological impact of the economic decline at home caused by the pandemic on adolescents. The response pertaining to a decrease in household finances due to the pandemic was generally categorized as “yes” or “no” and was specifically classified as “no financial decline,” “inappreciable financial decline,” “moderate financial decline,” or “substantial financial decline.” Data on this variable were collected only for the 2-year period, spanning from 2020 to 2021.

The covariates were demographic and socioeconomic variables (sex, school grade, household income, academic level, residential area (metropolitan, urban, or rural), type of residence (living with family or not), mental health-related variables (perceived stress and depressive symptoms), and health behavior variables (exercise, smoking, and smartphone usage).

Statistical analysis

The chi-square test was used to evaluate and compare the general characteristics of the study population. Multinomial logistic regression was used to examine the associations between household financial hardship due to COVID-19 and sleep duration. Subgroup analyses were conducted to investigate the combined effects of perceived household financial difficulty and other covariates on sleep duration. The results are presented as ORs with 95% CIs. No multicollinearity was found in any of the variables when the variance inflation factor was used. Statistical significance was set at $P \leq 0.05$. Statistical analyses were performed using SAS, version 9.4 (SAS Institute Inc., Cary, North Carolina, US).

Data availability

The data that support the findings of this study are available from the KOREA YOUTH RISK BEHAVIOR SURVEYS (<https://www.kdca.go.kr/yhs/home.jsp>).

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Author contributions

S.K. designed the study and performed computations. H.M.Y. and Y.H.J. validated the analytical method. E.C.P. conceptualized the study, provided statistical expertise, and contributed to the interpretation of the results. All authors read and approved the final manuscript.

Declarations

Competing interests

The authors declare no competing interests.

Additional information

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